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Rebuttal Testimony of

Jamie R. Moe and Pauline M. Ahern

W-01445A-15-0277

Part 2 of 2

Please see barcode 0000169663 for Part 1

Moe

ARIZONA WATER COMPANY

Docket No. W-01445A-15-0277

2015 WESTERN GROUP RATE HEARING

(For Test Year Ending 12/31/14)

Prepared

REBUTTAL TESTIMONY

of

JAMIE R. MOE

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EXHIBITS

ARIZONA WATER COMPANY

Rebuttal Testimony of

Jamie R. Moe

I. Introduction

Q. PLEASE STATE YOUR NAME, EMPLOYER, AND TITLE.

A. My name is Jamie R. Moe. I am employed by Arizona Water Company ("AWC" or "Company") as Manager of Rates and Regulatory Accounting. In this role, I have overall responsibility for regulatory matters including rate case applications, exhibits, testimony, and tariffs for filing at the Arizona Corporations Commission ("Commission").

Q. HAVE YOU PREVIOUSLY PROVIDED DIRECT TESTIMONY IN THIS PROCEEDING?

A. No.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND WORK EXPERIENCE.

A. In 2000, I graduated from North Dakota State University, receiving a Bachelor of Science degree in Accounting. I have attended various seminars and classes on general regulatory and business issues, including the National Association of Regulatory Utility Commissioners ("NARUC") Annual Regulatory Studies Program and the NARUC Utility Rate School.

My regulatory experience includes employment by the Commission as a Public Utilities Analyst from 2003 through 2006, in which my main duties included reviewing, auditing, and analyzing utility financial and accounting information and presenting recommendations to the Commission on behalf of Staff regarding revenue requirements, rate design, and other matters.

Subsequent to my employment with the Commission, I was employed by Global Water Management, LLC ("Global") as a Regulatory Accountant from 2007 through 2009. My primary duties included analyzing and examining accounting, financial, statistical, and other information and preparing reports based on my analyses. My responsibilities also included preparation of monthly accounting entries, preparation of certificate of convenience and necessity ("CCN") applications and rate cases, assistance in regulatory matters, and providing input on regulatory accounting issues.

Beginning in 2010, I was employed by Arizona Public Service Company ("APS") as a Rate and Regulatory Analyst – a position I held for the majority of my time with APS from 2010 to 2015. My primary duties with APS involved ensuring the proper implementation of tariffs, maintenance of rate tariffs and service schedules, and analysis of customer usage history to calculate rate comparisons and projections.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. Yes. I have testified before the Commission numerous times on behalf of Staff and Global in cases involving rates, financings, and CCN proceedings.

Q. HAVE YOU REVIEWED THE DIRECT TESTIMONY FILED BY THE OTHER PARTIES TO THIS PROCEEDING?

A. Yes. I have reviewed the testimony of each of the witnesses for the Residential Utility Consumer Office ("RUCO"), the Commission Utilities Division Staff ("Staff"), and Abbott Laboratories, Inc. ("Abbott").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of my rebuttal testimony is to respond to the direct testimony of RUCO witness John Cassidy and Staff witness Briton A. Baxter.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. My testimony is presented in four sections, including this introductory Section I. In Section II, I present the Company's updated revenue requirement. In Section III, I respond to RUCO witness John Cassidy's testimony regarding RUCO's recommended adjustments to AWC's rate base and operating income. In Section IV, I respond to Staff witness Briton A. Baxter's testimony regarding Staff's recommended adjustments to AWC's rate base and operating income.

II. Updated Revenue Requirement

Q. PLEASE SUMMARIZE THE COMPANY'S PROPOSED REBUTTAL REVENUE REQUIREMENT AND ASSOCIATED INCREASE, AS WELL AS THOSE OF STAFF AND RUCO.

A. The proposed revenue requirements of the parties are summarized in the following table:

PROPOSED REVENUE REQUIREMENTS

SYSTEM	COMPANY REBUTTAL	STAFF DIRECT	RUCO DIRECT
Pinal Valley	$ 23,778,440	$ 21,866,557	$ 21,453,741
White Tank	2,906,777	2,656,279	2,644,196
Ajo	538,892	495,763	474,049
Total Western Group	**$ 27,224,109**	**$ 25,018,599**	**$ 24,571,986**

The Company has provided updated standard filing Rebuttal Schedules (A-1 through D-1) detailing the Company's rebuttal adjustments and updated revenue requirements in Rebuttal Exhibit JRM-RB1. The proposed rebuttal revenue increases are shown below:

PROPOSED REVENUE INCREASES

SYSTEM	COMPANY REBUTTAL	STAFF DIRECT	RUCO DIRECT
Pinal Valley	$ 5,310,551	$ 3,398,668	$ 2,862,004
White Tank	595,785	334,737	298,814
Ajo	101,003	55,510	28,608
Total Western Group	**$ 6,007,339**	**$ 3,788,915**	**$ 3,189,426**

III. <u>Response to RUCO</u>

A. <u>Rate Base</u>

Q. WHICH OF RUCO'S RATE BASE ADJUSTMENTS DO YOU ADDRESS IN THIS SECTION OF YOUR REBUTTAL TESTIMONY?

A. In this section I address RUCO's rate base adjustments No. 1 and 2 regarding post-test year plant and accumulated depreciation. Company witnesses Joel M. Reiker, Joseph D. Harris, and Fredrick K. Schneider address RUCO's other rate base adjustments in their rebuttal testimony.

<u>RUCO Rate Base Adj. No. 1 – Post-Test Year Plant</u>

Q. WHAT IS RUCO'S POSITION ON POST-TEST TEAR PLANT?

A. According to Mr. Cassidy's testimony, RUCO supports post-test year plant if the projects were completed within six months of the test year end and for projects RUCO considers to be "major projects". RUCO defines major projects as "transmission and distribution mains, wells and pumping equipment, services, and projects that typically improve infrastructure."[1] In the Company's last Eastern Group general rate case, however, RUCO supported the inclusion of the Company's Oasis arsenic treatment plant in its Superstition system, which was completed in December 2011, a full twelve months after the test year in Docket W-01445A-11-0310.

Additionally, RUCO claims to support the post-test year rate base treatment for major projects which improve water quality, reduce significant repair expenses, and would include projects that ensure regulatory compliance. According to Mr. Cassidy, RUCO believes that only by matching costs and revenues will the test period be the proper basis for setting rates that are just and reasonable.[2] RUCO's adjustments reduce rate base by $5,167,279, $352,391, and $4,326 for the Pinal Valley, White Tank, and Ajo systems respectively.

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[1] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 10 at 7-13.
[2] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 9 at 13-14.

Q. BASED ON RUCO'S STANDARD FOR RECOMMENDING THAT POST-TEST YEAR PLANT BE INCLUDED IN RATE BASE, SHOULD MR. CASSIDY HAVE RECOMMENDED ANY ADJUSTMENTS TO AWC'S PROPOSED POST-TEST YEAR PLANT?

A. Certainly not, as all of the post-test year projects AWC proposes to include in rate base meet Mr. Cassidy's stated definition of "major projects." In fact, all of AWC's capital improvements and additions are undertaken to improve infrastructure, quality of service, or to comply with water quality standards. However, in order to justify recommending that the Commission disallow a number of items that obviously meet RUCO's stated criteria, Mr. Cassidy simply creates a "catch-all" exception for "...'small and/or recurring type projects' that are purchased on a an ongoing bases [sic] and are not directly improving the quality of service to ratepayers."[3]

Q. HAS MR. CASSIDY SHOWN THAT ANY OF THE PROJECTS AWC PROPOSES TO INCLUDE IN RATE BASE AS POST-TEST YEAR PLANT DO NOT IMPROVE THE QUALITY OF SERVICE PROVIDED TO THE COMPANY'S CUSTOMERS?

A. No. Mr. Cassidy simply recommends disallowing over $375,000 in utility plant which he argues falls into this "catch-all" category.[4] Mr. Cassidy provides no explanation, and certainly no evidence, to support his assertion.

Q. RUCO CLAIMS THAT THE COMISSION ADDRESSED THE POST-TEST YEAR PLANT ISSUE IN PRIOR RATE CASES CONTRARY TO THE POSITION STAFF HAS TAKEN IN THIS AND OTHER RECENT RATE CASES. CAN YOU ELABORATE ON THIS?

A. Yes. Mr. Cassidy claims that Staff has recommended rate base treatment of post-test year plant additions even in cases where the Staff Engineer allegedly did not make a used and useful determination.[5] Mr. Cassidy then refers to 2009 Decision No. 71410

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[3] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 10 at 16-19.
[4] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 10 at 21 to p. 11 at 3.
[5] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 8 at 11-14.

which he claims supports limiting post-test year plant to those projects completed within six months of the test year.

Q. DID MR. CASSIDY MAKE A USED AND USEFUL DETERMINATION RELATED TO THE POST-TEST YEAR PLANT HE RECOMMENDS THE COMMISSION INCLUDE IN RATE BASE IN THIS PROCEEDING?

A. No. Mr. Cassidy's testimony amounts to "the pot calling the kettle black." Be that as it may, the Staff Engineer did make a used and useful determination regarding post-test year plant in this proceeding,[6] and Mr. Cassidy provides no evidence to refute Staff's used and useful determination. To the extent RUCO relies on Staff's engineering analysis for a determination of whether utility plant in service is used and useful, as RUCO has done in the past, Mr. Cassidy should revise his recommendation.[7]

Q. WHAT IS RUCO'S SECOND POINT REGARDING POST-TEST YEAR PLANT?

A. In attempting to support RUCO's position that only projects completed within six months of the end of the test year should be included in rate base, with certain exceptions, Mr. Cassidy refers to Decision No. 71410,[8] which was issued on December 8, 2009. According to Mr. Cassidy, Staff's reasoning for excluding post-test year plant in that six-plus year old case should be applied in this proceeding.

Q. HAS THE COMMISSION MADE ANY SUBSEQUENT RULINGS REGARDING POST-TEST YEAR PLANT?

A. Yes. In response to RUCO making the same argument in Docket 14-0010, the Commission, in adopting Staff's recommendation to include 12 months of post-test year plant in rate base in Decision 75268, found that "Staff's verification that the [post-test year] plant was in-service, and used and useful, was sufficient to justify its inclusion in rate base."[9]

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[6] *See* Direct Testimony of Frank Smaila, Engineering Report attachment, pp. 44-48.
[7] *See* Decision 74568, p. 5 at 18-21.
[8] Arizona-American Water Company; Docket No. W-01303A-08-0227, pp. 19-22.
[9] *See* Decision 75268, p. 17 at 14-17.

Mr. Cassidy focuses on Staff recommendations and Commission decisions during the period 2008 through 2010, and as a result fails to recognize the emerging issues affecting Arizona utilities and their customers. In 2016, regulators need to consider the effects of increasingly stringent safe drinking water regulations, aging infrastructure, and declining sales. As these issues begin to weigh more heavily on water utilities, RUCO should give more consideration to the long-term effect on customers.

It is also important to realize the "matching principle" cited by RUCO involves more than strict, mechanical adherence to the historical test year. For rates to be just and reasonable to both customers and the utility, those rates need to be designed to recover the costs of service the utility will incur during the period those rates are in effect.

Q. DOESN'T MR. CASSIDY STATE THAT RUCO WILL SUPPORT POST-TEST YEAR PLANT COMPLETED WITHIN SIX MONTHS OF THE TEST YEAR AND FOR PROJECTS THAT MEET RUCO'S DEFINITION OF "MAJOR PROJECTS"?

A. Yes, RUCO does make that general claim and even states that major projects would include projects that ensure regulatory compliance.[10] However, to put that claim in context, RUCO recommends the Commission exclude from the Pinal Valley service area's rate base AWC's arsenic treatment plant at Valley Farms Well No. 2 in the amount of $1,250,000 that was placed in service on July 8, 2015.[11] This falls squarely into RUCO's category of "major projects," because this is a federally mandated project necessary to ensure public health, improved water quality, and compliance with safe drinking water standards. This is a project for which the Company has filed and been granted an Arsenic Cost Recovery Mechanism ("ACRM") surcharge. Yet Mr. Cassidy recommends that the Commission disallow this project simply because it was placed

[10] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 10.
[11] *See* Direct Testimony of John Cassidy on Revenue Requirement, Sch. JAC-8 at 1.

in service eight days after RUCO's arbitrary cut-off for post-test year plant of six months after the test year. Yet Mr. Cassidy makes no recommendation concerning the ACRM surcharge that is already in place.

In fact, new rates in this proceeding will not go into effect until well over one year after RUCO's arbitrary cutoff, thereby creating a significant mismatch between RUCO's recommended rate base and the level of plant that will actually be serving customers, and the rates designed to recover the costs of serving those customers. RUCO's recommended adjustment to post-test year plant neglects known and measurable investments that can be and have been verified by Staff as used and useful.

Q. DOES THE INCLUSION OF POST-TEST YEAR PLANT IN RATE BASE CREATE A MISMATCH WHICH FAVORS THE STOCKHOLDERS TO THE DETRIMENT OF THE RATEPAYERS?

A. No. In fact, the post-test year plant is revenue neutral and was financed by stockholders and placed in service specifically to ensure safe and reliable service for the benefit and not the detriment of ratepayers. Nowhere does RUCO show that the level of revenues resulting from the inclusion of post-test year plant would result in a detriment to ratepayers. RUCO provides no financial analysis showing this. RUCO produces no studies and no evidence suggesting that utilities that receive rate base treatment of post-test year plant over-earn in times of increasing investment requirements or reductions in usage.

Q. DOES THE COMPANY ACCEPT RUCO'S RECOMMENDED DISALLOWANCE RELATED TO POST-TEST YEAR PLANT?

A. No. RUCO's recommendation limits the inclusion of post-test year plant to some projects which were placed in service within six months of the end of the test year, but also removes necessary projects placed in service within twelve months of the end of the test year. As explained by Mr. Schneider in his rebuttal testimony, the post-test year projects are currently in service and benefiting customers, and this plant should be included in rate base. In addition, Staff, which conducted an extensive review of these projects, has concluded that they are used and useful.

RUCO Rate Base Adj. No. 2 – Accumulated Depreciation

Q. HOW DID RUCO ADJUST ACCUMULATED DEPRECIATION?

A. RUCO adjusted accumulated depreciation to reflect RUCO's adjustments related to the removal of post-test year plant. The result of RUCO's adjustment is to reduce accumulated depreciation by $117,932, $11,568, and $201 for the Pinal Valley, White Tank, and Ajo systems respectively.[12]

Q. DOES AWC AGREE WITH RUCO'S ADJUSTMENTS TO ACCUMULATED DEPRECIATION?

A. No. As previously stated, the Company disagrees with RUCO's recommendation to arbitrarily disallow significant amounts of post-test year plant from rate base. With that being said, the Company agrees and acknowledges that an adjustment needs to be made to accumulated depreciation for any post-test year plant which is removed from rate base.

Q. HAS AWC PROPOSED ADJUSTMENTS RELATED TO BONUS DEPRECIATION FOR POST-TEST YEAR PLANT ADJUSTMENTS AS DISCUSSED BY RUCO?

A. Yes. The Company proposes a rebuttal rate base adjustment to reflect the deferred tax effect of bonus depreciation on the post-test year plant AWC proposes to include in rate base, which was unknown at the time of filing its application in this matter. Mr. Harris discusses this issue in his rebuttal testimony.

B. Operating Income

Q. WHICH OF RUCO'S OPERATING INCOME ADJUSTMENTS DO YOU ADDRESS IN THIS SECTION OF YOUR REBUTTAL TESTIMONY?

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[12] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 11 at 17-20.

A. In this section, I address RUCO operating income adjustments No. 1 (depreciation expense), No. 3 (tank maintenance), No. 4 (payroll annualization Adj. # 1), No. 5 (payroll annualization Adj. # 2), No. 6 (payroll annualization Adj. # 3), and No. 10 (income tax expense). Mr. Reiker addresses RUCO's remaining operating income adjustments in his rebuttal testimony.

RUCO Operating Income Adjustment No. 1 – Depreciation Expense

Q. PLEASE EXPLAIN RUCO OPERATING INCOME ADJUSTMENT NO. 1 REGARDING DEPRECIATION EXPENSE.

A. Mr. Cassidy's adjustment to depreciation expense is related to RUCO's recommended adjustments to post-test year plant. RUCO's adjustment reduces depreciation expense by $117,932, $11,568, and $201 for the Pinal Valley, White Tank, and Ajo systems respectively.[13] Although the Company disagrees with Mr. Cassidy's recommendation regarding post-test year plant in service, the Company recognizes that the adopted level of depreciation expense should reflect the adopted utility plant balances.

Q. DOES MR. CASSIDY'S ADJUSTMENT CONTAIN ERRORS?

A. Yes. In calculating the reduction to depreciation expense related to RUCO's adjustment to post-test year plant, Mr. Cassidy understates depreciation expense by one half.

RUCO Operating Income Adjustment No. 3 – Tank Maintenance

Q. PLEASE EXPLAIN RUCO'S OPERATING INCOME ADJUSTMENT NO. 3 REGARDING TANK MAINTENANCE EXPENSE.

A. Mr. Cassidy reverses the Company's adjustment to normalize tank maintenance expense, thereby reducing operating expenses by $99,896, $55,199, and $18,953 in the Pinal Valley, White Tank, and Ajo systems respectively.[14] Mr. Cassidy's rationale

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[13] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 15 at 12-14.
[14] *See* Direct Testimony of John Cassidy on Revenue Requirement, pp. 17-19.

for recommending that the Commission disallow tank maintenance expense is "uncertainty" associated with making forecasts over a 14-year period, which is the estimated number of years between interior tank re-coatings, and the fact that AWC does not expect to incur the same level of tank maintenance expense in each individual year for the next 14 years.

Below, I discuss why RUCO's testimony fails to demonstrate an understanding of the purpose of normalizing adjustments, and why the Commission should adopt the Company's proposed adjustments for this expense. Mr. Schneider also discusses the Company's plan, schedule, and need for normalizing tank maintenance expense.

Q. PLEASE EXPLAIN THE COMPANY'S PROPOSED ADJUSTMENT TO NORMALIZE TANK MAINTENANCE EXPENSE.

A. As explained in the direct testimony of Mr. Schneider (pp. 91-97), water storage tanks are inspected and cleaned on a routine basis. Interiors are recoated every 14 years and exteriors are painted every seven years. Without this program, water storage tanks would deteriorate more rapidly, shortening the useful life of each tank. Because the level and cost of tank maintenance varies from year to year, the level incurred during the test year is not representative of the average annual expense incurred over the 14-year tank maintenance period.

Consequently, Mr. Cassidy's reason for recommending disallowance is the very same reason that the Company's adjustment for tank maintenance expense is necessary. As explained above, AWC incurs these expenses at intervals of 7 and 14 years for each of the Company's water storage tanks. As a result, there may be years in which AWC incurs tank maintenance expense lower than the normalized amount, just as there may be other years in which AWC incurs tank maintenance expense greater than the normalized amount. Over the long-term, AWC is made whole on its tank maintenance expense through recovery of the normalized amount in rates.

Mr. Cassidy states that AWC expects to incur no tank maintenance expense in certain years in the Ajo service area, but he omits the fact that in 2019, the Company projects to spend approximately $108,000 – nearly 5½ times the normalized expense level of $18,953. Under Mr. Cassidy's version of ratemaking, a utility would be forced to tailor its general rate case filings around its tank painting schedule to recover this necessary expense. This would cause the Company's expenses to spike in a test year and cause its tank painting schedule to fluctuate with rate case cycles. This clearly demonstrates why the Company's normalizing adjustment is necessary.

RUCO Operating Income Adjustment No. 4 – Payroll Annualization Adj. # 1

Q. PLEASE EXPLAIN RUCO'S RECOMMENDED PAYROLL ANNUALIZATION ADJ. # 1?

A. According to Mr. Cassidy's testimony, RUCO "allowed the '2015 [wage] rate[s],' but made an adjustment to remove the 3.0 percent across the board salary increase proposed for 2016."[15] RUCO payroll annualization adjustment #1 reduces payroll expense by $85,980, $8,713, and $2,910 for the Pinal Valley, White Tank, and Ajo systems respectively.[16]

Q. SHOULD THE COMMISSION DISALLOW AWC'S 3 PERCENT WAGE INCREASE?

A. No. Although 2014 is the historical test year in this proceeding, it is simply the starting point for determining the Company's cost of serving customers at the time rates will go into effect. The end result of this proceeding should be based on the level of expense the Company will prudently incur during the period new rates are in effect. It is currently 2016, and new rates are expected to go into effect before the end of this year. Setting rates based on wages that were in effect during 2015 fails to recognize the level of prudently incurred expense during the period new rates will be in effect.

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[15] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 19 at 22-23.
[16] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 20 at 4-8.

Therefore, it is necessary to reflect AWC's proposed 3 percent wage increase in this proceeding.

<u>RUCO Operating Income Adjustment No. 5 – Payroll Annualization Adj. # 2</u>

Q. PLEASE DISCUSS RUCO'S SECOND PAYROLL ADJUSTMENT TO REDUCE THE SALARIES OF THE CHAIRMAN/CEO AND ASSISTANT SECRETARY BY ONE HALF.

A. RUCO's second adjustment reduces the salaries of the Chairman/CEO and Assistant Secretary by one half to reflect a sharing of payroll costs between the Company and its California affiliate, San Gabriel Valley Water Company ("San Gabriel"). RUCO's payroll adjustment #2 reduces payroll expense by $44,616, $3,446, and $1,246 for the Pinal Valley, White Tank, and Ajo systems respectively.[17]

Q. DOES THE COMPANY AGREE WITH RUCO'S SECOND ADJUSTMENT TO SALARIES AND WAGES?

A. No. Only the portion of RUCO's adjustment related to the Assistant Secretary is appropriate, as AWC's Assistant Secretary retired from the Company in 2015. However, RUCO's adjustment to remove one half of the salary of the Chairman/CEO, Mr. Whitehead, is inappropriate and should not be adopted. The salary Mr. Whitehead receives from AWC does not include any compensation for the time he devotes to San Gabriel. Mr. Whitehead receives a salary directly from San Gabriel based on the relative amount of time he devotes to that company, and the total amount of his salary from both utilities represents the market rate for his position. The California Public Utilities Commission ("CPUC") has ruled in this regard, as set forth below:

> The Chairman is paid directly by [San Gabriel] and directly by AWC for the time he devotes to those companies based on daily time records. Those records comply with the affiliated transaction rules adopted in D.93-09-036 and subsequently affirmed in D.04-07-034. We stated in that later

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[17] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 20 at 12-21.

> decision that we will not disallow any portion of the Chairman's salary since [San Gabriel] appears to be in compliance with D.93-09-036, and we find nothing else in the record that might support the recommended disallowance.[18] Nothing in this record warrants a reversal of our prior decisions on the Chairman's salary. There should be no adjustment to the Chairman's salary. This issue should not be readdressed in future proceedings unless new evidence is brought forward for our consideration.[19]

As stated above, the CPUC has determined that there is no cross-subsidy and no sharing of costs related to the Chairman/CEO's salary between AWC and San Gabriel.

Q. IS MR. CASSIDY'S RECOMMENDATION TO DISALLOW 50% OF THE CHAIRMAN/CEO'S SALARY CONSISTENT WITH RUCO'S RECOMMENDATIONS IN PRIOR AWC GENERAL RATE CASES?

A. No. In each of the seven prior general rate cases the Company has filed, RUCO's recommended rates have included 100% of the Chairman/CEO's salary.[20] Further, the Commission has consistently adopted rates for AWC that include 100% of the Chairman/CEO's salary.[21]

RUCO Operating Income Adjustment No. 6 – Payroll Annualization Adj. # 3

Q. DOES THE COMPANY AGREE WITH RUCO'S THIRD ADJUSTMENT TO SALARIES AND WAGES TO DISALLOW THE SALARY OF THE VICE PRESIDENT – RATES AND REVENUE, MR. REIKER?[22]

A. No. Although Mr. Cassidy recommends disallowing 100 percent of Mr. Reiker's salary, RUCO recommends no adjustment to reflect the salary of his replacement, myself, despite being made aware of my employment through AWC's response to

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[18] D.04-07-034, p. 30 and Findings of Fact 22 and 23, p. 67. (footnote in original)

[19] California Public Utilities Commission Decision 08-06-022, dated June 12, 2008, p. 46.

[20] *See* Direct Testimony of Marylee Diaz Cortez in docket 00-0962, Direct Testimony of Tim Coley in docket 02-0619, Direct Testimony of William Rigsby in docket 02-0619, Direct Testimony of William Rigsby in docket 04-0650, Direct Testimony of Tim Coley in docket 04-0650, Direct Testimony of William Rigsby in docket 08-0440, Direct Testimony of Tim Coley in docket 08-0440, Direct Testimony of Tim Coley in docket 10-0517, Direct Testimony of Robert Mease in docket 11-0310, Direct Testimony of Jorn Keller in docket 12-0348.

[21] *See* Decision Nos. 64282, 66849, 68302, 71845, 73144, 73736, 74081.

[22] *See* Direct Testimony of John Cassidy on Revenue Requirement, p. 21 at 3-10.

Staff data request BAB 4.5. If an adjustment is made to remove Mr. Reiker's salary, then a corresponding adjustment should be made to reflect his replacement. Accepting the portion of RUCO's 2nd payroll adjustment related to the Assistant Secretary, and correcting RUCO's 3rd payroll adjustment to reflect the salary of my position, results in a total reduction to payroll expense in the amount of $29,343, $2,266, and $820 for the Pinal Valley, White Tank, and Ajo systems respectively.

RUCO Operating Income Adjustment No. 10 – Income Tax Expense

Q. DOES THE COMPANY ACCEPT RUCO'S ADJUSTMENT TO APPLY A HYPOTHETICAL IMPUTED FEDERAL TAX RATE AND GROSS REVENUE CONVERSION FACTOR ("GRCF") TO THOSE SYSTEMS WHICH HAVE FEDERAL TAXABLE INCOME OF LESS THAN $335,000?

A. No. AWC is a single corporate entity that files a single Federal tax return and as a result, pays 35 percent of its taxable income to the Federal government regardless of where that taxable income is earned. This means that the applicable federal income tax rate for ratemaking purposes in each of AWC's service areas is 35 percent, including the Company's smaller service areas such as Ajo. Much like costs related to the removal of arsenic and nitrates, Federal income taxes are Federally-mandated, and the Commission should allow full recovery of this known and measurable expense.

Q. DO RUCO'S CALCULATIONS HAVE BROADER POLICY IMPLICATIONS?

A. Yes. Aside from abandoning the long-held regulatory axiom that rates are to be set at a level designed to recover the cost of providing service, RUCO's methodology, if adopted, would serve to discourage the consolidation of smaller, troubled water systems in the State of Arizona. It is unlikely that a water utility the size of AWC would pursue the acquisition of a water system the size of Ajo knowing that the Company's shareholders would be required to subsidize a portion of the Federal income taxes going forward.

Q. HAS MR. CASSIDY PROVIDED ANY EVIDENCE SHOWING THAT THE INCOME TAX EXPENSE AWC PAYS TO THE INTERNAL REVENUE SERVICE IS IMPRUDENT?

A. No. As stated above, AWC is required by law to pay its federal income taxes.

IV. Response to Staff

A. Rate Base

Q. WHICH OF STAFF'S RATE BASE ADJUSTMENTS DO YOU ADDRESS IN THIS SECTION OF YOUR REBUTTAL TESTIMONY?

A. In this section I address Staff's rate base adjustment No. 1 regarding post-test year plant. Company witnesses Joel M. Reiker, Joseph D. Harris, and Fredrick K. Schneider address Staff's other rate base adjustments.

Staff Rate Base Adjustment No. 1 – Post-Test Year Plant

Q. HAVE YOU REVIEWED STAFF'S ADJUSTMENT TO POST-TEST YEAR PLANT?

A. Yes. Staff's adjustment to post-test year plant is largely based on their recommendation to limit post-test year plant to projects placed in service by December 31, 2015, as well as adjustments related to the Company's estimated costs at the time of filing its rate case. Staff recommends adjustments reducing rate base by $3,208,287, $72,481, and $12,585 for the Pinal Valley, White Tank, and Ajo systems respectively.[23]

Q. DOES THE COMPANY AGREE WITH STAFF'S ADJUSTMENT TO RATE BASE?

A. For the most part, yes. I believe there are some issues related to project cost estimates that will be resolved as Staff has more time to review AWC's final year-end 2015, project costs which were provided in AWC's response to Staff data request BAB 8.1. Staff's direct testimony relies on project costs incurred as of November 30, 2015.

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[23] *See* Direct Testimony of Briton Baxter on Revenue Requirement, p. 14 at 11-12, p. 19 at 11-12, and p. 24 at 7-8.

Additionally, after Staff is able to further review the "blanket" projects and the related support AWC has provided, Staff may change their adjustment as all of the support for "blanket" projects completed during 2015 has also been provided. Mr. Schneider further discusses "blanket" projects and whether they are used and useful in his rebuttal testimony. After using the Company's response to Staff data request BAB 8.1 to update project costs and include blanket projects as well as project 0076 as used and useful, the Company believes it is appropriate to adjust plant in service by ($1,817,676), $18,488, and $3,337 for the Pinal Valley, White Tank, and Ajo systems respectively.

Q. ARE THERE ANY OTHER ISSUES RELATED TO STAFF'S ADJUSTMENT TO POST-TEST YEAR PLANT?

A. Yes. Although Staff makes adjustments removing plant balances, they do not make any corresponding adjustment to remove the related accumulated depreciation of that plant. A corresponding adjustment needs to be made to accumulated depreciation for any plant removed from rate base.

B. <u>Operating Income</u>

Q. WHICH OF STAFF'S OPERATING INCOME ADJUSTMENTS DO YOU ADDRESS IN THIS SECTION OF YOUR REBUTTAL TESTIMONY?

A. In this section I address Staff's operating income adjustments No. 2 (salaries and wages), No. 3 (vehicles), No. 6 (depreciation expense), and No. 7 (income tax expense). Mr. Reiker addresses Staff's remaining operating income adjustments in his rebuttal testimony.

<u>Staff Operating Income Adjustment No. 2 – Salaries and Wages</u>

Q. PLEASE EXPLAIN STAFF'S OPERATING INCOME ADJUSTMENT NO. 2 REGARDING AWC'S SALARIES AND WAGES.

A. Staff's adjustment to salaries and wages consist of two components, an adjustment to the Company's proposed 2016, 3% wage increase and the disallowance of five of the seven additional positions AWC included in its adjustment to payroll expense. Staff's recommendations result in a reduction to payroll expense in Pinal Valley, White Tank, and Ajo by $231,579, $89,282, and $2,179 respectively.[24]

Q. PLEASE DISCUSS THE PORTION OF STAFF'S ADJUSTMENT RELATED TO AWC'S 3% WAGE INCREASE.

A. According to Mr. Baxter, Staff reviewed the actual history of annual percentage wage increases since 2010, the test year in AWC's last Western Group rate case, and calculated the average annual increase during that period. Based on Mr. Baxter's calculation, Staff recommends that the applicable wage increase for 2016 be limited to 1.6%.

Q. DOES THE COMPANY AGREE WITH STAFF'S ADJUSTMENT REGARDING THE LEVEL OF ANNUAL SALARY INCREASE?

A. No. The period Staff used to calculate the average increase includes a period of time in which Company was still working towards recovering from the effects of the Great Recession. Additionally, by the time a decision is reached in this rate case and the new rates go into effect, the Company will be adjusting wages for the 2016 annual wage increase. Based on this fact alone, the Company's proposed 3% increase is conservative based on Mr. Baxter's calculated average annual wage increase of 1.6%. As a result, AWC maintains that an adjustment to reflect a 3% increase in wages best reflects what the Company's payroll costs will be at the time that new rates are approved in this proceeding.

Q. PLEASE DISCUSS THE PORTION OF STAFF'S ADJUSTMENT RELATED TO THE ADDITIONAL EMPLOYEES HIRED AFTER THE TEST YEAR.

A. Staff recommends disallowing the salaries of four of six additional positions AWC included in its adjustment to payroll expense, stating that only two of the positions were actually filled by the end of 2015. Staff also removes one additional position,

[24] *See* Direct Testimony of Briton Baxter on Revenue Requirement, p. 30 at 8-9, p. 39 at 11-12, and p. 48 at 8-9.

which I assume is the position of Rate Analyst, stating that the position did not provide service to test year customers.

Q. DOES THE COMPANY AGREE WITH STAFF'S ADJUSTMENT REGARDING THE ADDITIONAL EMPLOYEES HIRED AFTER THE TEST YEAR?

A. No. Four of the new positions filled after the test year were filled by promotions from within the Company, and only two of these additional positions remain unfilled. Mr. Baxter appears to have relied upon AWC's response to Staff data request BAB 4.5b, which concerned new hires after the test year, and as a result erred in removing these positions.

In addition, Staff's argument that the Rate Analyst position should be disallowed because it did not provide service to test year customers should be rejected. The Rate Analyst position was filled in the first week of 2015, and the salary is known and measurable. AWC's Rate Analyst was hired to assist in the preparation of the Company's application in this rate case as well the preparation of filings required pursuant to the Commission's arsenic cost recovery mechanism and other required Commission filings.

Q. IF THESE POSITIONS WEREN'T FILLED DURING THE TEST YEAR, WHY SHOULD THEY BE INCLUDED IN THIS RATE CASE?

A. AWC has determined that these positions are necessary to continue providing safe, adequate and reliable service to its customers. The rate case test year is often a time in which personnel levels are reviewed and the budgeting for new positions is accomplished.

These are no longer the days where systems are growing so quickly that new positions can be added at any time with the comfort that increased revenues from growth will cover the additional cost. Rates should be designed to recover the level of prudently incurred costs during the period such rates will be in effect, and not the simple result of applying a mechanical formula or an arbitrary cut-off date.

As stated above, AWC included these positions because they are necessary to provide safe, adequate, and reliable service, and no party has presented evidence that these positions do not represent reasonable and prudent costs. Staff has not disputed the need or the cost for these employees. Although a historic test year is the basis for the revenue requirement, pro-forma adjustments are used to ensure that rates are designed to recover expenses at the levels incurred when the rates ultimately go into effect. If these positions are not included in the revenue requirement of this rate case, it will result in increasing strain on existing employees and associated overtime.

Staff Operating Income Adjustment No. 3 – Vehicles

Q. HOW DID STAFF ADJUST VEHICLE EXPENSES?

A. Staff recommends an adjustment reducing vehicle expense by $18,154 and $5,899 for the Pinal Valley and White Tank systems respectively.[25] Staff's adjustment is based on the same rationale as their adjustment to salaries and wages, which is the erroneous conclusion that only two of six positions have been filled.

Q. DOES THE COMPANY AGREE WITH STAFF'S ADJUSTMENT?

A. No. The Company disagrees with Staff's adjustment for the same reasons it opposes Staff's adjustment to salaries and wages. Once again, the Company has filled four of six new positions, but all of the requested positions are necessary to provide customers with the appropriate level of service, and the related vehicle expense is necessary as well. In order to best match the level of expenses that the Company will be incurring when rates go into effect, Staff's adjustment to vehicle expense should be rejected.

Staff Operating Income Adjustment No. 6 – Depreciation Expense

Q. DOES AWC HAVE ANY ISSUES WITH STAFF'S CALCULATION AND ADJUSTMENT TO DEPRECIATION EXPENSE?

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[25] *See* Direct Testimony of Briton Baxter on Revenue Requirement, p. 30 at 25-26 and p. 40 at 2-3.

A. Yes. Aside from the differences related to rate base treatment of post-test year plant, Mr. Baxter applies the wrong amortization rate for contributions in aid of construction ("CIAC"). In Decision Nos. 66849 and 71845, the Commission agreed with the Company that the CIAC amortization rate should reflect the annual depreciation associated with the plant accounts that include contributions (i.e. transmission and distribution mains, fire sprinkler taps, services, meters, and hydrants) (Decision No. 71845, pp. 30-31):

> We agree with the Company that the proposed CIAC amortization rate of 2.00 percent should be adopted in this case. As the Company witness indicated, the CIAC amortization rate should reflect the plant accounts that include contributions (i.e., transmission and distribution mains, fire sprinkler taps, services, meters, and hydrants). Based on the Company's testimony and supporting documents, the proposed 2.00 percent rate is reasonable and shall be adopted.

Staff's methodology uses a composite amortization rate based on all depreciable plant accounts, including those accounts such as office furniture (e.g. computers) and power operated equipment, which do not typically include contributed plant. This is neither the theoretically correct CIAC amortization rate, nor the rate currently approved for the Company by the Commission. The appropriate rate, and the rate approved by the Commission in the above referenced decisions, is 2.00%. Staff has apparently used the same methodology it has previously proposed, which the Commission rejected in Decision Nos. 66849 (pp. 16-16) and 71845 (pp. 30-31). The Commission should continue to apply the Company's current CIAC amortization rate of 2.00% in this proceeding.

Staff Operating Income Adjustment No. 7 – Income Tax Expense

Q. DOES THE COMPANY ACCEPT STAFF'S ADJUSTMENT TO APPLY A HYPOTHETICAL FEDERAL TAX RATE OR GROSS REVENUE CONVERSION FACTOR ("GRCF") TO THOSE SYSTEMS WHICH HAVE FEDERAL TAXABLE INCOME OF LESS THAN $335,000?

A. No. For the same reasons RUCO's recommendation to apply a hypothetical imputed federal income tax rate should be rejected, so should Staff's recommendation. As stated above, AWC is a single corporate entity that files a single Federal tax return and as a result, pays 35% of its taxable income to the Federal government regardless of where that taxable income is earned. Staff provides no evidence to support the disallowance of a portion of AWC's federal income taxes, which AWC is required by law to pay. Disallowing federal income taxes is confiscatory and Staff's calculation should not be adopted in this proceeding.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

EXHIBIT JRM-RB1

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Increase in Gross Revenue Requirement

Exhibit
Schedule A-1 Rebuttal

Witness: Moe

Line No.	Description	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
		Western Group							
1									
2		Company - As Filed				Company - Rebuttal			
3									
4	Adjusted Rate Base	$ 67,417,785				$ 64,367,950			
5									
6	Adjusted Operating Income	$ 2,357,130				$ 2,328,462			
7									
8	Current Rate of Return (Ln. 6 ÷ Ln. 4)	3.50%				3.62%			
9									
10	Required Operating Income (Ln. 4 X Ln. 12)	$ 6,021,978				$ 5,991,480			
11									
12	Required Rate of Return	8.93%				9.31%			
13									
14	Operating Income Deficiency (Ln. 10 - Ln. 6)	$ 3,664,848				$ 3,663,018			
15									
16	Gross Revenue Conversion Factor	1.6400				1.6400			
17									
18	Required Increase in Gross Revenue								
19	(Ln. 14 X Ln. 16)	$ 6,010,408				$ 6,007,339			
20									
21	Add: Consolidated Revenue Adjustment	$ -				$ -			
22									
23	Proposed Increase in Gross Revenues	$ 6,010,408				$ 6,007,339			
24									
25									
26									
27		Revenue -	Revenue -			Revenue -	Revenue -		
28		Present	Proposed	Dollar	Percent	Present	Proposed	Dollar	Percent
29	Customer Classification	Rates	Rates	Increase	Increase	Rates	Rates	Increase	Increase
30									
31	Residential	$ 13,396,945	$ 17,069,179	$ 3,672,234	27.41%	$ 13,396,945	$ 17,172,294	$ 3,775,350	28.18%
32	Commercial	5,959,602	7,935,581	1,975,979	33.16%	5,959,602	7,996,988	2,037,386	34.19%
33	Industrial	973,961	1,195,514	221,554	22.75%	209,904	218,971	9,066	4.32% [1]
34	Private Fire Service	124,650	174,510	49,860	40.00%	124,650	174,510	49,860	40.00%
35	Other Water Revenues	251,834	342,551	90,717	36.02%	251,834	344,460	92,626	36.78%
36									
37	Total Water Revenues	$ 20,706,991	$ 26,717,335	$ 6,010,344	29.03%	$ 19,942,935	$ 25,907,223	$ 5,964,288	29.91%
38									
39	Miscellaneous Revenues	509,842	509,842	-	0.00%	509,842	509,842	-	0.00%
40									
41	Total Operating Revenues	$ 21,216,833	$ 27,227,177	$ 6,010,344	28.33%	$ 20,452,777	$ 26,417,065	$ 5,964,288	29.16%
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55	[1]Reflects 15% rate reduction for Abbott Laboratories.								

Supporting Schedules:
B-1 Rebuttal, C-1 Rebuttal, C-3 Rebuttal, H-1 Rebuttal

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Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Increase in Gross Revenue Requirement

Line No.	Description	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
		Pinal Valley							
		Company - As Filed				Company - Rebuttal			
4	Adjusted Rate Base	$ 61,344,294				$ 58,322,921			
6	Adjusted Operating Income	$ 2,215,360				$ 2,191,278			
8	Current Rate of Return (Ln. 6 ÷ Ln. 4)	3.61%				3.76%			
10	Required Operating Income (Ln. 4 X Ln. 12)	$ 5,479,474				$ 5,428,798			
12	Required Rate of Return	8.93%				9.31%			
14	Operating Income Deficiency (Ln. 10 - Ln. 6)	$ 3,264,114				$ 3,237,521			
16	Gross Revenue Conversion Factor	1.6403				1.6403			
18	Required Increase in Gross Revenue								
19	(Ln. 14 X Ln. 16)	$ 5,354,172				$ 5,310,551			
21	Add: Consolidated Revenue Adjustment	$ -				$ -			
23	Proposed Increase in Gross Revenues	$ 5,354,172				$ 5,310,551			
27–29	Customer Classification	Revenue - Present Rates	Revenue - Proposed Rates	Dollar Increase	Percent Increase	Revenue - Present Rates	Revenue - Proposed Rates	Dollar Increase	Percent Increase
31	Residential	$ 11,298,423	$ 14,478,782	$ 3,180,359	28.15%	$ 11,298,423	$ 14,553,499	$ 3,255,076	28.81%
32	Commercial	5,412,847	7,237,593	1,824,746	33.71%	5,412,847	7,287,152	1,874,306	34.63%
33	Industrial	957,969	1,171,957	213,988	22.34%	209,904	218,971	9,066	4.32% [1]
34	Private Fire Service	121,650	170,310	48,660	40.00%	121,650	170,310	48,660	40.00%
35	Other Water Revenues	215,938	302,299	86,361	39.99%	215,938	303,902	87,964	40.74%
37	Total Water Revenues	$ 18,006,827	$ 23,360,941	$ 5,354,114	29.73%	$ 17,258,762	$ 22,533,834	$ 5,275,072	30.56%
39	Miscellaneous Revenues	461,120	461,120	-	0.00%	461,120	461,120	-	0.00%
41	Total Operating Revenues	$ 18,467,946	$ 23,822,061	$ 5,354,114	28.99%	$ 17,719,882	$ 22,994,954	$ 5,275,072	29.77%

55 [1]Reflects 15% rate reduction for Abbott Laboratories.

Supporting Schedules:
B-1 Rebuttal, C-1 Rebuttal, C-3 Rebuttal, H-1 Rebuttal

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Increase in Gross Revenue Requirement

White Tank

Line No.	Description	[A] Company - As Filed	[E] Company - Rebuttal
4	Adjusted Rate Base	$ 5,107,756	$ 5,078,719
6	Adjusted Operating Income	$ 113,125	$ 108,940
8	Current Rate of Return (Ln. 6 ÷ Ln. 4)	2.21%	2.15%
10	Required Operating Income (Ln. 4 X Ln. 12)	$ 456,242	$ 472,736
12	Required Rate of Return	8.93%	9.31%
14	Operating Income Deficiency (Ln. 10 - Ln. 6)	$ 343,116	$ 363,796
16	Gross Revenue Conversion Factor	1.6377	1.6377
18	Required Increase in Gross Revenue		
19	(Ln. 14 X Ln. 16)	$ 561,919	$ 595,785
21	Add: Consolidated Revenue Adjustment	$ -	$ -
23	Proposed Increase in Gross Revenues	$ 561,919	$ 595,785

Line No.	Customer Classification	[A] Revenue - Present Rates	[B] Revenue - Proposed Rates	[C] Dollar Increase	[D] Percent Increase	[E] Revenue - Present Rates	[F] Revenue - Proposed Rates	[G] Dollar Increase	[H] Percent Increase
		Company - As Filed				Company - Rebuttal			
31	Residential	$ 1,791,595	$ 2,220,136	$ 428,541	23.92%	$ 1,791,595	$ 2,244,371	$ 452,776	25.27%
32	Commercial	421,627	542,416	120,789	28.65%	421,627	551,757	130,129	30.86%
33	Industrial	15,992	23,557	7,565	47.31%	-	-	-	0.00%
34	Private Fire Service	1,800	2,520	720	40.00%	1,800	2,520	720	40.00%
35	Other Water Revenues	35,331	39,659	4,328	12.25%	35,331	39,951	4,620	13.08%
37	Total Water Revenues	$ 2,266,346	$ 2,828,289	$ 561,944	24.80%	$ 2,250,354	$ 2,838,599	$ 588,245	26.14%
39	Miscellaneous Revenues	44,621	44,621	-	0.00%	44,621	44,621	-	0.00%
41	Total Operating Revenues	$ 2,310,966	$ 2,872,910	$ 561,944	24.32%	$ 2,294,974	$ 2,883,219	$ 588,245	25.63%

55 [1]Reflects 15% rate reduction for Abbott Laboratories.

Supporting Schedules:
B-1 Rebuttal, C-1 Rebuttal, C-3 Rebuttal, H-1 Rebuttal

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Increase in Gross Revenue Requirement

Ajo

Line No.	Description	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
		Company - As Filed				Company - Rebuttal			
4	Adjusted Rate Base	$ 965,735				$ 966,310			
6	Adjusted Operating Income	$ 28,644				$ 28,244			
8	Current Rate of Return (Ln. 6 ÷ Ln. 4)	2.97%				2.92%			
10	Required Operating Income (Ln. 4 X Ln. 12)	$ 86,263				$ 89,946			
12	Required Rate of Return	8.93%				9.31%			
14	Operating Income Deficiency (Ln. 10 - Ln. 6)	$ 57,618				$ 61,702			
16	Gross Revenue Conversion Factor	1.6369				1.6369			
18	Required Increase in Gross Revenue								
19	(Ln. 14 X Ln. 16)	$ 94,318				$ 101,003			
21	Add: Consolidated Revenue Adjustment	$ -				$ -			
23	Proposed Increase in Gross Revenues	$ 94,318				$ 101,003			
29	Customer Classification	Revenue - Present Rates	Revenue - Proposed Rates	Dollar Increase	Percent Increase	Revenue - Present Rates	Revenue - Proposed Rates	Dollar Increase	Percent Increase
31	Residential	$ 306,927	$ 370,261	$ 63,334	20.63%	$ 306,927	$ 374,425	$ 67,498	21.99%
32	Commercial	125,128	155,572	30,444	24.33%	125,128	158,079	32,951	26.33%
33	Industrial	-	-	-	0.00%	-	-	-	0.00%
34	Private Fire Service	1,200	1,680	480	40.00%	1,200	1,680	480	40.00%
35	Other Water Revenues	564	592	28	4.94%	564	607	42	7.46%
37	Total Water Revenues	$ 433,819	$ 528,105	$ 94,286	21.73%	$ 433,819	$ 534,790	$ 100,971	23.27%
39	Miscellaneous Revenues	4,101	4,101	-	0.00%	4,101	4,101	-	0.00%
41	Total Operating Revenues	$ 437,921	$ 532,206	$ 94,286	21.53%	$ 437,921	$ 538,892	$ 100,971	23.06%

55 [1]Reflects 15% rate reduction for Abbott Laboratories.

Supporting Schedules:
B-1 Rebuttal, C-1 Rebuttal, C-3 Rebuttal, H-1 Rebuttal

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Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Summary Original Cost Rate Base

Line No.		Western Group [A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal
1				
2	Gross Plant in Service	$ 207,103,607	$ (1,795,851)	$ 205,307,756
3				
4	Less:			
5	Accumulated Depreciation	50,872,499	(27,138)	50,845,361
6	Net Plant in Service	$ 156,231,108	$ (1,768,713)	$ 154,462,395
7				
8	Less:			
9	Advances in Aid of Construction	52,761,243	-	52,761,243
10	Contributions in Aid of Construction:			
11	Gross	33,654,716	-	33,654,716
12	Accumulated Amortization	(5,667,819)	-	(5,667,819)
13	Net Contributions in Aid of Construction	$ 27,986,897	$ -	$ 27,986,897
14				
15	Deferred Income Tax	14,084,977	1,333,074	15,418,051
16	Customer Deposits	466,238	-	466,238
17				
18	Add:			
19	Working Capital	1,732,229	51,952	1,784,180
20	Net Regulatory Asset / (Liability)	4,753,804	-	4,753,804
21				
22				
23	Total Rate Base	$ 67,417,785	$ (3,049,835)	$ 64,367,950
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Supporting Schedules:
B-2 Rebuttal, B-3 Rebuttal, B-5 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Summary Original Cost Rate Base

		Pinal Valley			White Tank			Ajo		
Line No.		[A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal	[A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal	[A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal
1										
2	Gross Plant in Service	$ 172,895,726	$ (1,817,676)	$ 171,078,051	$ 31,633,216	$ 18,488	$ 31,651,704	$ 2,574,664	$ 3,337	$ 2,578,001
3										
4	Less:									
5	Accumulated Depreciation	44,260,678	(27,484)	44,233,194	5,425,556	319	5,425,875	1,186,265	27	1,186,292
6	Net Plant in Service	$ 128,635,048	$ (1,790,192)	$ 126,844,856	$ 26,207,660	$ 18,169	$ 26,225,829	$ 1,388,399	$ 3,310	$ 1,391,710
7										
8	Less:									
9	Advances in Aid of Construction	36,540,428	-	36,540,428	16,185,732	-	16,185,732	35,084	-	35,084
10	Contributions in Aid of Construction:									
11	Gross	29,481,326	-	29,481,326	4,006,138	-	4,006,138	167,252	-	167,252
12	Accumulated Amortization	(5,181,305)	-	(5,181,305)	(458,417)	-	(458,417)	(28,097)	-	(28,097)
13	Net Contributions in Aid of Construction	$ 24,300,021	$ -	$ 24,300,021	$ 3,547,721	$ -	$ 3,547,721	$ 139,155	$ -	$ 139,155
14										
15	Deferred Income Tax	12,343,427	1,235,230	13,578,657	1,473,620	95,134	1,568,753	267,931	2,710	270,641
16	Customer Deposits	422,585	-	422,585	34,152	-	34,152	9,501	-	9,501
17										
18	Add:									
19	Working Capital	1,561,902	4,049	1,565,951	141,320	47,928	189,248	29,007	(25)	28,982
20	Net Regulatory Asset / (Liability)	4,753,804	-	4,753,804	-	-	-	-	-	-
21										
22										
23	Total Rate Base	$ 61,344,294	$ (3,021,374)	$ 58,322,921	$ 5,107,756	$ (29,036)	$ 5,078,719	$ 965,735	$ 575	$ 966,310

Supporting Schedules:
B-2 Rebuttal, B-3 Rebuttal, B-5 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Summary Original Cost Rate Base

		Phoenix Office			Meter Shop		
Line No.		[A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal	[A] Original Cost Rate Base - As Filed	[B] Rebuttal Adjustments	[C] Original Cost Rate Base - Rebuttal
1							
2	Gross Plant in Service	$ -	$ -	$ -	$ -	$ -	$ -
3							
4	Less:						
5	Accumulated Depreciation	-	-	-	-	-	-
6	Net Plant in Service	$ -	$ -	$ -	$ -	$ -	$ -
7							
8	Less:						
9	Advances in Aid of Construction	-	-	-	-	-	-
10	Contributions in Aid of Construction:						
11	Gross	-	-	-	-	-	-
12	Accumulated Amortization	-	-	-	-	-	-
13	Net Contributions in Aid of Construction	$ -	$ -	$ -	$ -	$ -	$ -
14							
15	Deferred Income Tax	-	-	-	-	-	-
16	Customer Deposits	-	-	-	-	-	-
17							
18	Add:						
19	Working Capital	-	-	-	-	-	-
20	Net Regulatory Asset / (Liability)	-	-	-	-	-	-
21							
22							
23	Total Rate Base	$ -	$ -	$ -	$ -	$ -	$ -
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Supporting Schedules:
B-2 Rebuttal, B-3 Rebuttal, B-5 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Original Cost Rate Base Pro Forma Adjustments

Exhibit
Schedule B-2 Rebuttal
Page 1 of 6
Witness: Moe

Western Group

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal RB-1	[E] Rebuttal RB-2	[F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
					Rebuttal Rate Base Adjustments								
1													
2	Plant Classification												
3	Intangible Plant	$ 2,004,857	$ 3,462	$ 2,008,319	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,008,319
4	Source of Supply Plant	9,203,159	387,593	9,590,752	16,383	-	-	-	-	-	-	16,383	9,607,135
5	Pumping Plant	17,282,691	2,753,500	20,036,191	(25,881)	-	-	-	-	-	-	(25,881)	20,010,310
6	Water Treatment Plant	19,755,246	3,123,776	22,879,022	(1,511,481)	-	-	-	-	-	-	(1,511,481)	21,367,541
7	Transmission & Distribution Plant	141,048,101	3,036,870	144,084,971	(287,765)	-	-	-	-	-	-	(287,765)	143,797,206
8	General Plant	5,116,182	3,388,170	8,504,352	63,540	-	-	-	-	-	(50,647)	12,892	8,517,244
9	Total Gross Plant in Service	$ 194,410,236	$ 12,693,371	$ 207,103,607	$ (1,745,203)	$ -	$ -	$ -	$ -	$ -	$ (50,647)	$ (1,795,851)	$ 205,307,756
10													
11	Less:												
12	Accumulated Depreciation	49,545,804	1,326,694	50,872,499	(25,969)	-	-	-	-	-	(1,169)	(27,138)	50,845,361
13	Net Plant in Service	$ 144,864,432	$ 11,366,676	$ 156,231,108	$ (1,719,234)	$ -	$ -	$ -	$ -	$ -	$ (49,479)	$ (1,768,713)	$ 154,462,395
14													
15	Less:												
16	Advances in Aid of Construction	52,761,243	-	52,761,243	-	-	-	-	-	-	-	-	52,761,243
17	Contributions in Aid of Construction:												
18	Gross	33,654,716	-	33,654,716	-	-	-	-	-	-	-	-	33,654,716
19	Accumulated Amortization	(5,667,819)	-	(5,667,819)	-	-	-	-	-	-	-	-	(5,667,819)
20	Net Contributions in Aid of Construction	$ 27,986,897	$ -	$ 27,986,897	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 27,986,897
21													
22	Deferred Income Tax	-	14,084,977	14,084,977	-	1,328,417	-	-	-	-	4,657	1,333,074	15,418,051
23	Customer Deposits	466,238	-	466,238	-	-	-	-	-	-	-	-	466,238
24													
25	Add:												
26	Working Capital	1,732,229	-	1,732,229	-	-	-	-	-	51,952	-	51,952	1,784,180
27	Net Regulatory Asset / (Liability)	-	4,753,804	4,753,804	-	-	-	-	-	-	-	-	4,753,804
28													
29													
30	Total Rate Base	$ 65,382,282	$ 2,035,503	$ 67,417,785	$ (1,719,234)	$ (1,328,417)	$ -	$ -	$ -	$ 51,952	$ (54,136)	$ (3,049,835)	$ 64,367,950
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Supporting Schedules:

Recap Schedules:
B-1 Rebuttal

Pinal Valley

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal RB-1	[E] Rebuttal RB-2	[F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
					Rebuttal Rate Base Adjustments								
1													
2	Plant Classification												
3	Intangible Plant	$ 1,986,263	$ 3,034	$ 1,989,297	$ -						$ -	$ -	$ 1,989,297
4	Source of Supply Plant	7,259,484	387,590	7,647,074	16,383						-	16,383	7,663,457
5	Pumping Plant	13,907,075	2,741,500	16,648,575	(47,493)						-	(47,493)	16,601,082
6	Water Treatment Plant	10,992,296	3,069,680	14,061,976	(1,526,340)						-	(1,526,340)	12,535,636
7	Transmission & Distribution Plant	122,439,758	2,879,586	125,319,344	(262,988)						-	(262,988)	125,056,356
8	General Plant	4,543,347	2,686,113	7,229,460	47,147						(44,385)	2,762	7,232,223
9	Total Gross Plant in Service	$ 161,128,223	$ 11,767,503	$ 172,895,726	$ (1,773,291)	$ -	$ -	$ -	$ -	$ -	$ (44,385)	$ (1,817,676)	$ 171,078,051
10													
11	Less:												
12	Accumulated Depreciation	43,090,136	1,170,542	44,260,678	(26,460)						(1,024)	(27,484)	44,233,194
13	Net Plant in Service	$ 118,038,087	$ 10,596,961	$ 128,635,048	$ (1,746,831)	$ -	$ -	$ -	$ -	$ -	$ (43,361)	$ (1,790,192)	$ 126,844,856
14													
15	Less:												
16	Advances in Aid of Construction	36,540,428	-	36,540,428								-	36,540,428
17	Contributions in Aid of Construction:												
18	Gross	29,481,326	-	29,481,326								-	29,481,326
19	Accumulated Amortization	(5,181,305)	-	(5,181,305)								-	(5,181,305)
20	Net Contributions in Aid of Construction	$ 24,300,021	$ -	$ 24,300,021	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 24,300,021
21													
22	Deferred Income Tax	-	12,343,427	12,343,427		1,231,149					4,081	1,235,230	13,578,657
23	Customer Deposits	422,585	-	422,585								-	422,585
24													
25	Add:												
26	Working Capital	1,561,902	-	1,561,902						4,049		4,049	1,565,951
27	Net Regulatory Asset / (Liability)	-	4,753,804	4,753,804								-	4,753,804
28													
29													
30	Total Rate Base	$ 58,336,956	$ 3,007,338	$ 61,344,294	$ (1,746,831)	$ (1,231,149)	$ -	$ -	$ -	$ 4,049	$ (47,442)	$ (3,021,374)	$ 58,322,921
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Supporting Schedules:

Recap Schedules:
B-1 Rebuttal

White Tank

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal RB-1	[E] Rebuttal RB-2	[F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
					Rebuttal Rate Base Adjustments								
1													
2	Plant Classification												
3	Intangible Plant	$ 14,082	$ 362	$ 14,444	$ -						$ -	$ -	$ 14,444
4	Source of Supply Plant	1,932,439	3	1,932,442	-						-	-	1,932,442
5	Pumping Plant	3,272,147	12,000	3,284,147	21,612						-	21,612	3,305,760
6	Water Treatment Plant	8,758,660	54,081	8,812,741	14,859						-	14,859	8,827,601
7	Transmission & Distribution Plant	16,561,673	146,040	16,707,713	(24,005)						-	(24,005)	16,683,709
8	General Plant	237,407	644,321	881,728	11,319						(5,299)	6,021	887,748
9	Total Gross Plant in Service	$ 30,776,409	$ 856,807	$ 31,633,216	$ 23,787	$ -	$ -	$ -	$ -	$ -	$ (5,299)	$ 18,488	$ 31,651,704
10													
11	Less:												
12	Accumulated Depreciation	5,291,428	134,127	5,425,556	441						(122)	319	5,425,875
13	Net Plant in Service	$ 25,484,981	$ 722,680	$ 26,207,660	$ 23,345	$ -	$ -	$ -	$ -	$ -	$ (5,177)	$ 18,169	$ 26,225,829
14													
15	Less:												
16	Advances in Aid of Construction	16,185,732	-	16,185,732								-	16,185,732
17	Contributions in Aid of Construction:												
18	Gross	4,006,138	-	4,006,138								-	4,006,138
19	Accumulated Amortization	(458,417)	-	(458,417)								-	(458,417)
20	Net Contributions in Aid of Construction	$ 3,547,721	$ -	$ 3,547,721	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,547,721
21													
22	Deferred Income Tax	-	1,473,620	1,473,620		94,646					487	95,134	1,568,753
23	Customer Deposits	34,152	-	34,152								-	34,152
24													
25	Add:												
26	Working Capital	141,320	-	141,320						47,928		47,928	189,248
27	Net Regulatory Asset / (Liability)	-	-	-								-	-
28													
29													
30	Total Rate Base	$ 5,858,696	$ (750,940)	$ 5,107,756	$ 23,345	$ (94,646)	$ -	$ -	$ -	$ 47,928	$ (5,664)	$ (29,036)	$ 5,078,719
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Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal Rate Base Adjustments: Rebuttal RB-1	[E] Rebuttal RB-2	[F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
1													
2	Plant Classification												
3	Intangible Plant	$ 4,512	$ 66	$ 4,578	$ -						$ -	$ -	$ 4,578
4	Source of Supply Plant	11,236	1	11,236	-						-	-	11,236
5	Pumping Plant	103,468	-	103,468	-						-	-	103,468
6	Water Treatment Plant	4,290	15	4,305	-						-	-	4,305
7	Transmission & Distribution Plant	2,046,670	11,244	2,057,913	(772)						-	(772)	2,057,141
8	General Plant	335,429	57,736	393,164	5,073						(963)	4,110	397,274
9	Total Gross Plant in Service	$ 2,505,604	$ 69,060	$ 2,574,664	$ 4,301	$ -	$ -	$ -	$ -	$ -	$ (963)	$ 3,337	$ 2,578,001
10													
11	Less:												
12	Accumulated Depreciation	1,164,240	22,025	1,186,265	49						(22)	27	1,186,292
13	Net Plant in Service	$ 1,341,364	$ 47,035	$ 1,388,399	$ 4,252	$ -	$ -	$ -	$ -	$ -	$ (941)	$ 3,310	$ 1,391,710
14													
15	Less:												
16	Advances in Aid of Construction	35,084	-	35,084								-	35,084
17	Contributions in Aid of Construction:												
18	Gross	167,252	-	167,252								-	167,252
19	Accumulated Amortization	(28,097)	-	(28,097)								-	(28,097)
20	Net Contributions in Aid of Construction	$ 139,155	$ -	$ 139,155	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 139,155
21													
22	Deferred Income Tax	-	267,931	267,931		2,621					89	2,710	270,641
23	Customer Deposits	9,501	-	9,501								-	9,501
24													
25	Add:												
26	Working Capital	29,007	-	29,007						(25)		(25)	28,982
27	Net Regulatory Asset / (Liability)	-	-	-								-	-
28													
29													
30	Total Rate Base	$ 1,186,631	$ (220,896)	$ 965,735	$ 4,252	$ (2,621)	$ -	$ -	$ -	$ (25)	$ (1,030)	$ 575	$ 966,310
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Original Cost Rate Base Pro Forma Adjustments

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	Phoenix Office — Rebuttal Rate Base Adjustments: [D] Rebuttal RB-1	[E] Rebuttal RB-2	[F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
1													
2	Plant Classification												
3	Intangible Plant	$ 9,147	$ (9,147)	$ -	$ -						$ -	$ -	$ -
4	Source of Supply Plant	-	-	-	-						-	-	-
5	Pumping Plant	-	-	-	-						-	-	-
6	Water Treatment Plant	-	-	-	-						-	-	-
7	Transmission & Distribution Plant	-	-	-	-						-	-	-
8	General Plant	7,607,446	(7,607,446)	-	(134,159)						134,159	-	-
9	Total Gross Plant in Service	$ 7,616,593	$ (7,616,593)	$ -	$ (134,159)	$ -	$ -	$ -	$ -	$ -	$ 134,159	$ -	$ -
10													
11	Less:												
12	Accumulated Depreciation	2,954,856	(2,954,856)	-	(3,106)						3,106	-	-
13	Net Plant in Service	$ 4,661,737	$ (4,661,737)	$ -	$ (131,053)	$ -	$ -	$ -	$ -	$ -	$ 131,053	$ -	$ -
14													
15	Less:												
16	Advances in Aid of Construction	-	-	-								-	-
17	Contributions in Aid of Construction:												
18	Gross	-	-	-								-	-
19	Accumulated Amortization	-	-	-								-	-
20	Net Contributions in Aid of Construction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
21													
22	Deferred Income Tax	37,212,622	(37,212,622)	-		11,985					(11,985)	-	-
23	Customer Deposits	-	-	-								-	-
24													
25	Add:												
26	Working Capital	-	-	-								-	-
27	Net Regulatory Asset / (Liability)	-	-	-								-	-
28													
29													
30	Total Rate Base	$ (32,550,885)	$ 32,550,885	$ -	$ (131,053)	$ (11,985)	$ -	$ -	$ -	$ -	$ 143,038	$ -	$ -
31													
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Supporting Schedules:

Recap Schedules:
B-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Original Cost Rate Base Pro Forma Adjustments

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	Meter Shop [D] Rebuttal RB-1	[E] Rebuttal RB-2	Rebuttal Rate Base Adjustments [F] Rebuttal BLANK	[G] Rebuttal BLANK	[H] Rebuttal BLANK	[I] Rebuttal RB-3	[J] Rebuttal RB-4	[K] Total Rebuttal Adjustments	[L] Adjusted Test Year - Rebuttal
1													
2	Plant Classification												
3	Intangible Plant	$ -	$ -	$ -	$ -						$ -	$ -	$ -
4	Source of Supply Plant	80	(80)	-	-						-	-	-
5	Pumping Plant	-	-	-	-						-	-	-
6	Water Treatment Plant	2,050	(2,050)	-	-						-	-	-
7	Transmission & Distribution Plant	6,066	(6,066)	-	-						-	-	-
8	General Plant	145,131	(145,131)	-	349						(349)	-	-
9	Total Gross Plant in Service	$ 153,327	$ (153,327)	$ -	$ 349	$ -	$ -	$ -	$ -	$ -	$ (349)	$ -	$ -
10													
11	Less:												
12	Accumulated Depreciation	73,158	(73,158)	-	19						(19)	-	-
13	Net Plant in Service	$ 80,169	$ (80,169)	$ -	$ 330	$ -	$ -	$ -	$ -	$ -	$ (330)	$ -	$ -
14													
15	Less:												
16	Advances in Aid of Construction	-	-	-								-	-
17	Contributions in Aid of Construction:												
18	Gross	-	-	-								-	-
19	Accumulated Amortization	-	-	-								-	-
20	Net Contributions in Aid of Construction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
21													
22	Deferred Income Tax	-	-	-		319					(319)	-	-
23	Customer Deposits	-	-	-								-	-
24													
25	Add:												
26	Working Capital	-	-	-								-	-
27	Net Regulatory Asset / (Liability)	-	-	-								-	-
28													
29													
30	Total Rate Base	$ 80,169	$ (80,169)	$ -	$ 330	$ (319)	$ -	$ -	$ -	$ -	$ (11)	$ -	$ -
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Supporting Schedules:

Recap Schedules:
B-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1
Post-Test Year Plant True-Up

				Pinal Valley			
				[A]	[B]	[C]	[D]
					Blankets		
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	60,000	88,238	28,238	1,660
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 60,000	$ 88,238	$ 28,238	$ 1,660
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-	24,917	24,917	713
22		Subtotal Water Trtmt. Plant		$ -	$ 24,917	$ 24,917	$ 713
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-	11,033	11,033	221
27	343	Trans. & Dist. Mains	1.79%	170,000	31,781	(138,219)	(2,474)
28	344	Fire Sprinkler Taps	2.00%	-	430	430	9
29	345	Services	2.38%	175,000	172,823	(2,177)	(52)
30	346	Meters	4.55%	410,000	225,964	(184,036)	(8,374)
31	348	Hydrants	1.82%	20,000	6,388	(13,612)	(248)
32		Subtotal Trans. & Dist.		$ 775,000	$ 448,418	$ (326,582)	$ (10,918)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-	7,193	7,193	180
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	8,000	14,392	6,392	426
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	12,000	9,705	(2,295)	(92)
40	395	Laboratory Equipment	5.00%	-	1,671	1,671	84
41	396	Power Operated Equipment	6.67%	-	4,042	4,042	270
42	397	Communication Equipment	6.67%	-	8,927	8,927	595
43	398	Miscellaneous Equipment	3.33%	-	22,766	22,766	758
44		Subtotal General Plant		$ 20,000	$ 68,697	$ 48,697	$ 2,221
45							
46		Total Utility Plant		$ 855,000	$ 630,270	$ (224,730)	$ (6,324)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (3,162)
49							
50		Net Plant					$ (221,568)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5167 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-	44,550	44,550	2,620
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ 44,550	$ 44,550	$ 2,620
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	1,250,000	1,281,823	31,823	910
22		Subtotal Water Trtmt. Plant		$ 1,250,000	$ 1,281,823	$ 31,823	$ 910
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-	6,073	6,073	152
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ 6,073	$ 6,073	$ 152
45							
46		Total Utility Plant		$ 1,250,000	$ 1,332,447	$ 82,447	$ 3,682
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 1,841
49							
50		Net Plant					$ 80,606
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5169 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	392,000	383,855	(8,145)	(146)
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-	18,776	18,776	447
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-	5,783	5,783	105
32		Subtotal Trans. & Dist.		$ 392,000	$ 408,414	$ 16,414	$ 406
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 392,000	$ 408,414	$ 16,414	$ 406
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 203
49							
50		Net Plant					$ 16,211
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Pinal Valley (Continued)

Line No.			Depreciation Rate	[A] Work Authorization 1-5171 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	517,000	551,402	34,402	616
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 517,000	$ 551,402	$ 34,402	$ 616
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 517,000	$ 551,402	$ 34,402	$ 616
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 308
49							
50		Net Plant					$ 34,094
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Line No.	Acct	Description	Depreciation Rate	[A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
				Pinal Valley (Continued) — Work Authorization 1-5164			
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	175,000	126,887	(48,113)	(2,829)
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 175,000	$ 126,887	$ (48,113)	$ (2,829)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 175,000	$ 126,887	$ (48,113)	$ (2,829)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (1,415)
49							
50		Net Plant					$ (46,699)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.	Acct	Description	Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5170 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1							
2		Intangible Plant					
3	301	Organization	0.00%	$ -			$ -
4	302	Franchises	n/a	-			-
5	303	Other Intangibles	n/a	-			-
6		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7		Source of Supply Plant					
8	310.1	Water Rights	0.00%	-		-	-
9	310.3	Other Source of Supply Land	0.00%	-		-	-
10	310.4	Wells - Other	n/a	-		-	-
11	314	Wells	3.13%	-		-	-
12		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13		Pumping Plant					
14	320	Pumping Plant Land	0.00%	-		-	-
15	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325	Electric Pumping Equipment	5.88%	1,200,000	1,270,570	70,570	4,150
17	328	Gas Engine Equipment	4.00%	-		-	-
18		Subtotal Pumping Plant		$ 1,200,000	$ 1,270,570	$ 70,570	$ 4,150
19		Water Treatment Plant					
20	330	Water Treatment Plant Land	0.00%	-		-	-
21	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332	Water Treatment Equipment	2.86%	-		-	-
23		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24		Transmission & Distribution Plant					
25	340	Trans. and Dist. Land	0.00%	-		-	-
26	341	Transmission and Distribution Structur	3.33%	-		-	-
27	342	Storage Tanks	2.00%	-		-	-
28	343	Trans. & Dist. Mains	1.79%	-		-	-
29	344	Fire Sprinkler Taps	2.00%	-		-	-
30	345	Services	2.38%	-		-	-
31	346	Meters	4.55%	-		-	-
32	348	Hydrants	1.82%	-		-	-
33		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
34		General Plant					
35	389	General Plant Land	0.00%	-		-	-
36	390	General Plant Structures	2.50%	-		-	-
37	390.1	Leasehold Improvements	n/a	-		-	-
38	391	Office Furniture & Equipment	6.67%	-		-	-
39	393	Warehouse Equipment	5.00%	-		-	-
40	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395	Laboratory Equipment	5.00%	-		-	-
42	396	Power Operated Equipment	6.67%	-		-	-
43	397	Communication Equipment	6.67%	-		-	-
44	398	Miscellaneous Equipment	3.33%	-		-	-
45		Subtotal General Plant		$ -	$ -	$ -	$ -
46							
47		Total Utility Plant		$ 1,200,000	$ 1,270,570	$ 70,570	$ 4,150
48							
49		Accumulated Depreciation (1/2-Year Convention)					$ 2,075
50							
51		Net Plant					$ 68,496
52							
53							
54							
55							

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

Line No.			Depreciation Rate	[A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
				Pinal Valley (Continued) — Work Authorization 1-5296			
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	175,000	242,450	67,450	3,966
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 175,000	$ 242,450	$ 67,450	$ 3,966
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 175,000	$ 242,450	$ 67,450	$ 3,966
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 1,983
49							
50		Net Plant					$ 65,467
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	[A] Pinal Valley (Continued) Work Authorization 1-5299 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	100,000	76,569	(23,431)	(670)
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 100,000	$ 76,569	$ (23,431)	$ (670)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 100,000	$ 76,569	$ (23,431)	$ (670)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (335)
49							
50		Net Plant					$ (23,096)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5301 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	180,000	194,840	14,840	266
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 180,000	$ 194,840	$ 14,840	$ 266
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 180,000	$ 194,840	$ 14,840	$ 266
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 133
49							
50		Net Plant					$ 14,707
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-4806 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-	-	-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	1,500,000	-	(1,500,000)	(42,900)
22		Subtotal Water Trtmt. Plant		$ 1,500,000	$ -	$ (1,500,000)	$ (42,900)
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 1,500,000	$ -	$ (1,500,000)	$ (42,900)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (21,450)
49							
50		Net Plant					$ (1,478,550)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

				Pinal Valley (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5303			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	174,000	173,112	(888)	(25)
22		Subtotal Water Trtmt. Plant		$ 174,000	$ 173,112	$ (888)	$ (25)
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 174,000	$ 173,112	$ (888)	$ (25)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (13)
49							
50		Net Plant					$ (875)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

				Pinal Valley (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5166			Adjstmt' to
Line			Depreciation	As		Increase /	Depreciation
No.			Rate	Filed	Rebuttal[1]	(Decrease)	Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	80,000	-	(80,000)	(2,288) x
22		Subtotal Water Trtmt. Plant		$ 80,000	$ -	$ (80,000)	$ (2,288)
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 80,000	$ -	$ (80,000)	$ (2,288)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (1,144)
49							
50		Net Plant					$ (78,856)
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	Pinal Valley (Continued) — Work Authorization 1-5304 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1	Intangible Plant					
2	301 Organization	0.00%	$ -		$ -	$ -
3	302 Franchises	n/a	-		-	-
4	303 Other Intangibles	n/a	-		-	-
5	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6	Source of Supply Plant					
7	310.1 Water Rights	0.00%	-		-	-
8	310.3 Other Source of Supply Land	0.00%	-		-	-
9	310.4 Wells - Other	n/a	-		-	-
10	314 Wells	3.13%	-		-	-
11	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12	Pumping Plant					
13	320 Pumping Plant Land	0.00%	-		-	-
14	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325 Electtric Pumping Equipment	5.88%	175,000	107,751	(67,249)	(3,954)
16	328 Gas Engine Equipment	4.00%	-		-	-
17	Subtotal Pumping Plant		$ 175,000	$ 107,751	$ (67,249)	$ (3,954)
18	Water Treatment Plant					
19	330 Water Treatment Plant Land	0.00%	-		-	-
20	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332 Water Treatment Equipment	2.86%	-		-	-
22	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23	Transmission & Distribution Plant					
24	340 Trans. and Dist. Land	0.00%	-		-	-
25	341 Transmission and Distribution Structur	3.33%	-		-	-
26	342 Storage Tanks	2.00%	-		-	-
27	343 Trans. & Dist. Mains	1.79%	-		-	-
28	344 Fire Sprinkler Taps	2.00%	-		-	-
29	345 Services	2.38%	-		-	-
30	346 Meters	4.55%	-		-	-
31	348 Hydrants	1.82%	-		-	-
32	Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33	General Plant					
34	389 General Plant Land	0.00%	-		-	-
35	390 General Plant Structures	2.50%	-		-	-
36	390.1 Leasehold Improvements	n/a	-		-	-
37	391 Office Furniture & Equipment	6.67%	-		-	-
38	393 Warehouse Equipment	5.00%	-		-	-
39	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395 Laboratory Equipment	5.00%	-		-	-
41	396 Power Operated Equipment	6.67%	-		-	-
42	397 Communication Equipment	6.67%	-		-	-
43	398 Miscellaneous Equipment	3.33%	-		-	-
44	Subtotal General Plant		$ -	$ -	$ -	$ -
45						
46	Total Utility Plant		$ 175,000	$ 107,751	$ (67,249)	$ (3,954)
47						
48	Accumulated Depreciation (1/2-Year Convention)					$ (1,977)
49						
50	Net Plant					$ (65,272)
51						
52						
53						
54						
55	[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5306 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1	Intangible Plant					
2	301 Organization	0.00%	$ -		$ -	$ -
3	302 Franchises	n/a	-		-	-
4	303 Other Intangibles	n/a	-		-	-
5	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6	Source of Supply Plant					
7	310.1 Water Rights	0.00%	-		-	-
8	310.3 Other Source of Supply Land	0.00%	-		-	-
9	310.4 Wells - Other	n/a	-		-	-
10	314 Wells	3.13%	-		-	-
11	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12	Pumping Plant					
13	320 Pumping Plant Land	0.00%	-		-	-
14	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325 Electtric Pumping Equipment	5.88%	43,000	40,760	(2,240)	(132)
16	328 Gas Engine Equipment	4.00%	-		-	-
17	Subtotal Pumping Plant		$ 43,000	$ 40,760	$ (2,240)	$ (132)
18	Water Treatment Plant					
19	330 Water Treatment Plant Land	0.00%	-		-	-
20	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332 Water Treatment Equipment	2.86%	-		-	-
22	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23	Transmission & Distribution Plant					
24	340 Trans. and Dist. Land	0.00%	-		-	-
25	341 Transmission and Distribution Structur	3.33%	-		-	-
26	342 Storage Tanks	2.00%	-		-	-
27	343 Trans. & Dist. Mains	1.79%	-		-	-
28	344 Fire Sprinkler Taps	2.00%	-		-	-
29	345 Services	2.38%	-		-	-
30	346 Meters	4.55%	-		-	-
31	348 Hydrants	1.82%	-		-	-
32	Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33	General Plant					
34	389 General Plant Land	0.00%	-		-	-
35	390 General Plant Structures	2.50%	-		-	-
36	390.1 Leasehold Improvements	n/a	-		-	-
37	391 Office Furniture & Equipment	6.67%	-		-	-
38	393 Warehouse Equipment	5.00%	-		-	-
39	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395 Laboratory Equipment	5.00%	-		-	-
41	396 Power Operated Equipment	6.67%	-		-	-
42	397 Communication Equipment	6.67%	-		-	-
43	398 Miscellaneous Equipment	3.33%	-		-	-
44	Subtotal General Plant		$ -	$ -	$ -	$ -
45						
46	Total Utility Plant		$ 43,000	$ 40,760	$ (2,240)	$ (132)
47						
48	Accumulated Depreciation (1/2-Year Convention)					$ (66)
49						
50	Net Plant					$ (2,174)
51						
52						
53						
54						
55	[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

				Pinal Valley (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5307			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	40,000	42,163	2,163	62
22		Subtotal Water Trtmt. Plant		$ 40,000	$ 42,163	$ 2,163	$ 62
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 40,000	$ 42,163	$ 2,163	$ 62
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 31
49							
50		Net Plant					$ 2,132
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5168 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	110,000	115,552	5,552	99
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 110,000	$ 115,552	$ 5,552	$ 99
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 110,000	$ 115,552	$ 5,552	$ 99
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 50
49							
50		Net Plant					$ 5,502
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5345 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	62,000	56,452	(5,548)	(99)
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 62,000	$ 56,452	$ (5,548)	$ (99)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 62,000	$ 56,452	$ (5,548)	$ (99)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (50)
49							
50		Net Plant					$ (5,498)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5329 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	24,000	20,780	(3,220)	(58)
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 24,000	$ 20,780	$ (3,220)	$ (58)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 24,000	$ 20,780	$ (3,220)	$ (58)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (29)
49							
50		Net Plant					$ (3,191)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5332 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1						
2	Intangible Plant					
3	301 Organization	0.00%	$ -		$ -	$ -
4	302 Franchises	n/a	-		-	-
5	303 Other Intangibles	n/a	-		-	-
6	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7	Source of Supply Plant					
8	310.1 Water Rights	0.00%	-		-	-
9	310.3 Other Source of Supply Land	0.00%	-		-	-
10	310.4 Wells - Other	n/a	-		-	-
11	314 Wells	3.13%	-		-	-
12	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13	Pumping Plant					
14	320 Pumping Plant Land	0.00%	-		-	-
15	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325 Electric Pumping Equipment	5.88%	-		-	-
17	328 Gas Engine Equipment	4.00%	-		-	-
18	Subtotal Pumping Plant		$ -	$ -	$ -	$ -
19	Water Treatment Plant					
20	330 Water Treatment Plant Land	0.00%	-		-	-
21	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332 Water Treatment Equipment	2.86%	-		-	-
23	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24	Transmission & Distribution Plant					
25	340 Trans. and Dist. Land	0.00%	-		-	-
26	341 Transmission and Distribution Structur	3.33%	-		-	-
27	342 Storage Tanks	2.00%	-		-	-
28	343 Trans. & Dist. Mains	1.79%	300,000	299,926	(74)	(1)
29	344 Fire Sprinkler Taps	2.00%	-		-	-
30	345 Services	2.38%	-		-	-
31	346 Meters	4.55%	-		-	-
32	348 Hydrants	1.82%	-		-	-
33	Subtotal Trans. & Dist.		$ 300,000	$ 299,926	$ (74)	$ (1)
34	General Plant					
35	389 General Plant Land	0.00%	-		-	-
36	390 General Plant Structures	2.50%	-		-	-
37	390.1 Leasehold Improvements	n/a	-		-	-
38	391 Office Furniture & Equipment	6.67%	-		-	-
39	393 Warehouse Equipment	5.00%	-		-	-
40	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395 Laboratory Equipment	5.00%	-		-	-
42	396 Power Operated Equipment	6.67%	-		-	-
43	397 Communication Equipment	6.67%	-		-	-
44	398 Miscellaneous Equipment	3.33%	-		-	-
45	Subtotal General Plant		$ -	$ -	$ -	$ -
46						
47	Total Utility Plant		$ 300,000	$ 299,926	$ (74)	$ (1)
48						
49	Accumulated Depreciation (1/2-Year Convention)					$ (1)
50						
51	Net Plant					$ (73)
52						
53						
54						
55						

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5339 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	62,000	57,381	(4,619)	(110)
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 62,000	$ 57,381	$ (4,619)	$ (110)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 62,000	$ 57,381	$ (4,619)	$ (110)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (55)
49							
50		Net Plant					$ (4,564)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

			Pinal Valley (Continued)			
			[A]	[B]	[C]	[D]
			Work Authorization 1-5341			
Line No.		Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1	Intangible Plant					
2	301 Organization	0.00%	$ -		$ -	$ -
3	302 Franchises	n/a	-		-	-
4	303 Other Intangibles	n/a	-		-	-
5	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6	Source of Supply Plant					
7	310.1 Water Rights	0.00%	-		-	-
8	310.3 Other Source of Supply Land	0.00%	-		-	-
9	310.4 Wells - Other	n/a	-		-	-
10	314 Wells	3.13%	-		-	-
11	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12	Pumping Plant					
13	320 Pumping Plant Land	0.00%	-		-	-
14	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325 Electtric Pumping Equipment	5.88%	-		-	-
16	328 Gas Engine Equipment	4.00%	-		-	-
17	Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18	Water Treatment Plant					
19	330 Water Treatment Plant Land	0.00%	-		-	-
20	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332 Water Treatment Equipment	2.86%	-		-	-
22	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23	Transmission & Distribution Plant					
24	340 Trans. and Dist. Land	0.00%	-		-	-
25	341 Transmission and Distribution Structur	3.33%	-		-	-
26	342 Storage Tanks	2.00%	-		-	-
27	343 Trans. & Dist. Mains	1.79%	-		-	-
28	344 Fire Sprinkler Taps	2.00%	-		-	-
29	345 Services	2.38%	43,000	34,918	(8,082)	(192)
30	346 Meters	4.55%	-	247.04	247	11
31	348 Hydrants	1.82%	-		-	-
32	Subtotal Trans. & Dist.		$ 43,000	$ 35,165	$ (7,835)	$ (181)
33	General Plant					
34	389 General Plant Land	0.00%	-		-	-
35	390 General Plant Structures	2.50%	-		-	-
36	390.1 Leasehold Improvements	n/a	-		-	-
37	391 Office Furniture & Equipment	6.67%	-		-	-
38	393 Warehouse Equipment	5.00%	-		-	-
39	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395 Laboratory Equipment	5.00%	-		-	-
41	396 Power Operated Equipment	6.67%	-		-	-
42	397 Communication Equipment	6.67%	-		-	-
43	398 Miscellaneous Equipment	3.33%	-		-	-
44	Subtotal General Plant		$ -	$ -	$ -	$ -
45						
46	Total Utility Plant		$ 43,000	$ 35,165	$ (7,835)	$ (181)
47						
48	Accumulated Depreciation (1/2-Year Convention)					$ (91)
49						
50	Net Plant					$ (7,745)
51						
52						
53						
54						
55	[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-0076 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	120,000	125,690	5,690	259
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 120,000	$ 125,690	$ 5,690	$ 259
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 120,000	$ 125,690	$ 5,690	$ 259
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 129
49							
50		Net Plant					$ 5,561
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

				Pinal Valley (Continued)			
				Work Authorization 1-5344			
				[A]	[B]	[C]	[D]
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1							
2		Intangible Plant					
3	301	Organization	0.00%	$ -		$ -	$ -
4	302	Franchises	n/a	-		-	-
5	303	Other Intangibles	n/a	-		-	-
6		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7		Source of Supply Plant					
8	310.1	Water Rights	0.00%	-		-	-
9	310.3	Other Source of Supply Land	0.00%	-		-	-
10	310.4	Wells - Other	n/a	-		-	-
11	314	Wells	3.13%	-		-	-
12		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13		Pumping Plant					
14	320	Pumping Plant Land	0.00%	-		-	-
15	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325	Electric Pumping Equipment	5.88%	-		-	-
17	328	Gas Engine Equipment	4.00%	-		-	-
18		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
19		Water Treatment Plant					
20	330	Water Treatment Plant Land	0.00%	-		-	-
21	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332	Water Treatment Equipment	2.86%	-		-	-
23		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24		Transmission & Distribution Plant					
25	340	Trans. and Dist. Land	0.00%	-		-	-
26	341	Transmission and Distribution Structur	3.33%	-		-	-
27	342	Storage Tanks	2.00%	-		-	-
28	343	Trans. & Dist. Mains	1.79%	-		-	-
29	344	Fire Sprinkler Taps	2.00%	27,000	25,368	(1,632)	(29)
30	345	Services	2.38%	-		-	-
31	346	Meters	4.55%	-		-	-
32	348	Hydrants	1.82%	-		-	-
33		Subtotal Trans. & Dist.		$ 27,000	$ 25,368	$ (1,632)	$ (29)
34		General Plant					
35	389	General Plant Land	0.00%	-		-	-
36	390	General Plant Structures	2.50%	-		-	-
37	390.1	Leasehold Improvements	n/a	-		-	-
38	391	Office Furniture & Equipment	6.67%	-		-	-
39	393	Warehouse Equipment	5.00%	-		-	-
40	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395	Laboratory Equipment	5.00%	-		-	-
42	396	Power Operated Equipment	6.67%	-		-	-
43	397	Communication Equipment	6.67%	-		-	-
44	398	Miscellaneous Equipment	3.33%	-		-	-
45		Subtotal General Plant		$ -	$ -	$ -	$ -
46							
47		Total Utility Plant		$ 27,000	$ 25,368	$ (1,632)	$ (29)
48							
49		Accumulated Depreciation (1/2-Year Convention)					$ (15)
50							
51		Net Plant					$ (1,618)
52							
53							
54							
55							

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5260 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	25,000	20,645	(4,355)	(125)
22		Subtotal Water Trtmt. Plant		$ 25,000	$ 20,645	$ (4,355)	$ (125)
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 25,000	$ 20,645	$ (4,355)	$ (125)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (62)
49							
50		Net Plant					$ (4,293)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

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Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5348 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	27,000	19,377	(7,623)	(508)
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 27,000	$ 19,377	$ (7,623)	$ (508)
45							
46		Total Utility Plant		$ 27,000	$ 19,377	$ (7,623)	$ (508)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (254)
49							
50		Net Plant					$ (7,369)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

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Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5358 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1	Intangible Plant					
2	301 Organization	0.00%	$ -		$ -	$ -
3	302 Franchises	n/a	-		-	-
4	303 Other Intangibles	n/a	-		-	-
5	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6	Source of Supply Plant					
7	310.1 Water Rights	0.00%	-		-	-
8	310.3 Other Source of Supply Land	0.00%	-		-	-
9	310.4 Wells - Other	n/a	-		-	-
10	314 Wells	3.13%	-		-	-
11	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12	Pumping Plant					
13	320 Pumping Plant Land	0.00%	-		-	-
14	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325 Electtric Pumping Equipment	5.88%	115,000	124,002	9,002	529
16	328 Gas Engine Equipment	4.00%	-		-	-
17	Subtotal Pumping Plant		$ 115,000	$ 124,002	$ 9,002	$ 529
18	Water Treatment Plant					
19	330 Water Treatment Plant Land	0.00%	-		-	-
20	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332 Water Treatment Equipment	2.86%	-		-	-
22	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23	Transmission & Distribution Plant					
24	340 Trans. and Dist. Land	0.00%	-		-	-
25	341 Transmission and Distribution Structur	3.33%	-		-	-
26	342 Storage Tanks	2.00%	-		-	-
27	343 Trans. & Dist. Mains	1.79%	-		-	-
28	344 Fire Sprinkler Taps	2.00%	-		-	-
29	345 Services	2.38%	-		-	-
30	346 Meters	4.55%	-		-	-
31	348 Hydrants	1.82%	-		-	-
32	Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33	General Plant					
34	389 General Plant Land	0.00%	-		-	-
35	390 General Plant Structures	2.50%	-		-	-
36	390.1 Leasehold Improvements	n/a	-		-	-
37	391 Office Furniture & Equipment	6.67%	-		-	-
38	393 Warehouse Equipment	5.00%	-		-	-
39	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395 Laboratory Equipment	5.00%	-		-	-
41	396 Power Operated Equipment	6.67%	-		-	-
42	397 Communication Equipment	6.67%	-		-	-
43	398 Miscellaneous Equipment	3.33%	-		-	-
44	Subtotal General Plant		$ -	$ -	$ -	$ -
45						
46	Total Utility Plant		$ 115,000	$ 124,002	$ 9,002	$ 529
47						
48	Accumulated Depreciation (1/2-Year Convention)					$ 265
49						
50	Net Plant					$ 8,737
51						
52						
53						
54						
55	[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Pinal Valley (Continued)

Line No.			Depreciation Rate	[A] Work Authorization 1-5362 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	117,000	74,910	(42,090)	(2,475)
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 117,000	$ 74,910	$ (42,090)	$ (2,475)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 117,000	$ 74,910	$ (42,090)	$ (2,475)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (1,237)
49							
50		Net Plant					$ (40,852)
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

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Recap Schedules:

Exhibit
Schedule B-2 Rebuttal Appendix
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Witness: Moe

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

			Pinal Valley (Continued)			
			Work Authorization 1-5359			
			[A]	[B]	[C]	[D]
Line No.		Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1						
2	Intangible Plant					
3	301 Organization	0.00%	$ -		$ -	$ -
4	302 Franchises	n/a	-		-	-
5	303 Other Intangibles	n/a	-		-	-
6	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7	Source of Supply Plant					
8	310.1 Water Rights	0.00%	-		-	-
9	310.3 Other Source of Supply Land	0.00%	-		-	-
10	310.4 Wells - Other	n/a	-		-	-
11	314 Wells	3.13%	-	16,383	16,383	513
12	Subtotal Source of Sup. Plant		$ -	$ 16,383	$ 16,383	$ 513
13	Pumping Plant					
14	320 Pumping Plant Land	0.00%	-		-	-
15	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325 Electric Pumping Equipment	5.88%	200,000	117,871	(82,129)	(4,829)
17	328 Gas Engine Equipment	4.00%	-		-	-
18	Subtotal Pumping Plant		$ 200,000	$ 117,871	$ (82,129)	$ (4,829)
19	Water Treatment Plant					
20	330 Water Treatment Plant Land	0.00%	-		-	-
21	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332 Water Treatment Equipment	2.86%	-		-	-
23	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24	Transmission & Distribution Plant					
25	340 Trans. and Dist. Land	0.00%	-		-	-
26	341 Transmission and Distribution Structur	3.33%	-		-	-
27	342 Storage Tanks	2.00%	-		-	-
28	343 Trans. & Dist. Mains	1.79%	-		-	-
29	344 Fire Sprinkler Taps	2.00%	-		-	-
30	345 Services	2.38%	-		-	-
31	346 Meters	4.55%	-		-	-
32	348 Hydrants	1.82%	-		-	-
33	Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
34	General Plant					
35	389 General Plant Land	0.00%	-		-	-
36	390 General Plant Structures	2.50%	-		-	-
37	390.1 Leasehold Improvements	n/a	-		-	-
38	391 Office Furniture & Equipment	6.67%	-		-	-
39	393 Warehouse Equipment	5.00%	-		-	-
40	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395 Laboratory Equipment	5.00%	-		-	-
42	396 Power Operated Equipment	6.67%	-		-	-
43	397 Communication Equipment	6.67%	-		-	-
44	398 Miscellaneous Equipment	3.33%	-		-	-
45	Subtotal General Plant		$ -	$ -	$ -	$ -
46						
47	Total Utility Plant		$ 200,000	$ 134,254	$ (65,746)	$ (4,316)
48						
49	Accumulated Depreciation (1/2-Year Convention)					$ (2,158)
50						
51	Net Plant					$ (63,588)
52						
53						
54						
55						

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.	Account	Description	Depreciation Rate	Pinal Valley (Continued) Work Authorization 1-5361 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	70,000	79,622	9,622	192
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 70,000	$ 79,622	$ 9,622	$ 192
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 70,000	$ 79,622	$ 9,622	$ 192
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 96
49							
50		Net Plant					$ 9,526
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	[A] Work Authorization 1-5076 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
			Pinal Valley (Continued)			
1						
2	Intangible Plant					
3	301 Organization	0.00%	$ -		$ -	$ -
4	302 Franchises	n/a	-		-	-
5	303 Other Intangibles	n/a	-		-	-
6	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7	Source of Supply Plant					
8	310.1 Water Rights	0.00%	-		-	-
9	310.3 Other Source of Supply Land	0.00%	-		-	-
10	310.4 Wells - Other	n/a	-		-	-
11	314 Wells	3.13%	-		-	-
12	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13	Pumping Plant					
14	320 Pumping Plant Land	0.00%	-		-	-
15	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325 Electric Pumping Equipment	5.88%	-		-	-
17	328 Gas Engine Equipment	4.00%	-		-	-
18	Subtotal Pumping Plant		$ -	$ -	$ -	$ -
19	Water Treatment Plant					
20	330 Water Treatment Plant Land	0.00%	-		-	-
21	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332 Water Treatment Equipment	2.86%	-		-	-
23	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24	Transmission & Distribution Plant					
25	340 Trans. and Dist. Land	0.00%	-		-	-
26	341 Transmission and Distribution Structur	3.33%	-		-	-
27	342 Storage Tanks	2.00%	-		-	-
28	343 Trans. & Dist. Mains	1.79%	-		-	-
29	344 Fire Sprinkler Taps	2.00%	195,574	195,574	0	0
30	345 Services	2.38%	-		-	-
31	346 Meters	4.55%	-		-	-
32	348 Hydrants	1.82%	-		-	-
33	Subtotal Trans. & Dist.		$ 195,574	$ 195,574	$ 0	$ 0
34	General Plant					
35	389 General Plant Land	0.00%	-		-	-
36	390 General Plant Structures	2.50%	-		-	-
37	390.1 Leasehold Improvements	n/a	-		-	-
38	391 Office Furniture & Equipment	6.67%	-		-	-
39	393 Warehouse Equipment	5.00%	-		-	-
40	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395 Laboratory Equipment	5.00%	-		-	-
42	396 Power Operated Equipment	6.67%	-		-	-
43	397 Communication Equipment	6.67%	-		-	-
44	398 Miscellaneous Equipment	3.33%	-		-	-
45	Subtotal General Plant		$ -	$ -	$ -	$ -
46						
47	Total Utility Plant		$ 195,574	$ 195,574	$ 0	$ 0
48						
49	Accumulated Depreciation (1/2-Year Convention)					$ 0
50						
51	Net Plant					$ 0
52						
53						
54						
55						

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Exhibit
Schedule B-2 Rebuttal Appendix
Page 31 of 51
Witness: Moe

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5173 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	106,065	103,598	(2,467)	(145)
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 106,065	$ 103,598	$ (2,467)	$ (145)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 106,065	$ 103,598	$ (2,467)	$ (145)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (73)
49							
50		Net Plant					$ (2,395)
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5165 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	387,563	387,563	0	0
11		Subtotal Source of Sup. Plant		$ 387,563	$ 387,563	$ 0	$ 0
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	4,397	4,397	(0)	(0)
15	325	Electtric Pumping Equipment	5.88%	25,486	25,486	(0)	(0)
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 29,883	$ 29,882	$ (1)	$ (0)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 417,446	$ 417,446	$ (0)	$ (0)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (0)
49							
50		Net Plant					$ (0)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Pinal Valley (Continued) [A] Work Authorization 1-5251 As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	245,552	245,968	416	24
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 245,552	$ 245,968	$ 416	$ 24
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 245,552	$ 245,968	$ 416	$ 24
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 12
49							
50		Net Plant					$ 404
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.	Acct	Description	Depreciation Rate	Pinal Valley - Total: Total - All Post-T.Y. Plant [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -	$ -	$ -	$ -
3	302	Franchises	n/a	-	-	-	-
4	303	Other Intangibles	n/a	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-	-	-	-
8	310.3	Other Source of Supply Land	0.00%	-	-	-	-
9	310.4	Wells - Other	n/a	-	-	-	-
10	314	Wells	3.13%	387,563	403,946	16,383	513
11		Subtotal Source of Sup. Plant		$ 387,563	$ 403,946	$ 16,383	$ 513
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-	-	-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	104,397	80,966	(23,431)	(670)
15	325	Electtric Pumping Equipment	5.88%	2,637,103	2,613,041	(24,062)	(1,415)
16	328	Gas Engine Equipment	4.00%	-	-	-	-
17		Subtotal Pumping Plant		$ 2,741,500	$ 2,694,007	$ (47,493)	$ (2,085)
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-	-	-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-	-	-	-
21	332	Water Treatment Equipment	2.86%	3,069,000	1,542,660	(1,526,340)	(43,653)
22		Subtotal Water Trtmt. Plant		$ 3,069,000	$ 1,542,660	$ (1,526,340)	$ (43,653)
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-	-	-	-
25	341	Transmission and Distribution Structur	3.33%	-	-	-	-
26	342	Storage Tanks	2.00%	70,000	90,656	20,656	413
27	343	Trans. & Dist. Mains	1.79%	1,977,574	1,875,530	(102,044)	(1,827)
28	344	Fire Sprinkler Taps	2.00%	-	430	430	9
29	345	Services	2.38%	280,000	283,898	3,898	93
30	346	Meters	4.55%	530,000	351,901	(178,099)	(8,103)
31	348	Hydrants	1.82%	20,000	12,171	(7,829)	(142)
32		Subtotal Trans. & Dist.		$ 2,877,574	$ 2,614,586	$ (262,988)	$ (9,558)
33		General Plant					
34	389	General Plant Land	0.00%	-	-	-	-
35	390	General Plant Structures	2.50%	-	13,266	13,266	332
36	390.1	Leasehold Improvements	n/a	-	-	-	-
37	391	Office Furniture & Equipment	6.67%	8,000	14,392	6,392	426
38	393	Warehouse Equipment	5.00%	-	-	-	-
39	394	Tools, Shop & Garage Equip.	4.00%	12,000	9,705	(2,295)	(92)
40	395	Laboratory Equipment	5.00%	-	1,671	1,671	84
41	396	Power Operated Equipment	6.67%	-	4,042	4,042	270
42	397	Communication Equipment	6.67%	27,000	28,305	1,305	87
43	398	Miscellaneous Equipment	3.33%	-	22,766	22,766	758
44		Subtotal General Plant		$ 47,000	$ 94,147	$ 47,147	$ 1,865
45							
46		Total Utility Plant		$ 9,122,637	$ 7,349,346	$ (1,773,291)	$ (52,919)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (26,460)
49							
50		Net Plant					$ (1,746,831)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

				White Tank			
				[A]	[B]	[C]	[D]
				Blankets			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	12,000	24,757	12,757	750
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ 12,000	$ 24,757	$ 12,757	$ 750
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-	14,672	14,672	420
22		Subtotal Water Trtmt. Plant		$ -	$ 14,672	$ 14,672	$ 420
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	5,000	11,222	6,222	111
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	25,000	31,072	6,072	145
30	346	Meters	4.55%	38,800	105	(38,695)	(1,761)
31	348	Hydrants	1.82%	5,000	3,867	(1,133)	(21)
32		Subtotal Trans. & Dist.		$ 73,800	$ 46,267	$ (27,533)	$ (1,525)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	1,000		(1,000)	(67)
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	1,250	$ 239	(1,011)	(40)
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-	47	47	3
43	398	Miscellaneous Equipment	3.33%	-	3,974	3,974	132
44		Subtotal General Plant		$ 2,250	$ 4,260	$ 2,010	$ 28
45							
46		Total Utility Plant		$ 88,050	$ 89,956	$ 1,906	$ (327)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (164)
49							
50		Net Plant					$ 2,070
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	White Tank (Continued) Work Authorization 1-5032 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-	8,855	8,855	521
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ 8,855	$ 8,855	$ 521
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	327,000	336,310	9,310	621
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 327,000	$ 336,310	$ 9,310	$ 621
45							
46		Total Utility Plant		$ 327,000	$ 345,165	$ 18,165	$ 1,142
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 571
49							
50		Net Plant					$ 17,594
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	[A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
				White Tank (Continued)	Work Authorization 1-5309		
1							
2		Intangible Plant					
3	301	Organization	0.00%	$ -		$ -	$ -
4	302	Franchises	n/a	-		-	-
5	303	Other Intangibles	n/a	-		-	-
6		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7		Source of Supply Plant					
8	310.1	Water Rights	0.00%	-		-	-
9	310.3	Other Source of Supply Land	0.00%	-		-	-
10	310.4	Wells - Other	n/a	-		-	-
11	314	Wells	3.13%	-		-	-
12		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13		Pumping Plant					
14	320	Pumping Plant Land	0.00%	-		-	-
15	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325	Electric Pumping Equipment	5.88%	-		-	-
17	328	Gas Engine Equipment	4.00%	-		-	-
18		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
19		Water Treatment Plant					
20	330	Water Treatment Plant Land	0.00%	-		-	-
21	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332	Water Treatment Equipment	2.86%	54,000	54,187	187	5
23		Subtotal Water Trtmt. Plant		$ 54,000	$ 54,187	$ 187	$ 5
24		Transmission & Distribution Plant					
25	340	Trans. and Dist. Land	0.00%	-		-	-
26	341	Transmission and Distribution Structur	3.33%	-		-	-
27	342	Storage Tanks	2.00%	-		-	-
28	343	Trans. & Dist. Mains	1.79%	-		-	-
29	344	Fire Sprinkler Taps	2.00%	-		-	-
30	345	Services	2.38%	-		-	-
31	346	Meters	4.55%	-		-	-
32	348	Hydrants	1.82%	-		-	-
33		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
34		General Plant					
35	389	General Plant Land	0.00%	-		-	-
36	390	General Plant Structures	2.50%	-		-	-
37	390.1	Leasehold Improvements	n/a	-		-	-
38	391	Office Furniture & Equipment	6.67%	-		-	-
39	393	Warehouse Equipment	5.00%	-		-	-
40	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395	Laboratory Equipment	5.00%	-		-	-
42	396	Power Operated Equipment	6.67%	-		-	-
43	397	Communication Equipment	6.67%	-		-	-
44	398	Miscellaneous Equipment	3.33%	-		-	-
45		Subtotal General Plant		$ -	$ -	$ -	$ -
46							
47		Total Utility Plant		$ 54,000	$ 54,187	$ 187	$ 5
48							
49		Accumulated Depreciation (1/2-Year Convention)					$ 3
50							
51		Net Plant					$ 184
52							
53							
54							
55							

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

				White Tank (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5263			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	52,000	57,524	5,524	99
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 52,000	$ 57,524	$ 5,524	$ 99
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ -	$ -	$ -	$ -
45							
46		Total Utility Plant		$ 52,000	$ 57,524	$ 5,524	$ 99
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 49
49							
50		Net Plant					$ 5,475
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.	Account	Description	Depreciation Rate	[A] Work Authorization 1-5360 As Filed	[B] Work Authorization 1-5360 Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
				White Tank (Continued)			
1							
2		Intangible Plant					
3	301	Organization	0.00%	$ -		$ -	$ -
4	302	Franchises	n/a	-		-	-
5	303	Other Intangibles	n/a	-		-	-
6		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
7		Source of Supply Plant					
8	310.1	Water Rights	0.00%	-		-	-
9	310.3	Other Source of Supply Land	0.00%	-		-	-
10	310.4	Wells - Other	n/a	-		-	-
11	314	Wells	3.13%	-		-	-
12		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
13		Pumping Plant					
14	320	Pumping Plant Land	0.00%	-		-	-
15	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
16	325	Electric Pumping Equipment	5.88%	-		-	-
17	328	Gas Engine Equipment	4.00%	-		-	-
18		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
19		Water Treatment Plant					
20	330	Water Treatment Plant Land	0.00%	-		-	-
21	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
22	332	Water Treatment Equipment	2.86%	-		-	-
23		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
24		Transmission & Distribution Plant					
25	340	Trans. and Dist. Land	0.00%	-		-	-
26	341	Transmission and Distribution Structur	3.33%	-		-	-
27	342	Storage Tanks	2.00%	-		-	-
28	343	Trans. & Dist. Mains	1.79%	20,000	18,004	(1,996)	(36)
29	344	Fire Sprinkler Taps	2.00%	-		-	-
30	345	Services	2.38%	-		-	-
31	346	Meters	4.55%	-		-	-
32	348	Hydrants	1.82%	-		-	-
33		Subtotal Trans. & Dist.		$ 20,000	$ 18,004	$ (1,996)	$ (36)
34		General Plant					
35	389	General Plant Land	0.00%	-		-	-
36	390	General Plant Structures	2.50%	-		-	-
37	390.1	Leasehold Improvements	n/a	-		-	-
38	391	Office Furniture & Equipment	6.67%	-		-	-
39	393	Warehouse Equipment	5.00%	-		-	-
40	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
41	395	Laboratory Equipment	5.00%	-		-	-
42	396	Power Operated Equipment	6.67%	-		-	-
43	397	Communication Equipment	6.67%	-		-	-
44	398	Miscellaneous Equipment	3.33%	-		-	-
45		Subtotal General Plant		$ -	$ -	$ -	$ -
46							
47		Total Utility Plant		$ 20,000	$ 18,004	$ (1,996)	$ (36)
48							
49		Accumulated Depreciation (1/2-Year Convention)					$ (18)
50							
51		Net Plant					$ (1,978)
52							
53							
54							
55							

[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

Recap Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Line No.			Depreciation Rate	White Tank - Total: Total - All Post-T.Y. Plant [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -	$ -	$ -	$ -
3	302	Franchises	n/a	-	-	-	-
4	303	Other Intangibles	n/a	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-	-	-	-
8	310.3	Other Source of Supply Land	0.00%	-	-	-	-
9	310.4	Wells - Other	n/a	-	-	-	-
10	314	Wells	3.13%	-	-	-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-	-	-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-	-	-	-
15	325	Electric Pumping Equipment	5.88%	12,000	33,612	21,612	1,271
16	328	Gas Engine Equipment	4.00%	-	-	-	-
17		Subtotal Pumping Plant		$ 12,000	$ 33,612	$ 21,612	$ 1,271
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-	-	-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-	-	-	-
21	332	Water Treatment Equipment	2.86%	54,000	68,859	14,859	425
22		Subtotal Water Trtmt. Plant		$ 54,000	$ 68,859	$ 14,859	$ 425
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-	-	-	-
25	341	Transmission and Distribution Structur	3.33%	-	-	-	-
26	342	Storage Tanks	2.00%	-	-	-	-
27	343	Trans. & Dist. Mains	1.79%	77,000	86,750	9,750	175
28	344	Fire Sprinkler Taps	2.00%	-	-	-	-
29	345	Services	2.38%	25,000	31,072	6,072	145
30	346	Meters	4.55%	38,800	105	(38,695)	(1,761)
31	348	Hydrants	1.82%	5,000	3,867	(1,133)	(21)
32		Subtotal Trans. & Dist.		$ 145,800	$ 121,795	$ (24,005)	$ (1,462)
33		General Plant					
34	389	General Plant Land	0.00%	-	-	-	-
35	390	General Plant Structures	2.50%	-	-	-	-
36	390.1	Leasehold Improvements	n/a	-	-	-	-
37	391	Office Furniture & Equipment	6.67%	1,000	-	(1,000)	(67)
38	393	Warehouse Equipment	5.00%	-	-	-	-
39	394	Tools, Shop & Garage Equip.	4.00%	1,250	239	(1,011)	(40)
40	395	Laboratory Equipment	5.00%	-	-	-	-
41	396	Power Operated Equipment	6.67%	-	-	-	-
42	397	Communication Equipment	6.67%	327,000	336,357	9,357	624
43	398	Miscellaneous Equipment	3.33%	-	3,974	3,974	132
44		Subtotal General Plant		$ 329,250	$ 340,569	$ 11,319	$ 649
45							
46		Total Utility Plant		$ 541,050	$ 564,837	$ 23,787	$ 883
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 441
49							
50		Net Plant					$ 23,345
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

				Ajo			
				[A]	[B]	[C]	[D]
					Blankets		
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	2,000	1,409	(591)	(11)
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	5,000	9,019	4,019	96
30	346	Meters	4.55%	4,200		(4,200)	(191)
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ 11,200	$ 10,428	$ (772)	$ (106)
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	200	481	281	19
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	250	3,974	3,724	149
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-	16	16	1
43	398	Miscellaneous Equipment	3.33%	-	1,053	1,053	35
44		Subtotal General Plant		$ 450	$ 5,523	$ 5,073	$ 204
45							
46		Total Utility Plant		$ 11,650	$ 15,951	$ 4,301	$ 98
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 49
49							
50		Net Plant					$ 4,252
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Phoenix Office [A] Blankets As Filed	[B] Blankets Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	52,000	38,737	(13,263)	(885)
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-	3,660	3,660	244
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 52,000	$ 42,397	$ (9,603)	$ (641)
45							
46		Total Utility Plant		$ 52,000	$ 42,397	$ (9,603)	$ (641)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (320)
49							
50		Net Plant					$ (9,283)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

				Phoenix Office (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5324			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	85,000	-	(85,000)	(5,670)
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 85,000	$ -	$ (85,000)	$ (5,670)
45							
46		Total Utility Plant		$ 85,000	$ -	$ (85,000)	$ (5,670)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (2,835)
49							
50		Net Plant					$ (82,165)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.			Depreciation Rate	Phoenix Office (Continued) Work Authorization 1-5325 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	31,000	-	(31,000)	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 31,000	$ -	$ (31,000)	$ -
45							
46		Total Utility Plant		$ 31,000	$ -	$ (31,000)	$ -
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ -
49							
50		Net Plant					$ (31,000)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Depreciation Rate	Phoenix Office (Continued) Work Authorization 1-5326 [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1	Intangible Plant					
2	301 Organization	0.00%	$ -		$ -	$ -
3	302 Franchises	n/a	-		-	-
4	303 Other Intangibles	n/a	-		-	-
5	Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6	Source of Supply Plant					
7	310.1 Water Rights	0.00%	-		-	-
8	310.3 Other Source of Supply Land	0.00%	-		-	-
9	310.4 Wells - Other	n/a	-		-	-
10	314 Wells	3.13%	-		-	-
11	Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12	Pumping Plant					
13	320 Pumping Plant Land	0.00%	-		-	-
14	321 Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325 Electtric Pumping Equipment	5.88%	-		-	-
16	328 Gas Engine Equipment	4.00%	-		-	-
17	Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18	Water Treatment Plant					
19	330 Water Treatment Plant Land	0.00%	-		-	-
20	331 Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332 Water Treatment Equipment	2.86%	-		-	-
22	Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23	Transmission & Distribution Plant					
24	340 Trans. and Dist. Land	0.00%	-		-	-
25	341 Transmission and Distribution Structur	3.33%	-		-	-
26	342 Storage Tanks	2.00%	-		-	-
27	343 Trans. & Dist. Mains	1.79%	-		-	-
28	344 Fire Sprinkler Taps	2.00%	-		-	-
29	345 Services	2.38%	-		-	-
30	346 Meters	4.55%	-		-	-
31	348 Hydrants	1.82%	-		-	-
32	Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33	General Plant					
34	389 General Plant Land	0.00%	-		-	-
35	390 General Plant Structures	2.50%	-		-	-
36	390.1 Leasehold Improvements	n/a	-		-	-
37	391 Office Furniture & Equipment	6.67%	14,000	25,444	11,444	763
38	393 Warehouse Equipment	5.00%	-		-	-
39	394 Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395 Laboratory Equipment	5.00%	-		-	-
41	396 Power Operated Equipment	6.67%	-		-	-
42	397 Communication Equipment	6.67%	-		-	-
43	398 Miscellaneous Equipment	3.33%	-		-	-
44	Subtotal General Plant		$ 14,000	$ 25,444	$ 11,444	$ 763
45						
46	Total Utility Plant		$ 14,000	$ 25,444	$ 11,444	$ 763
47						
48	Accumulated Depreciation (1/2-Year Convention)					$ 382
49						
50	Net Plant					$ 11,062
51						
52						
53						
54						
55	[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

				Phoenix Office (Continued)			
				[A]	[B]	[C]	[D]
				Work Authorization 1-5327			
Line No.			Depreciation Rate	As Filed	Rebuttal[1]	Increase / (Decrease)	Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-		-	-
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	-		-	-
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-		-	-
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	20,000	-	(20,000)	(666)
44		Subtotal General Plant		$ 20,000	$ -	$ (20,000)	$ (666)
45							
46		Total Utility Plant		$ 20,000	$ -	$ (20,000)	$ (666)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (333)
49							
50		Net Plant					$ (19,667)
51							
52							
53							
54							
55		[1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.		Description	Depreciation Rate	Phoenix Office - Total [A] Total - All Post-T.Y. Plant As Filed	[B] Rebutal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -	$ -	$ -	$ -
3	302	Franchises	n/a	-	-	-	-
4	303	Other Intangibles	n/a	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-	-	-	-
8	310.3	Other Source of Supply Land	0.00%	-	-	-	-
9	310.4	Wells - Other	n/a	-	-	-	-
10	314	Wells	3.13%	-	-	-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-	-	-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-	-	-	-
15	325	Electtric Pumping Equipment	5.88%	-	-	-	-
16	328	Gas Engine Equipment	4.00%	-	-	-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-	-	-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-	-	-	-
21	332	Water Treatment Equipment	2.86%	-	-	-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-	-	-	-
25	341	Transmission and Distribution Structur	3.33%	-	-	-	-
26	342	Storage Tanks	2.00%	-	-	-	-
27	343	Trans. & Dist. Mains	1.79%	-	-	-	-
28	344	Fire Sprinkler Taps	2.00%	-	-	-	-
29	345	Services	2.38%	-	-	-	-
30	346	Meters	4.55%	-	-	-	-
31	348	Hydrants	1.82%	-	-	-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-	-	-	-
35	390	General Plant Structures	2.50%	-	-	-	-
36	390.1	Leasehold Improvements	n/a	31,000	-	(31,000)	-
37	391	Office Furniture & Equipment	6.67%	66,000	64,181	(1,819)	(121)
38	393	Warehouse Equipment	5.00%	-	-	-	-
39	394	Tools, Shop & Garage Equip.	4.00%	-	-	-	-
40	395	Laboratory Equipment	5.00%	-	-	-	-
41	396	Power Operated Equipment	6.67%	-	-	-	-
42	397	Communication Equipment	6.67%	85,000	3,660	(81,340)	(5,425)
43	398	Miscellaneous Equipment	3.33%	20,000	-	(20,000)	(666)
44		Subtotal General Plant		$ 202,000	$ 67,841	$ (134,159)	$ (6,213)
45							
46		Total Utility Plant		$ 202,000	$ 67,841	$ (134,159)	$ (6,213)
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ (3,106)
49							
50		Net Plant					$ (131,053)
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-1 (continued)
Post-Test Year Plant True-Up

Line No.	Acct.	Description	Depreciation Rate	Meter Shop Blankets [A] As Filed	[B] Rebuttal[1]	[C] Increase / (Decrease)	[D] Adjstmt' to Depreciation Expense
1		Intangible Plant					
2	301	Organization	0.00%	$ -		$ -	$ -
3	302	Franchises	n/a	-		-	-
4	303	Other Intangibles	n/a	-		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -
6		Source of Supply Plant					
7	310.1	Water Rights	0.00%	-		-	-
8	310.3	Other Source of Supply Land	0.00%	-		-	-
9	310.4	Wells - Other	n/a	-		-	-
10	314	Wells	3.13%	-		-	-
11		Subtotal Source of Sup. Plant		$ -	$ -	$ -	$ -
12		Pumping Plant					
13	320	Pumping Plant Land	0.00%	-		-	-
14	321	Pumping Plant Struct. & Improv.	2.86%	-		-	-
15	325	Electtric Pumping Equipment	5.88%	-		-	-
16	328	Gas Engine Equipment	4.00%	-		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -
18		Water Treatment Plant					
19	330	Water Treatment Plant Land	0.00%	-		-	-
20	331	Water Trtmt. Struct. & Improv.	2.50%	-		-	-
21	332	Water Treatment Equipment	2.86%	-		-	-
22		Subtotal Water Trtmt. Plant		$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant					
24	340	Trans. and Dist. Land	0.00%	-		-	-
25	341	Transmission and Distribution Structur	3.33%	-		-	-
26	342	Storage Tanks	2.00%	-		-	-
27	343	Trans. & Dist. Mains	1.79%	-		-	-
28	344	Fire Sprinkler Taps	2.00%	-		-	-
29	345	Services	2.38%	-		-	-
30	346	Meters	4.55%	-		-	-
31	348	Hydrants	1.82%	-		-	-
32		Subtotal Trans. & Dist.		$ -	$ -	$ -	$ -
33		General Plant					
34	389	General Plant Land	0.00%	-		-	-
35	390	General Plant Structures	2.50%	-	281	281	7
36	390.1	Leasehold Improvements	n/a	-		-	-
37	391	Office Furniture & Equipment	6.67%	750	1,818	1,068	71
38	393	Warehouse Equipment	5.00%	-		-	-
39	394	Tools, Shop & Garage Equip.	4.00%	1,000		(1,000)	(40)
40	395	Laboratory Equipment	5.00%	-		-	-
41	396	Power Operated Equipment	6.67%	-		-	-
42	397	Communication Equipment	6.67%	-		-	-
43	398	Miscellaneous Equipment	3.33%	-		-	-
44		Subtotal General Plant		$ 1,750	$ 2,099	$ 349	$ 38
45							
46		Total Utility Plant		$ 1,750	$ 2,099	$ 349	$ 38
47							
48		Accumulated Depreciation (1/2-Year Convention)					$ 19
49							
50		Net Plant					$ 330
51							
52							
53							
54							

55 [1]Updated costs provided in response to Staff data request BAB 8.1/RUCO data request 6.01.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-2
Adjust Deferred Income Tax to Reflect Bonus Depreciation on Post-Test Year Plant

Line No.	System	Increase / (Decrease)
1		
2	Western Group	
3	Pinal Valley	$ 1,231,149
4	White Tank	94,646
5	Ajo	2,621
6		
7	Subtotal	$ 1,328,417
8		
9	Phoenix	$ 11,985
10	Meter Shop	319
11		
12	Subtotal	12,303
13		
14	Total	$ 1,340,720
15		
16		
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55	[1]See Rebuttal Testimony of Joseph D. Harris	

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\B2.1
Processing Date: 4/11/2016 11:07 AM

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-3
Adjust Working Capital to Reflect Rebuttal Adjustments

Line No.	System	Western Group - Working Capital [A] As Filed	[B] Rebuttal	[C] Increase / (Decrease)
1				
2	Western Group			
3	Pinal Valley	$ 1,561,902	$ 1,565,951	$ 4,049
4	White Tank	141,320	189,248	47,928
5	Ajo	29,007	28,982	(25)
6				
7	Subtotal	$ 1,732,229	$ 1,784,180	$ 51,952
8				
9	Total	$ 1,732,229	$ 1,784,180	$ 51,952
10				
11				
12	Increase/(Decrease) in Working Capital			$ 51,952
13				
14				
15				
16				
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Rate Base Adjustment RB-4
Allocate Phoenix Office & Meter Shop Rate Base

Line No.		[A] Test Year - Rebuttal	Western Group [B] Allocated Pinal Valley	Western Group [C] Allocated White Tank	Western Group [D] Allocated Ajo
1					
2	3-Factor Allocation Ratio		0.3317	0.0396	0.0072
3					
4	Phoenix Office				
5	Plant Classification				
6	Intangible Plant	$ -	$ -	$ -	$ -
7	Source of Supply Plant	-	-	-	-
8	Pumping Plant	-	-	-	-
9	Water Treatment Plant	-	-	-	-
10	Transmission & Distribution Plant	-	-	-	-
11	General Plant	(134,159)	(44,501)	(5,313)	(966)
12	Total Gross Plant in Service	$ (134,159)	$ (44,501)	$ (5,313)	$ (966)
13	Less:				
14	Accumulated Depreciation	(3,106)	(1,030)	(123)	(22)
15	Net Plant in Service	$ (131,053)	$ (43,470)	$ (5,190)	$ (944)
16	Less:				
17	Deferred Income Tax	11,985	3,975	475	86
18	Total Rate Base	$ (143,038)	$ (47,446)	$ (5,664)	$ (1,030)
19					
20	Meter Shop				
21	Plant Classification				
22	Intangible Plant	$ -	$ -	$ -	$ -
23	Source of Supply Plant	-	-	-	-
24	Pumping Plant	-	-	-	-
25	Water Treatment Plant	-	-	-	-
26	Transmission & Distribution Plant	-	-	-	-
27	General Plant	349	116	14	3
28	Total Gross Plant in Service	$ 349	$ 116	$ 14	$ 3
29	Less:				
30	Accumulated Depreciation	19	6	1	0
31	Net Plant in Service	$ 330	$ 109	$ 13	$ 2
32	Less:				
33	Deferred Income Tax	319	106	13	2
34	Total Rate Base	$ 11	$ 4	$ 0	$ 0
35					
36					
37					
38	Total Phoenix Office & Meter Shop				
39	Plant Classification				
40	Intangible Plant	$ -	$ -	$ -	$ -
41	Source of Supply Plant	-	-	-	-
42	Pumping Plant	-	-	-	-
43	Water Treatment Plant	-	-	-	-
44	Transmission & Distribution Plant	-	-	-	-
45	General Plant	(133,811)	(44,385)	(5,299)	(963)
46	Total Gross Plant in Service	$ (133,811)	$ (44,385)	$ (5,299)	$ (963)
47	Less:				
48	Accumulated Depreciation	$ (3,087)	(1,024)	(122)	(22)
49		$ (130,724)	$ (43,361)	$ (5,177)	$ (941)
50	Less:				
51	Deferred Income Tax	12,303	4,081	487	89
52	Total Rate Base	$ (143,027)	$ (47,442)	$ (5,664)	$ (1,030)
53					
54					
55					

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Working Capital

Line No.		Western Group [A] Working Capital - As Filed	[B] Rebuttal Adjustments	[C] Working Capital - Rebuttal
1				
2	Working Cash Requirement			
3	(Sch. B-5 Appendix)	$ 180,385	$ 51,952	$ 232,337
4				
5	Material and Supplies Inventories[1]	136,425	-	136,425
6				
7	Required Bank Balances[1]	911,860	-	911,860
8				
9	Prepayments & Special Deposits[1]	503,558	-	503,558
10				
11	Total Working Capital Allowance	$ 1,732,229	$ 51,952	$ 1,784,180

55 [1]13-month average balances

Supporting Schedules:
B-5 Rebuttal Appendix

Recap Schedules:
B-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Working Capital

Line No.		Pinal Valley [A] Working Capital - As Filed	Pinal Valley [B] Rebuttal Adjustments	Pinal Valley [C] Working Capital - Rebuttal	White Tank [D] Working Capital - As Filed	White Tank [E] Rebuttal Adjustments	White Tank [F] Working Capital - Rebuttal	Ajo [G] Working Capital - As Filed	Ajo [H] Rebuttal Adjustments	Ajo [I] Working Capital - Rebuttal
1										
2	Working Cash Requirement									
3	(Sch. B-5 Appendix)	$ 201,938	$ 4,049	$ 205,987	$ (21,040)	$ 47,928	$ 26,888	$ (513)	$ (25)	$ (538)
4										
5	Material and Supplies Inventories[1]	119,556	-	119,556	14,273	-	14,273	2,595	-	2,595
6										
7	Required Bank Balances[1]	799,112	-	799,112	95,402	-	95,402	17,346	-	17,346
8										
9	Prepayments & Special Deposits[1]	441,295	-	441,295	52,684	-	52,684	9,579	-	9,579
10										
11	Total Working Capital Allowance	$ 1,561,902	$ 4,049	$ 1,565,951	$ 141,320	$ 47,928	$ 189,248	$ 29,007	$ (25)	$ 28,982

55 [1] 13-month average balances

Supporting Schedules:
B-5 Rebuttal Appendix

Recap Schedules:
B-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Working Cash Requirement

	Pinal Valley											
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]
	Company - As Filed						Company - Rebuttal					
	Adjusted Results - As Filed	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [B - C]	Lead / Lag Factor [D ÷ 365]	Working Cash Requirement [A X E]	Adjusted Results - Rebuttal	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [H - I]	Lead / Lag Factor [J ÷ 365]	Working Cash Requirement [G X K]
Operating Expenses												
Purchased Power	$ 2,071,310	29.50	30.87	(1.37)	(0.0038)	$ (7,775)	$ 2,071,310	29.50	30.87	(1.37)	(0.0038)	$ (7,775)
Payroll	3,869,443	29.50	14.00	15.50	0.0425	164,319	3,869,443	29.50	14.00	15.50	0.0425	164,319
Purchased Water	715,000	29.50	(57.84)	87.34	0.2393	171,091	715,000	29.50	(57.84)	87.34	0.2393	171,091
Chemicals	407,363	29.50	(18.11)	47.61	0.1304	53,136	407,363	29.50	(18.11)	47.61	0.1304	53,136
Property & Liability Insurance	215,569	29.50	(45.27)	74.77	0.2048	44,159	215,569	29.50	(45.27)	74.77	0.2048	44,159
Worker's Compensation Insurance	56,136	29.50	(46.50)	76.00	0.2082	11,689	56,136	29.50	(46.50)	76.00	0.2082	11,689
Medical, Vision, Dental, LTD & Life Insurance	868,512	29.50	(8.92)	38.42	0.1053	91,420	868,512	29.50	(8.92)	38.42	0.1053	91,420
Other O&M (Excluding Rate Case Expense)	1,999,287	29.50	(9.27)	38.77	0.1062	212,363	2,039,085	29.50	(9.27)	38.77	0.1062	216,590
Federal Income Taxes	1,839,977	29.50	37.00	(7.50)	(0.0205)	(37,808)	1,863,265	29.50	37.00	(7.50)	(0.0205)	(38,286)
State Income Taxes	313,163	29.50	37.00	(7.50)	(0.0205)	(6,435)	317,126	29.50	37.00	(7.50)	(0.0205)	(6,516)
FICA Taxes	267,606	29.50	14.00	15.50	0.0425	11,364	267,606	29.50	14.00	15.50	0.0425	11,364
FUTA & SUTA Taxes	3,202	29.50	83.10	(53.60)	(0.1468)	(470)	3,202	29.50	83.10	(53.60)	(0.1468)	(470)
Property Taxes	1,062,879	29.50	212.00	(182.50)	(0.5000)	(531,439)	1,062,116	29.50	212.00	(182.50)	(0.5000)	(531,058)
Registration, Svc. Contracts, & Misc. Fees	86,918	29.50	(98.83)	128.33	0.3516	30,559	86,918	29.50	(98.83)	128.33	0.3516	30,559
Retirement Annuities (401k)	296,049	29.50	34.72	(5.22)	(0.0143)	(4,234)	296,049	29.50	34.72	(5.22)	(0.0143)	(4,234)
Total	$ 14,072,414					$ 201,938	$ 14,138,700					$ 205,987

[1]2014 Actual lag days per AWC billing system.
Revenue lag days for White Tank updated in response
Staff data request BAB 1.16.
[2]Dec. No. 64282 as amended by Dec. Nos. 66849
& 68302. Purchased power lag days per
Dec. No. 71845. Purchased water lag days
are actual 2014.
-Purchased Water expense exludes amortization
of deferred CAP M&I Capital charges.

Supporting Schedules:

Recap Schedules:
B-5 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Working Cash Requirement

White Tank

Line No.		[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]
		Company - As Filed						Company - Rebuttal					
		Adjusted Results - As Filed	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [B - C]	Lead / Lag Factor [D ÷ 365]	Working Cash Requirement [A X E]	Adjusted Results - Rebuttal	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [H - I]	Lead / Lag Factor [J ÷ 365]	Working Cash Requirement [G X K]
1													
2													
3	Operating Expenses												
4	Purchased Power	$ 286,661	20.77	30.87	(10.10)	(0.0277)	$ (7,932)	$ 286,661	31.50	30.87	0.63	0.0017	$ 495
5	Payroll	476,932	20.77	14.00	6.77	0.0185	8,846	476,932	31.50	14.00	17.50	0.0479	22,867
6	Purchased Water	-	20.77	41.88	(21.11)	(0.0578)	-	-	31.50	41.88	(10.38)	(0.0284)	-
7	Chemicals	47,058	20.77	(18.11)	38.88	0.1065	5,013	47,058	31.50	(18.11)	49.61	0.1359	6,396
8	Property & Liability Insurance	25,736	20.77	(45.27)	66.04	0.1809	4,656	25,736	31.50	(45.27)	76.77	0.2103	5,413
9	Worker's Compensation Insurance	4,335	20.77	(46.50)	67.27	0.1843	799	4,335	31.50	(46.50)	78.00	0.2137	926
10	Medical, Vision, Dental, LTD & Life Insurance	67,130	20.77	(8.92)	29.69	0.0813	5,460	67,130	31.50	(8.92)	40.42	0.1107	7,434
11	Other O&M (Excluding Rate Case Expense)	354,699	20.77	(9.27)	30.04	0.0823	29,192	360,554	31.50	(9.27)	40.77	0.1117	40,273
12	Federal Income Taxes	153,203	20.77	37.00	(16.23)	(0.0445)	(6,812)	162,252	31.50	37.00	(5.50)	(0.0151)	(2,445)
13	State Income Taxes	26,075	20.77	37.00	(16.23)	(0.0445)	(1,159)	27,615	31.50	37.00	(5.50)	(0.0151)	(416)
14	FICA Taxes	28,684	20.77	14.00	6.77	0.0185	532	28,684	31.50	14.00	17.50	0.0479	1,375
15	FUTA & SUTA Taxes	319	20.77	83.10	(62.33)	(0.1708)	(54)	319	31.50	83.10	(51.60)	(0.1414)	(45)
16	Property Taxes	118,521	20.77	212.00	(191.23)	(0.5239)	(62,095)	119,057	31.50	212.00	(180.50)	(0.4945)	(58,876)
17	Registration, Svc. Contracts, & Misc. Fees	10,342	20.77	(98.83)	119.60	0.3277	3,389	10,342	31.50	(98.83)	130.33	0.3571	3,693
18	Retirement Annuities (401k)	22,863	20.77	34.72	(13.95)	(0.0382)	(874)	22,863	31.50	34.72	(3.22)	(0.0088)	(202)
19													
20													
21	Total	$ 1,622,559					$ (21,040)	$ 1,639,539					$ 26,888

47 [1]2014 Actual lag days per AWC billing system.
48 Revenue lag days for White Tank updated in response
49 Staff data request BAB 1.16.
50 [2]Dec. No. 64282 as amended by Dec. Nos. 66849
51 & 68302. Purchased power lag days per
52 Dec. No. 71845. Purchased water lag days
53 are actual 2014.
54 -Purchased Water expense exludes amortization
55 of deferred CAP M&I Capital charges.

Ajo

Line No.		[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]
		Company - As Filed						Company - Rebuttal					
1		Adjusted Results - As Filed	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [B - C]	Lead / Lag Factor [D ÷ 365]	Working Cash Requirement [A X E]	Adjusted Results - Rebuttal	Revenue Lag Days[1]	Expense Lag Days[2]	Net Lag Days [H - I]	Lead / Lag Factor [J ÷ 365]	Working Cash Requirement [G X K]
2													
3	Operating Expenses												
4	Purchased Power	$ 4,903	28.91	30.87	(1.96)	(0.0054)	$ (26)	$ 4,903	28.91	30.87	(1.96)	(0.0054)	$ (26)
5	Payroll	118,010	28.91	14.00	14.91	0.0408	4,821	118,010	28.91	14.00	14.91	0.0408	4,821
6	Purchased Water	117,312	28.91	35.95	(7.04)	(0.0193)	(2,263)	117,312	28.91	35.95	(7.04)	(0.0193)	(2,263)
7	Chemicals	502	28.91	(18.11)	47.02	0.1288	65	502	28.91	(18.11)	47.02	0.1288	65
8	Property & Liability Insurance	4,679	28.91	(45.27)	74.18	0.2032	951	4,679	28.91	(45.27)	74.18	0.2032	951
9	Worker's Compensation Insurance	1,568	28.91	(46.50)	75.41	0.2066	324	1,568	28.91	(46.50)	75.41	0.2066	324
10	Medical, Vision, Dental, LTD & Life Insurance	24,173	28.91	(8.92)	37.83	0.1036	2,505	24,173	28.91	(8.92)	37.83	0.1036	2,505
11	Other O&M (Excluding Rate Case Expense)	36,170	28.91	(9.27)	38.18	0.1046	3,784	36,889	28.91	(9.27)	38.18	0.1046	3,859
12	Federal Income Taxes	28,967	28.91	37.00	(8.09)	(0.0222)	(642)	30,871	28.91	37.00	(8.09)	(0.0222)	(684)
13	State Income Taxes	4,930	28.91	37.00	(8.09)	(0.0222)	(109)	5,254	28.91	37.00	(8.09)	(0.0222)	(116)
14	FICA Taxes	8,841	28.91	14.00	14.91	0.0408	361	8,841	28.91	14.00	14.91	0.0408	361
15	FUTA & SUTA Taxes	99	28.91	83.10	(54.19)	(0.1485)	(15)	99	28.91	83.10	(54.19)	(0.1485)	(15)
16	Property Taxes	21,529	28.91	212.00	(183.09)	(0.5016)	(10,799)	21,631	28.91	212.00	(183.09)	(0.5016)	(10,850)
17	Registration, Svc. Contracts, & Misc. Fees	1,893	28.91	(98.83)	127.74	0.3500	663	1,893	28.91	(98.83)	127.74	0.3500	663
18	Retirement Annuities (401k)	8,270	28.91	34.72	(5.81)	(0.0159)	(132)	8,270	28.91	34.72	(5.81)	(0.0159)	(132)
19													
20													
21	Total	$ 381,845					$ (513)	$ 384,895					$ (538)

[1] 2014 Actual lag days per AWC billing system. Revenue lag days for White Tank updated in response Staff data request BAB 1.16.

[2] Dec. No. 64282 as amended by Dec. Nos. 66849 & 68302. Purchased power lag days per Dec. No. 71845. Purchased water lag days are actual 2014.

-Purchased Water expense exludes amortization of deferred CAP M&I Capital charges.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Adjusted Test Year Income Statement

Western Group

Line No.		[A] Test Year Ended 12/31/2014	[B] Company - As Filed: Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal Adjustments	[E] Company - Rebuttal: Adjusted Test Year - Rebuttal	[F] Company - Rebuttal: Required Increase - Rebuttal	[G] Adjstd' w/ Increase - Rebuttal
1	Operating Revenues							
2	Residential	$ 14,933,743	$ (1,536,843)	$ 13,396,900	$ -	$ 13,396,900		
3	Commercial	6,649,318	(689,780)	5,959,538	-	5,959,538		
4	Industrial	1,099,890	(125,928)	973,961	-	973,961		
5	Private Fire Service	138,940	(14,290)	124,650	-	124,650		
6	Other Water Revenues	273,425	(21,552)	251,873	-	251,873		
7	Total Water Revenues	$ 23,095,315	$ (2,388,393)	$ 20,706,922	$ -	$ 20,706,922		
8								
9	Miscellaneous	1,128,795	(618,949)	509,846	-	509,846		
10	Total Operating Revenues	$ 24,224,110	$ (3,007,342)	$ 21,216,768	$ -	$ 21,216,768	$ 6,007,339	$ 27,224,107
11								
12	Operating Expenses							
13	Source of Supply Expenses:							
14	Purchased Water	627,277	575,578	1,202,855	-	1,202,855	-	1,202,855
15	Other	87,192	10,555	97,747	81	97,828	-	97,828
16	Pumping Expenses:							
17	Purchased Power	2,290,426	72,448	2,362,874	-	2,362,874	-	2,362,874
18	Purchased Gas	878	-	878	-	878	-	878
19	Other	914,922	174,672	1,089,594	3,262	1,092,856	-	1,092,856
20	Water Treatment Expenses	1,552,922	107,688	1,660,610	834	1,661,444	-	1,661,444
21	Transmission & Distribution Expenses	1,550,665	341,279	1,891,944	6,753	1,898,697	-	1,898,697
22	Customer Accounting Expenses	1,359,159	74,032	1,433,191	1,819	1,435,010	12,948	1,447,957
23	Customer Service & Sales Expense	2,362	2,413	4,775	-	4,775	-	4,775
24	Administrative & General Expenses	2,419,106	443,701	2,862,807	33,624	2,896,431	-	2,896,431
25	Total Operations & Maintenance Expense	$ 10,804,910	$ 1,802,367	$ 12,607,277	$ 46,372	$ 12,653,649	$ 12,948	$ 12,666,597
26								
27	Depreciation & Amortization Expenses	4,450,676	367,759	4,818,436	(54,275)	4,764,160	-	4,764,160
28								
29	Taxes							
30	Federal Income Taxes	1,392,854	(1,275,185)	117,669	35,191	152,861	1,903,527	2,056,388
31	State Income Taxes	147,755	(127,728)	20,027	5,990	26,017	323,979	349,996
32	Property Taxes	1,048,313	50,623	1,098,936	-	1,098,936	103,867	1,202,803
33	Other	2,434,405	(2,237,112)	197,293	(4,610)	192,683	-	192,683
34	Total Taxes	$ 5,023,327	$ (3,589,402)	$ 1,433,926	$ 36,571	$ 1,470,497	$ 2,331,373	$ 3,801,870
35								
36	Total Operating Expenses	$ 20,278,914	$ (1,419,276)	$ 18,859,638	$ 28,668	$ 18,888,307	$ 2,344,320	$ 21,232,627
37	Operating Income	$ 3,945,196	$ (1,588,067)	$ 2,357,130	$ (28,668)	$ 2,328,462	$ 3,663,018	$ 5,991,480
38								
39	Other Income & Deductions:							
40	Interest:							
41	Long-Term Debt	1,868,679	262,015	2,130,695	(96,388)	2,034,307	-	2,034,307
42	Short-Term Debt	-	-	-	-	-	-	-
43	Other	(185,620)	185,620	-	-	-	-	-
44	Total Interest	$ 1,683,059	$ 447,636	$ 2,130,695	$ (96,388)	$ 2,034,307	$ -	$ 2,034,307
45								
46	Other (Income) - Net	(189,231)	189,231	-	-	-	-	-
47								
48	Total Other (Income) & Deductions	$ 1,493,827	$ 636,867	$ 2,130,695	$ (96,388)	$ 2,034,307	$ -	$ 2,034,307
49								
50	Net Income	$ 2,451,369	$ (2,224,934)	$ 226,435	$ 67,720	$ 294,155	$ 3,663,018	$ 3,957,173
51								
52								
53								
54								
55								

Supporting Schedules:
C-2 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Adjusted Test Year Income Statement

Pinal Valley

Line No.		[A] Test Year Ended 12/31/2014	[B] Company - As Filed: Pro Forma Adjustments - As Filed	[C] Company - As Filed: Adjusted Test Year - As Filed	[D] Rebuttal Adjustments	[E] Company - Rebuttal: Adjusted Test Year - Rebuttal	[F] Company - Rebuttal: Required Increase - Rebuttal	[G] Company - Rebuttal: Adjstd' w/ Increase - Rebuttal
1	Operating Revenues							
2	Residential	$ 12,680,567	$ (1,382,206)	$ 11,298,361	$ -	$ 11,298,361		
3	Commercial	6,057,907	(645,125)	5,412,782	-	5,412,782		
4	Industrial	1,083,041	(125,072)	957,969	-	957,969		
5	Private Fire Service	135,733	(14,083)	121,650	-	121,650		
6	Other Water Revenues	235,041	(19,039)	216,003	-	216,003		
7	Total Water Revenues	$ 20,192,290	$ (2,185,525)	$ 18,006,765	$ -	$ 18,006,765		
8								
9	Miscellaneous	1,076,452	(615,328)	461,124	-	461,124		
10	Total Operating Revenues	$ 21,268,742	$ (2,800,853)	$ 18,467,889	$ -	$ 18,467,889	$ 5,310,551	$ 23,778,440
11								
12	Operating Expenses							
13	Source of Supply Expenses:							
14	Purchased Water	509,966	575,578	1,085,544	-	1,085,544	-	1,085,544
15	Other	70,295	5,129	75,424	49	75,473	-	75,473
16	Pumping Expenses:							
17	Purchased Power	2,008,337	62,974	2,071,310	-	2,071,310	-	2,071,310
18	Purchased Gas	878	-	878	-	878	-	878
19	Other	753,918	138,929	892,848	2,720	895,568	-	895,568
20	Water Treatment Expenses	1,322,049	82,694	1,404,743	722	1,405,464	-	1,405,464
21	Transmission & Distribution Expenses	1,410,908	250,563	1,661,471	6,083	1,667,554	-	1,667,554
22	Customer Accounting Expenses	1,175,477	64,082	1,239,559	1,543	1,241,102	11,371	1,252,474
23	Customer Service & Sales Expense	2,093	-	2,093	-	2,093	-	2,093
24	Administrative & General Expenses	2,145,599	397,613	2,543,213	28,681	2,571,893	-	2,571,893
25	Total Operations & Maintenance Expense	$ 9,399,520	$ 1,577,563	$ 10,977,082	$ 39,798	$ 11,016,880	$ 11,371	$ 11,028,252
26								
27	Depreciation & Amortization Expenses	3,620,630	342,946	3,963,576	(54,967)	3,908,609	-	3,908,609
28								
29	Taxes							
30	Federal Income Taxes	1,293,556	(1,149,811)	143,745	37,107	180,852	1,682,412	1,863,265
31	State Income Taxes	137,221	(112,756)	24,465	6,316	30,781	286,345	317,126
32	Property Taxes	934,218	34,996	969,214	-	969,214	92,901	1,062,116
33	Other	2,219,660	(2,045,215)	174,445	(4,171)	170,274	-	170,274
34	Total Taxes	$ 4,584,655	$ (3,272,785)	$ 1,311,870	$ 39,252	$ 1,351,122	$ 2,061,659	$ 3,412,781
35								
36	Total Operating Expenses	$ 17,604,804	$ (1,352,276)	$ 16,252,529	$ 24,082	$ 16,276,611	$ 2,073,030	$ 18,349,641
37	Operating Income	$ 3,663,938	$ (1,448,578)	$ 2,215,360	$ (24,082)	$ 2,191,278	$ 3,237,521	$ 5,428,798
38								
39	Other Income & Deductions:							
40	Interest:							
41	Long-Term Debt	1,667,318	271,428	1,938,746	(95,489)	1,843,258	-	1,843,258
42	Short-Term Debt	-	-	-	-	-	-	-
43	Other	(165,619)	165,619	-	-	-	-	-
44	Total Interest	$ 1,501,699	$ 437,047	$ 1,938,746	$ (95,489)	$ 1,843,258	$ -	$ 1,843,258
45								
46	Other (Income) - Net	(165,834)	165,834	-	-	-	-	-
47								
48	Total Other (Income) & Deductions	$ 1,335,866	$ 602,880	$ 1,938,746	$ (95,489)	$ 1,843,258	$ -	$ 1,843,258
49								
50	Net Income	$ 2,328,072	$ (2,051,458)	$ 276,614	$ 71,406	$ 348,020	$ 3,237,521	$ 3,585,541
51								
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Supporting Schedules:
C-2 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Adjusted Test Year Income Statement

White Tank

Line No.		[A] Test Year Ended 12/31/2014	[B] Company - As Filed Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal Adjustments	[E] Company - Rebuttal Adjusted Test Year - Rebuttal	[F] Company - Rebuttal Required Increase - Rebuttal	[G] Adjstd' w/ Increase - Rebuttal
1	Operating Revenues							
2	Residential	$ 1,916,678	$ (125,034)	$ 1,791,645	$ -	$ 1,791,645		
3	Commercial	457,425	(35,797)	421,627	-	421,627		
4	Industrial	16,848	(856)	15,992	-	15,992		
5	Private Fire Service	1,930	(130)	1,800	-	1,800		
6	Other Water Revenues	37,917	(2,610)	35,306	-	35,306		
7	Total Water Revenues	$ 2,430,798	$ (164,428)	$ 2,266,370	$ -	$ 2,266,370		
8								
9	Miscellaneous	47,983	(3,362)	44,621	-	44,621		
10	Total Operating Revenues	$ 2,478,781	$ (167,790)	$ 2,310,991	$ -	$ 2,310,991	$ 595,785	$ 2,906,776
11								
12	Operating Expenses							
13	Source of Supply Expenses:							
14	Purchased Water	-	-	-	-	-	-	-
15	Other	16,474	9,742	26,216	31	26,247	-	26,247
16	Pumping Expenses:							
17	Purchased Power	279,222	7,439	286,661	-	286,661	-	286,661
18	Purchased Gas	-	-	-	-	-	-	-
19	Other	142,677	36,031	178,709	502	179,211	-	179,211
20	Water Treatment Expenses	206,953	25,044	231,997	58	232,056	-	232,056
21	Transmission & Distribution Expenses	101,410	70,306	171,716	550	172,266	-	172,266
22	Customer Accounting Expenses	146,766	7,885	154,650	233	154,883	1,341	156,225
23	Customer Service & Sales Expense	223	2,413	2,636	-	2,636	-	2,636
24	Administrative & General Expenses	222,981	37,148	260,129	4,481	264,610	-	264,610
25	Total Operations & Maintenance Expense	$ 1,116,705	$ 196,009	$ 1,312,714	$ 5,856	$ 1,318,570	$ 1,341	$ 1,319,911
26								
27	Depreciation & Amortization Expenses	770,228	18,295	788,523	638	789,161	-	789,161
28								
29	Taxes							
30	Federal Income Taxes	80,995	(106,096)	(25,101)	(1,698)	(26,799)	189,050	162,252
31	State Income Taxes	8,592	(12,864)	(4,272)	(289)	(4,561)	32,176	27,615
32	Property Taxes	90,735	18,901	109,635	-	109,635	9,422	119,057
33	Other	182,109	(165,743)	16,366	(322)	16,044	-	16,044
34	Total Taxes	$ 362,430	$ (265,802)	$ 96,628	$ (2,309)	$ 94,319	$ 230,648	$ 324,968
35								
36	Total Operating Expenses	$ 2,249,363	$ (51,497)	$ 2,197,866	$ 4,185	$ 2,202,051	$ 231,990	$ 2,434,040
37	Operating Income	$ 229,418	$ (116,293)	$ 113,125	$ (4,185)	$ 108,940	$ 363,796	$ 472,736
38								
39	Other Income & Deductions:							
40	Interest:							
41	Long-Term Debt	167,446	(6,019)	161,427	(918)	160,510	-	160,510
42	Short-Term Debt	-	-	-	-	-	-	-
43	Other	(16,633)	16,633	-	-	-	-	-
44	Total Interest	$ 150,813	$ 10,614	$ 161,427	$ (918)	$ 160,510	$ -	$ 160,510
45								
46	Other (Income) - Net	(19,798)	19,798	-	-	-	-	-
47								
48	Total Other (Income) & Deductions	$ 131,015	$ 30,412	$ 161,427	$ (918)	$ 160,510	$ -	$ 160,510
49								
50	Net Income	$ 98,403	$ (146,705)	$ (48,302)	$ (3,267)	$ (51,569)	$ 363,796	$ 312,226
51								
52								
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54								
55								

Supporting Schedules:
C-2 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Adjusted Test Year Income Statement

Exhibit
Schedule C-1 Rebuttal
Page 4 of 4
Witness: Moe

Ajo

Line No.		[A] Test Year Ended 12/31/2014	[B] Company - As Filed: Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal Adjustments	[E] Company - Rebuttal: Adjusted Test Year - Rebuttal	[F] Required Increase - Rebuttal	[G] Adjstd' w/ Increase - Rebuttal
1	Operating Revenues							
2	Residential	$ 336,497	$ (29,602)	$ 306,895	$ -	$ 306,895		
3	Commercial	133,986	(8,858)	125,128	-	125,128		
4	Industrial	-	-	-	-	-		
5	Private Fire Service	1,276	(76)	1,200	-	1,200		
6	Other Water Revenues	467	97	564	-	564		
7	Total Water Revenues	$ 472,227	$ (38,439)	$ 433,787	$ -	$ 433,787		
8								
9	Miscellaneous	4,360	(259)	4,101	-	4,101		
10	Total Operating Revenues	$ 476,587	$ (38,698)	$ 437,888	$ -	$ 437,888	$ 101,003	$ 538,891
11								
12	Operating Expenses							
13	Source of Supply Expenses:							
14	Purchased Water	117,312	-	117,312	-	117,312	-	117,312
15	Other	423	(4,317)	(3,893)	1	(3,892)	-	(3,892)
16	Pumping Expenses:							
17	Purchased Power	2,868	2,035	4,903	-	4,903	-	4,903
18	Purchased Gas	-	-	-	-	-	-	-
19	Other	18,327	(288)	18,038	39	18,077	-	18,077
20	Water Treatment Expenses	23,920	(50)	23,870	54	23,924	-	23,924
21	Transmission & Distribution Expenses	38,348	20,410	58,757	120	58,877	-	58,877
22	Customer Accounting Expenses	36,916	2,065	38,982	42	39,024	235	39,259
23	Customer Service & Sales Expense	46	-	46	-	46	-	46
24	Administrative & General Expenses	50,526	8,939	59,465	463	59,928	-	59,928
25	Total Operations & Maintenance Expense	$ 288,686	$ 28,794	$ 317,480	$ 719	$ 318,199	$ 235	$ 318,434
26								
27	Depreciation & Amortization Expenses	59,819	6,518	66,337	53	66,390	-	66,390
28								
29	Taxes							
30	Federal Income Taxes	18,303	(19,278)	(975)	(218)	(1,193)	32,064	30,871
31	State Income Taxes	1,942	(2,108)	(166)	(37)	(203)	5,457	5,254
32	Property Taxes	23,360	(3,274)	20,086	-	20,086	1,544	21,631
33	Other	32,637	(26,155)	6,482	(117)	6,365	-	6,365
34	Total Taxes	$ 76,242	$ (50,815)	$ 25,427	$ (371)	$ 25,056	$ 39,066	$ 64,121
35								
36	Total Operating Expenses	$ 424,747	$ (15,503)	$ 409,244	$ 401	$ 409,645	$ 39,301	$ 448,945
37	Operating Income	$ 51,840	$ (23,196)	$ 28,644	$ (401)	$ 28,244	$ 61,702	$ 89,946
38								
39	Other Income & Deductions:							
40	Interest:							
41	Long-Term Debt	33,915	(3,393)	30,521	18	30,540	-	30,540
42	Short-Term Debt	-	-	-	-	-	-	-
43	Other	(3,369)	3,369	-	-	-	-	-
44	Total Interest	$ 30,546	$ (25)	$ 30,521	$ 18	$ 30,540	$ -	$ 30,540
45								
46	Other (Income) - Net	(3,600)	3,600	-	-	-	-	-
47								
48	Total Other (Income) & Deductions	$ 26,946	$ 3,575	$ 30,521	$ 18	$ 30,540	$ -	$ 30,540
49								
50	Net Income	$ 24,894	$ (26,771)	$ (1,877)	$ (419)	$ (2,296)	$ 61,702	$ 59,406
51								
52								
53								
54								
55								

Supporting Schedules:
C-2 Rebuttal

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

					Western Group							
		[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
					Rebuttal Income Statement Adjustments							
Line No.		Test Year Ended 12/31/2014	Pro Forma Adjustments - As Filed	Adjusted Test Year - As Filed	Rebuttal IS-1	Rebuttal IS-2	Rebuttal IS-3	Rebuttal IS-4	Rebuttal IS-5	Rebuttal IS-6	Rebuttal BLANK	Rebuttal BLANK
1	Operating Revenues											
2	Residential	$ 14,933,743	$ (1,536,843)	$ 13,396,900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3	Commercial	6,649,318	(689,780)	5,959,538	-	-	-	-	-	-	-	-
4	Industrial	1,099,890	(125,928)	973,961	-	-	-	-	-	-	-	-
5	Private Fire Service	138,940	(14,290)	124,650	-	-	-	-	-	-	-	-
6	Other Water Revenues	273,425	(21,552)	251,873	-	-	-	-	-	-	-	-
7	Total Water Revenues	$ 23,095,315	$ (2,388,393)	$ 20,706,922	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8												
9	Miscellaneous	1,128,795	(618,949)	509,846	-	-	-	-	-	-	-	-
10	Total Operating Revenues	$ 24,224,110	$ (3,007,342)	$ 21,216,768	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water	627,277	575,578	1,202,855	-	-	-	-	-	-	-	-
15	Other	87,192	10,555	97,747	-	-	81	-	-	-	-	-
16	Pumping Expenses:											
17	Purchased Power	2,290,426	72,448	2,362,874	-	-	-	-	-	-	-	-
18	Purchased Gas	878	-	878	-	-	-	-	-	-	-	-
19	Other	914,922	174,672	1,089,594	-	-	3,262	-	-	-	-	-
20	Water Treatment Expenses	1,552,922	107,688	1,660,610	-	-	834	-	-	-	-	-
21	Transmission & Distribution Expenses	1,550,665	341,279	1,891,944	-	-	6,753	-	-	-	-	-
22	Customer Accounting Expenses	1,359,159	74,032	1,433,191	-	-	1,819	-	-	-	-	-
23	Customer Service & Sales Expense	2,362	2,413	4,775	-	-	-	-	-	-	-	-
24	Administrative & General Expenses	2,419,106	443,701	2,862,807	(27,819)	-	61,443	-	-	-	-	-
25	Total Operations & Maintenance Expense	$ 10,804,910	$ 1,802,367	$ 12,607,277	$ (27,819)	$ -	$ 74,191	$ -	$ -	$ -	$ -	$ -
26												
27	Depreciation & Amortization Expenses	4,450,676	367,759	4,818,436	-	(54,275)	-	-	-	-	-	-
28												
29	Taxes											
30	Federal Income Taxes	1,392,854	(1,275,185)	117,669	-	-	-	-	-	35,191	-	-
31	State Income Taxes	147,755	(127,728)	20,027	-	-	-	-	-	5,990	-	-
32	Property Taxes	1,048,313	50,623	1,098,936	-	-	-	-	-	-	-	-
33	Other	2,434,405	(2,237,112)	197,293	(4,610)	-	-	-	-	-	-	-
34	Total Taxes	$ 5,023,327	$ (3,589,402)	$ 1,433,926	$ (4,610)	$ -	$ -	$ -	$ -	$ 41,181	$ -	$ -
35												
36	Total Operating Expenses	$ 20,278,914	$ (1,419,276)	$ 18,859,638	$ (32,428)	$ (54,275)	$ 74,191	$ -	$ -	$ 41,181	$ -	$ -
37	Operating Income	$ 3,945,196	$ (1,588,067)	$ 2,357,130	$ 32,428	$ 54,275	$ (74,191)	$ -	$ -	$ (41,181)	$ -	$ -
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt	1,868,679	262,015	2,130,695	-	-	-	(96,388)	-	-	-	-
42	Short-Term Debt	-	-	-	-	-	-	-	-	-	-	-
43	Other	(185,620)	185,620	-	-	-	-	-	-	-	-	-
44	Total Interest	$ 1,683,059	$ 447,636	$ 2,130,695	$ -	$ -	$ -	$ (96,388)	$ -	$ -	$ -	$ -
45												
46	Other (Income) - Net	(189,231)	189,231	-	-	-	-	-	-	-	-	-
47												
48	Total Other (Income) & Deductions	$ 1,493,827	$ 636,867	$ 2,130,695	$ -	$ -	$ -	$ (96,388)	$ -	$ -	$ -	$ -
49												
50	Net Income	$ 2,451,369	$ (2,224,934)	$ 226,435	$ 32,428	$ 54,275	$ (74,191)	$ 96,388	$ -	$ (41,181)	$ -	$ -
51												
52												
53												
54												
55												

Supporting Schedules:

Recap Schedules:
C-1 Rebuttal

Western Group

Line No.		[L] Rebuttal BLANK	[M] Rebuttal BLANK	[N] Rebuttal BLANK	[O] Rebuttal BLANK	[P] Rebuttal BLANK	[Q] Rebuttal BLANK	[R] Rebuttal BLANK	[S] Total Rebuttal Adjustments	[T] Adjusted Test Year - Rebuttal	[U] Required Increase - Rebuttal	[V] Adjstd' w/ Increase - Rebuttal
		Rebuttal Income Statement Adjustments										
1	Operating Revenues											
2	Residential	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,396,900		
3	Commercial	-	-	-	-	-	-	-	-	5,959,538		
4	Industrial	-	-	-	-	-	-	-	-	973,961		
5	Private Fire Service	-	-	-	-	-	-	-	-	124,650		
6	Other Water Revenues	-	-	-	-	-	-	-	-	251,873		
7	Total Water Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 20,706,922		
8												
9	Miscellaneous	-	-	-	-	-	-	-	-	509,846		
10	Total Operating Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 21,216,768	$ 6,007,339	$ 27,224,107
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water	-	-	-	-	-	-	-	-	1,202,855		1,202,855
15	Other	-	-	-	-	-	-	-	81	97,828		97,828
16	Pumping Expenses:											
17	Purchased Power	-	-	-	-	-	-	-	-	2,362,874		2,362,874
18	Purchased Gas	-	-	-	-	-	-	-	-	878		878
19	Other	-	-	-	-	-	-	-	3,262	1,092,856		1,092,856
20	Water Treatment Expenses	-	-	-	-	-	-	-	834	1,661,444		1,661,444
21	Transmission & Distribution Expenses	-	-	-	-	-	-	-	6,753	1,898,697		1,898,697
22	Customer Accounting Expenses	-	-	-	-	-	-	-	1,819	1,435,010	12,948	1,447,957
23	Customer Service & Sales Expense	-	-	-	-	-	-	-	-	4,775		4,775
24	Administrative & General Expenses	-	-	-	-	-	-	-	33,624	2,896,431		2,896,431
25	Total Operations & Maintenance Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 46,372	$ 12,653,649	$ 12,948	$ 12,666,597
26												
27	Depreciation & Amortization Expenses	-	-	-	-	-	-	-	(54,275)	4,764,160		4,764,160
28												
29	Taxes											
30	Federal Income Taxes	-	-	-	-	-	-	-	35,191	152,861	1,903,527	2,056,388
31	State Income Taxes	-	-	-	-	-	-	-	5,990	26,017	323,979	349,996
32	Property Taxes	-	-	-	-	-	-	-	-	1,098,936	103,867	1,202,803
33	Other	-	-	-	-	-	-	-	(4,610)	192,683	-	192,683
34	Total Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 36,571	$ 1,470,497	$ 2,331,373	$ 3,801,870
35												
36	Total Operating Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 28,668	$ 18,888,307	$ 2,344,320	$ 21,232,627
37	Operating Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (28,668)	$ 2,328,462	$ 3,663,018	$ 5,991,480
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt	-	-	-	-	-	-	-	(96,388)	2,034,307		2,034,307
42	Short-Term Debt	-	-	-	-	-	-	-	-	-		-
43	Other	-	-	-	-	-	-	-	-	-		-
44	Total Interest	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (96,388)	$ 2,034,307	$ -	$ 2,034,307
45												
46	Other (Income) - Net	-	-	-	-	-	-	-	-	-		-
47												
48	Total Other (Income) & Deductions	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (96,388)	$ 2,034,307	$ -	$ 2,034,307
49												
50	Net Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 67,720	$ 294,155	$ 3,663,018	$ 3,957,173
51												
52												
53												
54												
55												

Supporting Schedules:

Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

Pinal Valley

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal IS-1	[E] Rebuttal IS-2	[F] Rebuttal IS-3	[G] Rebuttal IS-4	[H] Rebuttal IS-5	[I] Rebuttal IS-6	[J] Rebuttal BLANK	[K] Rebuttal BLANK
					Rebuttal Income Statement Adjustments							
1	Operating Revenues											
2	Residential	$ 12,680,567	$ (1,382,206)	$ 11,298,361								
3	Commercial	6,057,907	(645,125)	5,412,782								
4	Industrial	1,083,041	(125,072)	957,969								
5	Private Fire Service	135,733	(14,083)	121,650								
6	Other Water Revenues	235,041	(19,039)	216,003								
7	Total Water Revenues	$ 20,192,290	$ (2,185,525)	$ 18,006,765	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8												
9	Miscellaneous	1,076,452	(615,328)	461,124								
10	Total Operating Revenues	$ 21,268,742	$ (2,800,853)	$ 18,467,889	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water	509,966	575,578	1,085,544								
15	Other	70,295	5,129	75,424			49					
16	Pumping Expenses:											
17	Purchased Power	2,008,337	62,974	2,071,310								
18	Purchased Gas	878	-	878								
19	Other	753,918	138,929	892,848			2,720					
20	Water Treatment Expenses	1,322,049	82,694	1,404,743			722					
21	Transmission & Distribution Expenses	1,410,908	250,563	1,661,471			6,083					
22	Customer Accounting Expenses	1,175,477	64,082	1,239,559			1,543					
23	Customer Service & Sales Expense	2,093	-	2,093								
24	Administrative & General Expenses	2,145,599	397,613	2,543,213	(25,172)		53,852					
25	Total Operations & Maintenance Expense	$ 9,399,520	$ 1,577,563	$ 10,977,082	$ (25,172)	$ -	$ 64,970	$ -	$ -	$ -	$ -	$ -
26												
27	Depreciation & Amortization Expenses	3,620,630	342,946	3,963,576		(54,967)						
28												
29	Taxes											
30	Federal Income Taxes	1,293,556	(1,149,811)	143,745						37,107		
31	State Income Taxes	137,221	(112,756)	24,465						6,316		
32	Property Taxes	934,218	34,996	969,214					-			
33	Other	2,219,660	(2,045,215)	174,445	(4,171)							
34	Total Taxes	$ 4,584,655	$ (3,272,785)	$ 1,311,870	$ (4,171)	$ -	$ -	$ -	$ -	$ 43,423	$ -	$ -
35												
36	Total Operating Expenses	$ 17,604,804	$ (1,352,276)	$ 16,252,529	$ (29,343)	$ (54,967)	$ 64,970	$ -	$ -	$ 43,423	$ -	$ -
37	Operating Income	$ 3,663,938	$ (1,448,578)	$ 2,215,360	$ 29,343	$ 54,967	$ (64,970)	$ -	$ -	$ (43,423)	$ -	$ -
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt	1,667,318	271,428	1,938,746				(95,489)				
42	Short-Term Debt	-	-	-								
43	Other	(165,619)	165,619	-								
44	Total Interest	$ 1,501,699	$ 437,047	$ 1,938,746	$ -	$ -	$ -	$ (95,489)	$ -	$ -	$ -	$ -
45												
46	Other (Income) - Net	(165,834)	165,834	-								
47												
48	Total Other (Income) & Deductions	$ 1,335,866	$ 602,880	$ 1,938,746	$ -	$ -	$ -	$ (95,489)	$ -	$ -	$ -	$ -
49												
50	Net Income	$ 2,328,072	$ (2,051,458)	$ 276,614	$ 29,343	$ 54,967	$ (64,970)	$ 95,489	$ -	$ (43,423)	$ -	$ -
51												
52												
53												
54												
55												

Supporting Schedules:

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Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

Pinal Valley

Line No.		[L] Rebuttal BLANK	[M] Rebuttal BLANK	[N] Rebuttal BLANK	[O] Rebuttal BLANK	[P] Rebuttal BLANK	[Q] Rebuttal BLANK	[R] Rebuttal BLANK	[S] Total Rebuttal Adjustments	[T] Adjusted Test Year - Rebuttal	[U] Required Increase - Rebuttal	[V] Adjstd' w/ Increase - Rebuttal
		Rebuttal Income Statement Adjustments										
1	Operating Revenues											
2	Residential								$ -	$ 11,298,361		
3	Commercial								-	5,412,782		
4	Industrial								-	957,969		
5	Private Fire Service								-	121,650		
6	Other Water Revenues								-	216,003		
7	Total Water Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,006,765		
8												
9	Miscellaneous								-	461,124		
10	Total Operating Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,467,889	$ 5,310,551	$ 23,778,440
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water								-	1,085,544		1,085,544
15	Other								49	75,473		75,473
16	Pumping Expenses:											
17	Purchased Power								-	2,071,310		2,071,310
18	Purchased Gas								-	878		878
19	Other								2,720	895,568		895,568
20	Water Treatment Expenses								722	1,405,464		1,405,464
21	Transmission & Distribution Expenses								6,083	1,667,554		1,667,554
22	Customer Accounting Expenses								1,543	1,241,102	11,371	1,252,474
23	Customer Service & Sales Expense								-	2,093		2,093
24	Administrative & General Expenses								28,681	2,571,893		2,571,893
25	Total Operations & Maintenance Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 39,798	$ 11,016,880	$ 11,371	$ 11,028,252
26												
27	Depreciation & Amortization Expenses								(54,967)	3,908,609		3,908,609
28												
29	Taxes											
30	Federal Income Taxes								37,107	180,852	1,682,412	1,863,265
31	State Income Taxes								6,316	30,781	286,345	317,126
32	Property Taxes								-	969,214	92,901	1,062,116
33	Other								(4,171)	170,274		170,274
34	Total Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 39,252	$ 1,351,122	$ 2,061,659	$ 3,412,781
35												
36	Total Operating Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 24,082	$ 16,276,611	$ 2,073,030	$ 18,349,641
37	Operating Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (24,082)	$ 2,191,278	$ 3,237,521	$ 5,428,798
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt								(95,489)	1,843,258		1,843,258
42	Short-Term Debt								-	-		-
43	Other								-	-		-
44	Total Interest	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (95,489)	$ 1,843,258	$ -	$ 1,843,258
45												
46	Other (Income) - Net								-	-		-
47												
48	Total Other (Income) & Deductions	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (95,489)	$ 1,843,258	$ -	$ 1,843,258
49												
50	Net Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 71,406	$ 348,020	$ 3,237,521	$ 3,585,541
51												
52												
53												
54												
55												

Supporting Schedules:

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Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

White Tank

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal IS-1	[E] Rebuttal IS-2	[F] Rebuttal IS-3	[G] Rebuttal IS-4	[H] Rebuttal IS-5	[I] Rebuttal IS-6	[J] Rebuttal BLANK	[K] Rebuttal BLANK
					Rebuttal Income Statement Adjustments							
1	Operating Revenues											
2	Residential	$ 1,916,678	$ (125,034)	$ 1,791,645								
3	Commercial	457,425	(35,797)	421,627								
4	Industrial	16,848	(856)	15,992								
5	Private Fire Service	1,930	(130)	1,800								
6	Other Water Revenues	37,917	(2,610)	35,306								
7	Total Water Revenues	$ 2,430,798	$ (164,428)	$ 2,266,370	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8												
9	Miscellaneous	47,983	(3,362)	44,621								
10	Total Operating Revenues	$ 2,478,781	$ (167,790)	$ 2,310,991	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water	-	-	-								
15	Other	16,474	9,742	26,216			31					
16	Pumping Expenses:											
17	Purchased Power	279,222	7,439	286,661								
18	Purchased Gas	-	-	-								
19	Other	142,677	36,031	178,709			502					
20	Water Treatment Expenses	206,953	25,044	231,997			58					
21	Transmission & Distribution Expenses	101,410	70,306	171,716			550					
22	Customer Accounting Expenses	146,766	7,885	154,650			233					
23	Customer Service & Sales Expense	223	2,413	2,636								
24	Administrative & General Expenses	222,981	37,148	260,129	(1,944)		6,425					
25	Total Operations & Maintenance Expense	$ 1,116,705	$ 196,009	$ 1,312,714	$ (1,944)	$ -	$ 7,800	$ -	$ -	$ -	$ -	$ -
26												
27	Depreciation & Amortization Expenses	770,228	18,295	788,523		638						
28												
29	Taxes											
30	Federal Income Taxes	80,995	(106,096)	(25,101)						(1,698)		
31	State Income Taxes	8,592	(12,864)	(4,272)						(289)		
32	Property Taxes	90,735	18,901	109,635					-			
33	Other	182,109	(165,743)	16,366	(322)							
34	Total Taxes	$ 362,430	$ (265,802)	$ 96,628	$ (322)	$ -	$ -	$ -	$ -	$ (1,987)	$ -	$ -
35												
36	Total Operating Expenses	$ 2,249,363	$ (51,497)	$ 2,197,866	$ (2,266)	$ 638	$ 7,800	$ -	$ -	$ (1,987)	$ -	$ -
37	Operating Income	$ 229,418	$ (116,293)	$ 113,125	$ 2,266	$ (638)	$ (7,800)	$ -	$ -	$ 1,987	$ -	$ -
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt	167,446	(6,019)	161,427				(918)				
42	Short-Term Debt	-	-	-								
43	Other	(16,633)	16,633	-								
44	Total Interest	$ 150,813	$ 10,614	$ 161,427	$ -	$ -	$ -	$ (918)	$ -	$ -	$ -	$ -
45												
46	Other (Income) - Net	(19,798)	19,798	-								
47												
48	Total Other (Income) & Deductions	$ 131,015	$ 30,412	$ 161,427	$ -	$ -	$ -	$ (918)	$ -	$ -	$ -	$ -
49												
50	Net Income	$ 98,403	$ (146,705)	$ (48,302)	$ 2,266	$ (638)	$ (7,800)	$ 918	$ -	$ 1,987	$ -	$ -
51												
52												
53												
54												
55												

Supporting Schedules:

Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

White Tank

Line No.		[L] Rebuttal BLANK	[M] Rebuttal BLANK	[N] Rebuttal BLANK (Rebuttal Income Statement Adjustments)	[O] Rebuttal BLANK	[P] Rebuttal BLANK	[Q] Rebuttal BLANK	[R] Rebuttal BLANK	[S] Total Rebuttal Adjustments	[T] Adjusted Test Year - Rebuttal	[U] Required Increase - Rebuttal	[V] Adjstd' w/ Increase - Rebuttal
1	Operating Revenues											
2	Residential								$ -	$ 1,791,645		
3	Commercial								-	421,627		
4	Industrial								-	15,992		
5	Private Fire Service								-	1,800		
6	Other Water Revenues								-	35,306		
7	Total Water Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,266,370		
8												
9	Miscellaneous								-	44,621		
10	Total Operating Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,310,991	$ 595,785	$ 2,906,776
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water								-	-		-
15	Other								31	26,247		26,247
16	Pumping Expenses:											
17	Purchased Power								-	286,661		286,661
18	Purchased Gas								-	-		-
19	Other								502	179,211		179,211
20	Water Treatment Expenses								58	232,056		232,056
21	Transmission & Distribution Expenses								550	172,266		172,266
22	Customer Accounting Expenses								233	154,883	1,341	156,225
23	Customer Service & Sales Expense								-	2,636		2,636
24	Administrative & General Expenses								4,481	264,610		264,610
25	Total Operations & Maintenance Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,856	$ 1,318,570	$ 1,341	$ 1,319,911
26												
27	Depreciation & Amortization Expenses								638	789,161		789,161
28												
29	Taxes											
30	Federal Income Taxes								(1,698)	(26,799)	189,050	162,252
31	State Income Taxes								(289)	(4,561)	32,176	27,615
32	Property Taxes								-	109,635	9,422	119,057
33	Other								(322)	16,044		16,044
34	Total Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (2,309)	$ 94,319	$ 230,648	$ 324,968
35												
36	Total Operating Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,185	$ 2,202,051	$ 231,990	$ 2,434,040
37	Operating Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (4,185)	$ 108,940	$ 363,796	$ 472,736
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt								(918)	160,510		160,510
42	Short-Term Debt								-	-		-
43	Other								-	-		-
44	Total Interest	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (918)	$ 160,510	$ -	$ 160,510
45												
46	Other (Income) - Net								-	-		-
47												
48	Total Other (Income) & Deductions	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (918)	$ 160,510	$ -	$ 160,510
49												
50	Net Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (3,267)	$ (51,569)	$ 363,796	$ 312,226
51												
52												
53												
54												
55												

Supporting Schedules:

Recap Schedules:
C-1 Rebuttal

Ajo

Line No.		[A] Test Year Ended 12/31/2014	[B] Pro Forma Adjustments - As Filed	[C] Adjusted Test Year - As Filed	[D] Rebuttal IS-1	[E] Rebuttal IS-2	[F] Rebuttal IS-3	[G] Rebuttal IS-4	[H] Rebuttal IS-5	[I] Rebuttal IS-6	[J] Rebuttal BLANK	[K] Rebuttal BLANK
					Rebuttal Income Statement Adjustments							
1	Operating Revenues											
2	Residential	$ 336,497	$ (29,602)	$ 306,895								
3	Commercial	133,986	(8,858)	125,128								
4	Industrial	-	-	-								
5	Private Fire Service	1,276	(76)	1,200								
6	Other Water Revenues	467	97	564								
7	Total Water Revenues	$ 472,227	$ (38,439)	$ 433,787	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8												
9	Miscellaneous	4,360	(259)	4,101								
10	Total Operating Revenues	$ 476,587	$ (38,698)	$ 437,888	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water	117,312	-	117,312								
15	Other	423	(4,317)	(3,893)			1					
16	Pumping Expenses:											
17	Purchased Power	2,868	2,035	4,903								
18	Purchased Gas	-	-	-								
19	Other	18,327	(288)	18,038			39					
20	Water Treatment Expenses	23,920	(50)	23,870			54					
21	Transmission & Distribution Expenses	38,348	20,410	58,757			120					
22	Customer Accounting Expenses	36,916	2,065	38,982			42					
23	Customer Service & Sales Expense	46	-	46								
24	Administrative & General Expenses	50,526	8,939	59,465	(703)		1,166					
25	Total Operations & Maintenance Expense	$ 288,686	$ 28,794	$ 317,480	$ (703)	$ -	$ 1,422	$ -	$ -	$ -	$ -	$ -
26												
27	Depreciation & Amortization Expenses	59,819	6,518	66,337		53						
28												
29	Taxes											
30	Federal Income Taxes	18,303	(19,278)	(975)						(218)		
31	State Income Taxes	1,942	(2,108)	(166)						(37)		
32	Property Taxes	23,360	(3,274)	20,086					-			
33	Other	32,637	(26,155)	6,482	(117)							
34	Total Taxes	$ 76,242	$ (50,815)	$ 25,427	$ (117)	$ -	$ -	$ -	$ -	$ (255)	$ -	$ -
35												
36	Total Operating Expenses	$ 424,747	$ (15,503)	$ 409,244	$ (820)	$ 53	$ 1,422	$ -	$ -	$ (255)	$ -	$ -
37	Operating Income	$ 51,840	$ (23,196)	$ 28,644	$ 820	$ (53)	$ (1,422)	$ -	$ -	$ 255	$ -	$ -
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt	33,915	(3,393)	30,521				18				
42	Short-Term Debt	-	-	-								
43	Other	(3,369)	3,369	-								
44	Total Interest	$ 30,546	$ (25)	$ 30,521	$ -	$ -	$ -	$ 18	$ -	$ -	$ -	$ -
45												
46	Other (Income) - Net	(3,600)	3,600	-								
47												
48	Total Other (Income) & Deductions	$ 26,946	$ 3,575	$ 30,521	$ -	$ -	$ -	$ 18	$ -	$ -	$ -	$ -
49												
50	Net Income	$ 24,894	$ (26,771)	$ (1,877)	$ 820	$ (53)	$ (1,422)	$ (18)	$ -	$ 255	$ -	$ -
51												
52												
53												
54												
55												

Supporting Schedules:

Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Income Statement Pro Forma Adjustments

Ajo

Line No.		[L] Rebuttal BLANK	[M] Rebuttal BLANK	[N] Rebuttal BLANK	[O] Rebuttal BLANK	[P] Rebuttal BLANK	[Q] Rebuttal BLANK	[R] Rebuttal BLANK	[S] Total Rebuttal Adjustments	[T] Adjusted Test Year - Rebuttal	[U] Required Increase - Rebuttal	[V] Adjstd' w/ Increase - Rebuttal
		Rebuttal Income Statement Adjustments										
1	Operating Revenues											
2	Residential								$ -	$ 306,895		
3	Commercial								-	125,128		
4	Industrial								-	-		
5	Private Fire Service								-	1,200		
6	Other Water Revenues								-	564		
7	Total Water Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 433,787		
8												
9	Miscellaneous								-	4,101		
10	Total Operating Revenues	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 437,888	$ 101,003	$ 538,891
11												
12	Operating Expenses											
13	Source of Supply Expenses:											
14	Purchased Water								-	117,312		117,312
15	Other								1	(3,892)		(3,892)
16	Pumping Expenses:											
17	Purchased Power								-	4,903		4,903
18	Purchased Gas								-	-		-
19	Other											
20	Water Treatment Expenses								39	18,077		18,077
21	Transmission & Distribution Expenses								54	23,924		23,924
22	Customer Accounting Expenses								120	58,877		58,877
23	Customer Service & Sales Expense								42	39,024	235	39,259
24	Administrative & General Expenses								-	46		46
									463	59,928		59,928
25	Total Operations & Maintenance Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 719	$ 318,199	$ 235	$ 318,434
26												
27	Depreciation & Amortization Expenses								53	66,390		66,390
28												
29	Taxes											
30	Federal Income Taxes								(218)	(1,193)	32,064	30,871
31	State Income Taxes								(37)	(203)	5,457	5,254
32	Property Taxes								-	20,086	1,544	21,631
33	Other								(117)	6,365		6,365
34	Total Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (371)	$ 25,056	$ 39,066	$ 64,121
35												
36	Total Operating Expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 401	$ 409,645	$ 39,301	$ 448,945
37	Operating Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (401)	$ 28,244	$ 61,702	$ 89,946
38												
39	Other Income & Deductions:											
40	Interest:											
41	Long-Term Debt								18	30,540		30,540
42	Short-Term Debt								-	-		-
43	Other								-	-		-
44	Total Interest	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18	$ 30,540	$ -	$ 30,540
45												
46	Other (Income) - Net								-	-		-
47												
48	Total Other (Income) & Deductions	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18	$ 30,540	$ -	$ 30,540
49												
50	Net Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (419)	$ (2,296)	$ 61,702	$ 59,406
51												
52												
53												
54												
55												

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\C2
Processing Date: 4/11/2016 11:09 AM

Recap Schedules:
C-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-1
Partially Accept RUCO Operating Income Adjustments No. 4 & 5 - Payroll Annualization Adjustments No. 2 & 3

Line No.	System	[A] Source of Supply Increase / (Decrease)	[B] Pumping Increase / (Decrease)	[C] Water Treatment Increase / (Decrease)	[D] Transmission & Distribution Increase / (Decrease)	[E] Customer Accounting Increase / (Decrease)	[F] Administrative & General Increase / (Decrease)	[G] Taxes - Other Increase / (Decrease)	[H] Total Increase / (Decrease)
		Western Group - Total Payroll & Related							
1									
2	Western Group								
3	Pinal Valley	$ -	$ -	$ -	$ -	$ -	$ (25,172)	$ (4,171)	$ (29,343)
4	White Tank	-	-	-	-	-	(1,944)	(322)	(2,266)
5	Ajo	-	-	-	-	-	(703)	(117)	(820)
6									
7	Subtotal	$ -	$ -	$ -	$ -	$ -	$ (27,819)	$ (4,610)	$ (32,428)
8									
9	Total	$ -	$ -	$ -	$ -	$ -	$ (27,819)	$ (4,610)	$ (32,428)
10									
11									
12	Increase/(Decrease) in Expenses								$ (32,428)
13									
14									
15									
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-2
Adjust Depreciation Expense to Reflect Rebuttal Plant Balances

Pinal Valley

Line No.	Acct. No.		[A] Depreciation Rate	[B] Rebuttal Rate Base Adjustments - Direct Plant	[C] Rebuttal Rate Base Adjustments - P.T.Y.P.	[D] Increase / (Decrease) Depr. Exp.	[E] Increase / (Decrease) Phoenix Office (3-factor Alloc.) 0.3317	[F] Increase / (Decrease) Meter Shop (3-factor Alloc.) 0.3317	[G] Total Increase / (Decrease) [D + E + F]
1		Intangible Plant							
2	301	Organization	0.00%		$ -	$ -	$ -	$ -	$ -
3	302	Franchises	note_1		-	-	-	-	-
4	303	Other Intangibles	note_1		-	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -	$ -	$ -
6		Source of Supply Plant							
7	310.1	Water Rights	0.00%		-	-	-	-	-
8	310.3	Other Source of Supply Land	0.00%		-	-	-	-	-
9	310.4	Wells - Other	note_1		-	-	-	-	-
10	314	Wells	3.13%		16,383	513	-	-	513
11		Subtotal Source of Supply Plant		$ -	$ 16,383	$ 513	$ -	$ -	$ 513
12		Pumping Plant							
13	320	Pumping Plant Land	0.00%		-	-	-	-	-
14	321	Pumping Plant Structures & Improvements	2.86%		(23,431)	(670)	-	-	(670)
15	325	Electtric Pumping Equipment	5.88%		(24,062)	(1,415)	-	-	(1,415)
16	328	Gas Engine Equipment	4.00%		-	-	-	-	-
17		Subtotal Pumping Plant		$ -	$ (47,493)	$ (2,085)	$ -	$ -	$ (2,085)
18		Water Treatment Plant							
19	330	Water Treatment Plant Land	0.00%		-	-	-	-	-
20	331	Water Treatment Structures & Improvements	2.50%		-	-	-	-	-
21	332	Water Treatment Equipment	2.86%		(1,526,340)	(43,653)	-	-	(43,653)
22		Subtotal Water Treatment Plant		$ -	$ (1,526,340)	$ (43,653)	$ -	$ -	$ (43,653)
23		Transmission & Distribution Plant							
24	340	Transmission and Distribution Land	0.00%		-	-	-	-	-
25	341	Transmission and Distribution Structures	3.33%		-	-	-	-	-
26	342	Storage Tanks	2.00%		20,656	413	-	-	413
27	343	Transmission & Distribution Mains	1.79%		(102,044)	(1,827)	-	-	(1,827)
28	344	Fire Sprinkler Taps	2.00%		430	9	-	-	9
29	345	Services	2.38%		3,898	93	-	-	93
30	346	Meters	4.55%		(178,099)	(8,103)	-	-	(8,103)
31	348	Hydrants	1.82%		(7,829)	(142)	-	-	(142)
32		Subtotal Transmission & Distribution Plant		$ -	$ (262,988)	$ (9,558)	$ -	$ -	$ (9,558)
33		General Plant							
34	389	General Plant Land	0.00%		-	-	-	-	-
35	390	General Plant Structures	2.50%		13,266	332	-	2	334
36	390.1	Leasehold Improvements	note_2		-	-	-	-	-
37	391	Office Furniture & Equipment	6.67%		6,392	426	(40)	24	410
38	393	Warehouse Equipment	5.00%		-	-	-	-	-
39	394	Tools, Shop & Garage Equipment	4.00%		(2,295)	(92)	-	(13)	(105)
40	395	Laboratory Equipment	5.00%		1,671	84	-	-	84
41	396	Power Operated Equipment	6.67%		4,042	270	-	-	270
42	397	Communication Equipment	6.67%		1,305	87	(1,800)	-	(1,713)
43	398	Miscellaneous Equipment	3.33%		22,766	758	(221)	-	537
44		Subtotal General Plant		$ -	$ 47,147	$ 1,865	$ (2,061)	$ 13	$ (184)
45									
46		Totals		$ -	$ (1,773,291)	$ (52,919)	$ (2,061)	$ 13	$ (54,967)
47		Amortization of Regulatory Assets/(Liabilities) (Sch. B-2 Rebuttal Appndx.)							note_3
48		Less: Contribution Depreciation	2.00%						-
49									
50		Total Increase/(Decrease) in Depreciation & Amortization Expense - Rebuttal							$ (54,967)
51									

52 note_1 Acct. 302 - Franchises amortized over 25 years. Acct. 303 - Other intangibles amortized over 15 & 20 Years.
53 Acct. 310.4 - Wells - Other amortized over 24 years. Accumulated Amortization booked to Acct. 111 - Amort. Of Ltd. Term Investments.
54 note_2 Acct. 390.1 - Leasehold Improvements amortized over the remaining life of the associated lease.
55 note_3 Amortization of deferred CAP M&I Capital charges included in rate base is charged to account 60220 - Purchased CAP water.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-2 (continued)
Adjust Depreciation Expense to Reflect Rebuttal Plant Balances

			White Tank						
			[A]	[B]	[C]	[D]	[E]	[F]	[G]
Line No.	Acct. No.		Depreciation Rate	Rebuttal Rate Base Adjustments - Direct Plant	Rebuttal Rate Base Adjustments - P.T.Y.P.	Increase / (Decrease) Depr. Exp.	Increase / (Decrease) Phoenix Office (3-factor Alloc.) 0.0396	Increase / (Decrease) Meter Shop (3-factor Alloc.) 0.0396	Total Increase / (Decrease) [D + E + F]
1		Intangible Plant							
2	301	Organization	0.00%		$ -	$ -	$ -	$ -	$ -
3	302	Franchises	note_1		-	-	-	-	-
4	303	Other Intangibles	note_1		-	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -	$ -	$ -
6		Source of Supply Plant							
7	310.1	Water Rights	0.00%		-	$ -	-	-	-
8	310.3	Other Source of Supply Land	0.00%		-	-	-	-	-
9	310.4	Wells - Other	note_1		-	-	-	-	-
10	314	Wells	3.13%		-	-	-	-	-
11		Subtotal Source of Supply Plant		$ -	$ -	$ -	$ -	$ -	$ -
12		Pumping Plant							
13	320	Pumping Plant Land	0.00%		-	-	-	-	-
14	321	Pumping Plant Structures & Improvements	2.86%		-	-	-	-	-
15	325	Electtric Pumping Equipment	5.88%		21,612	1,271	-	-	1,271
16	328	Gas Engine Equipment	4.00%		-	-	-	-	-
17		Subtotal Pumping Plant		$ -	$ 21,612	$ 1,271	$ -	$ -	$ 1,271
18		Water Treatment Plant							
19	330	Water Treatment Plant Land	0.00%		-	-	-	-	-
20	331	Water Treatment Structures & Improvements	2.50%		-	-	-	-	-
21	332	Water Treatment Equipment	2.86%		14,859	425	-	-	425
22		Subtotal Water Treatment Plant		$ -	$ 14,859	$ 425	$ -	$ -	$ 425
23		Transmission & Distribution Plant							
24	340	Transmission and Distribution Land	0.00%		-	-	-	-	-
25	341	Transmission and Distribution Structures	3.33%		-	-	-	-	-
26	342	Storage Tanks	2.00%		-	-	-	-	-
27	343	Transmission & Distribution Mains	1.79%		9,750	175	-	-	175
28	344	Fire Sprinkler Taps	2.00%		-	-	-	-	-
29	345	Services	2.38%		6,072	145	-	-	145
30	346	Meters	4.55%		(38,695)	(1,761)	-	-	(1,761)
31	348	Hydrants	1.82%		(1,133)	(21)	-	-	(21)
32		Subtotal Transmission & Distribution Plant		$ -	$ (24,005)	$ (1,462)	$ -	$ -	$ (1,462)
33		General Plant							
34	389	General Plant Land	0.00%		-	-	-	-	-
35	390	General Plant Structures	2.50%		-	-	-	0	0
36	390.1	Leasehold Improvements	note_2		-	-	-	-	-
37	391	Office Furniture & Equipment	6.67%		(1,000)	(67)	(5)	3	(69)
38	393	Warehouse Equipment	5.00%		-	-	-	-	-
39	394	Tools, Shop & Garage Equipment	4.00%		(1,011)	(40)	-	(2)	(42)
40	395	Laboratory Equipment	5.00%		-	-	-	-	-
41	396	Power Operated Equipment	6.67%		-	-	-	-	-
42	397	Communication Equipment	6.67%		9,357	624	(215)	-	409
43	398	Miscellaneous Equipment	3.33%		3,974	132	(26)	-	106
44		Subtotal General Plant		$ -	$ 11,319	$ 649	$ (246)	$ 2	$ 405
45									
46		Totals		$ -	$ 23,787	$ 883	$ (246)	$ 2	$ 638
47		Amortization of Regulatory Assets/(Liabilities) (Sch. B-2 Rebuttal Appndx.)							-
48		Less: Contribution Depreciation	2.00%						-
49									
50		Total Increase/(Decrease) in Depreciation & Amortization Expense - Rebuttal							$ 638
51									
52									

53 note_1 Acct. 302 - Franchises amortized over 25 years. Acct. 303 - Other intangibles amortized over 15 & 20 Years.
54 Acct. 310.4 - Wells - Other amortized over 24 years. Accumulated Amortization booked to Acct. 111 - Amort. Of Ltd. Term Investments.
55 note_2 Acct. 390.1 - Leasehold Improvements amortized over the remaining life of the associated lease.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-2 (continued)
Adjust Depreciation Expense to Reflect Rebuttal Plant Balances

			Ajo						
			[A]	[B]	[C]	[D]	[E]	[F]	[G]
Line No.	Acct. No.		Depreciation Rate	Rebuttal Rate Base Adjustments - Direct Plant	Rebuttal Rate Base Adjustments - P.T.Y.P.	Increase / (Decrease) Depr. Exp.	Increase / (Decrease) Phoenix Office (3-factor Alloc.) 0.0072	Increase / (Decrease) Meter Shop (3-factor Alloc.) 0.0072	Total Increase / (Decrease) [D + E + F]
1		Intangible Plant							
2	301	Organization	0.00%		$ -	$ -	$ -	$ -	$ -
3	302	Franchises	note_1		-	-	-	-	-
4	303	Other Intangibles	note_1		-	-	-	-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -	$ -	$ -	$ -
6		Source of Supply Plant							
7	310.1	Water Rights	0.00%		-	-	-	-	-
8	310.3	Other Source of Supply Land	0.00%		-	-	-	-	-
9	310.4	Wells - Other	note_1		-	-	-	-	-
10	314	Wells	3.13%		-	-	-	-	-
11		Subtotal Source of Supply Plant		$ -	$ -	$ -	$ -	$ -	$ -
12		Pumping Plant							
13	320	Pumping Plant Land	0.00%		-	-	-	-	-
14	321	Pumping Plant Structures & Improvements	2.86%		-	-	-	-	-
15	325	Electtric Pumping Equipment	5.88%		-	-	-	-	-
16	328	Gas Engine Equipment	4.00%		-	-	-	-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -	$ -	$ -	$ -
18		Water Treatment Plant							
19	330	Water Treatment Plant Land	0.00%		-	-	-	-	-
20	331	Water Treatment Structures & Improvements	2.50%		-	-	-	-	-
21	332	Water Treatment Equipment	2.86%		-	-	-	-	-
22		Subtotal Water Treatment Plant		$ -	$ -	$ -	$ -	$ -	$ -
23		Transmission & Distribution Plant							
24	340	Transmission and Distribution Land	0.00%		-	-	-	-	-
25	341	Transmission and Distribution Structures	3.33%		-	-	-	-	-
26	342	Storage Tanks	2.00%		-	-	-	-	-
27	343	Transmission & Distribution Mains	1.79%		(591)	(11)	-	-	(11)
28	344	Fire Sprinkler Taps	2.00%		-	-	-	-	-
29	345	Services	2.38%		4,019	96	-	-	96
30	346	Meters	4.55%		(4,200)	(191)	-	-	(191)
31	348	Hydrants	1.82%		-	-	-	-	-
32		Subtotal Transmission & Distribution Plant		$ -	$ (772)	$ (106)	$ -	$ -	$ (106)
33		General Plant							
34	389	General Plant Land	0.00%		-	-	-	-	-
35	390	General Plant Structures	2.50%		-	-	-	0	0
36	390.1	Leasehold Improvements	note_2		-	-	-	-	-
37	391	Office Furniture & Equipment	6.67%		281	19	(1)	1	18
38	393	Warehouse Equipment	5.00%		-	-	-	-	-
39	394	Tools, Shop & Garage Equipment	4.00%		3,724	149	-	(0)	149
40	395	Laboratory Equipment	5.00%		-	-	-	-	-
41	396	Power Operated Equipment	6.67%		-	-	-	-	-
42	397	Communication Equipment	6.67%		16	1	(39)	-	(38)
43	398	Miscellaneous Equipment	3.33%		1,053	35	(5)	-	30
44		Subtotal General Plant		$ -	$ 5,073	$ 204	$ (45)	$ 0	$ 159
45									
46		Totals		$ -	$ 4,301	$ 98	$ (45)	$ 0	$ 53
47		Amortization of Regulatory Assets/(Liabilities) (Sch. B-2 Rebuttal Appndx.)							-
48		Less: Contribution Depreciation	2.00%						-
49									
50		Total Increase/(Decrease) in Depreciation & Amortization Expense - Rebuttal							$ 53
51									
52									

53 note_1 Acct. 302 - Franchises amortized over 25 years. Acct. 303 - Other intangibles amortized over 15 & 20 Years.
54 Acct. 310.4 - Wells - Other amortized over 24 years. Accumulated Amortization booked to Acct. 111 - Amort. Of Ltd. Term Investments.
55 note_2 Acct. 390.1 - Leasehold Improvements amortized over the remaining life of the associated lease.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-2 (continued)
Adjust Depreciation Expense to Reflect Rebuttal Plant Balances

Line No.	Acct. No.		[A] Depreciation Rate	[B] Phoenix Office Rebuttal Rate Base Adjustments - Direct Plant	[C] Phoenix Office Rebuttal Rate Base Adjustments - P.T.Y.P.	[D] Increase / (Decrease) Depr. Exp.
1		Intangible Plant				
2	301	Organization	0.00%		$ -	$ -
3	302	Franchises	note_1		-	-
4	303	Other Intangibles	note_1		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -
6		Source of Supply Plant				
7	310.1	Water Rights	0.00%		-	-
8	310.3	Other Source of Supply Land	0.00%		-	-
9	310.4	Wells - Other	note_1		-	-
10	314	Wells	3.13%		-	-
11		Subtotal Source of Supply Plant		$ -	$ -	$ -
12		Pumping Plant				
13	320	Pumping Plant Land	0.00%		-	-
14	321	Pumping Plant Structures & Improvements	2.86%		-	-
15	325	Electtric Pumping Equipment	5.88%		-	-
16	328	Gas Engine Equipment	4.00%		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -
18		Water Treatment Plant				
19	330	Water Treatment Plant Land	0.00%		-	-
20	331	Water Treatment Structures & Improvements	2.50%		-	-
21	332	Water Treatment Equipment	2.86%		-	-
22		Subtotal Water Treatment Plant		$ -	$ -	$ -
23		Transmission & Distribution Plant				
24	340	Transmission and Distribution Land	0.00%		-	-
25	341	Transmission and Distribution Structures	3.33%		-	-
26	342	Storage Tanks	2.00%		-	-
27	343	Transmission & Distribution Mains	1.79%		-	-
28	344	Fire Sprinkler Taps	2.00%		-	-
29	345	Services	2.38%		-	-
30	346	Meters	4.55%		-	-
31	348	Hydrants	1.82%		-	-
32		Subtotal Transmission & Distribution Plant		$ -	$ -	$ -
33		General Plant				
34	389	General Plant Land	0.00%		-	-
35	390	General Plant Structures	2.50%		-	-
36	390.1	Leasehold Improvements	note_2		(31,000)	-
37	391	Office Furniture & Equipment	6.67%		(1,819)	(121)
38	393	Warehouse Equipment	5.00%		-	-
39	394	Tools, Shop & Garage Equipment	4.00%		-	-
40	395	Laboratory Equipment	5.00%		-	-
41	396	Power Operated Equipment	6.67%		-	-
42	397	Communication Equipment	6.67%		(81,340)	(5,425)
43	398	Miscellaneous Equipment	3.33%		(20,000)	(666)
44		Subtotal General Plant		$ -	$ (134,159)	$ (6,213)
45						
46	Totals			$ -	$ (134,159)	$ (6,213)
47	Amortization of Regulatory Assets/(Liabilities) (Sch. B-2 Rebuttal Appndx.)					-
48	Less: Contribution Depreciation		2.00%			-
49						
50	Total Increase/(Decrease) in Depreciation & Amortization Expense - Rebuttal					$ (6,213)
51						
52						

53 note_1 Acct. 302 - Franchises amortized over 25 years. Acct. 303 - Other intangibles amortized over 15 & 20 Years.
54 Acct. 310.4 - Wells - Other amortized over 24 years. Accumulated Amortization booked to Acct. 111 - Amort. Of Ltd. Term Investments.
55 note_2 Acct. 390.1 - Leasehold Improvements amortized over the remaining life of the associated lease.

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-2 (continued)
Adjust Depreciation Expense to Reflect Rebuttal Plant Balances

Line No.	Acct. No.		[A] Depreciation Rate	Meter Shop [B] Rebuttal Rate Base Adjustments - Direct Plant	Meter Shop [C] Rebuttal Rate Base Adjustments - P.T.Y.P.	[D] Increase / (Decrease) Depr. Exp.
1		Intangible Plant				
2	301	Organization	0.00%		$ -	$ -
3	302	Franchises	note_1		-	-
4	303	Other Intangibles	note_1		-	-
5		Subtotal Intangible Plant		$ -	$ -	$ -
6		Source of Supply Plant				
7	310.1	Water Rights	0.00%		-	-
8	310.3	Other Source of Supply Land	0.00%		-	-
9	310.4	Wells - Other	note_1		-	-
10	314	Wells	3.13%		-	-
11		Subtotal Source of Supply Plant		$ -	$ -	$ -
12		Pumping Plant				
13	320	Pumping Plant Land	0.00%		-	-
14	321	Pumping Plant Structures & Improvements	2.86%		-	-
15	325	Electric Pumping Equipment	5.88%		-	-
16	328	Gas Engine Equipment	4.00%		-	-
17		Subtotal Pumping Plant		$ -	$ -	$ -
18		Water Treatment Plant				
19	330	Water Treatment Plant Land	0.00%		-	-
20	331	Water Treatment Structures & Improvements	2.50%		-	-
21	332	Water Treatment Equipment	2.86%		-	-
22		Subtotal Water Treatment Plant		$ -	$ -	$ -
23		Transmission & Distribution Plant				
24	340	Transmission and Distribution Land	0.00%		-	-
25	341	Transmission and Distribution Structures	3.33%		-	-
26	342	Storage Tanks	2.00%		-	-
27	343	Transmission & Distribution Mains	1.79%		-	-
28	344	Fire Sprinkler Taps	2.00%		-	-
29	345	Services	2.38%		-	-
30	346	Meters	4.55%		-	-
31	348	Hydrants	1.82%		-	-
32		Subtotal Transmission & Distribution Plant		$ -	$ -	$ -
33		General Plant				
34	389	General Plant Land	0.00%		-	-
35	390	General Plant Structures	2.50%		281	7
36	390.1	Leasehold Improvements	note_2		-	-
37	391	Office Furniture & Equipment	6.67%		1,068	71
38	393	Warehouse Equipment	5.00%		-	-
39	394	Tools, Shop & Garage Equipment	4.00%		(1,000)	(40)
40	395	Laboratory Equipment	5.00%		-	-
41	396	Power Operated Equipment	6.67%		-	-
42	397	Communication Equipment	6.67%		-	-
43	398	Miscellaneous Equipment	3.33%		-	-
44		Subtotal General Plant		$ -	$ 349	$ 38
45						
46	Totals			$ -	$ 349	$ 38
47	Amortization of Regulatory Assets/(Liabilities) (Sch. B-2 Rebuttal Appndx.)					-
48	Less: Contribution Depreciation		2.00%			-
49						
50	Total Increase/(Decrease) in Depreciation & Amortization Expense - Rebuttal					$ 38
51						
52						
53	note_1 Acct. 302 - Franchises amortized over 25 years. Acct. 303 - Other intangibles amortized over 15 & 20 Years.					
54	Acct. 310.4 - Wells - Other amortized over 24 years. Accumulated Amortization booked to Acct. 111 - Amort. Of Ltd. Term Investments.					
55	note_2 Acct. 390.1 - Leasehold Improvements amortized over the remaining life of the associated lease.					

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-3
Rebuttal Insurance Expense Adjustment

Line No.	System	[A] Source of Supply Increase / (Decrease)	[B] Pumping Increase / (Decrease)	[C] Water Treatment Increase / (Decrease)	[D] Transmission & Distribution Increase / (Decrease)	[E] Customer Accounting Increase / (Decrease)	[F] Administrative & General Increase / (Decrease)	[G] Total Increase / (Decrease)
		Western Group - Insurance						
1								
2	Western Group							
3	Pinal Valley	$ 49	$ 2,720	$ 722	$ 6,083	$ 1,543	$ 53,852	$ 64,970
4	White Tank	31	502	58	550	233	6,425	7,800
5	Ajo	1	39	54	120	42	1,166	1,422
6								
7	Subtotal	$ 81	$ 3,262	$ 834	$ 6,753	$ 1,819	$ 61,443	$ 74,191
8								
9	Total	$ 81	$ 3,262	$ 834	$ 6,753	$ 1,819	$ 61,443	$ 74,191
10								
11								
12	Increase/(Decrease) in Expenses							
13								$ 74,191

Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-4
Synchronize Interest Expense with Rate Base

Western Group - Synchronized Interest

Line No.	System	[A] Rebuttal Orig. Cost Rate Base Sch. B-1 Ln. 23	[B] Weighted Cost of Long-Term Debt Sch. D-1	[C] Synchronized Interest - Long-Term Debt	[D] Adjusted T.Y. Long-Term Interest - As Filed	[E] Increase / (Decrease) Long-Term Interest Exp.	[F] Weighted Cost of Short-Term Debt Sch. D-1	[G] Synchronized Interest - Short-Term Debt	[H] Adjusted T.Y. Short-Term Interest - As Filed	[I] Increase / (Decrease) Short-Term Interest Exp.	[J] Test Year Other Interest - As Filed	[K] Increase / (Decrease) Other Interest Exp.
1												
2												
3	Western Group											
4	Pinal Valley	$ 58,322,921	3.16%	$ 1,843,258	$ 1,938,746	$ (95,489)	0.00%	$ -	$ -	$ -	$ -	$ -
5	White Tank	5,078,719	3.16%	160,510	161,427	(918)	0.00%	-	-	-	-	-
6	Ajo	966,310	3.16%	30,540	30,521	18	0.00%	-	-	-	-	-
7	Subtotal	$ 64,367,950		$ 2,034,307	$ 2,130,695	$ (96,388)		$ -	$ -	$ -	$ -	$ -
8												
9	Total	$ 64,367,950		$ 2,034,307	$ 2,130,695	$ (96,388)		$ -	$ -	$ -	$ -	$ -
10												
11												
12	Increase/(Decrease) in Expenses											$ (96,388)
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-5
Adjust Property Taxes

Line No.		Pinal Valley [A] T.Y. Adjstd' - Rebuttal	Pinal Valley [B] Adjusted - Rebuttal w/ Increase	White Tank [C] T.Y. Adjstd' - Rebuttal	White Tank [D] Adjusted - Rebuttal w/ Increase	Ajo [E] T.Y. Adjstd' - Rebuttal	Ajo [F] Adjusted - Rebuttal w/ Increase
1							
2	Adjusted Revenues - Rebuttal	$ 18,467,889	$ 18,467,889	$ 2,310,991	$ 2,310,991	$ 437,888	$ 437,888
3	Adjusted Revenues - Rebuttal	18,467,889	18,467,889	2,310,991	2,310,991	437,888	437,888
4	Adjusted Revenues - Rebuttal / Proposed Revenues	18,467,889	23,778,440	2,310,991	2,906,776	437,888	538,891
5							
6	Average Revenue	$ 18,467,889	$ 20,238,072	$ 2,310,991	$ 2,509,586	$ 437,888	$ 471,556
7							
8	Average Revenue Multiplied by 2	$ 36,935,778	$ 40,476,145	$ 4,621,982	$ 5,019,172	$ 875,777	$ 943,112
9							
10							
11							
12							
13							
14							
15	Deduct:						
16	Net Book Value of Transportation Equipment	$ -	$ -	$ -	$ -	$ -	$ -
17							
18							
19	Full Cash Value	$ 36,935,778	$ 40,476,145	$ 4,621,982	$ 5,019,172	$ 875,777	$ 943,112
20							
21	Assessment Ratio	18.0%	18.0%	18.0%	18.0%	18.0%	18.0%
22							
23	Assessed Value	6,648,440	7,285,706	831,957	903,451	157,640	169,760
24							
25	Property Tax Rate	14.58%	14.58%	13.18%	13.18%	12.74%	12.74%
26							
27	Property Tax	969,214	1,062,116	109,635	119,057	20,086	21,631
28							
29	Tax on Parcels	-	-	-	-	-	-
30							
31	Total Property Taxes - Calculated	$ 969,214	$ 1,062,116	$ 109,635	$ 119,057	$ 20,086	$ 21,631
32							
33	Adjusted Property Taxes - As filed	969,214		109,635		20,086	
34							
35	Increase / (Decrease) in Property Taxes - Rebuttal	$ -		$ -		$ -	
36							
37	Adjusted Property Taxes - Rebuttal		969,214		109,635		20,086
38							
39	Inc. / (Dec.) in Property Taxes at Proposed Rates - Rebuttal		$ 92,901		$ 9,422		$ 1,544
40							
41	As % of Change in Revenue Requirement		1.75%		1.58%		1.53%
42							
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-5 (continued)
Adjust Property Taxes

Line No.		Western Group [A] T.Y. Adjstd' - Rebuttal	Western Group [B] Adjusted - Rebuttal w/ Increase
2	Adjusted Revenues - Test Year Ended 12/31/2014	$ 21,216,768	$ 21,216,768
3	Adjusted Revenues - Test Year Ended 12/31/2014	21,216,768	21,216,768
4	Adjusted Revenues - T.Y.E. 12/31/2014 / Proposed Revenues	21,216,768	27,224,107
6	Average Revenue	$ 21,216,768	$ 23,219,214
8	Average Revenue Multiplied by 2	$ 42,433,536	$ 46,438,429
15	Deduct:		
16	Net Book Value of Transportation Equipment	$ -	$ -
19	Full Cash Value	$ 42,433,536	$ 46,438,429
21	Assessment Ratio	18.0%	18.0%
23	Assessed Value	7,638,037	8,358,917
25	Property Tax Rate	14.39%	14.39%
27	Property Tax	1,098,936	1,202,803
29	Tax on Parcels	-	-
31	Total Property Taxes - Calculated	$ 1,098,936	$ 1,202,803
33	Adjusted Property Taxes - As filed	1,098,936	
35	Increase / (Decrease) in Property Taxes - Rebuttal	$ -	
37	Adjusted Property Taxes - Rebuttal		1,098,936
39	Inc. / (Dec.) in Property Taxes at Proposed Rates - Rebuttal		$ 103,867
41	As % of Change in Revenue Requirement		1.73%

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-6
Adjust Income Taxes to Reflect Adjusted Test Year Results & Proposed Revenues

Line No.			[A] Total Company - T.Y. Actual
1			
2			
3	Operating Income Before Inc. Taxes		$ 17,766,451
4	Interest Expense		4,607,365
5	Arizona Taxable Income (Ln. 3 - Ln. 4)		$ 13,159,086
6			
7	Less Arizona Income Tax (Ln. 5 X Ln. 8)		$ 723,750
8	Arizona Income Tax Rate =	5.500%	
9			
10	Federal Income Before Taxes (Ln. 5)		$ 13,159,086
11	Less Arizona Income Taxes (Ln. 7)		723,750
12	Federal Taxable Income (Ln. 10 - Ln. 11)		$ 12,435,337
13			
14	Federal Income Taxes:		
15	15% Bracket from $1 to $50,000		$ 7,500
16	25% Bracket from $50,001 to $75,000		6,250
17	34% Bracket from $75,001 to $100,000		8,500
18	39% Bracket from $100,001 to $335,000		91,650
19	34% Bracket from $335,001 to $10,000,000		3,286,100
20	35% Bracket from $10,000,001 to $15,000,000		852,368
21	38% Bracket from $15,000,001 to $18,333,333		-
22	35% Bracket over $18,333,333		-
23			
24	Federal Income Taxes:		$ 4,252,368
25			
26			
27	Applicable Federal Income Tax Rate - T.Y. Actual (Ln. 24 ÷ Ln. 12)		34.20%
28			
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Supporting Schedules:

Recap Schedules:

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-6
Adjust Income Taxes to Reflect Adjusted Test Year Results & Proposed Revenues

Line No.			Pinal Valley [A] T.Y. Adjusted - Rebuttal	Pinal Valley [B] Adjusted - Rebuttal w/ Increase	White Tank [C] T.Y. Adjusted - Rebuttal	White Tank [D] Adjusted - Rebuttal w/ Increase	Ajo [E] T.Y. Adjusted - Rebuttal	Ajo [F] Adjusted - Rebuttal w/ Increase
1								
2								
3	Operating Income Before Inc. Taxes		$ 2,402,911	$ 7,609,189	$ 77,580	$ 662,603	$ 26,848	$ 126,071
4	Interest Expense		1,843,258	1,843,258	160,510	160,510	30,540	30,540
5	Arizona Taxable Income (Ln. 3 - Ln. 4)		$ 559,654	$ 5,765,932	$ (82,929)	$ 502,093	$ (3,692)	$ 95,532
6								
7	Less Arizona Income Tax (Ln. 5 X Ln. 8)		$ 30,781	$ 317,126	$ (4,561)	$ 27,615	$ (203)	$ 5,254
8	Arizona Income Tax Rate:	5.500%						
9								
10	Federal Income Before Taxes (Ln. 5)		$ 559,654	$ 5,765,932	$ (82,929)	$ 502,093	$ (3,692)	$ 95,532
11	Less Arizona Income Taxes (Ln. 7)		30,781	317,126	(4,561)	27,615	(203)	5,254
12	Federal Taxable Income (Ln. 10 - Ln. 11)		$ 528,873	$ 5,448,805	$ (78,368)	$ 474,478	$ (3,489)	$ 90,277
13								
14	Federal Income Taxes:							
15								
16	Applicable Federal Income Tax Rate:	34.20%	180,852	1,863,265	(26,799)	162,252	(1,193)	30,871
17								
18								
19								
20								
21	Federal Income Taxes:		$ 180,852	$ 1,863,265	$ (26,799)	$ 162,252	$ (1,193)	$ 30,871
22								
23								
24	Total Income Tax (Ln. 11 + Ln. 21)		$ 211,633	$ 2,180,391	$ (31,360)	$ 189,867	$ (1,396)	$ 36,125
25								
26	Tax Rate (Ln. 24 ÷ Ln. 5)		37.82%	37.82%	37.82%	37.82%	37.82%	37.82%
27								
28	Effective Income Tax Rates							
29	State (Ln. 7 ÷ Ln. 5)		5.50%	5.50%	5.50%	5.50%	5.50%	5.50%
30	Federal (Ln. 21 ÷ Ln. 5)		32.32%	32.32%	32.32%	32.32%	32.32%	32.32%
31								
32								
33	Adjusted Federal Income Taxes - As Filed (Sch. C-2, Ln. 30)		$ 143,745		$ (25,101)		$ (975)	
34	Increase / (Decrease) in Federal Income Taxes (Ln. 21 - Ln. 33)		37,107		(1,698)		(218)	
35								
36	Adjusted State Income Taxes - As filed (Sch. C-2, Ln. 31)		$ 24,465		$ (4,272)		$ (166)	
37	Increase / (Decrease) in State Income Taxes (Ln. 11 - Ln. 36)		6,316		(289)		(37)	
38								
39	Adjusted Federal Income Taxes - Rebuttal			$ 180,852		$ (26,799)		$ (1,193)
40	Increase / (Decrease) in Federal Income Taxes (Ln. 21 - Ln. 39)			1,682,412		189,050		32,064
41								
42	Adjusted State Income Taxes - Rebuttal			30,781		(4,561)		(203)
43	Increase / (Decrease) in State Income Taxes (Ln. 11 - Ln. 42)			286,345		32,176		5,457
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Rebuttal Income Statement Adjustment IS-6 (continued)
Adjust Income Taxes to Reflect Adjusted Test Year Results & Proposed Revenues

Line No.			Western Group [A] T.Y. Adjusted - Rebuttal	Western Group [B] Adjusted - Rebuttal w/ Increase
1				
2				
3	Operating Income Before Inc. Taxes		$ 2,507,339	$ 8,397,863
4	Interest Expense		2,034,307	2,034,307
5	Arizona Taxable Income (Ln. 3 - Ln. 4)		$ 473,032	$ 6,363,557
6				
7	Less Arizona Income Tax (Ln. 5 X Ln. 8)		$ 26,017	$ 349,996
8	Arizona Income Tax Rate: 5.500%			
9				
10	Federal Income Before Taxes (Ln. 5)		$ 473,032	$ 6,363,557
11	Less Arizona Income Taxes (Ln. 7)		26,017	349,996
12	Federal Taxable Income (Ln. 10 - Ln. 11)		$ 447,016	$ 6,013,561
13				
14	Federal Income Taxes:			
15				
16	Applicable Federal Income Tax Rate:	34.20%	152,861	2,056,388
17				
18				
19				
20				
21	Federal Income Taxes:		$ 152,861	$ 2,056,388
22				
23				
24	Total Income Tax (Ln. 11 + Ln. 21)		$ 178,878	$ 2,406,383
25				
26	Tax Rate (Ln. 24 ÷ Ln. 5)		37.82%	37.82%
27				
28	Effective Income Tax Rates			
29	State (Ln. 7 ÷ Ln. 5)		5.50%	5.50%
30	Federal (Ln. 21 ÷ Ln. 5)		32.32%	32.32%
31				
32				
33	Adjusted Federal Income Taxes - As Filed (Sch. C-2, Ln. 30)		$ 117,669	
34	Increase / (Decrease) in Federal Income Taxes (Ln. 21 - Ln. 33)		35,191	
35				
36	Adjusted State Income Taxes - As filed (Sch. C-2, Ln. 31)		$ 20,027	
37	Increase / (Decrease) in State Income Taxes (Ln. 11 - Ln. 36)		5,990	
38				
39	Adjusted Federal Income Taxes - Rebuttal			$ 152,861
40	Increase / (Decrease) in Federal Income Taxes (Ln. 21 - Ln. 39)			1,903,527
41				
42	Adjusted State Income Taxes - Rebuttal			26,017
43	Increase / (Decrease) in State Income Taxes (Ln. 11 - Ln. 42)			323,979
44				
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ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Gross Revenue Conversion Factor

Exhibit
Schedule C-3 Rebuttal
Page 1 of 2
Witness: Moe

Line No.	Description	Western Group [A]
1		
2	Effective Federal Income Tax Rate	32.32%
3	(Sch. C-2 Appdx.)	
4		
5	Effective State Income Tax Rate	5.50%
6	(Sch. C-2 Appdx.)	
7		
8	Combined Federal & State Income Tax Rate	37.82%
9	(Ln. 2 + Ln. 5)	
10		
11	100% Minus Combined Federal & State IncomeTax Rate	62.18%
12		
13	Uncollectible Rate	0.22%
14		
15	Effective Uncollectible Factor	0.13%
16	(Ln. 11 x Ln. 13)	
17		
18	100% Minus Effective Uncollectible Factor	99.87%
19		
20	Property Tax Factor	1.73%
21	(Sch. C-2 Appdx.)	
22		
23	Effective Property Tax Factor	1.08%
24	(Ln. 11 x Ln. 20)	
25		
26	Combined Federal & State Income & Property Tax Rate	38.89%
27	(Ln. 8 + Ln. 23)	
28		
29	Operating Income %	60.98%
30	(Ln. 18 - Ln. 26)	
31		
32	Revenue Conversion Factor	1.6400
33	(100% ÷ Ln. 29)	
34		
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Supporting Schedules:

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Computation of Gross Revenue Conversion Factor

Line No.	Description	Pinal Valley [A]	White Tank [B]	Ajo [C]
1				
2	Effective Federal Income Tax Rate	32.32%	32.32%	32.32%
3	(Sch. C-2 Appdx.)			
4				
5	Effective State Income Tax Rate	5.50%	5.50%	5.50%
6	(Sch. C-2 Appdx.)			
7				
8	Combined Federal & State Income Tax Rate	37.82%	37.82%	37.82%
9	(Ln. 2 + Ln. 5)			
10				
11	100% Minus Combined Federal & State IncomeTax Rate	62.18%	62.18%	62.18%
12				
13	Uncollectible Rate	0.21%	0.23%	0.23%
14				
15	Effective Uncollectible Factor	0.13%	0.14%	0.14%
16	(Ln. 11 x Ln. 13)			
17				
18	100% Minus Effective Uncollectible Factor	99.87%	99.86%	99.86%
19				
20	Property Tax Factor	1.75%	1.58%	1.53%
21	(Sch. C-2 Appdx.)			
22				
23	Effective Property Tax Factor	1.09%	0.98%	0.95%
24	(Ln. 11 x Ln. 20)			
25				
26	Combined Federal & State Income & Property Tax Rate	38.90%	38.80%	38.77%
27	(Ln. 8 + Ln. 23)			
28				
29	Operating Income %	60.96%	61.06%	61.09%
30	(Ln. 18 - Ln. 26)			
31				
32	Revenue Conversion Factor	1.6403	1.6377	1.6369
33	(100% ÷ Ln. 29)			

Supporting Schedules:

N:\RATES\2015_Rate_Case\Schedules\2015 WG Rate Case Model REBUTTAL FINAL 2016.04.07 w_ABBOTT 15% DISCOUNT\C3
Processing Date: 4/11/2016 11:13 AM

Recap Schedules:
A-1 Rebuttal

ARIZONA WATER COMPANY
Test Year Ended December 31, 2014
Summary Cost of Capital

Line No.	Description	Western Group [A]	[B]	[C]	[D]
		End of Test Year - Actual			
		Dollar Amount[1]	Percent of Total	Rate of Return	Weighted Return
1					
2	Short-Term Debt	$ -	0.00%	0.00%	0.00%
3					
4	Long-Term Debt	28,387,500	46.31%	6.82%	3.16%
5					
6	Common Equity	32,914,056	53.69%	7.45%	4.00%
7					
8	Totals	$ 61,301,556	100.00%		7.16%
9					
10					
11					
12					
13					
14					
15					
16		Proposed - As Filed			
17		Dollar	Percent	Cost	Weighted
18		Amount[1]	of Total	Rate	Cost
19					
20	Short-Term Debt	$ -	0.00%	0.00%	0.00%
21					
22	Long-Term Debt	28,492,500	46.31%	6.82%	3.16%
23					
24	Common Equity	33,035,799	53.69%	10.75%	5.77%
25					
26	Totals	$ 61,528,299	100.00%		8.93%
27					
28					
29					
30					
31					
32					
33					
34		Proposed - Rebuttal			
35		Dollar	Percent	Cost	Weighted
36		Amount[1]	of Total	Rate	Cost
37					
38	Short-Term Debt	$ -	0.00%	0.00%	0.00%
39					
40	Long-Term Debt	28,492,500	46.31%	6.82%	3.16%
41					
42	Common Equity	33,035,799	53.69%	11.45%	6.15%
43					
44	Totals	$ 61,528,299	100.00%		9.31%
45					
46					
47					
48					
49					
50					
51					
52					
53					
54	[1]Allocated based on				
55	3-factor methodology				

Supporting Schedules:

Recap Schedules:

Ahern

ARIZONA WATER COMPANY

Docket No. W-01445A-15-0277

2015 WESTERN GROUP RATE HEARING

(For Test Year Ending 12/31/14)

Prepared

REBUTTAL TESTIMONY

of

PAULINE M. AHERN

TABLE OF CONTENTS

APPENDICES & EXHIBITS

EXECUTIVE SUMMARY

Ms. Ahern's rebuttal testimony responds to certain aspects of the direct testimony of David C. Parcell, witness for the Arizona Corporation Commission's Utilities Division and John Cassidy, Witness for the Residential Utility Consumer Office on the following issues:

Debt Cost Rate

Ms. Ahern provides evidence that Mr. Cassidy's recommended debt cost rate of 5.43%, if approved, would provide Arizona Water Company ("AWC" or "the Company") with an opportunity to actually earn only 8.20% which is much less than his recommended return on common equity of 8.95%

Common Equity Cost Rate

Ms. Ahern also provides evidence that both Mr. Parcell's and Mr. Cassidy's single-stage Discounted Cash Flow model results, 8.60% and 8.63%, respectively, significantly understate the investors' required return when applied to an original cost less depreciation rate base, i.e., book value. Ms. Ahern also provides evidence that both Mr. Parcell's and Mr. Cassidy's applications of the Capital Asset Pricing Model ("CAPM") and the Comparable Earnings Model ("CE") are flawed in several respects. She also provides corrections to these flaws below.

As a result of these corrections Mr. Parcell's and Mr. Cassidy's indicated common equity cost rates are 10.08% and 10.09%, respectively.

Credit Risk Adjustment

As noted in her rebuttal testimony, Ms. Ahern explains that neither Mr. Parcell nor Mr. Cassidy included an adjustment to reflect the greater credit risk of the Company, as evidenced by its likely bond rating of Moody's Baa2 / S&P BBB. An indication of the magnitude of such an adjustment is 1.00% which will be discussed in detail below.

Business Risk Adjustment

Ms. Ahern also explains that neither Mr. Parcell nor Mr. Cassidy included an adjustment to reflect the greater business risk of the Company, as evidenced by its smaller size relative to the water utilities upon whose market data their respective recommended common equity cost rates were based. Based upon her analysis, Ms. Ahern supports a conservative adjustment of 50 basis points based upon the size of the Company.

Properly including these adjustments, coupled with the proper applications of the CAPM and CE analyses results in a range of common equity cost rate for Mr. Parcell and Mr. Cassidy of 11.58% - 11.59% , only slightly higher than her updated common equity cost rate of 11.45%% discussed below.

Updated Common Equity Cost Rate

Finally, Ms. Ahern's rebuttal testimony provides an updated common equity cost rate of 11.45% which Ms. Ahern finds is a reasonable common equity cost rate for AWC in the current economic and capital market environment.

ARIZONA WATER COMPANY

Rebuttal Testimony of

Pauline M. Ahern

I. Introduction

Q. PLEASE STATE YOUR NAME, OCCUPATION AND BUSINESS ADDRESS.

A. My name is Pauline M. Ahern and I am a Partner with Sussex Economic Advisors, LLC. My business address is 1900 West Park Drive, Suite 250, Westborough, MA, 01581. My mailing address is 3000 Atrium Way, Suite 241, Mt Laurel, NJ, 08054.

Q. ARE YOU THE SAME PAULINE M. AHERN WHO PREVIOUSLY SUBMITTED DIRECT TESTIMONY IN THIS PROCEEDING?

A. Yes, I am.

Q. HAVE YOU PREPARED EXHIBITS WHICH SUPPORT YOUR REBUTTAL TESTIMONY?

A. Yes. They are Exhibit PMA-R1 through PMA-R32.

II. Purpose

Q. WHAT IS THE PURPOSE OF THIS TESTIMONY?

A. The purpose is to provide testimony on behalf of Arizona Water Company ("AWC" or "the Company") in rebuttal to certain aspects of the direct testimonies of David C. Parcell, witness for the Arizona Corporation Commission's Utilities Division ("Staff") and John Cassidy, Witness for the Residential Utility Consumer Office ("RUCO") concerning the rate of return which AWC should be allowed the opportunity to earn.

First, I will provide general comments in response to Mr. Parcell's and Mr. Cassidy's respective recommendations. Second, I will provide a discussion concerning current capital market conditions in response to both Mr. Parcell's and Mr. Cassidy's discussions of "General Economic Conditions". Third, I will address Mr. Parcell's and

Mr. Cassidy's Direct Testimonies relative to their respective costs of common equity, including their selection of proxy group[1] and the failure of Mr. Parcell and Mr. Cassidy to address the greater credit and business risks of AWC relative to the proxy group due to its likely bond rating of Baa2 / BBB by Moody's and Standard & Poor's ("S&P"), respectively, as well as AWC's smaller size relative to the proxy group. Fourth, and finally, I will also respond to some of the comments and critiques on my Direct Testimony by both Mr. Parcell and Mr. Cassidy. The fact that I do not address each and every comment or critique should not be construed as meaning that I am in agreement with them.

III. <u>General Comments on the Recommended Overall Rates of Return of Mr. Parcell and Mr. Cassidy</u>

Q. DO YOU HAVE ANY GENERAL COMMENTS CONCERNING THE RECOMMENDED OVERALL RATES OF RETURN OF MR. PARCELL AND MR. CASSIDY?

A. Yes. Both Mr. Parcell's low recommended range of overall rates of return of 7.78% - 8.26% (midpoint of 8.02%), and Mr. Cassidy's recommended overall rate of return of 7.32% for AWC are unreasonable and will likely be viewed by the investment community as unnecessarily inadequate for a relatively small water utility. Both Mr. Parcell and Mr. Cassidy have accepted the Company's proposed capital structure ratios, with Mr. Parcell also accepting the Company's debt cost rate. Mr. Parcell's low recommended overall rate of return is a direct result of his insufficient range of recommended common equity cost rates of 8.60% - 9.50%, with a midpoint of 9.05%. Mr. Cassidy's low recommended overall rate of return is a function of both his deficient recommended common equity cost rate of 8.95%, and his recommendation of a fictitious debt cost rate of 5.43%, the effect of which is an implied rate of return on

[1] Mr. Parcell and Mr. Cassidy use the same proxy group.

common equity of only 8.20%, which is significantly lower than his already inadequate recommended 8.95% common equity cost rate.

Mr. Cassidy's recommended debt cost rate, as well as the common equity cost rate analyses of both Mr. Parcell and Mr. Cassidy, will be discussed later in this Rebuttal Testimony.

Q. HOW DO MR. PARCELL'S AND MR. CASSIDY'S RECOMMENDED RETURNS ON COMMON EQUITY AFFECT AWC'S CUSTOMERS?

A. The authorized return on common equity provides an indication, or lack thereof, of regulatory support for the utilities under a commission's jurisdiction. It provides a useful benchmark to investors which can be compared among utilities. The authorized rate of return on common equity must be fair and reasonable for all stakeholders, i.e., customers and shareholders alike, as well as sufficient to meet investors' requirements.

A fair and reasonable return is one that is consistent with the mandates of *Hope*[2] and *Bluefield*[3] regarding the maintenance of the financial integrity of presently-invested capital, while enabling the attraction of needed new capital. A fair and reasonable return must also be consistent with and reflective of expected capital market conditions. The recommended common equity cost rates of both Mr. Parcell and Mr. Cassidy do not meet the *Hope* and *Bluefield* mandates, are neither consistent with, nor reflective of, the previously discussed expected capital market conditions and investor expectations, and are therefore grossly inadequate.

IV. General Comments on Capital Market Conditions

Q. PLEASE DESCRIBE CURRENT CAPITAL MARKET CONDITIONS.

A. Because the models used to estimate the cost of common equity are meant to reflect current and expected capital market conditions, it is important to assess the

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[2] *Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591 (1944).
[3] *Bluefield Water Works Improvement Co. v. Public Serv. Comm'n*, 262 U.S. 679 (1922).

reasonableness of the results of any model in the context of observable market data. To the extent model assumptions or results are incompatible with such data, judgment must be applied in both the application of methods and in the interpretation of their results.

a. <u>Federal Reserve Bank Market Intervention</u>

Q. PLEASE DISCUSS HOW THE FEDERAL RESERVE BANK'S MARKET INTERVENTION AFFECTS THE ESTIMATION OF THE COST OF CAPITAL.

A. Much has been reported about the Federal Reserve Bank's ("Fed") market intervention since 2007, and the effect of that intervention on interest rates. Aside from that effect, an important consideration is the extent to which those actions have obscured the long-standing relationships among financial metrics sometimes used in assessing the cost of common equity.

Beginning in 2008, the Fed proceeded on a deliberate path of initiatives designed to lower long-term government bond yields. Fed policy actions were intended to put downward pressure on longer-term interest rates by having the Fed take onto its balance sheet some of the duration and prepayment risks that would otherwise have been borne by private investors. Under that policy, "Securities Held Outright" on the Fed's balance sheet increased from approximately $491 billion at the beginning of October 2008 to approximately $4.25 trillion by the end of March 2016. In context, the securities held by the Fed represented approximately 3.31% of gross domestic product ("GDP") at the end of September 2008 and rose to approximately 23.40% of GDP at the end of March 2016[4]. As such, Fed policy actions have been a significant source of liquidity, and have had a substantial effect on capital markets.

As a result of the Fed's accommodative monetary policies, the U.S. stock market has recovered with the S&P 500 rising more than 200.0% from its lows in early March 2009. That appreciation occurred despite the market's recent extreme volatility

[4] www.federalreserve.gov / www.bea.gov/national/

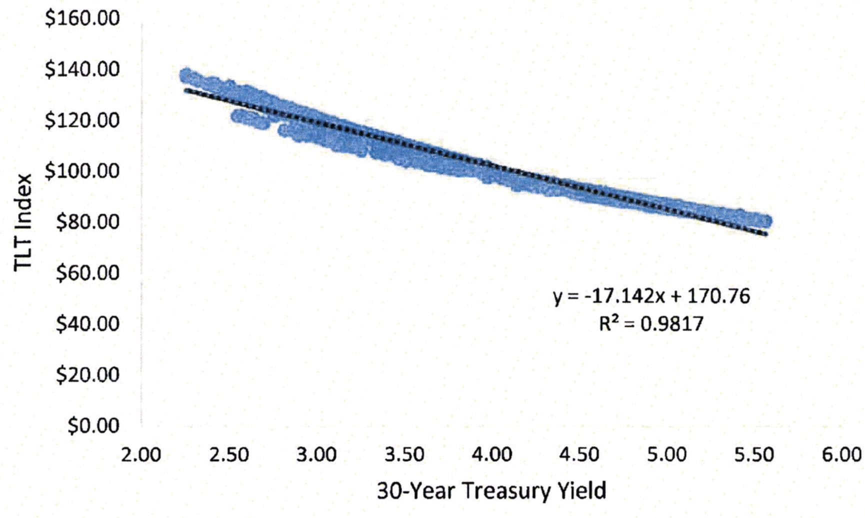
in response to the turmoil in the global economy, falling oil prices, and the uncertainty and direction of the Fed's interest rate decisions.

b. Interest Rate Environment

Q. IS THE MARKET EXPECTING INCREASES IN INTEREST RATES?

A. Yes. The U.S. 30-Year Treasury bond is currently forecasted to yield an average of 3.22%[5] over the six quarters ended with the third quarter of 2017, 4.5% for 2017-2021 and 4.8% for 2022-2026[6] by *Blue Chip Financial Forecasts* ("*Blue Chip*"). In addition to economists' forecasts, the iShares 20+ year Treasury Bond ("TLT"), an exchange-traded fund of long-term U.S. government bonds, can provide insight into the market's expectations of future interest rate trends. Because the price of bonds is inversely related to interest rates, the TLT has increased in value as interest rates have fallen over time (see Chart 1 below).

Chart 1: TLT Index vs. 30-Year Treasury Yield[7]



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[5] From *Blue Chip Financial Forecasts*, April 1, 2016. See page 4 of Exhibit PMA-R9.
[6] From *Blue Chip Financial Forecasts*, December 1, 2015. See page 5 of Exhibit PMA-R9.
[7] Source: Yahoo! Finance.

The TLT provides a market-based understanding of whether investors expect interest rates to increase or decrease by reviewing the premium they are willing to pay for the option to buy or sell the TLT, at the current market price, in the future. If investors are willing to pay more for the option to sell the TLT in the future (at today's price) than they are willing to pay for the option to buy the TLT (also at today's price) that suggests that on balance, the market perceives a greater prospect of interest rate increases than decreases.

Based on data from NASDAQ, as of early April 2016, the option to sell the TLT in January 2018 (the furthest priced option) at the current price is more about twice the value of the option to buy the TLT. Because bond prices fall as interest rates increase, this means that investors perceive a greater likelihood of increases in long-term interest rates than decreases. Thus, Mr. Parcell's testimony that "it cannot be maintained that low interest rates...are temporary and do not reflect investor expectations" (see Mr. Parcell's Direct Testimony at page 31, lines 5-7) is not correct. Nor is it true that "there is good reason to believe that interest rates, and hence, the cost of capital, would be expected to remain at or near current levels for the next several years", (see Mr. Cassidy's Direct Testimony at page 13, lines 10-12.)

c. Equity Market Volatility

Q. WHAT IS THE MARKET'S CURRENT ASSESSMENT OF EXPECTED VOLATILITY?

A. One measure of the expected volatility, or risk, of the U.S. stock market is the Chicago Board Options Exchange Volatility Index ("VIX") which measures market expectations of near-term volatility in the U.S. stock market implied by near and next-term options on the VIX index. The VIX, sometimes referred to as the "fear index," is a highly visible and often-reported barometer of investor risk sentiments.

Although the VIX is not presented as a percentage, it should be understood as such. Thus, if the VIX stood at 17.00, it would be interpreted as an expected standard deviation in annual returns on the market index of 17.00% over the coming 30 trading days. As Chart 2 shows, since its inception in 1990, the VIX has averaged approximately 19.83, which is relatively close to the long-term average annual standard deviation in returns on the S&P 500 of 20.11 through 2015%.

Chart 2: VIX Daily Levels and Long-Term Average8

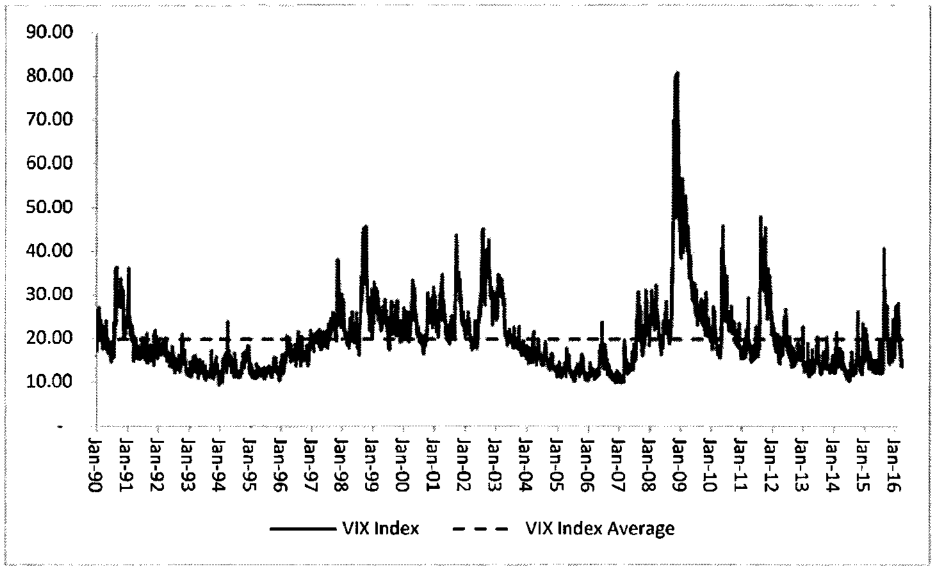


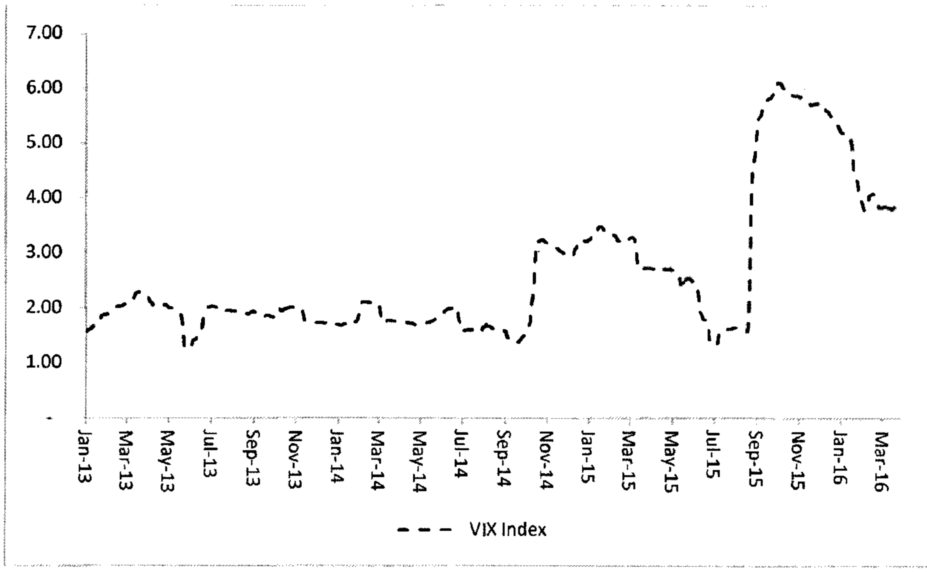
Chart 2 reveals some key points. First, the VIX has been at relatively low levels in recent years. However, beginning in the latter portion of 2015, significant volatility has returned in to the U.S. stock market. From that broad perspective, equity risk is currently elevated relative to recent historical levels.

A further measure of market uncertainty is the volatility of the VIX itself, or the volatility of volatility, as measured by the standard deviation of the VIX. As Chart 3 (below) shows, the standard deviation of the VIX moved in a relatively narrow range during 2013, but since then have increased quite noticeably. Such volatility indicates that although interest rates are still near historical lows in the U.S. market, there remains significant, if not greater, risk to common equity investment in today's markets

[8] Source: Bloomberg Financial.

with investors requiring greater returns to bear that risk, consistent with the basic financial principle of risk and return.

Chart 3: Standard Deviation (100 days) of VIX[9]



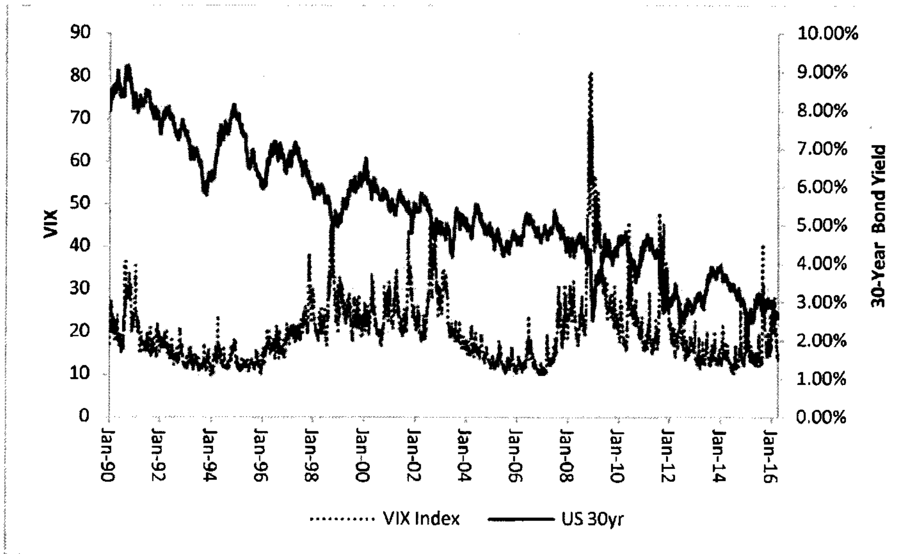
Just as market intervention by the Fed has reduced interest rates, it has also reduced volatility. For example, each time the Fed began to purchase bonds (as evidenced by the increase in "Securities Held Outright" on its balance sheet), volatility subsequently declined. In fact, in September 2012, when the Fed began to purchase long-term securities at a pace of $85 billion per month, volatility (as measured by the VIX) fell, and through October 2014 remained in a relatively narrow range. The reason is quite straightforward: investors became confident that the Fed would intervene if markets became unstable.

Even with the effect of Fed intervention, periods of increased equity market volatility have been associated with unusually low government bond yields. That relationship makes sense given that investors increasingly focus on capital preservation during turbulent markets. As Chart 4 below demonstrates, when volatility

[9] Source: Bloomberg Financial.

peaks (as measured by the VIX), government bond yields fall; because increased demand for safe-haven securities will bid up their price and down their yield.

Chart 4: VIX and U.S. Treasury Yields[10]



The important analytical issue is whether we can infer that risk aversion among equity investors is at a historically low level or lower than it has been in recent years, implying a correspondingly low cost of common equity. Given the negative relationship between the expansion of the Fed's balance sheets and equity market volatility (as measured by the VIX) and in light of the fact that current volatility is considerably greater than prior levels, it is inappropriate to conclude that fundamental investor risk aversion and investor return requirements are lower than they have been in recent years. In other words, since investors require higher returns for bearing greater risk, given that current market volatility, i.e., risk, is higher than in recent years, investors' required returns must be higher as well.

The low interest rate environment associated with the Fed's intervention may lead some analysts to conclude that current capital costs, including the cost of

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[10] Source: Bloomberg Financial.

common equity, are low and will continue to be so. That conclusion, however, only holds true under the hypothesis of Perfectly Competitive Capital Markets ("PCCM") and the classical valuation framework which, under normal economic and capital market conditions, underpin the traditional cost of common equity models. PCCM are capital markets in which no single trader, or "market-mover," would have the power to change the prices of goods or services, including bond and common stock securities. In other words, under the PCCM hypothesis, no single trader would have a significant effect on market prices.

Classic valuation theory assumes that investors trade securities rationally with prices reflecting their perceptions of value. Although the Fed has always had the ability to set benchmark interest rates, it has been maintaining below-normal rates to stimulate continued economic and capital market recovery. It therefore is reasonable to conclude that the Fed and other central banks are acting as market-movers which has a significant effect on the market prices of both bonds and stocks in all markets where a central bank is maintaining historically low interest rates. The presence of market-movers such as the Fed in current capital markets runs counter to the PCCM which is the foundation of traditional cost of common equity models.

Therefore, the results of traditional cost of common equity models should be viewed with even greater scrutiny under current economic and capital market conditions. The current and expected interest rate environment, coupled with the Fed's engineering of interest rates suggests that the traditional cost of common equity models'[11] tendency to understate the investor required cost of common equity will be exacerbated. Consequently, the results of these models, including those presented in this testimony, are currently and prospectively particularly conservative estimates, i.e., on the low side, of the investor required rate of return on common equity.

[11] The DCF, RPM and CAPM.

In view of all the foregoing, it is clear that there is a market expectation of increasing interest rates as well as increased volatility, i.e., risk, in the stock market. The cost of capital, including the cost of common equity, is expectational. Mr. Parcell agrees when he states on page 7, lines 16-18 of his Direct Testimony, that "the costs of capital, for both fixed-cost (debt and preferred stock) components and common equity, are determined in part by current and prospective economic and financial conditions." Mr. Parcell then lists "the level and trend of interest rates" and "current and expected economic conditions" as two factors influencing the cost of capital.

Similarly, Mr. Cassidy concurs when he states on page 5, lines 17-18 of his Direct Testimony that "[t]he cost of capital is determined in part by the current and future economic and financial conditions." Mr. Cassidy then lists "the trend in interest rates" as a factor which influences the cost of capital. However, the cost of capital also reflects investor perceptions of volatility, which have been increasing dramatically recently. Both investor perceptions of volatility, or risk, and increasing interest rates must be reflected in any estimate of the cost of capital by using forecasted growth rates, interest rates, forecasted market equity risk premiums, and forecasted returns. To do so is consistent with the prospective nature of the cost of capital.

V. Debt Cost Rate

a. Mr. Parcell's Recommended Debt Cost Rate

Q. DO YOU HAVE ANY DISAGREEMENT WITH MR. PARCELL'S RECOMMENDED DEBT COST RATE FOR AWC?

A. No, I do not because Mr. Parcell accepted the Company's actual embedded debt cost rate of 6.82%.

b. Mr. Cassidy's Recommended Debt Cost Rate

Q. MR. CASSIDY RECOMMENDS THAT THE COMMISSION ADOPT A FICTITIOUS DEBT COST RATE OF 5.43% FOR AWC. PLEASE COMMENT.

A. Mr. Cassidy's recommended overall rate of return of 7.32%, including his recommended cost of common equity of 8.95% and recommended debt cost rate of 5.43%, violates the economic principle of opportunity cost, meaning the return given, up or foregone, by investing in one investment as opposed to an alternative investment of comparable risk. While Mr. Cassidy applies his recommended common equity cost rate of 8.95% to the Company's actual equity ratio, he does not apply the Company's actual debt cost rate of 6.82% to the actual debt ratio. Rather, he recommends and applies a fictitious debt cost rate of 5.43%, which results in an overall rate of return of 7.32%.

Because the Company is contractually obligated to make the interest payments on its outstanding bonds, under Mr. Cassidy's recommendation AWC only has an opportunity to earn a return on common equity of 8.20%, and not his recommended 8.95%, as shown in Exhibit PMA-R1. A common equity cost rate of 8.20% implies that the equity risk premium is only 138 basis points[12] above AWC's embedded cost of debt of 6.82%. Such a low equity risk premium demonstrates how Mr. Cassidy's recommendation violates the economic principle of opportunity cost, when compared with the historical and projected equity risk premiums for the Standard & Poor's ("S&P") equity risk premium relative to Moody's A-rated public utility bonds of 3.84%, 3.94% and 3.76 % as well as the beta adjusted equity risk premium of 5.56% shown on pages 17 and 21 of Exhibit PMA-R32. An equity risk premium of 1.38% is especially egregious when compared with the Predictive Risk Premium Model derived equity risk premium for my proxy group of eight water companies of 8.38%, as can be derived from page 12 of Exhibit PMA-R32.

If the Commission adopts Mr. Cassidy's recommended fictitious debt cost rate, not only will the Company not recover its actual, out-of-pocket interest expense, which is based on a cost of 6.82%, AWC will not be allowed the opportunity to earn a fair

[12] 1.36% = 8.20% - 6.84%.

rate of return on common equity commensurate with those expected on investments of comparable risk. Furthermore, Mr. Cassidy's recommended debt cost rate of 5.43% violates traditional cost of service principles as discussed by Company witness Joel M. Reiker in his Rebuttal Testimony.

Q. HOW DOES MR. CASSIDY'S RECOMMENDED DEBT COST RATE OF 5.43% VIOLATE COST OF SERVICE PRINCIPLES?

A. In recommending a fictitious debt cost rate, Mr. Cassidy's has demonstrated a lack of understanding of the cost of service principles embedded in the revenue requirement paradigm, where the Company is entitled to: 1) recover the expenses it incurs, with debt expense recovered through the cost of capital at the Company's actual, or embedded, weighted cost of debt[13] (See page 4 of Exhibit PMA-R2); and, 2) the opportunity for shareholders, i.e., investors, to earn a return on their investment through the weighted cost of common equity.

Even Mr. Parcell agrees with this ratemaking principle when he states on page 36, line 19 of his Direct Testimony that "AWC's cost of debt is fully recoverable through its COC [cost of capital]." Only by using the Company's actual cost of debt will the Company be able to meet the actual fixed charges on that debt, as noted by Mr. Reiker's citation of Phillips in Section II of his Rebuttal Testimony. If the Commission adopts both Mr. Cassidy's recommended cost of debt and cost of common equity in this proceeding, the Company will be doubly penalized, as it will be deprived of full recovery of the interest expense on its debt, and only have an opportunity to earn a return on equity of 8.20%, much less than Mr. Cassidy's already deficient recommended common equity cost rate, let alone a fair rate of return, which is significantly greater than Mr. Cassidy's recommended 8.95% cost of common equity.

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[13] James C. Bonbright, Albert L. Danielsen and David R. Kamerschen, Principles of Public Utility Rates (Public Utilities Reports, Inc., 1988) 313.

Assuming Mr. Cassidy's recommended 8.95% cost of common equity was reasonable, which it is not, there is no incentive for an investor to invest in AWC because he / she would have to accept a much lower return on common equity of only 8.20%. In the real world, investors would simply put their money into alternative investments of comparable risk, but that offered an expected return on 8.95%. The Commission should reject both Mr. Cassidy's recommended debt cost rate, adopting the Company's actual debt cost rate consistent with its previous findings for AWC, as well as reject his recommended common equity cost rate.

VI. Common Equity Cost Rate

a. Proxy Groups

i. Mr. Parcell's and Mr. Cassidy's Proxy Group

Q. PLEASE COMMENT UPON MR. PARCELL'S AND MR. CASSIDY'S PROXY GROUPS.

A. While Mr. Parcell and Mr. Cassidy included Artesian Resources Corp. ("ARTNA") in their identical proxy groups, I excluded ARTNA from my proxy group because it is not included in *Value Line Investment Survey's* Standard Edition. Nevertheless, I have no objection to its inclusion in Mr. Parcell's or Mr. Cassidy's proxy group.

b. Mr. Parcell's and Mr. Cassidy's Discounted Cash Flow Model

Q. PLEASE COMMENT UPON MR. PARCELL'S AND MR. CASSIDY'S DCF COST RATES.

A. Even though I do not agree with Mr. Parcell's estimation of growth in the DCF, his ultimate conclusion of a DCF cost rate of 8.60%, is similar to both my original average DCF result of 8.93% and somewhat higher than my updated average DCF result of 8.19% shown on page 2 of Exhibit PMA-R32.

Mr. Cassidy correctly relied on earnings per share ("EPS") growth rates in his DCF analysis which resulted in a DCF cost rate of 8.63%, also similar to my DCF results. Thus, I will not address either Mr. Parcell's or Mr. Cassidy's DCF analyses in the spirit of the "End Result" doctrine of *Hope*, which states:

> It is not theory but the impact of the rate order which counts. If the total effect of the rate order cannot be said to be unjust or unreasonable, judicial inquiry under the Act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important.

That being said, given the current high level of market-to-book ratios for the water utility industry, all of the DCF results in this proceeding mis-specify the investor-required return.

Q. PLEASE EXPLAIN.

A. The DCF model has a tendency to mis-specify investors' required return on common equity when the market value of common stock differs significantly from its book value. Mathematically, because the "simplified" DCF model traditionally used in rate regulation assumes a market-to-book ratio of one, it understates or overstates investors' required return rates when market value exceeds or is less than book value.

This is because, in many instances, market prices reflect investors' assessments of the long-range market price growth potential (consistent with the infinite investment horizon implicit in the standard regulatory version of the DCF model) not fully reflected in analysts' shorter range forecasts of future growth in earnings per share (EPS). Thus, the market-based DCF model will result in a total annual dollar return on book common equity equal to the total annual dollar return expected by investors only when market and book values are equal, a rare and unlikely situation.

For example, in recent years, the market values of water utilities' common stocks have been well in excess of their book values, ranging between 181.79% and 212.84%, for the five years ending 2014, as shown on page 2 of Exhibit PMA-3 accompanying my Direct Testimony. These high market values relative to book values tend to generate DCF results that understate investors' true required rates of return.

Under DCF theory, the rate of return investors require is related to the market price paid for a security. Thus, market prices form the basis of investment decisions and investors' expected rates of return. In contrast, a regulated utility is generally limited to earning on a net book value (depreciated original cost) rate base. Although market prices are significantly influenced by analysts' EPS growth forecasts, market values can diverge from book values for a myriad of macroeconomic reasons including, but not limited to, EPS and DPS expectations, merger or acquisition expectations, interest rates, investor sentiment, unemployment levels, monetary policy, fiscal policy, etc.

Traditional rate base / rate of return regulation, where a market-based common equity cost rate is applied to a book value rate base, presumes that market-to-book ratios are at unity, or 1.00. However, there is ample empirical evidence over sustained periods of time which demonstrate that this is an incorrect presumption. Roger A. Morin[14] states on page 4 of Exhibit PMA-R3:

> The third and perhaps most important reason for caution and skepticism is that application of the DCF model produces estimates of common equity cost that are consistent with investors' expected return only when stock price and book value are reasonably similar, that is, when the M/B is close to unity. As shown below, application of the standard DCF model to utility stocks understates the investor's expected return when the market-to-book (M/B) ratio of a given stock exceeds unity. This was particularly relevant in the capital market environment of the 1990s and 2000s whose utility stocks are trading at M/B ratios well above unity and have been for nearly two decades. The converse is also true, that is, the DCF model overstates that investor's return when the stock's M/B ratio is less than unity. The reason for the distortion is that the DCF market return is applied to a book value rate base by the regulator, that is, a utility's earnings are limited to earnings on a book value rate base. (emphasis supplied)

As noted by Phillips on page 4 of Exhibit PMA-R4:[15]

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[14] Roger A. Morin, New Regulatory Finance (Public Utility Reports, Inc., 2006) 434.

[15] Phillips, Charles F., The Regulation of Public Utilities – Theory and Practice (Public Utility Reports, Inc., 1993) 395.

> Many question the assumption that market price should equal book value, believing that 'the earnings of utilities should be sufficiently high to achieve market-to-book ratios which are consistent with those prevailing for stocks of unregulated companies.'

In addition, Bonbright[16] states on page 6 of Exhibit PMA-R2:

> In the first place, commissions cannot forecast, except within wide limits, the effect their rate orders will have on the market prices of the stocks of the companies they regulate. In the second place, whatever the initial market prices may be, they are sure to change not only with the changing prospects for earnings, but with the changing outlook of an inherently volatile stock market. In short, market prices are beyond the control, though not beyond the influence of rate regulation. Moreover, even if a commission did possess the power of control, any attempt to exercise it ... would result in harmful, uneconomic shifts in public utility rate levels. (italics added)

Q. IS IT REASONABLE TO EXPECT THE MARKET VALUES OF UTILITIES' COMMON STOCKS TO CONTINUE TO SELL WELL ABOVE THEIR BOOK VALUES?

A. Yes. Market-to-book ratios of regulated utilities vary from year to year, due to such influences as the effects of the "Great Recession", subsequent economic and capital market recovery and turmoil, global economic and geopolitical conditions, and the like. In my opinion, the common stocks of utilities will continue to sell substantially above their book values, on average, because many investors will likely continue to commit a greater percentage of their available capital to common stocks in view of lower interest rate alternative investment opportunities in today's markets. The recent past and current capital market environment is in stark and historical contrast to the late 1970s and early 1980s when very high (by historical standards) yields on secured debt instruments in public utilities were available.

Despite the fact that the market declined to a low in March 2009, as the "Great Recession" unfolded and from which the U.S. is still recovering, the majority of utility stocks, on average, have continued to sell at market prices well above their book values. As previously discussed, such sustained high market-to-book ratios have

[16] Bonbright, Danielsen and Kamerschen, 334.

been influenced by factors other than fundamentals such as actual and reported growth in EPS and DPS.

Q. CAN THE UNDER- OR OVERSTATEMENT OF THE INVESTORS' REQUIRED RATE OF RETURN BASED ON THE DCF MODEL BE DEMONSTRATED MATHEMATICALLY?

A. Yes. Exhibit PMA-R5 demonstrates how an average market-based DCF cost rate of either 8.60% (Mr. Parcell's DCF conclusion) or 8.63% (Mr. Cassidy's DCF conclusion) applied to a book value which is below market value will understate the investors' required return on market value.

As shown, there is no realistic opportunity to earn the expected market-based rate of return on book value. In Columns [A] and [D], investors expect either an 8.60% or 8.63% return on an average market price of $33.56. Columns [B] and [D] show that when the 8.60% and 8.63% return rates on market value are applied to a book value which is 45.89%[17] of market value, the total annual return opportunity is just $1.980 (based on an 8.60% return) and $1.987 (based on an 8.63% return) on book value. Columns [A] and [B] show that the same $0.906 dividend is indicated, but when the 8.60% is applied to book value, the investor only has the opportunity for $0.418 in market appreciation, or 1.25%. Column [C] and [D] show that the same $0.909 dividend is indicated, but when the 8.63% is applied to book value, the investor only has the opportunity for $0.420 in market appreciation, or 1.25% as well.

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[17] Representing a market-to-book ratio of 217.92%.

Table 1

	Mr. Parcell		Mr. Cassidy	
	Mkt. Val.	Book Val.	Mkt. Val.	Book Val.
Per Share	$35.56	$15.40	$35.56	$15.40
DCF Cost Rate	8.60%	8.60%	8.63%	8.63%
Return in $	$2.886	$1.324	$2.896	$1.329
Dividends	$0.906	$0.906	$0.909	$0.909
Growth in $	$1.980	$0.418	$1.987	$0.420
Return on Mkt. Val.	8.60%	8.60%	8.63%	8.63%
Rate of Growth on Mkt. Val.	5.90%	1.25%	5.92%	1.25%

Source: Exhibit PMA-R5.

Of course, the converse is also true. When the market-to-book value is below 1, the DCF cost rate will overstate the investors' required return on market value.

Hence, it is clear that the DCF model mis-specifies, that is, it either understates or overstates investors' required cost of common equity capital when market values exceed / are less than their underlying book values. Therefore, as stated above, in order to add reliability to the estimation of the cost of common equity, multiple cost of common equity models should be used, rather than exclusive reliance upon the DCF model, when estimating investors' expectations.

In view of the foregoing, the traditional application of the DCF mis-specifies investors' required return. Specifically, it understates investors' required return because of the confluence of recently rising and volatile market prices, the use of accounting measures as proxies for capital appreciation in the DCF, and the expected continued rise in interest rates and capital costs discussed above.

The magnitude of this understatement can be found in the difference between the 5.90% and 5.92% average expected growth in market value, i.e., growth in EPS, shown in Columns [A] and [C] on Exhibit PMA-R5 and the growth in market value of 1.25%, shown in Columns [B] and [D], when either Mr. Parcell's 8.60% or Mr.

Cassidy's 8.63% DCF cost rates are applied to book value, or up to approximately 465- 467 basis points.[18]

c. Capital Asset Pricing Model ("CAPM")

i. Mr. Parcell's and Mr. Cassidy's CAPM Analysis

Q. DO YOU HAVE ANY GENERAL COMMENTS ON MR. PARCELL'S CAPM ANALYSIS?

A. Yes. At page 23 lines 19-22 of his Direct Testimony, Mr. Parcell states "...the CAPM is generally superior to the simple RP method because the CAPM specifically recognizes the risk of a particular company or industry, (i.e., beta) whereas the simple RP method assumes the same COE for all companies exhibiting similar bond ratings or other characteristics." Mr. Parcell is incorrect.

In his application of the CAPM, he relies upon the yield on 20-year U.S. Treasury bonds as the risk-free rate. By definition, the yield on 20-year U.S. Treasury bonds cannot recognize the risk of a particular company or industry because it reflects the "risk" of the U.S. Government. Moreover, beta is a measure of systematic risk only. As Mr. Parcell notes on page 24, lines 11-12, "Beta is a measure of the relative volatility (and thus risk) of a particular stock in relation to the overall market." Thus, it does not reflect non-systematic or company-specific risks. Moreover, beta measures only a small percentage of the total risk of a particular company because the R^2 (R-Squared), or the correlation coefficients of betas, average only 0.1823 for Mr. Parcell's proxy group indicating that the average betas of these water companies reflect only 18.23% of the total risk of the proxy group, as shown on Exhibit PMA-R6.

In contrast, the risk premium method <u>relies upon the use of a company- or proxy group-specific expected bond yield</u>. As shown in Exhibit PMA-R7, S&P[19] explains how and why the utility bond rating process takes into account all of the basic

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[18] 4.65% = 5.90% - 1.25% and 4.67% = 5.92% - 1.25%.
[19] Standard & Poor's Ratings Services – "Key Credit Factors For The Regulated Utilities Industry" (Nov. 19, 2013).

components of business and financial risk. In addition, a significant portion of one application of the risk premium method is derived by the use of beta to allocate a total market equity risk premium. Also, an even greater proportion of company-specific risk is reflected with the use of the Predictive Risk Premium Model ("PRPM") which only uses the volatility of a company's equity risk premiums as a measure of risk as discussed in my Direct Testimony at page 29, line 18 through page 31, line 2. These approaches to the risk premium analysis reflect all company-specific risk.

In view of the foregoing, Mr. Parcell's comments that the CAPM is somehow superior to the risk premium method because the risk premium method is "simple" are without merit.

Q. PLEASE COMMENT UPON MR. PARCELL'S AND MR. CASSIDY'S CAPM ANALYSES.

A. Both Mr. Parcell's and Mr. Cassidy's CAPM analyses are flawed in three respects. First, they have incorrectly relied on an historical risk-free rate despite the fact the both ratemaking and the cost of capital are prospective.

Second, Mr. Parcell and Mr. Cassidy have incorrectly calculated the market equity risk premium by relying upon: actually achieved, or non-market based, rates of return on book common equity for the S&P 500, a proxy for the market. In addition, Mr. Parcell incorrectly relied on a geometric mean historical market equity risk premium; the historical <u>total</u> return on U.S. Treasury securities; as well as not employing a prospective, or forward-looking equity risk premium.

Third, neither Mr. Parcell nor Mr. Cassidy incorporated an empirical CAPM ("ECAPM") analysis despite the fact that empirical evidence indicates that the low-beta securities, such as utilities, earn returns higher than the CAPM predicts and high-beta securities earn less.

Q. PLEASE COMMENT UPON MR. PARCELL'S USE OF THE 20-YEAR U.S. TREASURY BOND YIELD AS THE RISK-FREE RATE.

A. Mr. Parcell's use of the 20-year U.S. Treasury Bond yield is inappropriate for cost of capital purposes. Because both ratemaking and the cost of common equity are long-term concepts related to long-lived assets, i.e., the utility's rate base, the horizon of the chosen Treasury security should match the horizon of whatever is being valued, similar to the DCF model and its presumption of an infinite investment horizon. In other words, the horizon of the chosen risk-free rate is a function of the horizon of the investment.

The 2015 Ibbotson® SBBI® 2014 Classic Yearbook – Market Results for Stocks, Bonds, Bills and Inflation – 1926-2014 (SBBI – 2015) notes:[20]

> Our methodology for estimating the long-horizon equity risk premium makes use of the income return on a 20-year Treasury bond; however, the Treasury currently does not issue a 20-year bond. The 30-year bond that the Treasury recently began issuing again is theoretically more correct when dealing with to the long-term nature of business valuation, yet Ibbotson Associates instead creates a series of returns using bonds on the market with approximately 20 years to maturity. The reason for the use of a 20-year maturity bond is that 30-year Treasury securities have only been issued over the relatively recent past, starting in February of 1977, and were not issued at all through the early 2000s.
>
> The same reason exists for why we do not use the 10-year Treasury bond-a long history of market data is not available for 10-year bonds. We have persisted in using a 20-year bond to keep the basis of the time series consistent. (page 6 of Exhibit PMA-R8)

Morin confirms this when he states[21]

> ...[b]ecause common stock is a long-term investment and because the cash flows to investors in the form of dividends last indefinitely, the yield on very long-term government bonds, namely, the yield on 30-year Treasury bonds, is the best measure of the risk-free rate for use in the CAPM[5(footnote omitted)]. ...The expected common stock return is based on long-term cash flows, regardless of an individuals' holding time period. (page 16 of Exhibit PMA-R3)

Therefore, with the expectation that the U.S. Treasury Bond will be held to maturity, there is no market or unexpected inflation risk associated with its yield.

[20] 2014 Ibbotson® SBBI® 2015 Yearbook – Market Results for Stocks, Bonds, Bills and Inflation – 1926-2013 Morningstar, Inc., 2014 152.

[21] Morin 151.

Consequently, the yield on 30-year U.S. Treasury Bonds is the appropriate yield to use as the risk-free rate in a CAPM analysis, and not the 20-year bond.

Second, as discussed below, both Mr. Parcell and Mr. Cassidy incorrectly relied upon an historical or recent yield on U.S. Treasury Bonds as their risk-free rates, although Mr. Cassidy did correctly rely on the 30-year U.S. Treasury Bond yield.

Q. WHY ARE MR. PARCELL'S AND MR. CASSIDY'S USE OF HISTORICAL, I.E., A RECENT THREE-MONTH AVERAGE, YIELDS ON U.S. TREASURY BONDS NOT APPROPRIATE FOR COST OF CAPITAL PURPOSES.

A. Mr. Parcell's use of current, rather than projected, yields on 20-year U.S. Treasury bonds and Mr. Cassidy's use of current, not projected, yields on 30-year U.S. Treasury bonds ignore the fact that the cost of capital and ratemaking are prospective. Both Mr. Parcell and Mr. Cassidy concur when they both state on page 4 of their Direct Testimonies, Mr. Parcell at lines 6-10 that:

> Technically, "fair rate of return" is a legal and accounting concept that refers to an ex-post (after the fact) earned return on an asset base, while the cost of capital is an economic and financial concept which refers to an ex-ante (before the fact) expected, or required, return on a capital base. In regulatory proceedings, however, the two terms are often used interchangeably, and I have equated the two concepts in my testimony.

and Mr. Cassidy also at lines 18-20 that:

> From a technical perspective, a "fair rate of return" is an ex-post (after the fact) earned return on an asset base. Conversely, the cost of capital is an ex-ante (before the fact) expected, or required, return on a capital base. In regulatory proceedings, the two terms are often used interchangeably.

Mr. Parcell and Mr. Cassidy both implicitly agree when they use, and ultimately rely on, projected growth rates in their DCF analyses. As stated previously, the cost of capital, including the cost rate of common equity, is expectational in that it reflects investors' expectations of future capital markets, including an expectation of interest rate levels, as well as future risks. In addition, ratemaking is prospective in that the rates set in this proceeding will be in effect for a period of time in the future.

Therefore, the appropriate risk-free rate available at the time of the preparation of both Mr. Parcell and Mr. Cassidy's Direct Testimonies is the average of the consensus forecasts of approximately 50 economists from *Blue Chip* for the six quarters ending with the second quarter 2017, from the February 1, 2016 edition, and the long-range forecasts from the December 1, 2015, edition for 2017-2021 and 2022-2026, or 3.63%, derived In Note 1 on page 3 of Exhibit PMA-R9.

Q. PLEASE COMMENT UPON MR. PARCELL'S AND MR. CASSIDY'S ESTIMATION OF THE MARKET EQUITY RISK PREMIUM FOR THEIR CAPM ANALYSES.

A. Mr. Parcell's derivation of the market equity risk premium for his CAPM analysis is flawed for the following four reasons. First, he incorrectly relied on achieved rates of return on book common equity. Second, he incorrectly relied, in part, upon geometric mean historical market returns. Third, he incorrectly relied on the historical mean <u>total</u> return on U.S. Treasury securities. Fourth, he did not employ a prospective equity risk premium.

Likewise, Mr. Cassidy's derivation of the market equity risk premium for his CAPM analysis is flawed because he, like Mr. Parcell, incorrectly relied on achieved rates of return on book common equity.

Q. PLEASE COMMENT UPON MR. PARCELL AND MR. CASSIDY'S USE OF THE RATE OF RETURN ON BOOK COMMON EQUITY FOR THE S&P 500.

A. Mr. Parcell used the actual achieved rates of earnings on book common equity of the S&P 500 Composite for the period 1978-2014 as shown on Schedule 8 of Exhibit DCP-8, while Mr. Cassidy relied on the same returns, but for the period 1978-2015, as shown on Schedule JAC-4, page 2. To reiterate, both the cost of capital and ratemaking are prospective in nature. In addition, the underlying theory of the CAPM requires the use of an expected <u>market</u> return. Therefore, the use of historically achieved earnings on <u>book</u> common equity is inconsistent with both the prospective nature of the cost of capital and ratemaking, as well as with the very theory of the CAPM.

Moreover, the use of a market equity risk premium measured over such a short period of time is inconsistent with the long-term nature of the cost of capital, the perpetual life of common stock, as well as the infinite horizon presumed by the DCF model. In addition, the CAPM can be manipulated by the time period used to calculate the overall market return. SBBI 2015 notes on pages 153-154 of Exhibit PMA-R8:

> A proper estimate of the equity risk premium requires a data series long enough to give a reliable average without being unduly influenced by very good and very poor short-term returns. When calculated using a long data series, the historical equity risk premium is relatively stable. Furthermore, because an average of the realized equity risk premium is quite volatile when calculated using a short history, using a long series makes it less likely that the analyst can justify any number he or she wants. The magnitude of how shorter periods can affect the result will be explored later in this chapter. (emphasis added)
>
> * * *
>
> Without an appreciation of the 1920s and 1930s, no one would believe that such events could happen. The 89-year period starting with 1926 is representative of what can happen: it includes high and low returns, volatile and quiet markets, war and peace, inflation and deflation, and prosperity and depression. Restricting attention to a shorter historical period underestimates the amount of change that could occur in a long future period. Finally, because historical event-types (not specific events) tend to repeat themselves, long-run capital market return studies can reveal a great deal about the future. Investors probably expect "unusual" events to occur from time to time, and their return expectations reflect this. (emphasis added)

While SBBI-2015 refers to the use of market equity risk premiums estimated over shorter time periods as permitting analyst bias and instability to enter into the calculation, the discussion is equally applicable to the 1978-2014 / 2015 market equity risk premiums based on achieved returns on book common equity for the S&P 500. Moreover, as SBBI 2015 concludes that, without an appreciation of historical event-types and the impacts they may have on market returns over a long period of time, the use of short time periods would underestimate "the amount of change that could occur in a long future period." Therefore, consistent with the long-term nature of the cost of capital, "long-run capital market return studies" as noted by <u>SBBI – 2015</u> are appropriate for determining the expected market return and equity risk premium.

In summary, any market equity risk premium based on achieved returns on book common equity over the 1978-2014 / 2015 time period, should not be relied on. In addition, because this is the only market equity risk premium relied on by Mr. Cassidy, his entire CAPM analysis should be rejected by this Commission.

Q. PLEASE COMMENT UPON MR. PARCELL'S USE OF LONG-TERM HISTORICAL EQUITY RISK PREMIUMS.

A. Mr. Parcell also calculates the historical market equity risk premium from data tabulated by Morningstar (formerly Ibbotson Associates), presumably using the <u>SBBI – 2015</u>, which presents the average total return on large company stocks from 1926-2014, which are appropriately market returns – not returns on book common equity.

Thus, Mr. Parcell's derivation of his ultimate market equity risk premium for his CAPM analysis involves a mismatch because he has mixed returns on book common equity with market returns. Moreover, in estimating the total return on the market, whether by returns on book common equity or with market returns, he did not even consider forecasted market returns. This is in total contradiction to his recognition of the need to use an expected total return (page 23, lines 3-4 of his Direct Testimony) and his acknowledgement that the cost of capital is prospective (page 5, line 33 through page 6, line 1 of his Direct Testimony).

Q. PLEASE COMMENT UPON MR. PARCELL'S USE OF THE GEOMETRIC MEAN HISTORICAL MARKET RETURN.

A. At lines 4-7 on page 25 of his Direct Testimony, Mr. Parcell notes that he has relied on <u>both</u> the arithmetic and geometric mean returns for the S&P 500 as tabulated by Morningstar (Ibbotson Associates). Only arithmetic mean return rates and yields are appropriate for cost of capital purposes because ex-post (historical) total returns and equity risk premiums differ in size and direction over time, providing insight into the variance and standard deviation of returns. Because the arithmetic mean captures the prospect for variance in returns and equity risk premiums, it provides the valuable insight needed by investors in estimating risk in the *future* when making a current investment. Absent such valuable insight into the potential variance of returns, investors cannot meaningfully evaluate prospective risk.

In contrast, the geometric mean of ex-post equity risk premiums provides no insight into the potential variance of future returns because the geometric mean relates the change over many periods to a constant rate of change, rather than the year-to-year fluctuations, or variance, critical to risk analysis. Therefore, the geometric mean is of little or no value to investors seeking to measure risk. Moreover, from a statistical perspective, because stock returns and equity risk premiums are random, the arithmetic mean is also expectational, consistent with the prospective nature of the cost of capital and ratemaking noted above.

The financial literature is quite clear that risk is measured by the variability of expected returns, i.e., the probability distribution of returns.[22] Pages 153 and 90-91 of SBBI – 2015 (see page 5 and 6-7 of Exhibit PMA-R8 explain in detail why the arithmetic mean is the correct mean to use when estimating the cost of capital.

In addition, Weston and Brigham[23] provide the standard financial textbook definition of the riskiness of an asset when they state:

> The riskiness of an asset is defined in terms of the likely variability of future returns from the asset. (emphasis added) (Page 3 of Exhibit PMA-R10)

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[22] Eugene F. Brigham, Fundamentals of Financial Management (The Dryden Press, 1989) 639.

[23] J. Fred Weston and Eugene F. Brigham, Essentials of Managerial Finance, 3rd Edition (The Dryden Press, 1974) 272.

Furthermore, Morin states[24]:

> The geometric mean answers the question of <u>what constant return</u> you would have to achieve in each year to have your investment growth match the return achieved by the stock market. The arithmetic mean answers the question of what growth rate is the best estimate of the <u>future</u> amount of money that will be produced by continually reinvesting in the stock market. It is the rate of return which, compounded over multiple periods, gives the mean of the probability distribution of ending wealth. (emphasis added) (Page 11 of Exhibit PMA-R3)

In addition, Brealey and Myers25 note:

> The proper uses of arithmetic and compound rates of return from past investments are often misunderstood... Thus the arithmetic average of the returns correctly measures the opportunity cost of capital for investments... *Moral*: If the cost of capital is estimated from historical returns or risk premiums, use arithmetic averages, not compound annual rates of return. (italics in original) (Pages 3-4 of Exhibit PMA-R11)

As previously discussed, investors gain insight into relative riskiness by analyzing expected *future* variability. This is accomplished through the use of the arithmetic mean of a random distribution of returns / premiums. Only the arithmetic mean takes into account <u>all</u> of the returns / premiums, hence, providing meaningful insight into the variance and standard deviation of those returns / premiums.

Q. CAN IT BE DEMONSTRATED THAT THE ARITHMETIC MEAN TAKES INTO ACCOUNT ALL OF THE RETURNS AND THEREFORE, THE ARITHMETIC MEAN IS APPROPRIATE TO USE WHEN ESTIMATING THE OPPORTUNITY COST OF CAPITAL IN CONTRAST TO THE GEOMETRIC MEAN?

A. Yes. Pages 1 and 2 of Exhibit PMA-R12 graphically demonstrate this. Page 1 charts the returns on large company stocks for each and every year, 1926 through 2015, from the Morningstar SBBI Appendix A Tables[26]. It is clear from looking at the year-to-

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[24] Morin 133.

[25] Richard A. Brealey and Stewart C. Myers, S.C., Principles of Corporate Finance, 5th Ed. (McGraw-Hill Publications, Inc., 1996) 146 – 147.

[26] Table A-1. Morningstar SBBI Appendix A Tables, Morningstar Stocks, Bonds, Bills, and Inflation | 1926 – 2015, © 2016. Morningstar has decided to stop publishing the Ibbotson Classic Yearbook, but has provided the Appendix A Tables.

year variation of these returns, that stock market returns, and hence, equity risk premiums, vary.

The distribution of each and every one of those returns for the entire period from 1926 through 2015 is shown on page 2. There is a clear bell-shaped pattern to the histogram, or probability distribution, of returns, an indication that they are randomly generated and not serially correlated. The arithmetic mean of this distribution of returns considers each and every return in the distribution. In doing so, the arithmetic mean takes into account the standard deviation or likely variance which may be experienced in the future when estimating the rate of return based on such historical returns.

In contrast, the geometric mean of these returns considers only two of the returns, the initial and terminal years, which, in this case, are 1926 and 2015. Based on only those two years, a constant rate of return is calculated by the geometric average. That constant return is graphically represented by a flat line, showing no year-to-year variation, over the entire 1926 to 2015 time period, which is obviously far different from reality, based on the histogram, or probability distribution, of returns shown on page 2 and demonstrated on page 1 of Exhibit PMA-R12.

Clearly, only the arithmetic mean takes the volatility of returns into account. The geometric mean is appropriate only when measuring historical performance and should not be used to estimate the investors required rate of return.

As discussed in my Direct Testimony at page 25, line 19 through page 26, line 3, all of the cost of common equity models used by me as well as Mr. Parcell and Mr. Cassidy, including the DCF, are market-based, being based on market prices which embody investors risk expectations. If investors relied on the geometric mean of ex-post spreads, they would have no insight into the potential variance of future returns because the geometric mean relates the change over many periods to a constant rate of change, thereby obviating the year-to-year fluctuations, or variance.

To put it even more simply, using the geometric mean to estimate the equity risk premium is tantamount to reading the first and last page of a complete history of World War II and presuming to know what occurred during World War II. Consequently, Mr. Parcell should have relied on the historical arithmetic mean return on large company stocks from 1926-2014 from SBBI – 2015 in his CAPM analysis.

Q. PLEASE COMMENT UPON MR. PARCELL'S USE OF THE HISTORICAL MEAN TOTAL RETURN ON U.S. TREASURY SECURITIES.

A. Although relying upon Morningstar's (Ibbotson Associates) historical returns in his CAPM analysis, Mr. Parcell has ignored Ibbotson Associates' recommendation to rely on the income return and not the total return on U.S. Treasury securities in deriving an equity risk premium. As indicated on page 153 of the SBBI – 2015 (Page 5 of Exhibit PMA-R8):

> Another point to keep in mind when calculating the equity risk premium is that the income return on the appropriate-horizon Treasury security, rather than the total return, is used in the calculation.
>
> The total return is comprised of three return components: the income return, the capital appreciation return, and the reinvestment return. The income return is defined as the portion of the total return that results from a periodic cash flow or, in this case, the bond coupon payment. The capital appreciation return results from the price change of a bond over a specific period. Bond prices generally change in reaction to unexpected fluctuations in yields. Reinvestment return is the return on a given month's investment income when reinvested into the same asset class in the subsequent months of the year. The income return is thus used in the estimation of the equity risk premium because it represents the truly riskless portion of the return.

Hence, it is appropriate to use the income return and not the total return on long-term U.S. government bonds when calculating a market equity risk premium. Therefore, the correct derivation of the historical market equity risk premium is the difference between the arithmetic mean monthly[27] total return on large company

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[27] Monthly arithmetic means are used to be consistent with the Predictive Risk Premium ModelTM ("PRPM") use of monthly risk premiums as detailed in Ms. Ahern's Direct Testimony.

common stocks of 12.07%, and the arithmetic mean 1926-2014 income return on long-term government bonds of 5.23% which results in a monthly market equity risk premium of 6.84% as derived in Note 3 on page 3 of Exhibit PMA-R9.

Q. PLEASE COMMENT UPON MR. PARCELL'S FAILURE TO USE A PROSPECTIVE OR FORWARD-LOOKING MARKET EQUITY RISK PREMIUM?

A. As noted above, in addition to page 7, lines 4-5, Mr. Parcell clearly states on page 26, lines 9-10 of his Direct Testimony that the cost of common equity "is an opportunity cost: the prospective return available to investors from alternative investments of similar risk." Therefore, it is appropriate to also give weight to expected market returns. One way to do so is to use the forecasted market risk premium derived from *Value Line's* average median price appreciation potential and average median expected dividend yield 3-5 years hence of 10.50%, a PRPM-derived market risk premium of 8.32% coupled with a market risk premium based on the expected total return on the market based on the S&P 500 of 9.78%, described in Note 3 on page 3 of Exhibit PMA-R9. When the *Value Line*-derived market equity risk premium of 9.15%, the PRPM-derived market equity risk premium of 8.32%, and an expected total return on the market, i.e., S&P 500 of 9.78%, are averaged with the properly derived historical arithmetic mean monthly equity risk premium of 6.84%, a properly calculated weighted average market equity risk premium of 8.52% results, as derived in Note 3 on page 3 of Exhibit PMA-R9.

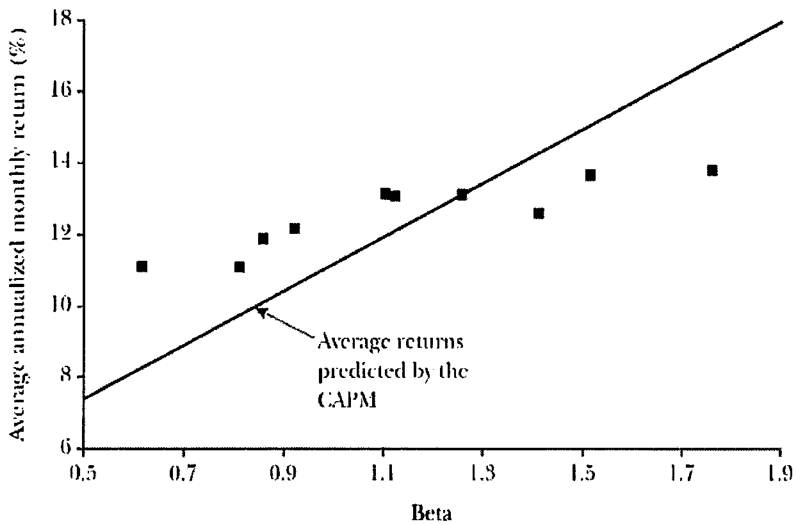
Q. DID MR. PARCELL OR MR. CASSIDY INCORPORATE AN EMPIRICAL OR ECAPM ANALYSIS?

A. No. Both Mr. Parcell and Mr. Cassidy failed to consider the ECAPM, despite the fact that numerous tests of the CAPM have confirmed its validity by showing that the empirical Security Market Line ("SML") described by the traditional CAPM is not as steeply sloped as the predicted SML. Numerous tests of the CAPM have measured the extent to which security returns and betas are related, as predicted by the CAPM, and confirm its validity. While the results of these tests support the notion that beta is related to security returns, the empirical SML described by the CAPM formula is not as steeply sloped as the predicted SML.[28]

The empirical CAPM ("ECAPM") reflects this empirical reality. Fama and French[29] clearly state on page 9 of Exhibit PMA-R13, regarding Figure 2, below that "[t]he returns on the low beta portfolios are too high, and the returns on the high beta portfolios are too low."

Figure 2 http://pubs.aeaweb.org/doi/pdfplus/10.1257/0895330042162430

Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003



In addition, Morin observes that while the results of these tests support the notion that beta is related to security returns, the empirical SML described by the CAPM formula is not as steeply sloped as the predicted SML. Morin[30] states:

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[28] Morin 175

[29] Eugene F. Fama and Kenneth R. French, "The Capital Asset Pricing Model: Theory and Evidence", *Journal of Economic Perspectives*, Vol. 18, No. 3, Summer 2004, p. 33.

[30] Morin 175.

> With few exceptions, the empirical studies agree that ... low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted. (Page 12 of Exhibit PMA-R3)
>
> * * *
>
> Therefore, the empirical evidence suggests that the expected return on a security is related to its risk by the following approximation:
>
> $$K = R_F + x\,\beta(R_M - R_F) + (1-x)\;\beta(R_M - R_F)$$
>
> where x is a fraction to be determined empirically. The value of x that best explains the observed relationship [is] Return = 0.0829 + 0.0520 β is between 0.25 and 0.30. If x = 0.25, the equation becomes:
>
> $$K = R_F + 0.25(R_M - R_F) + 0.75\,\beta(R_M - R_F)$$[31]
>
> (Page 14 of Exhibit PMA-R3)

Fama and French provide similar support for the ECAPM. On page 8 of Exhibit PMA-R13, Fama and French note:

> The early tests firmly reject the Sharpe-Lintner version of the CAPM. There is a positive relation between beta and average return, but it is too 'flat.'...The regressions consistently find that the intercept is greater than the average risk-free rate...and the coefficient on beta is less than the average excess market return...This is true in the early tests...as well as in more recent cross-section regressions tests, like Fama and French (1992).
>
> Finally, Fama and French note further on page 9 of Exhibit PMA-R13: Confirming earlier evidence, the relation between beta and average return for the ten portfolios is much flatter than the Sharpe-Linter CAPM predicts. The returns on low beta portfolios are too high, and the returns on the high beta portfolios are too low. For example, the predicted return on the portfolio with the lowest beta is 8.3 percent per year; the actual return as 11.1 percent. The predicted return on the portfolio with the t beta is 16.8 percent per year; the actual is 13.7 percent.

Clearly, Fama and French's paper along with their review of other academic research on the CAPM, validate the use of the ECAPM.

In view of theory and practical research, both the traditional CAPM and the ECAPM should have been used by Mr. Parcell and Mr. Cassidy.

[31] Morin 190.

Q. IF CORRECTED FOR THE ABOVE MISTAKES, WHAT WOULD BE THE CORRECTED RESULTS OF MR. PARCELL'S AND MR. CASSIDY'S CAPM ANALYSES?

A. Exhibit PMA-R9 presents the results of the correct applications of both the traditional CAPM and the ECAPM for Mr. Parcell's and Mr. Cassidy's proxy group. Page 1 shows the mean / median traditional CAPM results: 9.73% / 9.73% for the proxy group, while page 2 shows the mean / median ECAPM results: 10.40% / 10.40%. The mean / median traditional CAPM and ECAPM results average: 10.07% / 10.07% for the proxy group. However, this cost rate is still understated because it does not reflect any additional risk of the Company due to its greater credit risk and smaller relative size as will be discussed below.

Clearly, then, both Mr. Parcell's CAPM conclusion of 6.60% and Mr. Cassidy's CAPM conclusion of 7.79% are grossly understated.

Q. DOES MR. PARCELL RELY ON HIS 6.60% INDICATED CAPM COST RATE?

A. No. Mr. Parcell eliminates his CAPM analysis from his recommendation in this case. He does so because it is his opinion that "the level of interest rates on U.S. Treasury bonds ... has been lower in recent years." (lines 25-26 on page 30 of his Direct Testimony). Finally, Mr. Parcell opines that "it cannot be maintained that low interest rates (and low CAPM results) are temporary and do not reflect investor expectations." (lines 5-7 on page 31 of his Direct Testimony). I have previously discussed why the current low level of interest rates is temporary, with increasing interest rates a question of when, not if.

I have also previously discussed the prospective nature of both ratemaking and the cost of capital, which requires the use of forecasted interest rates (consistent with the use of forecasted growth in a DCF) so I will not repeat that discussion here. Also, Exhibit PMA-R9 clearly shows that a properly applied CAPM analysis is not too low to be considered when determining a common equity cost rate for a regulated public utility. In addition, I discussed and demonstrated previously in this Rebuttal Testimony that the current low interest rate environment is not expected to continue.

d. Comparable Earnings ("CE") Analysis

i. Mr. Parcell's and Mr. Cassidy's CE Analysis

Q. DO YOU HAVE ANY COMMENTS REGARDING MR. PARCELL'S APPLICATION OF THE CE ANALYSIS?

A. Yes. At page 29, lines 14 through page 30, line 2 of his Direct Testimony, Mr. Parcell discusses his CE result of no more than 9.0% to 10.0% (midpoint of 9.5%) for the proxy group. As support for his conclusion, he cites recent returns of 9.3% - 9.9% and market-to-book ratios greater than 180%, as well as prospective returns of 9.7% - 10.7% coupled with market-to-book ratios in excess of 200%.

He concludes on lines 17-19 on page 29, that "[a]s a result, it is apparent that authorized returns below this level would continue to result in an [sic] M/Bs of well above 100 percent." As I indicated earlier, the fact that M/Bs substantially exceeds 100 percent indicates that historic and prospective ROE [sic] of over 9.5 percent reflect earning [sic] levels that are well above the actual cost of equity for those regulated companies."[32] By these statements, it is clear that Mr. Parcell believes that a direct relationship exists between market-to-book ratios and the rate of earnings on book common equity. Such a relationship is neither supported by the academic literature nor by an historical analysis of the experience of unregulated companies.

Q. WHAT DOES THE ACADEMIC LITERATURE SAY ABOUT THE RELATIONSHIP BETWEEN ALLOWED REGULATORY RATES OF RETURN ON COMMON EQUITY AND UTILITY MARKET-TO-BOOK RATIOS?

A. As discussed previously in this rebuttal testimony, it is very clear from the academic literature by Phillips[33] and Bonbright[34], et al that there is no such direct relationship.

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[32] M/Bs = market-to-book ratios.
[33] Phillips 395.
[34] Bonbright 334.

Q. HAVE YOU PERFORMED AN ANALYSIS TO DETERMINE THE EXISTENCE OF A DIRECT RELATIONSHIP BETWEEN THE MARKET-TO-BOOK RATIOS OF UNREGULATED COMPANIES AND THEIR EARNED RATES OF RETURN ON BOOK COMMON EQUITY?

A. Yes. Since regulation acts as a surrogate for competition, it is reasonable to look to the competitive environment for evidence of a direct relationship between market-to-book ratios and earned returns on common equity (ROE). To determine if Mr. Parcell's implicit assumption of such a direct relationship has any merit, I observed the market-to-book ratios and the earned ROEs of the S&P Industrial Index and the S&P 500 Composite Index over a long period of time.

On Exhibit PMA-R14, I have shown the market-to-book ratios, rates of return on book common equity (earnings / book ratios, i.e., ROEs), annual inflation rates, and the earnings / book ratios net of inflation (real rate of earnings) annually for the years 1947 through 2014. In <u>each and every year</u>, the market-to-book ratios of the S&P Industrial Index equaled or exceeded 1.00. In 1949, the only year in which the market-to-book ratio was 1.00 (or 100%), the real rate of earnings on book equity, adjusted for <u>deflation</u>, was 18.1% (16.3% + 1.8%).

In contrast, in 1961, when the S&P Industrial Index experienced a market-to-book ratio of 2.01 times, the real rate of earnings on book equity for the Index was only 9.1% (9.8% - 0.7%). In 1997, the market-to-book ratio for the Index was 5.88 times, while the average real rate of earnings on book equity was 22.9% (24.6% - 1.7%).

This analysis clearly demonstrates that competitive, unregulated companies have never sold below book value, on average, and have sold at book value in only one year since 1947. The data show that there is no relationship between earnings / book ratios and market-to-book ratios.

Because of this lack of a relationship between earnings / book ratios and market-to-book ratios over a 68-year period, 1947 through 2014, it cannot be argued that a relationship would exist between earnings / book ratios and market-to-book ratios going forward. The analysis shown on Exhibit PMA-R14 coupled with the supportive academic literature, demonstrate the following:

1. That while regulation is a substitute for marketplace competition, it can influence but not directly control market prices, and, hence, market-to-book ratios; and,
2. That the rates of return investors expect to achieve and which influence their willingness to pay market prices well in excess of book values have no direct and exclusive relationship to rates of earnings on book equity.

Q. DO YOU HAVE ANY COMMENT UPON THE PROXY GROUPS MR. PARCELL AND MR. CASSIDY USED IN THEIR COMPARABLE EARNINGS ("CE") ANALYSES?

A. Yes. Both Mr. Parcell and Mr. Cassidy use their water proxy groups in their CE analyses, with Mr. Parcell also using the S&P 500, as discussed on pages 29 and 30 of Mr. Parcell's Direct Testimony and pages 36-37 of Mr. Cassidy's Direct Testimony. Any proxy group selected for a CE analysis should be broad-based in order to obviate any company-specific aberrations, and should exclude utilities to avoid circularity since the achieved returns on book common equity of utilities, being a function of the regulatory process, are substantially influenced by regulatory awards. Therefore, the achieved ROEs of utilities are not representative of the returns that could be earned in a truly competitive market. Hence, both Mr. Parcell's and Mr. Cassidy's use of their water proxy utilities in their CE analyses should be rejected.

Rejecting the achieved ROEs of utilities leaves Mr. Parcell's CE analysis with only the returns on the S&P 500 which is too broad-based to be comparable in total risk to his proxy utilities and hence, the Company. Also, the use of the S&P 500 does not meet the "'corresponding risk' concept discussed in the *Bluefield* and *Hope* cases" (Mr. Cassidy's Direct Testimony, page 26, lines 7-8).

Therefore, both Mr. Parcell's and Mr. Cassidy's entire CE analyses should be rejected and replaced with the results of market models applied to a non-regulated group of 11.57% as shown on page 4 of Exhibit PMA-R16.

Q. PLEASE EXPLAIN THE BASIS OF USING A NON-PRICE REGULATED PROXY GROUP IN A CE ANALYSIS.

A. Neither the *Hope* nor *Bluefield* cases specify that comparable risk companies must be regulated utilities. Since rate regulation is a substitute for the competition of the marketplace, non-price regulated firms operating in the competitive marketplace are an excellent proxy if a group can be selected to be comparable in total risk to the proxy group upon whose market data I rely to estimate the cost of common equity. The bases of the selection I apply are theoretically and empirically sound and results in a non-regulated proxy group which is comparable in total risk to the proxy group[35].

Q. PLEASE EXPLAIN HOW YOU CHOSE THE NON-PRICE REGULATED PROXY GROUP.

A. The first step in determining such an opportunity cost of common equity, based on the non-price regulated group comparable in total risk to the proxy group, is to choose an appropriate broad-based group of domestic non-price regulated firms which excludes utilities to avoid circularity.

The selection criteria for the non-price regulated firms are based on statistics derived from *Value Line* regression analyses of weekly market prices over the most recent 260 weeks, i.e., five years, from the market prices paid by investors. *Value Line* unadjusted betas were used as a measure of systematic risk, while the standard errors of the regressions giving rise to those beta coefficients are a measure of

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[35] Frank J. Hanley & Pauline M. Ahern, "Comparable Earnings: New Life for an Old Precept," American Gas Association, *Financial Quarterly Review*, Summer 1994, pp. 4 – 8. (See Exhibit PMA-R15).

unsystematic or firm-specific risk reflecting the extent to which events specific to a firm's operations affect its stock price. In essence, companies with similar betas and standard errors of the regression have similar total investment risk. Using a *Value Line* proprietary database dated March 2016[36], the application of the following criteria results in a non-price regulated proxy group comparable in total risk to the proxy group. The criteria used to select the Non-Price Regulated Proxy Group are:

1. The unadjusted beta coefficients from the *Value Line* regressions must lie within plus or minus two standard deviations of the average unadjusted beta coefficients of the of the proxy group;
2. The residual standard errors of the *Value Line* regressions which gave rise to the unadjusted beta coefficients must lie within plus or minus two standard deviations of the average residual standard error of the proxy group;
3. The non-regulated firms must be covered by *Value Line Investment Survey* (Standard Edition); and,
4. The firms must be domestic, non-price regulated companies, i.e., non-utilities.

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[36] It is not possible to go back and apply the market-based models to a non-regulated proxy group at January 29, 2015, the end of the three-month period over which both Mr. Parcell and Mr. Cassidy estimated their average dividend yields. Therefore, I have applied the market-based models to a non-regulated proxy group selected using the March 2016 *Value Line* database and market data as of the end of March 2016.

The basis of selection and the comparison group's regression statistics are shown on pages 1-3 of Exhibit PMA-R16. The following seventeen companies met these criteria:

- A.J. Gallagher Co. (AJG);
- Becton Dickinson (BDX);
- Brown-Forman 'B' (BFB);
- Ball Corp. (BLL);
- Costco Wholesale Corp. (COST);
- Amdocs Ltd. (DOX);
- Ecolab Inc. (ECL);
- Erie Indemnity Co. (ERIE);
- Hormel Foods Corp. (HRL);
- Lilly (Eli) and Co. (LLY);
- The Progressive Corp. of OH (PGR);
- Philip Morris Int'l, Inc. (PM);
- Stericycle Inc. (SRCL);
- Sysco Corp. (SYY);
- The Travelers Cos., Inc. (TRV);
- Waste Connections, Inc. (WCN); and,
- W.R. Berkley (W.R.) Corp. (WRB).

Q. DID YOU CALCULATE COMMON EQUITY COST RATES USING THE DCF, RPM, AND CAPM FOR THE NON-PRICE REGULATED PROXY GROUP THAT IS COMPARABLE IN TOTAL RISK TO THE PROXY GROUP?

A. Yes. Because the DCF, RPM and CAPM have been applied in an identical manner, as applied in my Direct Testimony, relative to the market data of the proxy group, I will not repeat the details of the rationale and application of each model shown on page 4 of Exhibit PMA-R16. An exception is that, in the application of the RPM, I did not use public utility-specific equity risk premiums nor did I apply the PRPM to the individual companies.

Page 5 of Exhibit PMA-R16 contains the derivation of the DCF cost rates. As shown, the average of the mean and median DCF cost rates for the non-price regulated proxy group is 12.98%.

Pages 6 through 8 of Exhibit PMA-R16 contain the data and calculations relating to the 11.46% RPM cost rate for the non-price regulated proxy group. As shown on Line No. 1 of page 6 of Exhibit PMA-R16, the consensus prospective yield on Moody's Baa rated corporate bonds of 5.86% is based on the forecasted yields for the six quarters ending with the third quarter of 2017 from the April 1, 2016 *Blue Chip*, averaged with the long-range forecasted yields for 2017-2021, and 2022-2026, also from the December 1, 2015 *Blue Chip.*[37] Because the Non-Price Regulated Proxy Group has an average Moody's long-term issuer rating of Baa1 as shown on page 7 of Exhibit PMA-R16, a downward adjustment of 0.35% to the prospective bond yield is necessary to reflect the difference in ratings[38] which results in a projected Baa1 corporate bond yield of 5.51%. When the beta-adjusted risk premium of 5.95%[39] relative to the non-price regulated proxy group is added to the prospective Baa1 rated corporate bond yields of 5.51%, the indicated RPM cost rate is 11.46%.

Page 9 of Exhibit PMA-R16 contains the details of the application of the traditional CAPM and ECAPM to the non-price regulated proxy group. As shown, the mean and median traditional average CAPM and ECAPM results are 10.62% / 10.60% for the non-price regulated proxy group which, when averaged, result in an indicated CAPM cost rate of 10.61%.[40]

Q. WHAT IS YOUR CONCLUSION OF THE COMMON EQUITY COST RATE BASED ON THE NON-PRICE REGULATED PROXY GROUP?

A. It is 11.57%, as shown on page 4 of Exhibit PMA-R16. The results of the DCF, RPM and CAPM applied to the non-price regulated group are 12.98%, 11.46% and 10.61%, respectively. Based on these results, the average of the mean and median results of the three models, which is 11.57% for the non-price regulated proxy group.

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[37] See pages 19 and 20 of Exhibit PMA-R32.
[38] As shown on Line No. 2 and explained in Note 2 on page 7 of Exhibit PMA-R16.
[39] Derived on page 8 of Exhibit PMA-R16.
[40] (10.61% = (10.62% + 10.60%) / 2).

e. Corrected Conclusion of Mr. Parcell's and Mr. Cassidy's Costs of Common Equity

Q. WHAT WOULD MR. PARCELL'S AND MR. CASSIDY'S CONCLUSIONS OF COMMON EQUITY COST RATE BE BASED ON THE CORRECTIONS TO THEIR CAPM ANALYSES DISCUSSED ABOVE?

A. Based on the corrections to Mr. Parcell's and Mr. Cassidy's CAPM analyses, as well as the inclusion of the results of market models applied to a non-regulated proxy group comparable in total risk to the water utility proxy group discussed above, their analyses produce the following:

	Mr. Parcell	Mr. Cassidy
DCF	8.60%	8.63%
CAPM	10.07%	10.07%
CE	11.57%	11.57%

Based on the average of these results: indicated cost rate of common equity or 10.08% results based on Mr. Parcell's analysis and 10.09% based on Mr. Cassidy's analysis. However, these cost rates still understate the Company's common equity cost rate because they do not reflect any adjustments for the Company's greater credit or unique business due to its smaller relative size as will be discussed below.

VII. Credit Risk Adjustment

Q. DOES YOUR CORRECTION EITHER TO MR. PARCELL'S OR MR. CASSIDY'S COMMON EQUITY COST RATE ANALYSES ADEQUATELY REFLECT THE RISK IMPLICATIONS OF AWC'S GREATER CREDIT RISK RELATIVE TO THEIR PROXY GROUP?

A. No. As discussed in my Direct Testimony at page 42, line 21 through page 43, line 26, if AWC's bonds were rated by Moody's and / or S&P, they would likely be rated in the Baa / BBB bond (or long-term issuer credit) rating category, specifically Baa2 /

BBB. In contrast, the average Moody's and S&P bond ratings for their proxy group are A2 / A3 and A, respectively, as shown on page 15 of Exhibit PMA-R32[41].

Consequently, AWC experiences greater credit risk than the proxy group on average. Consistent with the financial principle of risk and return discussed above, the cost of common equity derived from the market data of the proxy group must be adjusted to reflect AWC's greater credit risk relative to the proxy group because the market data for the proxy group reflects the lower credit risk.

As discussed on page 43, lines 22-26 of my Direct Testimony, an indication of the magnitude of the necessary upward adjustment to reflect the greater credit risk inherent in AWC's likely Baa2 Moody's bond (long-term issuer credit) rating is five-sixths of a three-month, ending January 2016, average spread between Moody's A and Baa2 rate public utility bond yields of 1.20% or 1.00% as shown on Exhibit PMA-R17.

VIII. Business Risk Adjustment

Q. DOES YOUR CORRECTION EITHER TO MR. PARCELL'S OR MR. CASSIDY'S COMMON EQUITY COST RATE ANALYSES ADEQUATELY REFLECT THE RISK IMPLICATIONS OF AWC'S SMALL SIZE RELATIVE TO THE PROXY GROUP?

A. No. As discussed in my Direct Testimony at page 21, line 21 through page 22, line 15 and again at 44, line 5 through page 45, line 19, relative company size is a significant element of business risk for which investors expect to be compensated through greater returns. Smaller companies are simply less able to cope with significant events which affect sales, revenues and earnings.

For example, smaller companies face more risk exposure to business cycles and economic conditions, both nationally and locally. Additionally, the loss of revenues from a few larger customers would have a greater effect on a small

[41] Since Artesian Resources Corp. has not been assigned a long-term issuer rating by Moody's or S&P, the average bond ratings for Mr. Parcell's and Mr. Cassidy's water proxy group is the same as those for my water proxy group.

company than on a much larger company with a larger, more diverse, customer base. Moreover, smaller companies are generally less diverse in their operations and have less financial flexibility. In addition, extreme weather conditions, i.e., prolonged droughts or extremely wet weather, will have a greater affect upon a small operating water utility than upon the much larger, more geographically diverse holding companies.

Further evidence of the risk effects of size include the fact that investors demand greater returns to compensate for the lack of marketability and liquidity of the securities of smaller firms. It is a generally-accepted financial principle that the risk of any investment is directly related to the assets in which the capital is invested. The Commission should focus on the risk and return on the common equity investment in the Company's jurisdictional rate base because it is the Company's rates which will be set in this proceeding. The fair rate of return must relate to where capital is invested. In other words, it is the use of funds invested and not the source of those funds which gives rise to the risk of any investment. Therefore, the relevant risk reflected in the cost of capital must be that of the Company, including the impact of its small size on common equity cost rate.

As noted above, the Company is significantly smaller than the average water proxy group company based on total capitalization. Consistent with the financial principle of risk and return discussed above, such increased risk due to small size must be taken into account in the allowed rate of return on common equity.

Q. DOES THE FINANCIAL LITERATURE SUPPORT THE BASIC FINANCIAL PRINCIPLE THAT IT IS THE USE OF THE FUNDS INVESTED WHICH GIVES RISE TO THE RISK OF THE INVESTMENT, NOT THE SOURCE OF THESE FUNDS?

A. Yes. As Richard A. Brealey and Stewart C. Myers state in Principles of Corporate Finance[42]:

> *But the company cost of capital rule can also get a firm into trouble if the new* projects *are more or less risky than its existing business. Each project should be evaluated at its own opportunity cost of capital.* This is a clear implication of the value-additivity principle introduced in Chapter 7. For a firm composed of assets A and B, the firm value is
>
> Firm Value = PV (AB) = PV (A) + PV(B) = sum of separate asset values
>
> Here PV(A) and PV(B) are valued just as if they were mini-firms in which stockholders could invest directly ...If the firm considers investing in a third project C, it should also value C as if C were a mini-firm. *That* is, the firm should discount the cash flows of C at the expected rate of return that investors would demand to make a separate investment in C. *The true cost of capital depends on the use to which the capital is put.* (Italics added to first paragraph, italics in original text in last paragraph) (Pages 5-6 of Exhibit PMA-R11)

In addition, Haim Levy and Marshall Sarnat[43] state:

> The cost of capital and the discount rate are two concepts which are used throughout the book interchangeably. However, there is a distinction between the *firm's* cost of capital and specific *project's* cost of capital. (Italics contained in original text.) (Pages 3-4 of Exhibit PMA-R18)
>
> In any case where the risk profile of the individual projects differ from that of the firm, an adjustment should be made in the required discount rate, to reflect this deviation in the risk profile.

It is fundamental that individual investors expect a return commensurate with the risk associated with where their capital is invested. Hence, the Company must be viewed on its own merits. As *Bluefield* so clearly states:

> "A public utility is entitled to such rates as will permit it to earn a return on the value of the property which it employs for the convenience of the public equal to that generally being made at the same time and in the same general part of the country on investments in other business undertakings which are attended by corresponding risks and uncertainties; ..."

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[42] Richard A. Brealey and Stewart C. Myers, Principles of Corporate Finance (McGraw-Hill Book Company, 1996) 204-205.

[43] Haim Levy and Marshall Sarnat, Capital Investments and Decisions, 5th Ed. (Prentice/Hall International, 1986) 464-465.

Bluefield is clear, then, that it is the "risks and uncertainties" surrounding the property employed for the "convenience of the public" which determines the appropriate level of rates and not the source of the capital financing that property. In this proceeding, the property employed "for the convenience of the public" is the rate base of the Company. Therefore, it is the total investment risk of the Company and its rate base alone that is relevant.

Q. PLEASE COMPARE THE SIZE OF THE COMPANY WITH THAT OF MR. PARCELL'S AND MR. CASSIDY'S PROXY GROUPS.

A. Exhibit PMA-R19 shows AWC's total capitalization at year-end 2014 of approximately $162 million, relative to the average total capitalization of $2.099 billion for Mr. Parcell's and Mr. Cassidy's proxy group, indicating greater business risk for AWC relative to the proxy group.

Once again, consistent with the basic financial principle of risk and return discussed above, such increased risk due to small size must be taken into account in the allowed rate of return on common equity. Because the total capitalization of my proxy group of eight water companies at year-end 2014 was $2.229, very similar to that of Mr. Parcell's and Mr. Cassidy's proxy group, the same business risk adjustment I made in my Direct Testimony, 0.50%, is a reasonable adjustment to make to the corrected analyses of Mr. Parcell and Mr. Cassidy.

In view of the foregoing, a 1.00% credit risk adjustment and a 0.50% risk adjustment due to AWC's smaller relative size are necessary. When added to a corrected common equity cost rate of 10.08% for Mr. Parcell and 10.09% for Mr. Cassidy, risk-adjusted common equity cost rates of 11.58%[44] result for Mr. Parcell and 11.59%[45] for Mr. Cassidy, respectively. A common equity cost rate of 11.58% is significantly higher than Mr. Parcell's recommended range of common equity cost rate

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[44] 11.58% = 10.08% + 1.00% + 0.50%.

[45] 11.59% = 10.09% + 1.00% + 0.50%.

of 8.60% - 9.50% (midpoint of 9.05%). In addition, a common equity cost rate of 11.59% is significantly higher than Mr. Cassidy's recommended common equity cost rate of 8.95%.

IX. Response to Mr. Parcell's and Mr. Cassidy's Comments on AWC's Cost of Capital Testimony

a. Capital Asset Pricing Model ("CAPM") and Risk Premium Model ("RPM")

Q. PLEASE COMMENT ON MR. PARCELL'S TESTIMONY ON PAGE 33, LINES 2-8, REGARDING YOUR APPLICATION OF THE PRPM.

A. Mr. Parcell states the PRPM is "a relatively new type of risk premium approach," that it "is new and untried" and that its results are a "higher cost of equity result."

Although the name, PRPM, may appear to be relatively new[46], the process of calculating the premiums is not, as discussed below. In addition, While the PRPM is new relative to the DCF and CAPM, as discussed in my Direct Testimony at page 29, line 18 through page 31, line 2, the PRPM is based on the work of Robert F. Engle who shared the Nobel Prize in Economics in 2003 "for methods of analyzing economic time series with time-varying volatility,"[47] based, in part, upon Engle's research which culminated in "Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model", *Econometrica*, (Engle, R.F., Lilein, D., & Robins, R.) (1987). Note that the development of the GARCH methodology and Dr. Engle's Nobel Prize in Economics predate our article by approximately eight (8) years, with Dr. Engle's original work beginning in the early 1980s. Hence, the methodology is not "relatively new." In addition, the GARCH methodology has been well tested by academia, since Engle's, et al research was originally published in 1987, nearly thirty (30) years ago. We use the well-established GARCH methodology to estimate the PRPM model using

[46] The name, PRPM, was first published in December 2011 in Autoregressive Conditional Heteroskedasticity. See "A New Approach for Estimating the Equity Risk Premium for Public Utilities," Pauline M. Ahern, Frank J. Hanley and Richard A. Michelfelder, Ph.D. The Journal of Regulatory Economics (December 2011), 40:261-278.

[47] www.nobelprize.org

a standard commercial and relatively inexpensive statistical package, Eviews©[48] to develop a means by which to estimate a predicted equity risk premium which, when added to a bond yield, results in a cost of common equity.

In addition, the PRPM, is in the public domain, having been published twice in academically peer reviewed journals, *The Journal of Regulatory Economics* (December 2011) and *The Electricity Journal* (May 2013), neither of which have been rebutted in the academic literature.

The PRPM has also been presented to a number of utility industry / regulatory / academic groups including the following as noted in Appendix A to my Direct Testimony: The Edison Electric Institute Cost of Capital Working Group; The NARUC Staff Subcommittee on Accounting and Finance; The National Association of Water Companies Finance / Accounting / Taxation and Rates and Regulations Committees; the NARUC Water Committee; The Wall Street Utility Group; the Indiana Utility Regulatory Commission Cost of Capital Task Force; the Financial Research Institute of the University of Missouri Hot Topic Hotline Webinar; and the Center for Research and Regulated Industries Annual Eastern Conference on two occasions. More recently, the PRPM was presented to the Asset Supervision and Administration Commission of the State Council of the Peoples Republic of China.

The PRPM also formed the basis of "Comparative Evaluation of the Predictive Risk Premium Model™", a follow-up article to the original "A New Approach for Estimating the Equity Risk Premium for Public Utilities" (co-authored with Richard A. Michelfelder, Ph.D., Rutgers Univ., Dylan W. D'Ascendis and Frank J. Hanley (both then with AUS Consultants) published in The Electricity Journal, May 2013).

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[48] In addition to EViews®, the GARCH methodology can be applied and the PRPM derived using other standard statistical software packages as SAS, RATS, S-Plus and JMulti, which are not cost-prohibitive. The software that I used in this proceeding Eviews®, currently costs $525.00 for a single user commercial license[48]. In addition, JMulti is a free downloadable software with GARCH estimation applications.

In addition, the PRPM has been presented in nearly 60 rate cases before 23 regulatory commissions in the U.S. and Canada since early 2012.

Q. ON PAGE 42, LINE 17 THROUGH PAGE 44, LINE 17 OF HIS DIRECT TESTIMONY, MR. CASSIDY CITES STEPHEN G. HILL'S ORAL SURREBUTTAL IN DOCKET NO. 2013-00362, RE: MAINE WATER COMPANY – CAMDEN & ROCKLAND DIVISION (MAINE WATER) BEFORE THE MAINE PUBLIC UTILITIES COMMISSION. PLEASE COMMENT.

A. Specifically, Mr. Cassidy paraphrases Mr. Hill's oral surrebuttal testimony regarding the PRPM at page 43, line 7 through page 44, line 3. On lines 7-10 on page 44 claims that "at no time did Ms. Ahern take exception to the criticism leveled against the PRPM™ by Mr. Hill."[49]

Before I address his paraphrasing of Mr. Hill's oral testimony, I need to clarify the record in that proceeding. By noting that I did not take exception to Mr. Hill's criticism, Mr. Cassidy is demonstrating both a lack of understanding about rate case procedural schedules as well a lack of understanding of what the transcript of that proceeding actually says. In Docket No. 2013-00362, the Maine Water proceeding, the company filed its direct case without filing rate of return testimony. Mr. Hill then filed his direct testimony with his rate of return recommendation. After Mr. Hill's direct testimony was filed, I was engaged to prepare written rebuttal testimony in response. It is to this rebuttal testimony that Mr. Hill presented oral surrebuttal testimony at evidentiary hearings. I did not have the opportunity to respond to Mr. Hill's oral surrebuttal testimony because I was excused after my oral rebuttal testimony, which preceded Mr. Hill's oral direct testimony as well as his oral surrebuttal testimony. There was no provision for rejoinder by the Company, i.e., by me. This is clear from reading the complete transcript[50]. This mischaracterization of the Maine Water

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[49] Note that the PRPM is no longer trademarked.

[50] Docket No, 2013-00362 re: Maine Water Company – Camden & Rockland Division, Maine Public Utilities Commission, Hearing Transcript, January 14, 2014. (See Exhibit PMA-R20)

proceeding only serves to confuse the record regarding the reasonableness of the PRPM.

Q. DO YOU HAVE ANY COMMENTS ON MR. CASSIDY PARAPHRASING OF MR. HILL'S ORAL SURREBUTTAL IN DOCKET NO. 2013-00362?

A. Yes. First, I would note that Mr. Cassidy did not conduct any research of his own whatsoever regarding Mr. Hill's claims. I will respond to Mr. Hill's claims point by point.

> 1. "The threshold question to be asked when a new cost of equity estimation model is introduced is whether it provides a reasonable estimate of the COE, and the PRPMTM model developed by Ms. Ahern and her former AUS colleagues fails to pass this threshold test because it **overstates** the COE." (lines 7-8, page 43 of Mr. Cassidy's Direct Testimony.

This statement is merely the opinion of a single witness, Mr. Hill, for which no academic, empirical evidence was provided in support.

> 2. "Unlike the DCF and CAPM models, both of which are based on financial economics, the PRPMTM is based on **behavioral economics**." (line 10, page 43 of Mr. Cassidy's Direct Testimony)

Mr. Hill seems to confuse the term "behavioral economics" with "behavioral finance." All cost of common equity models (DCF, CAPM, RPM) are an attempt to emulate, predict, or mathematically quantify investor behavior, as they are social sciences. The difference between the models is what each model uses to emulate, predict or quantify that behavior, i.e., decision making. The PRPM is based on classic valuation theory. As discussed in my Direct Testimony at lines 18-21 on page 29, the PRPM was developed from the work of Robert F. Engle, who shared the Nobel Prize in Economics in 2003, "for methods of analyzing economic time series with time-varying volatility ("ARCH")"[51] (with "ARCH" standing for autoregressive conditional heteroskedasticity). Engle's work began in the early 1980s[52] and continued with his

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[51] www.nobelprize.org.

[52] Robert F. Engle, "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, Volume 50, Issue 4 (Jul., 1982), 987 – 1008. (See Exhibit PMA-R21).

1987 article[53] which formed the basis of the article I co-authored[54]. In a simplifying article, Engle, explained how ARCH/GARCH models can be used in practice, concluding on page 167 (page 11 of Exhibit PMA-R24)[55]:

> ARCH and GARCH models have been applied to a wide range of time series analyses, but applications in finance have been particularly successful and have been the focus of this introduction. Financial decisions are generally based upon the tradeoff between risk and return; the econometric analysis of risk is therefore an integral part of asset pricing, portfolio optimization, option pricing and risk management. This paper has presented an example of risk measurement that could be the input to a variety of economic decisions. The analysis of ARCH and GARCH models and their many extensions provides a statistical stage on which many theories of asset pricing and portfolio analysis can be exhibited and tested.

The recent development of "behavioral finance" is well explained by Jeremy J. Siegel who notes in his book Stocks for the Long Run[56]:

> The finance profession is increasingly aware that psychological factors can thwart rational analysis and prevent investors from achieving the best results for their portfolio. The study of these psychological factors has burgeoned into the field of behavioral finance. (italics in original) (page 2 of Exhibit PMA-R25)

As stated previously, the PRPM is based on classic financial theory, not upon psychological factors that deter investors from achieving the best results for their portfolios. Mr. Hill's concern is misplaced.

3. "Behavioral economics is used to measure a "utility function," **not** a 'dollar return function;'." (line 11, page 43 of Mr. Cassidy's Direct Testimony)

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[53] Robert F. Engle, David M. Lilien, and Russell P. Robins, "Estimating Time Varying Risk Premia in the Term Structure, The ARCH-M Model", *Econometrica*, Volume 55, No. 2 (March 1987), 391 – 407. (See Exhibit PMA-R22).

[54] Pauline M. Ahern, Frank J. Hanley and Richard A. Michelfelder, Ph.D., "A New Approach for Estimating the Equity Risk Premium for Public Utilities", *The Journal of Regulatory Economics* (December 2011), 40:261-278 (See Exhibit PMA-R23).

[55] Robert Engle, "GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics", *Journal of Economic Perspectives*, Volume 15, Number 4, Fall 2001, 157 – 168.

[56] Jeremy J. Siegel, Stocks for the Long Run | The Definitive Guide to Financial Market Returns and Long-Term Investment Strategies, 3rd Ed., McGraw-Hill, 2002 315.

Mr. Hill is incorrect as utility functions are basic to both classic economic and financial theory. Walter Nicholson notes in his text, Microeconomic Theory | Basic Principles and Extensions[57] (pages 5-6 of Exhibit PMA-R26):

> Given the assumptions of completeness, transitivity, and continuity, it is possible to show formally that people are able to rank order all possible situation from the least desirable to the most.[1] (footnote omitted) Following the terminology introduced by the nineteenth-century political theorist Jeremy Bentham, economists call this ranking *utility*.[2] We also will follow Bentham by saying that more desirable situation off more utility than do less desirable ones. That is, if a person prefers situation *A* to situation *B*, we would say that the utility assigned to option *A*, denoted by *U(A)*, exceeds the utility assigned to *B*, (*U(B)*.
>
> [2]J. Bentham, *Introduction to the Principles of Morals and Legislation* (London: Hafner, 1848).

4. "The PRPMTM utilizes a historical data set of monthly returns and **assumes that investors are buying and selling the market every month**." (lines 11-12, page 43 of Mr. Cassidy's Direct Testimony)

Because the PRPM uses a historical data set of actual monthly stock returns based on the pricing decisions of the aggregate investor, it makes no assumption concerning the pattern of investors' collective buying and selling. The actual monthly stock returns are based on observed market returns. GARCH methodology is merely a statistical tool with which to analyze the pattern of the volatility, or variance, in observed returns and equity risk premiums. And because of that pattern identified by Engle in historical returns and equity risk premiums, GARCH can be used to estimate predicted volatility, or variances, and hence returns and equity risk premiums.

5. "In using the PRPM™ to estimate the cost of equity for utility companies, Ms. Ahern improperly assumes that utility stocks are **not** defensive stocks." (lines 13-14, page 43 of Mr. Cassidy's Direct Testimony)

[57] Walter Nicholson, Microeconomic Theory | Basic Principles and Extensions, 8th Edition (South-Western | Thomson Learning 2002) 66 – 67.

This statement is meaningless without the context of the entire article from which it was supposedly taken. In "A New Approach for Estimating the Equity Risk Premium for Public Utilities", my co-authors and I state that:

> "...several conclusions can be drawn from the general model of asset pricing... Third, hedging assets have desired patterns of volatility that result in expected rates of return that are less than the risk-free rate. We do not expect that public utility stocks serve as a hedging asset as they are not viewed as defensive stocks (they do not rise in value during downturns in the stock market) due to asymmetric regulation and returns as discussed in detail in Kolbe and Tye (1990). Under asymmetric regulation, utility regulators have a tendency to allow the return on equity to fall below the allowed return during downturns in the business cycle and to reduce the return should it rise above the allowed return during expansions. Therefore we expect that the parameter estimates of the return-risk relationship to be positive as utility stocks are hypothesized to not be hedges.
>
> * * *
>
> The model is tested to...ascertain whether utility stocks are assets that hedge shocks to the marginal utility of consumption.
>
> If utility stocks area hedging assets then the cost of common equity should reflect a downward adjustment to a specific risk-free rate to reflect investors' preferences for a hedge and the consumption that they are willing to pay for it.
>
> * * *
>
> Finally, the robust empirical evidence on the positive risk-return relationship also shows that utility stocks are not a consumption hedge and are not good hedging securities against contractions in the economy. The model and estimation methodology presented in this paper provide a relatively simple tool to determine whether any asset is a hedge to adverse changes in the business cycle through the level of consumption in the economy."[58]

Thus, the concept of utility stocks as defensive stocks during downturns in the stock market is not based on the co-authors research, but is based on the research and conclusions of Kolbe and Tye and was tested for by the co-authors. It was found that utility stocks are not a consumption hedge against contractions in the economy. The co-authors make no conclusion as to the defensive nature of utility stocks relative to stock market movements.

[58] Ahern, Hanley, Michelfelder 265 – 267, 277. (See pages XX of Exhibit PMA-R23

6. "The PRPM™ is a consumption-based asset pricing model subject to statistical GARCH analysis, and there are **three general problems** associated with such models:

a) Changes in conditional variance are much **more dramatic** when utilizing daily or **monthly data**, and much weaker at lower frequencies (i.e., the stock price volatilities obtained by Ms. Ahern when using monthly data are much more pronounced than had she utilized yearly data):
b) Forecasts of excess stock returns do not move proportionally with estimated of conditional variance – Ms. Ahern's PRPM™ analysis assumes that conditional variance determines stock price movements, but research shows that this is not the case; and
c) There is little evidence of cyclical variation and consumption volatility that could explain the variation in stock market volatility." (line 15, page 43 through line 3, page 44 of Mr. Cassidy's Direct Testimony)"

It is true that changes in conditional variance are greater utilizing monthly data than when using less frequent, i.e., quarterly or annual, observations. However, since the cost of capital, including the cost of common equity, is a function of investor expectations of risk as discussed above, to use less frequent data would serve to dampen the true volatility of historical stock returns and equity risk premiums, similar to the manner in which a geometric mean historical stock return over a long period of time does not reflect any of the volatility of those returns.

Exhibit PMA-R27 charts the predicted (using the GARCH methodology) and the actual market equity risk premiums over the income return on long-term U.S. Treasury bonds from 1936-2015. It is clear that the volatility pattern of the predicted equity risk premiums is nearly identical to the volatility pattern of the historical equity risk premiums.[59] Mr. Hill in comments in a) and b) above are incorrect.

In view of all of the foregoing, namely that the citation from Mr. Hill's oral testimony in Docket No. 2013-00362 is incorrect and unsubstantiated, the

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[59] Because the predicted equity risk premiums are derived from the predicted variance – squared, they will always be positive, but their magnitude will mimic that of the actual equity risk premiums.

Commission should disregard Mr. Cassidy's "insightful tutorial as to the reasons why…the PRPM™ should not be adopted in a regulatory rate proceeding."

Q. DO YOU HAVE A RESPONSE TO MR. CASSIDY'S CRITICISM REGARDING THE TRADING HISTORY OF YORK WATER COMPANY ("YORW")?

A. Yes. Mr. Cassidy's basic premise is that YORW was founded in 1816 with publicly traded common stock for 200 years. Mr. Cassidy, however, omits the fact that, before YORW was first listed on the NASDAQ in January of 2001, YORW's common stock was sold over-the-counter and a very low volume stock.

Q. DOES YORW HAVE A SUBSTANTIAL TIME SERIES HISTORY OF STOCK RETURNS AFTER ITS INCLUSION IN THE NASDAQ?

A. Yes. Ms. Cassidy implies that my use of YORW data from February 2001 through May 2015 is inconsistent with the article he quotes from *The Journal of Regulatory Economics* cited above and my "acknowledgement" that the PRPM "*requires a substantial time series history on stock returns data to develop stable estimates of risk premia.*" (See lines 17-18 on page 46 of his Direct Testimony) Once again, Mr. Cassidy is taking a statement out of context. The full citation should read[60]:

> "...the model requires a substantial time series history on stock returns data to develop stable estimates of risk premia. This is problematic especially for the electric and gas utility industries that have consolidated with many mergers in the recent past."

Since YORW has not been a participant in a merger or acquisition, the statement is not applicable to YORW. Moreover, the 172 month period from February 2001 through May 2015 greatly exceeds the 39 equity risk premium observations Mr. Cassidy utilized exclusively in his CAPM analysis.

In view of all the foregoing, Mr. Cassidy's criticisms are invalid and without merit.

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[60] Ahern, Hanley, Michelfelder 277.

Q. HOW DO YOU RESPOND TO MR. CASSIDY'S COMMENTS ON PAGE 47, LINES 15-17 OF HIS DIRECT TESTIMONY SAYING THAT YOU WERE NOT RESPONSIVE IN RESPONSE TO RUCO 2.08.

A. Once again, Mr. Cassidy mischaracterizes my statements. My response to RUCO 2.08, provided as part of Mr. Cassidy's Attachment 4, was indeed responsive as in part (i) I made myself, my staff and the Eviews® software available in person or by webinar to demonstrate how the data were used to generate the predicted equity risk premiums using the GARCH methodology. From the submission of the response up until the day of this filing, Mr. Cassidy has not reached out to AWC or to me to make arrangements for such a demonstration. In addition, while the requested inputs used to compute the PRPM derived predicted risk premiums was not provided in response to RUCO 2.08 (ii), they were provided in response to RUCO 2.01 to which RUCO was referred in my response to RUCO 2.08 (ii) which states: "Please refer to Ms. Ahern's response to RUCO 2.01 Cost of Capital Work Papers."

Moreover, Mr. Cassidy had ample time between the time of the submission of the response to RUCO 2.08 (November 30, 2015) and the time of the filing of his Direct Testimony (March 11, 2016) to avail himself of the opportunity I provided in response to RUCO 2.08. Mr. Cassidy cannot state that I did not provided the information requested, just because he did not take advantage of the opportunity provided in response to RUCO 2.08. Moreover, the GARCH methodology is available in various statistical packages such as EViews®, SAS, RATS, S-Plus and JMulti, which are not cost-prohibitive and provide instructions for using the various statistical methodologies in their software. The software that I used in this proceeding currently costs $525.00 for a single user commercial license[61]. In fact, JMulti is a free downloadable software with GARCH estimation applications.

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[61] http://www.eviews.com/general/prices/prices.html

Mr. Cassidy's comments in "closing the issue" on the PRPM are unsupported, without merit and should be disregarded.

Q. ON PAGE 48, LINES 15-16, OF HIS DIRECT TESTIMONY, MR. CASSIDY ALSO CRITICIZES YOUR USE OF BLOOMBERG BETAS IN YOUR CAPM ANALYSIS. PLEASE COMMENT.

A. Like much of his testimony, as explained by Mr. Reiker, Mr. Cassidy provides absolutely no support for his criticism of Bloomberg betas other than his opinion that they lead "to an overstatement to the beta component" in a CAPM analysis.

It is understandable that Bloomberg betas would differ from *Value Line* betas as they are calculated over different time periods. Both *Value Line* and Bloomberg betas are calculated weekly using via an Ordinary Least Squares ("OLS") regression with *Value Line* using the New York Stock Exchange Index ("NYSE") and Bloomberg using the S&P 500. *Value Line* calculates its betas over a five-year period, while Bloomberg calculates theirs over a two-year period. The differences observed between *Value Line* and Bloomberg betas may be attributed to use of different market indices to calculate the betas and the fact that short-term events could have a larger effect on the beta calculation over a two-year time period than over a five-year time period in one direction of the other.

Therefore, at times, depending upon different market conditions that may have been experienced over any recent two and five year periods, *Value Line* betas may be higher or lower than Bloomberg betas. Events and market conditions over five years may not reflect current conditions, in which case the Bloomberg methodology gives greater weight to more current conditions. Averaging Bloomberg betas with *Value Line* betas mitigates those effects.

Regardless of how Bloomberg betas are calculated, Mr. Cassidy provides no evidence, other than his opinion, that Bloomberg betas are not suitable for a CAPM analysis.

Q. ON PAGE 33, LINE 16 THROUGH PAGE 4, LINE 2 OF HIS DIRECT TESTIMONY, MR. PARCELL CRITICIZES YOUR USE OF THE 13.22% EXPECTED RETURN ON THE S&P 500 TO DEVELOP A MARKET RISK PREMIUM. LIKEWISE, MR. CASSIDY ALSO CRITICIZES YOUR DEVELOPMENT OF A MARKET RISK PREMIUM BASED ON THE EXPECTED RETURN ON THE S&P 500 ON PAGE 49, LINES 1-2 OF HIS DIRECT TESTIMONY. PLEASE COMMENT.

A. As discussed in my Direct Testimony at page 35, lines 19-24, I have applied the expected returns on the broad market, as calculated by the market capitalization-weighted DCF results for the S&P 500 based on expected earnings growth. Neither Mr. Parcell nor Mr. Cassidy provide any rationale for their criticism other than stating their opinion that the S&P 500 expected return of 13.22% (Mr. Parcell) and the market equity risk premium based on that return, 9.53% (Mr. Cassidy) are either well above the S&P 500's historical returns of 12.0% or less (Mr. Parcell) or that the premium far exceeds the others (Mr. Cassidy).

One means of assessing the reasonableness of the 13.22% estimate is to view it in the context of historical returns. Please see page 2 of Exhibit PMA-R12, discussed previously, which is a histogram of observed market returns in the U.S. from 1926 to 2015. As the histogram demonstrates, the expected return derived from the constant growth DCF model applied to the broad market is quite consistent with historical experience. The 13.22% expected return on the U.S. markets, i.e., S&P 500, for example, falls in the 48th percentile of observed returns. Given the historical 1926-2014 standard deviation of approximately 20.2%, my estimate is well within the bounds of a reasonable range being within 2.13 standard errors of the long-term average of the historical returns of approximately 12.0%.

Q. ON PAGE 34, LINES 6-22 OF HIS DIRECT TESTIMONY, MR. PARCELL CRITICIZES YOUR USE OF THE HOLDING PERIOD RETURNS PUBLISHED IN SBBI – 2015. PLEASE COMMENT.

A. Mr. Parcell's criticism of the long-term average holding period returns for the period 1926-2014 is invalid for the reasons given by Ibbotson Associates in its SBBI – 2015 discussed above on pages 153-154 of SBBI – 2015 (pages 5-6 of Exhibit PMA-R8). Mr. Parcell states on lines 6-8 on page 34 of his Direct Testimony that "use of total stock returns over the 1926-2014 period, in connection with bond yields over the same long period, seems to imply that investors in 2016 expect such relationships to be the same".

More than ever, given the recent deep recession experienced by the U.S. and international markets from which the U.S. and the world are still recovering in a relatively slow and faltering manner, unprecedented low interest rate levels, in light of unprecedented levels of unemployment, etc., an appreciation of what can occur over the long historical period of 1926-2014 is relevant and necessary for investors in formulating their expectations. At the present time, it is still unclear how rapidly, smoothly or persistently the current fledgling recovery will be. Hence, SBBI – 2015's following words are more relevant than ever[62]:

> It is even difficult for economists to predict the economic environment of the future. For example, if one were analyzing the stock market in 1987 before the crash, it would be statistically improbable to predict the impending short-term volatility without considering the stock market crash and market volatility of the 1929-1931 period.
>
> Without an appreciation of the 1920s and 1930s, no one would believe that such events could happen. ... Finally, because historical event-types (not specific events) tend to repeat themselves, long-run capital market return studies can reveal a great deal about the future. Investors probably expect "unusual" events to occur from time to time and their expectations reflect this. (Page 8 of Exhibit PMA-R8)

[62] SBBI – 2015 153 – 154.

I would also note that Mr. Parcell himself relied on the SBBI 2015 long-term holding period returns in arriving at his conclusion of the expected total return for the large company common stocks for use in his application of the CAPM, coupled with historically earned returns on the S&P 500 from 1978-2014.

In addition, the use of the long-term arithmetic mean by Mr. Parcell (in part only) and me is consistent with the long-term investment horizon of utilities' common stock. The typical application of the DCF model used in regulation presumes an infinite, i.e., long-term, investment horizon and a constant growth rate. This presumption of a constant growth rate is no different than the presumption of a constant equity risk premium based on long-term historical holding period returns. Both must be expectationally constant.

As stated above, the foregoing confirms that the RPM is similar to the DCF model. The use of a very long-term historic mean equity risk premium does not mean that it is actually constant from year to year in order for the model to be valid. The equity risk premium may vary randomly around some average expected value. Therefore, in view of the foregoing as well as Mr. Parcell's own use of long-term historic mean holding period returns, his criticisms of my use of such returns are unfounded, invalid, and should be disregarded.

Q. ON PAGE 35, LINES 3-16 OF HIS DIRECT TESTIMONY, MR. PARCELL CRITICIZES YOUR USE OF PROSPECTIVE INTEREST RATES IN BOTH YOUR RPM AND CAPM ANALYSES. LIKEWISE, MR. CASSIDY CRITICIZES YOUR USE OF A PROSPECTIVE RISK-FREE RATE ON PAGE 40, LINE 19 THROUGH PAGE 41, LINE 7 OF HIS DIRECT TESTIMONY. PLEASE RESPOND.

A. Since I have previously addressed why the use of prospective interest rates is consistent with the basic precepts of utility regulation and the expectational nature of the cost of capital, I will not repeat that discussion here.

However, Mr. Parcell is incorrect that the "[u]se of the current yield in a DCF context is similar to using the current risk-free rate in a CAPM context" (lines 11-35 on page 30 of Mr. Parcell's Direct Testimony). However, none of the witness in this proceeding use a current dividend yield in our applications of the DCF model -- all use an adjusted, or projected, yield, which is the current yield times one plus one-half the expected growth rate.

Therefore, the use of a dividend yield adjusted for expected, or prospective, growth in the DCF context is not similar to the use of current interest rates in the RPM and CAPM contexts. However, the use of a dividend yield adjusted for expected, or prospective, growth in a DCF context is indeed similar to the use of projected interest rates in the RPM and CAPM contexts.

Note, also, that Mr. Parcell is incorrect when he states that I have cited the "efficient market hypothesis" in my Direct Testimony. A review of my Direct Testimony will find that the phrase does not appear anywhere in the text.

In view of the foregoing, projected interest rates should be used in both the RPM and CAPM.

Q. ON PAGE 36, LINES 4-8 OF HIS DIRECT TESTIMONY, MR. PARCELL "DISAGREES" WITH YOUR ECAPM. SIMILARLY, ON PAGE 49, LINE 14, MR. CASSIDY STATES THAT YOUR ECAPM RESULTS "SHOULD NOT BE RELIED ON." PLEASE COMMENT.

A. Mr. Parcell criticizes the use of the ECAPM because he claims it "ignores the actual betas of the proxy utilities, and, instead, assigns hypothetical betas to them" on page 36, lines 7-8 of his Direct Testimony. Similarly, Mr. Cassidy claims that "the ECAPM beta adjustment is an unnecessary redundancy which only serves to overstate the cost of equity" on page 50, lines 1-2 of his Direct Testimony. Both of these "claims" demonstrate a lack of understanding of the ECAPM.

Some analysts, including Mr. Parcell and Mr. Cassidy as noted above, claim that using adjusted betas in a CAPM analysis addresses the empirical issues with the CAPM, discussed above, by increasing the expected returns for low beta stocks and decreasing the returns for high beta stocks, concluding that there is no need to use the ECAPM. I disagree. The use of adjusted betas in a traditional CAPM is not equivalent to the use of the ECAPM.

As discussed above, betas are adjusted because of the general regression tendency of betas to converge toward 1.0 <u>over time</u>, i.e., over successive calculations of beta. As also noted above, numerous studies have determined that the SML described by the CAPM formula at <u>any given moment</u> in time is not as steeply sloped as the predicted SML. Morin states on page 13 of Exhibit PMA-R3:

> Some have argued that the use of the ECAPM is inconsistent with the use of adjusted betas, such as those supplied by Value Line and Bloomberg. This is because the reason for using the ECAPM is to allow for the tendency of betas to regress toward the mean value of 1.00 over time, and, since Value Line betas are already adjusted for such trend [sic], an ECAPM analysis results in double-counting. This argument is erroneous. Fundamentally, the ECAPM is not an adjustment, increase or decrease, in beta. This is obvious from the fact that the expected return on high beta securities is actually lower than that produced by the CAPM estimate. The ECAPM is a formal recognition that the observed risk-return tradeoff is flatter than predicted by the CAPM based on myriad empirical evidence. The ECAPM and the use of adjusted betas comprised two separate features of asset pricing. Even if a company's beta is estimated accurately, the CAPM still understates the return for low-beta stocks. Even if the ECAPM is used, the return for low-beta securities is understated if the betas are understated. Referring back to Figure 6-1, the ECAPM is a return (vertical axis) adjustment and not a beta (horizontal axis) adjustment. Both adjustments are necessary.[63]

Nor should the slope of the SML be confused with beta. As Eugene F. Brigham and Louis C. Gapenski state on page 5 of Exhibit PMA-R28:

> The slope of the SML reflects the degree of risk aversion in the economy – the greater the average investor's aversion to risk, then (1) the steeper is the slope of the line, (2) the greater is the risk premium for any risky asset, and (3) the higher is the required rate of return on risky assets.[12]

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[63] Morin 191.

> [12]Students sometimes confuse beta with the slope of the SML. This is a mistake. As we saw earlier in connection with Figure 6-8, and as is developed further in Appendix 6A, beta does represent the slope of a line, but *not* the Security Market Line. This confusion arises partly because the SML equation is generally written, in this book and throughout the finance literature, as $k_i = R_F + b_i(k_M - R_F)$, and in this form b_i looks like the slope coefficient and $(k_M - R_F)$ the variable. It would perhaps be less confusing if the second term were written $(k_M - R_F)b_i$, but this is not generally done.[64]

In addition, in Appendix 6A of Brigham and Gapenski's textbook, entitled "Calculating Beta Coefficients," Brigham and Gapenski also demonstrate that beta, which accounts for regression bias, is not a return adjustment but rather is based on the slope of a different line.

Hence, using adjusted betas does not address the previously discussed empirical issues with the CAPM. In view of the foregoing, using adjusted betas in both the traditional and empirical applications of the CAPM is not incorrect, nor inconsistent with the financial literature.

In view of theory and practical research, it is therefore appropriate to include the ECAPM when estimated the cost of common equity.

b. <u>Credit Risk Adjustment</u>

Q. ON PAGE 36, LINES 14-20 OF HIS DIRECT TESTIMONY, MR. PARCELL STATES THAT A "FINANCIAL RISK ADJUSTMENT" TO A COMMON EQUITY COST RATE BASED ON THE PROXY GROUP IS NOT "WARRANTED." PLEASE COMMENT.

A. Mr. Parcell claims that a credit risk adjustment, what he terms a financial risk adjustment, is not warranted because "AWC's cost of debt is fully recoverable through its COC and there is no justification for inflating its ROE." Mr. Parcell misses the point of such an adjustment to the cost of common equity based on the proxy group.

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[64] Eugene F. Brigham and Louis C. Gapenski, Financial Management – Theory and Practice, 4th Ed. (The Dryden Press, 1985) 201-204.

The point of the credit risk adjustment is that financial risk not only affects the cost of debt, which is fully recoverable (at least under Mr. Parcell's recommendation but not Mr. Cassidy's), but also the cost of common equity. As financial risk increases, common equity shareholders move farther back in line in any claim on the earnings and assets of a firm as debtholders are first in line. To compensate for being farther back in line, common shareholders require a higher rate of return.

Hence, because the proxy group, with an average Moody's long-term issuer rating of A2 / A3 as shown on page 15 of Exhibit PMA-R32, experiences less financial risk than AWC which, would likely be assigned a more credit risky Baa2 rating by Moody's if its bonds were rated. The market data of any proxy group upon which Mr. Parcell's and Mr. Cassidy's recommended common equity cost rates are based reflect the lower risk of the proxy group's higher long-term issuer rating.

Once again, consistent with the basic financial principle of risk and return, in order for the proxy group based common equity cost rate recommendations to be applicable to the risk profile of AWC, which includes both greater credit risk, due to its likely lower Moody's bond rating of Baa2, and greater business risk due to its smaller size relative to the proxy group, adjustments for both credit and business risk must be made.

Note too, that while AWC's cost of debt is fully recoverable though its cost of capital, should the Commission adopt Mr. Cassidy's recommended fictitious debt cost rate of 5.43%, AWC's full cost of debt, 6.82%, will not be recovered in AWC's cost of service, with the difference being paid by shareholders.

Q. ON PAGE 51, LINES 3-10, MR. CASSIDY CRITICIZES YOUR CREDIT RISK ADJUSTMENT. PLEASE COMMENT.

A. Mr. Cassidy's citation from the 1994 study by S. Brooks Marshall is misplaced and irrelevant, as I have not used bond ratings as criteria for selecting the companies in my proxy group. Rather, I have used the difference in the credit risk of AWC's likely bond (long-term issuer) rating of Baa2 by Moody's and the credit risk of Mr. Parcell's and Mr. Cassidy's proxy group average Moody's long-term issuer rating, A2 / A3.

As fully discussed in my Direct Testimony at page 42, line 21 through page 43, line 26, consistent with the basic financial principle of risk and return, the greater credit risk of AWC's likely bond (long-term issuer) rating must be reflected in any common equity cost rate derived from the market data of their proxy group which reflects the lower credit risk of an average A2 / A3 rating.

c. **Business Risk Adjustment**

Q. AT PAGE 36, LINE 24 THROUGH PAGE 39, LINE 16, OF HIS DIRECT TESTIMONY, MR. PARCELL CRITICIZES YOUR BUSINESS RISK ADJUSTMENT BASED ON SIZE, WHILE MR. CASSIDY DOES SO AT PAGE 51, LINE 15 THROUGH PAGE 53, LINE 16 OF HIS DIRECT TESTIMONY. HOW DO YOU RESPOND?

A. In support of their criticism, they both cite an article by Dr. Annie Wong. However, Dr. Wong's study is flawed because she attempts to relate a change in size to beta, while beta accounts for only a small percentage of diversifiable company-specific risk. Size is company-specific and therefore diversifiable. For example, as discussed previously the average R-squared, or coefficient of determination for their proxy group 0.1823 and for Mr. Parcell's and Mr. Cassidy's proxy group as shown on Exhibit PMA-R6 and discussed previously. An R-squared of 0.1823 means that approximately only 18.23% of total risk is *unexplained* by beta.

Q. IS THERE ANY PUBLISHED RESPONSE TO PROFESSOR WONG'S ARTICLE?

A. Yes. In response to Professor Wong's article, *The Quarterly Review of Economics and Finance* published an article in 2003, authored by Thomas M. Zepp which commented upon the Annie Wong article cited by Mr. Parcell and Mr. Cassidy. Relative to Ms. Wong's results, Dr. Zepp concluded in the Abstract on page 1 of his article.[65] "Her weak results, however, do not rule out the possibility of a small firm effect for utilities." (page 1 of Exhibit PMA-R29) Dr. Zepp also noted on page 5 that: "Two other studies discussed here support a conclusion that smaller water utility stocks are more risky than larger ones.

To the extent that water utilities are representative of all utilities, there is support for smaller utilities being more risky than larger ones." Note that Professor Wong's study, while relying upon a large group of gas and electric utilities, used no water utilities. Professor Wong's study is flawed because she attempts to relate a change in size to beta, while beta accounts for only a small percentage of diversifiable company-specific risk. Moreover size is company-specific and therefore diversifiable.

Q. ARE YOU AWARE OF ANY OTHER ACADEMIC ARTICLE RELATING TO THE APPLICABILITY OF A SIZE PREMIUM?

A. Yes. Exhibit PMA-R30 is an article by Michael A. Paschall, ASA, CFA and George B. Hawkins ASA, CFA, "Do Smaller Companies Warrant a Higher Discount Rate for Risk?"[66] As my Direct Testimony makes clear at page 14, lines 5-17, as well as the Paschall and Hawkins' article, all else equal, size is a risk factor which must be taken into account when setting the cost of capital or capitalization (discount) rate.

In this proceeding, all else is presumed to be equal in terms of the risk differential between AWC and the proxy water companies by both Mr. Parcell and Mr. Cassidy, as neither witness added any risk adjustments to the costs of equity they derived based on the market data of their respective proxy groups. Paschall and Hawkins state in their conclusion on page 14 of Exhibit PMA-R30:

> "The current challenge to traditional thinking about a small stock premium is a very real and potentially troublesome issue. The challenge comes from bright and articulate people and has already been incorporated into some court cases, providing further ammunition for the IRS. Failing to consider the additional risk associated with most smaller companies,

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[65] Zepp, Thomas M. "Utility Stocks and the Size Effect --- Revisited", The Quarterly Review of Economics and Finance, 43 (2003) 578-582.

[66] Michael A. Paschall, ASA, CFA and George B. Hawkins ASA, CFA, "Do Smaller Companies Warrant a Higher Discount Rate for Risk?", CCH Business Valuation Alert, Vol. 1, Issue No. 2, December 1999.

> however, is to fail to acknowledge reality. Measured properly, small company stocks have proven to be more risky over a long period of time than have larger company stocks. This makes sense due to the various advantages that larger companies have over smaller companies. Investors looking to purchase a riskier company will require a greater return on investment to compensate for that risk. There are numerous other risks affecting a particular company, yet the use of a size premium is one way to quantify the risk associated with smaller companies."

Hence, Paschall and Hawkins corroborate the need for a small size adjustment, all else equal.

Q. AT LINES 3-8 ON PAGE 37 OF HIS DIRECT TESTIMONY, MR. PARCELL STATES THAT IT IS "NOT PROPER" TO COMPARE THE SIZE OF AWC TO THE WATER PROXY COMPANIES. PLEASE COMMENT.

A. Mr. Parcell is incorrect because both he and I, as well as Mr. Cassidy, have based our respective recommended returns on common equity upon the market data of our respective groups of water companies. Since market prices reflect the investor perceived investment risk of the proxy companies and size is a risk factor as discussed in my Direct Testimony and previously in this rebuttal testimony, our respective recommended common equity cost rates reflect the risk associated with the average size of each proxy group. Since these recommendations, if adopted by the Commission, will be applied to the jurisdictional rate base of AWC, which is significantly smaller than either proxy group, an upward adjustment for relative risk difference, in this case size, must be made.

Q. ON PAGE 39, LINES 2-16 OF HIS DIRECT TESTIMONY AND IN SCHEDULE 14 OF EXHIBIT DCP-14, MR. PARCELL PROVIDES A "DEMONSTRATION" THAT "SIZE IS NOT NECESSARILY A FACTOR IN ASSESSING RISK." PLEASE COMMENT.

A. The summary of Mr. Parcell's Schedule DCP-14 provides very broad measures of risk which Mr. Parcell assumes show no discernible pattern of risk differential. However, Mr. Parcell has not relied on such empirical analyses of the size differentials as a risk factor such as those provided by Duff & Phelps ("D&P") in its <u>2015 Valuation</u>

Handbook – Guide to Cost of Capital – Market Results Through 2014 (2015 - D&P)[67]. D&P provide a more granular method for estimating the risk premiums associated with size differentials than the 10-decile premiums published by SBBI – 2014 Classic.

In Exhibit B-1 of Appendix 4 – Risk Premium Report Study Exhibits of 2015 – D&P and provided as page 2 of Exhibit PMA-R31, Duff & Phelps provide a formula with which to calculate a size risk premium specific to a specific company's or group's market value of equity. Using that formula, relative to the market value of equity and the five size categories summarized on page 16 of Mr. Parcell's prefiled direct testimony, indicates a clear relationship between size and equity risk premiums, ranging from a low of 1.39% for >$20B in market capitalization to a high of 4.75% for <$2B in market capitalization providing additional empirical evidence of a risk premium relative to size.

It is clear from that using the 2015 – D&P data that there is a risk differential as the size of the electric utilities decrease from large to small, empirically supporting the greater relative risk of smaller utilities. Thus, a small size adjustment is indeed justified and the Commission should adopt it when determining the appropriate return on equity applicable to AWC in this proceeding.

Q. ON PAGE 53, AT LINES 17-20 OF HIS DIRECT TESTIMONY, MR. CASSIDY ACKNOWLEDGES THAT EPCOR WATER ARIZONA ("EPCOR") AND AWC "RANK AS THE TWO LARGEST WATER UTILITY COMPANIES IN ARIZONA SUBJECT TO RATE REGULATION BY THE COMMISSION." IS THIS RELEVANT TO SETTING THE RETURN ON COMMON EQUITY FOR AWC IN THIS PROCEEDING?

A. No. Neither AWC nor EPCOR as "the two largest water utility companies in Arizona" is relevant to setting the return on common equity for either water company. The relevant comparison is the size of both AWC and EPCOR relative to the size of the

[67] Formerly published by Morningstar, Inc. as the Morningstar/Ibbotson *SBBI® Valuation Yearbook.*

proxy group of comparable companies whose market data is used to estimate a cost of common equity. The market data of those companies reflects investors' collective perception of the risk of their size, which is comparatively larger than either AWC or EPCOR.

As discussed above, size is a risk factor which must be taken into account in the determination of a cost of common equity applicable to AWC in this proceeding. Since it is clear from both my direct testimony and the discussion above, AWC's smaller size relative to the proxy group indicates that AWC's experiences greater relative risk than the proxy group. Such greater risk, by definition, cannot be reflected in the market data upon which Mr. Cassidy, Mr. Parcell and myself relied in determining an indicated common equity cost rate based on the proxy group. Therefore, an upward adjustment to that indicated proxy group common equity cost rate must be made, along with the previously discussed credit risk adjustment, in order to determine a cost of common equity which reflects the specific risk of AWC.

X. <u>Updated Recommended Common Equity Cost Rate</u>

Q. Have you updated you recommended overall rate of return and rate of return on common equity for AWC?

A. Yes. Page 1 of Exhibit PMA-R32 shows my updated common equity cost rate recommendation of 11.45%. In arriving at my updated common equity cost rate recommendation, I have applied the same three cost of common equity models in a manner identical to their application in my Direct Testimony. In my opinion, a common equity cost rate of 11.45% is a reasonable common equity cost rate for AWC in the current economic and capital market environment.

Q. DOES THAT CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

PMA-R1

Arizona Water Company
Return on Common Equity Implied in
RUCO Witness Cassidy's Weighted Average Cost of Capital

Description	[A] Weight (%) (1)	[B] Cost (1)		[C] Weighted Cost (1)		[D] Pre-Tax Weighted Cost	
Weighted Average Cost of Capital ("WACC") with RUCO's Proposed Debt Cost Rate							
Debt	46.31%	5.43%		2.51%		2.51%	
Common Equity	53.69%	8.95%		4.80%		7.87%	(2)
Weighted Average Cost of Capital				7.32%		10.38%	
Implied Actual Return on Common Equity based upon RUCO's WACC with Arizona Water Co.'s Actual Debt Cost Rate							
Debt	46.31%	6.82%		3.16%		3.16%	
Common Equity	53.69%	8.20%	(5)	4.40%	(5)	7.22%	(3)
Weighted Average Cost of Capital				7.56%		10.38%	(4)

Notes:
(1) From Schedule JAC-1.
(2) Assuming a company-provided effective composite Federal and State income tax rate of 39.02%, the pre-tax weighted cost of common equity based upon RUCO Witness Cassidy's recommended 7.32% WACC using a 5.43% debt cost rate and the Company's proposed capital structure is: 7.87%. 7.87% = 4.80%/(1 + 0.3902)
(3) Pre-tax weighted cost rate of common equity equals the pre-tax overall weighted cost rate (7.22%) based upon RUCO Witness Cassidy's recommended 7.32% WACC using a 5.43% debt cost rate and the Company's proposed capital structure minus the weighted cost rate of debt based upon Arizona's Water Co.'s actual debt cost rate of 6.82%. 10.38% - 3.16% = 7.22%.
(4) Pre-tax weighted overall cost of capital based upon RUCO Witness Cassidy's proposed overall rate of return
(5) Weighted cost of common equity calculated as the pre-tax weighted cost of common equity, 7.22%, divided by Arizona Water Co.y's proposed capital structure ratio, 53.69%. 8.20% = 4.40% / 53.69%.

PMA-R2

Principles of Public Utility Rates

Second Edition

by
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Public Utilities Reports, Inc.
Arlington, Virginia

First Printing, 1961
Second Edition, March 1988

Library of Congress Catalog Card No. 88-60167
ISBN 0-910325-23-5
Printed in the United States of America

the existence of a cost minimizing capital structure. Whether this also implies the minimization of revenue requirements, hinges on the passing along of the interest tax savings to utility customers. Patterson also concluded that utilities tend to have capital structures with less than the optimal debt ratio so as to permit financing flexibility and a cushion of borrowing capacity. This is consistent with the position that the public interest is not necessarily served by resorting to debt ratios high enough to minimize the cost of capital. Lower ratios may well be worth their higher costs by reducing the risks of financial adversities which would have a serious impact on the quality and expansion of the supply of utility services. But the question where the line should be drawn between needlessly low and dangerously high debt ratios is subject to major differences of opinion. (For a discussion of the optimum capitalization structure see Abel, 1984 and Brigham *et al.*, 1987.)

ESTIMATION OF THE COST OF CAPITAL

Determination of the Cost of Senior Capital

Having determined the appropriate capital structure, such as the one used previously for purposes of illustration, the analyst usually finds no difficulty in computing the embedded cost of senior capital with precision. Actual fixed charges on the debt including any amortized discount or premium and issuance expense and actual dividend requirements on the preferred stock represent the annual cost in dollar terms. The dollar figures then are converted into percentages for each type of capital as measured by the net proceeds which the company has received from the issuance of the bonds and preferred stock.

Short-term Debt Debate. Some commissions include short-term debt in the capital structure, some do not. Whether or not short-term debt is included often depends on the purposes of the short-term debt. It is more likely to be included if it is permanent in nature, that is, it represents a reasonably constant proportion of total capital over time. Frequently, short-term debt is used as bridge financing. Construction is financed with short-term debt until it accumulates to an amount sufficient to justify a bond issue, then is rolled over into permanent financing.

There is no reason to believe that a utility should not be entitled to recover short-term interest expense just because it is short-term rather than long-term. Indeed, it likely would be in the ratepayers' best interests if a utility used short-term debt extensively when rates are low or if it is anticipated that long-term rates are likely to decline. If short-term debt is not allowed in the capital structure, the effect is to impute the overall cost of capital to short-term debt. If the weighted average cost of capital is above the cost of short-term debt, this could result in the imposition of an additional burden on ratepayers. In reality, and provided the proportion of short-term debt is small, the consequences of including or excluding short-term debt are usually minimal on the weighted average cost of capital. If short-term debt is included in the capital structure, it usually is carried at its current cost rate.

If a projected test year is used, sometimes a proxy for the company's actual short-term rate will be used. One proxy short-term rate that may be used is the rate on commercial paper. Commercial paper is unsecured notes issued by large corporations usually through a dealer market. The rate charged on commercial paper is generally lower than the prime rate, and the assumption is that the utility could raise capital in this market. The implication is that the prime rate is not the rate that a large company such as a utility would pay for short-term money.

Actual Versus Hypothetical Cost. Occasionally in a rate case, a witness will contend that the allowance for interest on long-term debt and preferred dividend requirements should be based, not on charges actually imposed by securities now outstanding but, rather, on the hypothetical cost of what that financing would cost under current market conditions. As will be noted later in this chapter, this position comports with the logic of a reproduction-cost theory of rate control; and it is arguably applicable even to a fair-value rate base which gives material, though not controlling, weight to reproduction-cost appraisals.

But in a calculation based on an actual-cost standard of reasonable utility rates, the objective is to determine, not what the senior capital would cost if it had to be secured *de novo*, but rather what it really does or will soon cost in view of the fact that much of it has been secured at an earlier date and under market conditions differing from those prevailing today. For ratemaking purposes, this actual or experienced cost is significant as indicating what the company presently will need in order to meet its interest and preferred-dividend requirements. Hence, the estimated *current* cost of new bonds and new preferred stock is directly relevant only as evidence of the probable cost of new senior issues that the company must contemplate in the near future for purposes of refunding or new financing.

The actual cost approach to long-term debt may be somewhat more complicated in the case of the treatment of the refunding of a high yield bond. Company witnesses argue that the cost rate assigned to the refunding bond should include an allowance designed to amortize, over the lives of the outstanding bonds, any unamortized debt discounts, call premiums, and financing expenses on the bonds called prior to maturity for the purpose of interest savings. For income-tax purposes, these prematurity refunding costs are treated as an immediate loss rather than as a deferred charge; and accounting-minded witnesses have urged similar treatment for ratemaking purposes. But the other position is defended on the ground that the losses, net of tax savings, should be borne by future ratepayers and not by the stockholders, since these ratepayers will be the primary beneficiaries of the refunding action.

Consistently applied, either of these alternative rules of ratemaking would be tenable and fair. For, if any losses from refunding operations are to fall on the stockholders, in the form of a resulting erosion of corporate surplus, the allowed fair rate of return can be made high enough to compensate stockholders for the risk of exposure to such losses in the future. But there is a practical ground for preferring the other alternative: namely, that a management may well hesitate to call high-yield bonds if the immediate financial loss must fall on the stockholders while the reduction in annual interest charges must be passed on to the ratepayers.

Derivation of the Cost of Equity Capital

The really critical problem in the determination of the weighted average cost of capital is that of estimating the cost of the common-stock component, or rather that of estimating the allowed return on common equity which can be said to reflect cost in a loose sense of that word. Here, the primary difficulty lies in the very nature of the common stock of ordinary business corporations, including most American public utility corporations; namely, the absence of any expressed or implied commitment as to the level of dividends. In this absence, the annual cost actually incurred by a company in floating stock issues, whether by rights offerings to old stockholders or by public offerings, is simply indeterminant. Dividend payments are contingent on earnings; yet the allowable amount of earnings is the very objective of inquiry in a rate case. Thus, there arises a vicious-circle difficulty somewhat similar to that which precludes the acceptance of the commercial or market value of utility property as the measure of the rate base. Hence, a public service commission, in its allowance the literature with some commissions totally disregarding the new issue to those that apply an adjustment to the entire equity balance.

The Market to Book Ratio Issue

Introduction. One ongoing critical issue is whether the allowed rate of return should be designed to prevent the market prices of public utility stocks from rising to substantially above book value or falling to substantially below book value? A rigorous and literal application of a cost-of-capital-measure of a fair rate of return as outlined above would indicate that a commission should attempt to regulate rates so as to maintain the market value of a utility's stock on a par with its book value (or rate-base value) plus some allowance for underpricing. Yet such an attempt may be impractical or even impossible.

In the first place, commissions cannot forecast, except within wide limits, the effect their rate orders will have on the market prices of the stocks of the companies they regulate. In the second place, whatever the initial market prices may be, they are sure to change not only with the changing prospects for earnings, but with the changing outlook of an inherently volatile stock market. In short, market prices are beyond the control, though not beyond the influence, of rate regulation. Moreover, even if a commission did possess the power of control, any attempt to exercise it in the manner just suggested would result in harmful, uneconomic shifts in public utility rate levels. In addition, many utilities are regulated by more than one jurisdiction. Even if one commission were to attempt to regulate on the basis of market to book ratios, the commissions in the other jurisdictions would not be bound by its actions. Finally, even if regulators could put them in parity it may be undesirable following the theory of the second best if the comparable earnings exceed the cost of capital (see Kahn, 1970, pp. 52-53).

Two Facts. This situation is recognized even by supporters of a cost-of-capital standard of a fair rate of return, who undertake to meet the difficulty in two ways. First, the current cost of equity capital is rarely identified as a spot cost. Instead, it is taken to mean a normal or average capital-attracting rate of return characteristic of the recent market and typical of the market anticipated in the not distant future. Secondly, the estimated weighted average cost of capital resulting from the application of this normalized estimate of the current cost of equity may be characterized as a minimum allowance, subject to a reasonable upward adjustment perhaps justified on the basis of possible attrition.

It follows that the common stocks of public utilities which actually succeed in earning a fair rate of return as derived by a cost of capital approach may be expected to sell at a premium over their book values or rate-base values except in periods of a depressed stock market. The premiums may be greater than the modest allowance for underpricing associated with stock offerings sometimes granted by commissions. A question arises whether the prevalence of these premiums is persuasive evidence of a corporate earning power higher than required to give adequate assurance of the continued ability to attract needed capital on terms that do not impair the integrity of the existing capital. Conversely, when market to book ratios fall below one, the questions arise whether this is persuasive evidence that a utility is not earning its cost of capital.

Consistent with the opinion that regulation is simply powerless to set rates which insure any particular market to book ratio, the answer must be in the negative. Lacking this power, regulation should recognize the possibility of earnings liberal enough to permit market to book ratios of utilities to rise slightly above one. Some argue that these ratios should be roughly at the level of well-managed companies that actually succeed in realizing these earnings fairly continuously. For many years in the 1970s and 1980s utilities in general sold at market prices well below book. The call was for rates sufficient to produce market to book ratios of 1.1 to 1.2. Now the question of what constitutes a proper *degree* of liberality remains and has not received a convincing answer. We doubt whether a conclusive answer can ever be found under such an indefinite standard of a fair rate of return as that of a flexible rate designed to rise and fall with changes in the anticipated rates of income necessary to induce new investments of equity capital.

The Q-Ratio and Market to Book Ratio

One interpretation of the mandates of the Supreme Court, and one consistent with a present-value standard of reasonable rates rather than with an original-cost standard, is that regulated enterprises should be permitted to earn on the current values of their corporate assets, as based on replacement-cost appraisals, rates of return similar to the rates actually being earned by unregulated enterprises on the values of their assets, similarly appraised. This is a mere attempt to spell out a criterion which the Supreme Court itself has never undertaken to rid of its ambiguities.

PMA-R3

NEW
REGULATORY
FINANCE

Roger A. Morin, PhD

2006
PUBLIC UTILITIES REPORTS, INC.
Vienna, Virginia

models, such as the Arbitrage Pricing Model (APM) and the Fama-French Three-Factor Model, assert that there are several broad factors that influence security returns and formally quantify the impact of these factors on security returns. What weights should be assigned to the competing approaches? Who is the winner? The quick answer is that all the relevant capital market data and financial theories available should be used in estimating the cost of capital.

15.2 Use of Multiple Methods

There are four broad generic methodologies available to measure the cost of equity: DCF, Risk Premium, and Capital Asset Pricing Model (CAPM), which are market-oriented, and Comparable Earnings, which is accounting-oriented. Each generic market-based methodology in turn contains several variants: For example, the Empirical CAPM and the Fama-French Three-Factor Model are sub-species of the CAPM methodology. The multiple-stage DCF model is a variation of the generic DCF approach.

Each methodology requires the exercise of considerable judgment on the reasonableness of the assumptions underlying the methodology and on the reasonableness of the proxies used to validate the theory. The inability of the DCF model to account for changes in relative market valuation, discussed below, is a vivid example of the potential shortcomings of the DCF model when applied to a given company. Similarly, the inability of the CAPM to account for variables that affect security returns other than beta tarnishes its use.

No one individual method provides the necessary level of precision for determining a fair return, but each method provides useful evidence to facilitate the exercise of an informed judgment. Reliance on any single method or preset formula is inappropriate when dealing with investor expectations because of possible measurement difficulties and vagaries in individual companies' market data.

Examples of such vagaries include dividend suspension, insufficient or unrepresentative historical data due to a recent merger, increased competition, impending merger or acquisition, and a new corporate identity due to restructuring activities. To illustrate, there were difficulties in applying cost of capital methodologies while the electric utility industry was experiencing structural change in the late 1990s and early 2000s. The traditional cost of equity estimation methodologies were difficult to implement during the fast-changing circumstances of the electric utility industry during that period. This is because utility company historical data had become less meaningful for an industry in a state of change. Past earnings and dividend trends were simply not indicative of the future. For example, historical growth rates of earnings and dividends had been depressed by eroding margins due to a variety of factors, including structural transformation and the transition to a more competitive environment. As a result, historical data were not representative of the future long-term earning power of these companies. Moreover, historical growth rates were not representative of future trends for several electric utilities involved in mergers and acquisitions, as these companies going forward were not the same companies for which historical data were available. A similar argument applied to historical risk measures. Historical risk measures, such as beta, were downward-biased in assessing the current industry risk circumstances.

As a general proposition, it is extremely dangerous to rely on only one generic methodology to estimate equity costs. The difficulty is compounded when only one variant of that methodology is employed. It is compounded even further when that one methodology is applied to a single company. Hence, several methodologies applied to several comparable-risk companies should be employed to estimate the cost of common equity. The advantage of using several different approaches is that the results of each one can be used to check the others. If the cost of equity estimation process is limited to one methodology, such as DCF or CAPM, it may severely bias the results. One major problem that results from using only one methodology is the lack of corroborating evidence. There is simply no objective cross check on the result. All the market data and financial theories available should be used in making an estimate.

There is no single model that conclusively determines or estimates the expected return for an individual firm. Each methodology possesses its own way of examining investor behavior, its own premises, and its own set of simplifications of reality. Each method proceeds from different fundamental premises that cannot be validated empirically. Investors do not necessarily subscribe to any one method, nor does the stock price reflect the application of any one single method by the price-setting investor. There is no monopoly as to which method is used by investors. In the absence of any hard evidence as to which method outdoes the other, all relevant evidence should be used and weighted equally, in order to minimize judgmental error, measurement error, and conceptual infirmities. A regulator should rely on the results of a variety of methods applied to a variety of comparable groups, and not on one particular method. There is no guarantee that a single DCF result is necessarily the ideal predictor of the stock price and of the cost of equity reflected in that price, just as there is no guarantee that a single CAPM or Risk Premium result constitutes the perfect explanation of that stock price. The DCF, CAPM, and Risk Premium models are three different ways of getting a handle on the same problem.

If a regulatory commission relies on a single cost of equity estimate or on a single methodology, that commission greatly limits its flexibility and increases the risk of authorizing unreasonable rates of return. The results from one methodology or from a one-company sample are likely to contain a high degree of measurement error and may be distorted by short-term aberrations. A commission's hands should not be bound to one single company-specific estimate of equity costs, nor should the commission ignore relevant evidence and back itself into a corner.

The financial literature supports the use of multiple methods. Professor Eugene Brigham, a widely respected scholar and finance academician, asserts:[1]

> Three methods typically are used: (1) the Capital Asset Pricing Model (CAPM), (2) the discounted cash flow (DCF) method, and (3) the bond-yield-plus-risk-premium approach. These methods are not mutually exclusive—no method dominates the others, and all are subject to error when used in practice. Therefore, when faced with the task of estimating a company's cost of equity, we generally use all three methods and then choose among them on the basis of our confidence in the data used for each in the specific case at hand.

Another prominent finance scholar, Professor Stewart Myers, in an early pioneering article on regulatory finance, stated:[2]

> Use more than one model when you can. Because estimating the opportunity cost of capital is difficult, only a fool throws away useful information. That means you should not use any one model or measure mechanically and exclusively. Beta is helpful as one tool in a kit, to be used in parallel with DCF models or other techniques for interpreting capital market data.

Reliance on multiple tests recognizes that no single methodology produces a precise definitive estimate of the cost of equity. As stated in Bonbright, Danielsen, and Kamerschen (1988), "*no single or group test or technique is conclusive.*" Only a fool discards relevant evidence.

15.3 Musings on DCF

While the DCF model has been fashionable in regulatory proceedings, although not nearly as much in academic circles, uncritical acceptance of the standard DCF equation vests the model with a degree of accuracy that simply is not

[1] See Brigham and Ehrhardt (2005).

[2] See Myers (1972).

there. One of the leading experts on regulation, Dr. C. F. Phillips,[3] discussed the dangers of relying on the DCF model:

> Use of the DCF model for regulatory purposes involves both theoretical and practical difficulties. The theoretical issues include the assumption of a constant retention ratio (i.e., a fixed payout ratio) and the assumption that dividends will continue to grow at a rate g in perpetuity. Neither of these assumptions has any validity, particularly in recent years. Further, the investors' capitalization rate and the cost of equity capital to a utility for application to book value (i.e., an original cost rate base) are identical only when market price is equal to book value. Indeed, DCF advocates assume that if the market price of a utility's common stock exceeds its book value, the allowable rate of return on common equity is too high and should be lowered; and vice versa. Many question the assumption that market price should equal book value, believing that the earnings of utilities should be sufficiently high to achieve market-to-book ratios which are consistent with those prevailing for stocks of unregulated companies.
>
> . . . [T]here remains the circularity problem: Since regulation establishes a level of authorized earnings which, in turn, implicitly influences dividends per share, estimation of the growth rate from such data is an inherently circular process. For all of these reasons, the DCF model suggests a degree of precision which is in fact not present and leaves wide room for controversy about the level of k [cost of equity].

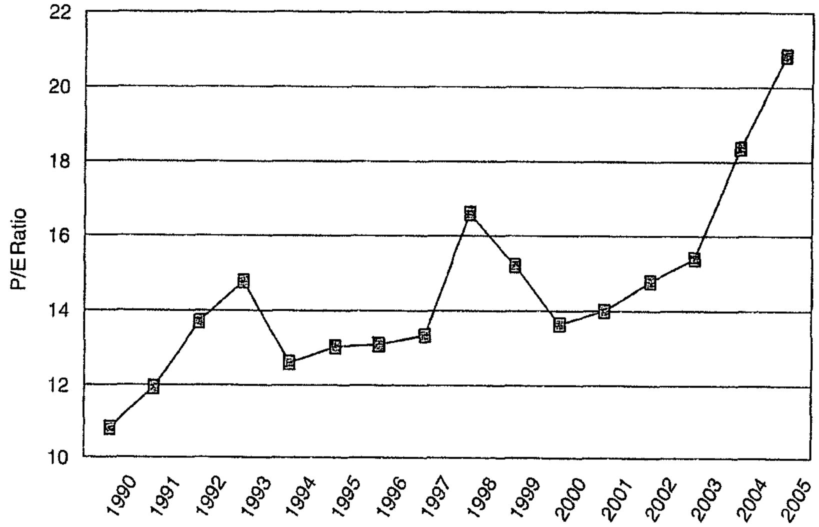
While it is certainly appropriate to use the DCF methodology to estimate the cost of equity, there is no proof that the DCF produces a more accurate estimate of the cost of equity than other methodologies. Sole reliance on the DCF model ignores the capital market evidence and financial theory formalized in the CAPM and other risk premium methods. The DCF model is one of many tools to be employed in conjunction with other methods to estimate the cost of equity. It is not a superior methodology that supplants other financial theory and market evidence. The broad usage of the DCF methodology in regulatory proceedings in contrast to its virtual disappearance in academic textbooks does not make it superior to other methods. The same is true of the Risk Premium and CAPM methodologies.

Applicability of the DCF Model

Caution has to be used in applying the DCF model to utility stocks for four reasons. The first reason is that the stock price used as input in the dividend

[3] See Phillips (1993), pp. 395–96.

FIGURE 15-2
ELECTRIC UTILITY INDUSTRY
P/E RATIOS 1990–2005



yield component may be unduly influenced by structural changes and changing investor expectations in the utility industry. Stock prices can also be influenced by mergers and acquisitions possibilities, by speculation concerning asset restructurings and deregulation of certain assets, and by corporate takeover rumors.

The second reason is that the traditional DCF model is based on a number of assumptions, some of which may be unrealistic in a given capital market environment. For example, the standard infinite growth DCF model assumes a constant market valuation multiple, that is, a constant price/earnings (P/E) ratio. In other words, the model assumes that investors expect the ratio of market price to dividends (or earnings) in any given year to be the same as the current price/dividend (or earnings) ratio. This must be true if the infinite growth assumption is made. This assumption can be somewhat unrealistic under certain capital market conditions. For example, the DCF model was not equipped to deal with the surge in price/earnings (P/E) ratios that were experienced by several utility stocks in the 1990s and mid 2000s. Figure 15-2 shows the volatile behavior of price/earnings ratios for electric utility stocks in that period.[4]

[4] The same volatile pattern can be observed in the natural gas distribution utility industry.

Several fundamental and structural changes have transformed the utility industry from the times when the standard DCF model and its assumptions were developed by Professor Gordon. Increased competition triggered by national policy, such as FERC Order 636, the 2005 Energy Bill, accounting rule changes, represcription of capital recovery rates, changes in customer attitudes regarding utility services, the evolution of alternative energy and information sources, deregulation, and mergers-acquisitions have all influenced stock prices in ways vastly different from the early assumptions of the DCF model. These changes suggest that some of the raw assumptions underlying the standard DCF model are questionable, and that the DCF model should be complemented by alternate methodologies to estimate the cost of common equity.

Contrary to the standard DCF assumption of a constant price/earnings ratio, stock price may not necessarily be expected to grow at the same rate as earnings and dividends by investors. This is especially true in the short run. Investors may very well assume that the price/earnings ratio will in fact continue to increase in the short run, fueling the expected rate of return. The converse is also true. Price/earnings ratios have proved volatile and unstable in recent years. The essential point is that the constancy of the price/earnings ratio required in the standard DCF model may not always be a valid assumption. To the extent that increases (decreases) in relative market valuation are anticipated by investors, especially myopic investors with short-term investment horizons, the standard DCF model will understate (overstate) the cost of equity.

Another way of stating the same point is that the DCF model does not account for the ebb and flow of investor sentiments over the course of the business cycle. The problem was particularly acute in the mid 1990s and mid 2000s where investors, faced with very low returns on short-term fixed-income securities and an uncertain market outlook, sought the higher yields offered by utility stocks in a so-called flight to quality, boosting their stock price and lowering their dividend yield.

The impact of erratic market valuation multiples on the DCF model can be illustrated with the following example. Assume that a utility's stock is trading at $100. Assume further that its earnings per share are expected to be $8.00 for the current year, and are expected to grow at 6% per year in the future. Finally, assume that the company pays out one-half of its earnings as dividends. The stock is initially trading at 12.5 times earnings, and the dividend yield is 4%. If investors do not expect the price/earnings ratio of 12.5 to change in the next year, the estimated expected return from holding the stock for one year using the standard DCF model is as follows: a dividend yield of 4%, plus growth in value (stock price) from $100 to $106, or 6%, for a total return of 10%. The ending stock price is $106, that is, 12.5 times next year's earnings of $8.48.

TABLE 15-1
EFFECT OF MARKET-TO-BOOK RATIO ON MARKET RETURN

	Situation 1	Situation 2	Situation 3
1 Initial purchase price	$25.00	$50.00	$100.00
2 Initial book value	$50.00	$50.00	$50.00
3 **Initial M/B**	**0.50**	**1.00**	**2.00**
4 **DCF Return 10% = 5% + 5%**	**10.00%**	**10.00%**	**10.00%**
5 Dollar Return	$5.00	$5.00	$5.00
6 Dollar Dividends 5% Yield	$1.25	$2.50	$5.00
7 Dollar Growth 5% Growth	$3.75	$2.50	$0.00
8 **Market Return**	**20.00%**	**10.00%**	**5.00%**

But what if investors expect an increase in the price/earnings ratio from 12.5 to 13.5? Then, the growth in value is from $100 to $114.48, or 13.5 times next year's earnings of $8.48, for a total return of 18.5% (dividend yield of 4%, plus growth in value of 14.5%). The orthodox DCF model would indicate returns of 10%, whereas the investors' true expected return is 18.5%. Investor-expected returns are substantially understated whenever investors anticipate increases in relative market valuation, and conversely.

The third and perhaps most important reason for caution and skepticism is that application of the DCF model produces estimates of common equity cost that are consistent with investors' expected return only when stock price and book value are reasonably similar, that is, when the M/B is close to unity. As shown below, application of the standard DCF model to utility stocks understates the investor's expected return when the market-to-book (M/B) ratio of a given stock exceeds unity. This was particularly relevant in the capital market environment of the 1990s and 2000s where utility stocks were trading at M/B ratios well above unity and have been for nearly two decades. The converse is also true, that is, the DCF model overstates the investor's return when the stock's M/B ratio is less than unity. The reason for the distortion is that the DCF market return is applied to a book value rate base by the regulator, that is, a utility's earnings are limited to earnings on a book value rate base.

The simple numerical illustration shown in Table 15-1 demonstrates the impact of M/B ratios on the DCF market return. The example shows the result of applying a market value cost rate to book value rate base under three different M/B scenarios. The three columns correspond to three M/B situations: the stock trades below, equal to, and above book value, respectively. The latter situation is noteworthy and representative of the capital market environment of the last two decades. As shown in the third column, the DCF cost rate of 10%, made up of a 5% dividend yield and a 5% growth rate, is applied to the book value rate base of $50 to produce $5.00 of earnings. Of the $5.00 of earnings, the full $5.00 are required for dividends to produce a dividend yield of 5% on a stock price of $100.00, and no dollars are available for growth. The investor's return is therefore only 5% versus his required return of 10%. A DCF cost rate of 10%, which implies $10.00 of earnings, translates to only $5.00 of earnings on book value, or a 5% return. The situation is reversed in the first column when the stock trades below book value. The $5.00 of earnings are more than enough to satisfy the investor's dividend requirements of $1.25, leaving $3.75 for growth, for a total return of 20%. This is because the DCF cost rate is applied to a book value rate base well above the market price. Therefore, the DCF cost rate understates (overstates) the investor's required return when stock prices are well above (below) book.

While a vast majority of regulatory commissions do not rely solely on the DCF model results in setting the allowed rate of return on common equity,[5] some regulatory commissions have explicitly recognized the need to avoid exclusive reliance on the DCF model and have acknowledged the need to adjust the DCF result when M/B ratios exceed one.[6]

A fourth concern deals with the realism of the constant growth rate assumption and with the difficulty of finding an adequate proxy for that growth rate. The standard DCF model assumes that a single growth rate of dividends is applicable in perpetuity. It is difficult to imagine that today's energy utility industry can be described as stable. Not only is the constant growth rate assumption somewhat unrealistic, but it is difficult to proxy. Analysts' growth forecasts are usually made for not more than 2 to 5 years, or if they are made for more than a few years, they are dominated by the near-term earnings and dividends picture. In short, the perpetual growth term of the DCF model does not square well with the shorter-term focus of institutional investors.

Also, when using the retention ratio method of estimating growth in the DCF model, there is a potential element of circularity in estimating ROE from a forecast of ROE itself for the utility being regulated, since ROE is determined in large part by regulation. To estimate what ROE resides in the minds of

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[5] According to the results posted in a survey conducted by the National Association of Regulatory Utility Commissioners ("NARUC"), regulators utilize a variety of methods and rely on all the evidence submitted.

[6] See the Indiana Utility Regulatory Commission decision in *Indiana Mich. Power Co.* (IURC 8/24/90), Cause No. 38728, 116 PUR4th 1, 17–18. See also the Iowa Utilities Board decision in *U.S. West Communications, Inc.*, Docket No. RPU-93-9, 152 PUR4th 446, 459 (1994). See also the Hawaii Public Utilities Commission decision in *Hawaiian Electric Company, Inc.*, Docket No. 6998, 134 PUR4th 418 (1992).

investors is equivalent to estimating the market's assessment of the outcome of regulatory hearings. Expected ROE is exactly what regulatory commissions set in determining an allowed rate of return. If a commission were to set the rate of return too high because it relied on too high a growth forecast as a result of an inflated ROE forecast, the prophecy of an exaggerated ROE would become self-fulfilling. This problem can be circumvented by applying the DCF method to a broad sample of comparable-risk firms, instead of only to forecast values of the utility being regulated, and/or by applying several other methodologies that examine market data not directly related to the firm's financial statistics such as Risk Premium, CAPM, and ECAPM. Another solution is to examine the DCF returns of comparable-risk industrial stocks.

It is abundantly clear from the previous chapters that investors take a prospective view in assessing security values so that the need to be forward-looking is apparent when feasible. A note of caution is necessary when using historical proxies. Historically based measures of risk and growth can be downward-biased in assessing current circumstances. This type of bias certainly applied to electric utility stocks following the deregulation and restructuring of the industry that began in the mid 1990s, and certainly applied to gas distribution utilities following FERC's Order 636 in 1993. The fundamental risks and growth prospects of electric utilities changed rapidly following the passage of the Energy Bill in 1993 and will change further as a result of the 2005 Energy Bill. These shifts in growth prospects take some time before they are fully reflected in the historical growth rates. Hence, backward-looking growth and statistical analysis may fail to fully reflect the fact that the risks and growth prospects of utilities have escalated, and may only provide limited evidence that the risk and the cost of capital to these utilities have increased. Of course, the converse may also be true under certain circumstances.

Historical growth rates also can be downward-biased by the impact of diversification and restructuring activities and by the impact of abnormal weather patterns in the case of energy utilities. Acquisitions, start-up expenses, front-end capital investments associated with diversification and restructuring efforts, and unfavorable weather patterns can retard and dilute historical earnings growth, and such growth is not representative of a company's long-term growth potential. Therefore, caution must be exercised when applying any of the growth estimating techniques directly to recent historical utility company data.

In summary, caution and judgment are required in interpreting the results of the DCF model. There is a clear need to go beyond the DCF model and to examine the results produced by alternate methodologies.[7]

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[7] Lesser (2003) documents the impact of the increased volatility of utility stock prices on the reduced reliability of the cost of equity estimates derived using the DCF model. Whittaker and Sefton (1987) also express concerns on the realism of the DCF model.

Appendix 4-A
Arithmetic versus Geometric Means in Estimating the Cost of Capital

The use of the arithmetic mean appears counter-intuitive at first glance, because we commonly use the geometric mean return to measure the average annual achieved return over some time period. For example, the long-term performance of a portfolio is frequently assessed using the geometric mean return.

But performance appraisal is one thing, and cost of capital estimation is another matter entirely. In estimating the cost of capital, the goal is to obtain the rate of return that investors expect, that is, a target rate of return. On average, investors expect to achieve their target return. This target expected return is in effect an arithmetic average. The achieved or retrospective return is the geometric average. In statistical parlance, the arithmetic average is the unbiased measure of the expected value of repeated observations of a random variable, not the geometric mean. This appendix formally illustrates that only arithmetic averages can be used as estimates of cost of capital, and that the geometric mean is not an appropriate measure of cost of capital.

The geometric mean answers the question of what constant return you would have had to achieve in each year to have your investment growth match the return achieved by the stock market. The arithmetic mean answers the question of what growth rate is the best estimate of the future amount of money that will be produced by continually reinvesting in the stock market. It is the rate of return which, compounded over multiple periods, gives the mean of the probability distribution of ending wealth.

While the geometric mean is the best estimate of performance over a long period of time, this does not contradict the statement that the arithmetic mean compounded over the number of years that an investment is held provides the best estimate of the ending wealth value of the investment. The reason is that an investment with uncertain returns will have a higher ending wealth value than an investment which simply earns (with certainty) its compound or geometric rate of return every year. In other words, more money, or terminal wealth, is gained by the occurrence of higher than expected returns than is lost by lower than expected returns.

In capital markets, where returns are a probability distribution, the answer that takes account of uncertainty, the arithmetic mean, is the correct one for estimating discount rates and the cost of capital.

While the geometric mean is appropriate when measuring performance over a long time period, it is incorrect when estimating a risk premium to compute the cost of capital.

Chapter 6
Alternative Asset Pricing Models

6.1 Empirical Validity of the CAPM

The last chapter showed that the practical difficulties of implementing the CAPM approach are surmountable. Conceptual and empirical problems remain, however.

At the conceptual level, the CAPM has been submitted to criticisms by academicians and practitioners. Contrary to the core assumption of the CAPM, investors may choose not to diversify, and bear company-specific risk if abnormal returns are expected. A substantial percentage of individual investors are indeed inadequately diversified. Short selling is somewhat restricted, in violation of CAPM assumptions. Factors other than market risk (beta) may also influence investor behavior, such as taxation, firm size, and restrictions on borrowing.

At the empirical level, there have been countless tests of the CAPM to determine to what extent security returns and betas are related in the manner predicted by the CAPM. The results of the tests support the idea that beta is related to security returns, that the risk-return tradeoff is positive, and that the relationship is linear. The contradictory finding is that the risk-return tradeoff is not as steeply sloped as predicted by the CAPM. With few exceptions, the empirical studies agree that the implied intercept term exceeds the risk-free rate and the slope term is less than predicted by the CAPM. That is, low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted. This is shown pictorially in Figure 6-1. A CAPM-based estimate of cost of capital underestimates the return required from low-beta securities and overstates the return required from high-beta securities, based on the empirical evidence. Brealey, Myers, and Allen (2006), among many others,[1] provide recent empirical evidence very similar to the relationship depicted in Figure 6-1. This is one of the most

[1] For a summary of the empirical evidence on the CAPM, see Jensen (1972) and Ross (1978). The major empirical tests of the CAPM were published by Friend and Blume (1975), Black, Jensen, and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973), Blume and Husic (1973), Fama and Macbeth (1972), Basu (1977), Reinganum (1981B), Litzenberger and Ramaswamy (1979), Banz (1981), Gibbons (1982), Stambaugh (1982), Shanken (1985), Black (1993), and Brealey, Myers, and Allen (2006). Evidence in the Canadian context is available in Morin (1980, 1981).

The model is analogous to the standard CAPM, but with the return on a minimum risk portfolio that is unrelated to market returns, R_Z, replacing the risk-free rate, R_F. The model has been empirically tested by Black, Jensen, and Scholes (1972), who find a flatter than predicted SML, consistent with the model and other researchers' findings. An updated version of the Black-Jensen-Scholes study is available in Brealey, Myers, and Allen (2006) and reaches similar conclusions.

The zero-beta CAPM cannot be literally employed to estimate the cost of capital, since the zero-beta portfolio is a statistical construct difficult to replicate. Attempts to estimate the model are formally equivalent to estimating the constants, a and b, in Equation 6-2. A practical alternative is to employ the Empirical CAPM, to which we now turn.

6.3 Empirical CAPM

As discussed in the previous section, several finance scholars have developed refined and expanded versions of the standard CAPM by relaxing the constraints imposed on the CAPM, such as dividend yield, size, and skewness effects. These enhanced CAPMs typically produce a risk-return relationship that is flatter than the CAPM prediction in keeping with the actual observed risk-return relationship. The ECAPM makes use of these empirical findings. The ECAPM estimates the cost of capital with the equation:

$$K = R_F + \acute{\alpha} + \beta \times (MRP - \acute{\alpha}) \qquad (6\text{-}5)$$

where $\acute{\alpha}$ is the "alpha" of the risk-return line, a constant, and the other symbols are defined as before. All the potential vagaries of the CAPM are telescoped into the constant $\acute{\alpha}$, which must be estimated econometrically from market data. Table 6-2 summarizes[10] the empirical evidence on the magnitude of alpha.[11]

[10] The technique is formally applied by Litzenberger, Ramaswamy, and Sosin (1980) to public utilities in order to rectify the CAPM's basic shortcomings. Not only do they summarize the criticisms of the CAPM insofar as they affect public utilities, but they also describe the econometric intricacies involved and the methods of circumventing the statistical problems. Essentially, the average monthly returns over a lengthy time period on a large cross-section of securities grouped into portfolios are related to their corresponding betas by statistical regression techniques; that is, Equation 6-5 is estimated from market data. The utility's beta value is substituted into the equation to produce the cost of equity figure. Their own results demonstrate how the standard CAPM underestimates the cost of equity capital of public utilities because of utilities' high dividend yield and return skewness.

[11] Adapted from Vilbert (2004).

TABLE 6-2
EMPIRICAL EVIDENCE ON THE ALPHA FACTOR

Author	Range of alpha
Fischer (1993)	−3.6% to 3.6%
Fischer, Jensen and Scholes (1972)	−9.61% to 12.24%
Fama and McBeth (1972)	4.08% to 9.36%
Fama and French (1992)	10.08% to 13.56%
Litzenberger and Ramaswamy (1979)	5.32% to 8.17%
Litzenberger, Ramaswamy and Sosin (1980)	1.63% to 5.04%
Pettengill, Sundaram and Mathur (1995)	4.6%
Morin (1989)	2.0%

For an alpha in the range of 1%–2% and for reasonable values of the market risk premium and the risk-free rate, Equation 6-5 reduces to the following more pragmatic form:

$$K = R_F + 0.25\,(R_M - R_F) + 0.75\,\beta(R_M - R_F) \qquad (6\text{-}6)$$

Over reasonable values of the risk-free rate and the market risk premium, Equation 6-6 produces results that are indistinguishable from the ECAPM of Equation 6-5.[12]

An alpha range of 1%–2% is somewhat lower than that estimated empirically. The use of a lower value for alpha leads to a lower estimate of the cost of capital for low-beta stocks such as regulated utilities. This is because the use of a long-term risk-free rate rather than a short-term risk-free rate already incorporates some of the desired effect of using the ECAPM. That is, the

[12] Typical of the empirical evidence on the validity of the CAPM is a study by Morin (1989) who found that the relationship between the expected return on a security and beta over the period 1926–1984 was given by:

$$\text{Return} = 0.0829 + 0.0520\,\beta$$

Given that the risk-free rate over the estimation period was approximately 6% and that the market risk premium was 8% during the period of study, the intercept of the observed relationship between return and beta exceeds the risk-free rate by about 2%, or 1/4 of 8%, and that the slope of the relationship is close to 3/4 of 8%. Therefore, the empirical evidence suggests that the expected return on a security is related to its risk by the following approximation:

$$K = R_F + x(R_M - R_F) + (1 - x)\beta(R_M - R_F)$$

where x is a fraction to be determined empirically. The value of x that best explains the observed relationship Return = 0.0829 + 0.0520 β is between 0.25 and 0.30. If x = 0.25, the equation becomes:

$$K = R_F + 0.25(R_M - R_F) + 0.75\beta(R_M - R_F)$$

long-term risk-free rate version of the CAPM has a higher intercept and a flatter slope than the short-term risk-free version which has been tested. Thus, it is reasonable to apply a conservative alpha adjustment. Moreover, the lowering of the tax burden on capital gains and dividend income enacted in 2002 may have decreased the required return for taxable investors, steepening the slope of the ECAPM risk-return trade-off and bring it closer to the CAPM predicted returns.[13]

To illustrate the application of the ECAPM, assume a risk-free rate of 5%, a market risk premium of 7%, and a beta of 0.80. The Empirical CAPM equation (6-6) above yields a cost of equity estimate of 11.0% as follows:

$$K = 5\% + 0.25\,(12\% - 5\%) + 0.75 \times 0.80\,(12\% - 5\%)$$
$$= 5.0\% + 1.8\% + 4.2\%$$
$$= 11.0\%$$

As an alternative to specifying alpha, see Example 6-1.

Some have argued that the use of the ECAPM is inconsistent with the use of adjusted betas, such as those supplied by Value Line and Bloomberg. This is because the reason for using the ECAPM is to allow for the tendency of betas to regress toward the mean value of 1.00 over time, and, since Value Line betas are already adjusted for such trend, an ECAPM analysis results in double-counting. This argument is erroneous. Fundamentally, the ECAPM is not an adjustment, increase or decrease, in beta. This is obvious from the fact that the expected return on high beta securities is actually lower than that produced by the CAPM estimate. The ECAPM is a formal recognition that the observed risk-return tradeoff is flatter than predicted by the CAPM based on myriad empirical evidence. The ECAPM and the use of adjusted betas comprised two separate features of asset pricing. Even if a company's beta is estimated accurately, the CAPM still understates the return for low-beta stocks. Even if the ECAPM is used, the return for low-beta securities is understated if the betas are understated. Referring back to Figure 6-1, the ECAPM is a return (vertical axis) adjustment and not a beta (horizontal axis) adjustment. Both adjustments are necessary. Moreover, recall from Chapter 3 that the use of adjusted betas compensates for interest rate sensitivity of utility stocks not captured by unadjusted betas.

[13] The lowering of the tax burden on capital gains and dividend income has no impact as far as non-taxable institutional investors (pension funds, 401K, and mutual funds) are concerned, and such investors engage in very large amounts of trading on security markets. It is quite plausible that taxable retail investors are relatively inactive traders and that large non-taxable investors have a substantial influence on capital markets.

where: $E(K)$ = expected return, or cost of capital
$E(R_F)$ = expected risk-free rate
$E(\beta)$ = expected beta
$E(R_M)$ = expected market return

The difficulty is that the CAPM model is a prospective model while most of the available capital market data required to match the three theoretical input variables (expected risk-free return, expected beta, and expected market risk premium) are historical. None of the input variables exists as a separate identifiable entity. It is thus necessary in practice to employ different proxies, with different results obtained with each set of proxy variables. Each of the three required inputs to the CAPM is examined below.

5.4 CAPM Application: Risk-free Rate

To implement the CAPM methodology, an estimate of the risk-free return is required. As a proxy for the risk-free rate, long-term rates are the relevant benchmarks when determining the cost of common equity rather than short-term or intermediate-term interest rates.[4] There are several reasons for this, both conceptual and practical.

At the conceptual level, because common stock is a long-term investment and because the cash flows to investors in the form of dividends last indefinitely, the yield on very long-term government bonds, namely, the yield on 30-year Treasury bonds, is the best measure of the risk-free rate for use in the CAPM and Risk Premium methods.[5] The expected common stock return is based on long-term cash flows, regardless of an individual's holding time period. Utility

[4] The absence of new long-term Treasury bond issues does not negate the use of long-term Treasury bond yields as proxies for the risk-free rate in the CAPM. For example, in the early 2000s, the Treasury temporarily ceased to issue 30-year Treasury bonds. In the same way that we can use stock prices in the application of the DCF model to a given company even though that company has not issued stock in the recent past, we still can rely on bond prices of 30-year Treasury bonds and the implied yields. As long as such bonds are actively traded on secondary markets, they provide useful price/yield signals and proxies for the risk-free rate.

[5] By definition, the beta of risk-free securities is zero. Financial theory, for example Modigliani-Miller's capital structure paradigm, generally assumes that debt, particularly government, is risk free, that is, that it has no default risk or that default risk is completely diversifiable (Beta = 0). Most financial scholars and finance textbooks make the commonplace assumption that the beta of debt is zero. Although it is difficult to measure the beta risk of a bond because a bond's maturity and coupon have a significant effect on the volatility of its prices, the beta of debt is very close to zero in practice.

asset investments generally have long-term useful lives and should be correspondingly matched with long-term maturity financing instruments. Moreover, short-term Treasury Bill yields reflect the impact of factors different from those influencing the yields on long-term securities such as common stock. For example, the premium for expected inflation embedded into 90-day Treasury Bills is likely to be far different than the inflationary premium embedded in the yields of long-term securities. On grounds of stability and consistency, the yields on long-term Treasury bonds match more closely with expected common stock returns. Finally, yields on 90-day Treasury Bills typically do not match the investor's planning horizons. Equity investors generally have an investment horizon far in excess of 90 days.

At the practical level, short-term rates are volatile, fluctuate widely, and are subject to more random disturbances than are long-term rates, leading to volatile and unreliable equity return estimates. Short-term rates are also largely administered rates. For example, Treasury Bills are used by the Federal Reserve as a policy vehicle to stimulate the economy and to control the money supply, and are used by foreign governments, companies, and individuals as a temporary safe harbor for money.

While long-term Treasury bonds are potentially subject to interest rate risk, and are not theoretically ''risk-free,'' this is only true if the bonds are sold prior to maturity. A substantial fraction of bond market participants, usually institutional investors with long-term liabilities[6] (pension funds, insurance companies), in fact, hold bonds until they mature, and therefore are not subject to interest rate risk.

Another way in which institutional investors immunize themselves against interest rate risk is by buying a pure discount bond (also known as a zero-coupon bond) with a maturity equal to their investment horizon and holding that bond until it matures.[7] This works because there are no cash flows to

6 The case of pension funds is noteworthy. If the assets of a pension fund are invested in bonds, the duration (i.e. weighted maturity) of the assets can be computed. The duration of the obligations to retirees, analogous to interest payments on debt, can be calculated as well. Managers of pension funds therefore choose pension assets whose duration is matched with the duration of the liabilities. In this way, changing interest rates do not affect the net worth of the pension fund. In a similar fashion, insurance firms invest on bonds where the duration of the bonds is matched to the duration of the future death benefits.

7 The question arises as to whether the yield on coupon-paying bonds differs from the yield on the zero-coupon bonds. Whether a zero-coupon bond has a higher or lower yield than a coupon-paying bond of the same maturity is a function of investor expectations as to future interest rates (shape of the yield curve), that is, at what rate the coupons are to be reinvested. The important point is that when considering

reinvest and there is no price risk if the bond is held to maturity. Holding a zero coupon bond eliminates reinvestment risk and interest rate risk as well if held to maturity. In the case of coupon bonds, this simple strategy has to be refined. It is still true that price risk is avoided if the bonds are held to maturity, but there remains reinvestment-rate risk since the coupons need to be reinvested at some unknown rate. Immunization is achieved by purchasing a coupon bond whose weighted maturity (''duration'') is equal to the investment horizon. This works regardless of interest rate movements. If rates decrease, the investor is forced to reinvest coupons at a lower rate but also makes a capital gain on the sale of the bonds at the end of the investment horizon. If rates increase, the capital loss on the sale at the horizon date is offset by the extra cash flow generated from investing the coupon payments at the new higher rate.

In short, institutional bondholders neutralize the impact of interest rate changes by matching the maturity of a bond portfolio with the investment planning period, or by engaging in hedging transactions in the financial futures markets. The merits and mechanics of such immunization strategies are well-documented by academicians and practitioners.

While the spot yield on long-term Treasury bonds provides a reasonable proxy for the risk-free rate, the CAPM specifically requires the expected spot yield. Market forecasts of rates on Treasury bonds are available in the form of interest rate futures contract yields, and can be employed as proxies for the expected yields on Treasury securities. Appendix 5-B discusses the use of interest rate forecasts as proxies for the risk-free rate.

5.5 CAPM Application: Beta Estimate

In Chapter 3, it was shown that beta is a useful, simple, objective measure of risk when used to gauge the relative risks of securities. The relative risk ranking of securities is somewhat immune to the beta estimation method. The situation is different when the objective of estimating beta is to obtain an absolute estimate of the cost of equity for an individual security. In this case, the reliability of the beta estimation technique has a direct effect on the confidence in the CAPM estimate of equity cost.

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bonds with interim cash flows over the investment horizon, the total return is no longer a sure thing. Changing interest rates can cause the reinvested value of these interim payments to change. In the case of a zero-coupon bond, this problem can be avoided entirely, as no interim cash flows have to be reinvested, and the total return from holding a zero-coupon bond is a sure thing assuming the U.S. government makes the principal payment at maturity.

PMA-R4

The Regulation of Public Utilities

Theory and Practice

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1993
PUBLIC UTILITIES REPORTS, INC.
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First Printing, May 1984
Second Edition, June, 1988
Third Edition, July 1993

Library of Congress Catalog Card No. 93-085285

ISBN 0-910325-45-6

Printed in the United States of America

allowances, however, are not uniform. For example, with respect to call premiums, some commissions have charged such costs of refunding bonds to stockholders,[97] while others have amortized the premiums over a reasonable period;[98] with respect to flotation costs, some commissions deny them unless a new stock issue is planned.[99]

Cost of Equity Capital. The most difficult problem in determining the overall cost of capital arises in estimating the cost of equity capital. The relevant question is: How much must a utility earn to induce investors to hold and to continue to buy common stock? In answering this question, it is important to realize that circular reasoning is involved. In the absence of a fixed, expressed or implied commitment as to the dividend rate, the actual cost of floating a stock issue is indeterminate. Investors' decisions are largely based on a utility's expected earnings and upon their stability, as well as upon alternative uses of investment funds. Yet, since the allowable amount of earnings is the object of a rate case, a commission's decision, in turn, will affect investors' decisions.

There are several approaches for estimating the cost of equity capital, but two principal methods have evolved in recent years: the "market-determined" standard and the "comparable earnings" standard.[100] The former is a market-oriented approach that focuses on investor expectations in terms of a utility's earnings, dividends and market prices. The latter is an alternative investment approach that focuses on what capital can earn in various alternatives with comparable risk.

Market-Determined Standard. The market-determined standard relies upon stock market transactions and estimates of investor expectations. Three major approaches have been, or are being, employed: e/p ratios (earnings-price ratios), the discounted cash flow (DCF) model, and the capital asset pricing model (CAPM).

The earnings-price ratio approach holds that the cost of equity capital to a utility is equal to the ratio of current earnings per share to the market price per share. Thus, if a utility's annual earnings are $5 per share and the average market price of its common stock for that same period is $38, the earnings-price ratio is 13.16 percent. (The ratio must be increased to allow for flotation costs. An allowance of 5 percent would result in an adjusted ratio of 13.85 percent — 13.16 percent divided by 0.95.) The method was widely used in the 1950s and early 1960s, although there was growing recognition of an underlying theoretical problem: The earnings-price ratio approach ignores the fact that investors purchase common stock for future growth and not for past or current earnings alone.[101] As a result, a growth factor must be added in computing the cost of equity capital.

Finance theory holds that the cost of common equity capital

> is the equity investors' capitalization rate, or required market rate of return, competitively determined in the capital markets, adjusted by

> an appropriate allowance for underpricing in connection with sales of additional shares, including allowance for market pressure and for costs of flotation and underwriting. The capitalization rate before the allowance for underpricing is the discount rate that equates all expected dividends in the future plus the market price that investors eventually expect to realize to the present market price. While this is a simple enough concept, it is difficult to measure since measurement requires the estimation of the expectations of the investors who determine the present market price. Such estimates, of course, involve the exercise of informed judgment.[102]

The DCF model represents an attempt to estimate the equity investors' capitalization rate. Mathematically,

$$K = \frac{d}{p} + g$$

where: k is the investor's capitalization or discount rate (i.e., the cost of capital)
d is the current dividend per share
p is the current market price per share
g is the expected rate of growth in dividends per share.[103]

Thus, if the stock of a particular utility pays a $3 dividend, which is expected to grow at a rate of 4.5 percent per year, and if investors are willing to pay $38 for the stock, the required return on common equity (assuming a 5 percent allowance for flotation costs) is 12.81 percent.[104] However, use of the DCF model for regulatory purposes involves both theoretical and practical difficulties.

The theoretical issues include the assumption of a constant retention ratio (i.e., a fixed payout ratio) and the assumption that dividends will continue to grow at rate g in perpetuity. Neither of these assumptions has any validity, particularly in recent years. Further, the investors' capitalization rate and the cost of equity capital to a utility for application to book value (i.e., an original cost rate base) are identical only when market price is equal to book value.[105] Indeed, DCF advocates assume that if the market price of a utility's common stock exceeds its book value, the allowable rate of return on common equity is too high and should be lowered — and vice versa.[106] Many question the assumption that market price should equal book value, believing that "the earnings of utilities should be sufficiently high to achieve market-to-book ratios which are consistent with those prevailing for stocks of unregulated companies."[107]

Most frequently, the major practical issue involves the determination of the growth rate, a determination that is highly complex and that requires considerable judgment.[108] The crux of the measurement problem is this: How can investors' expectations of *future* growth be measured? When past growth rates are used as a proxy for future growth rates, it is far from obvious as to (1) which time periods have the most relevance to investors and (2) whether the prospective growth rate should be determined by using trends in dividends per share, earnings per share and/or book value per share, and exactly how the information contained in these various measures is used by investors.[109] Indeed, one study showed that the expectations of security analysts outperformed the extrapolation of historical trends in explaining share prices.[110] But when future growth rates are used, it is not clear whether the prospective growth rate should be determined by using analysts' estimates, surveys of institutional investors or the expected return on common equity times the retention ratio.[111] And, even when all of these issues have been settled, there remains the circularity problem: Since regulation establishes a level of authorized earnings, which, in turn, implicitly influences dividends per share, estimation of the growth rate from such data is an inherently circular process. For these reasons, the DCF model "suggests a degree of precision which is in fact not present"[112] and leaves "wide room for controversy and argument about the level of k."[113]

The CAPM[114] holds that the cost of equity capital or expected return on a utility's common equity is equivalent to that on a riskless security plus a risk premium related to the risk inherent in a particular utility's stock; that is, the model combines risk and return in a single measure.[115] The formula is as follows:

$$R = R_f + (R_m - R_f)\,\beta$$

where: R is the total return
R_f is the risk free return
R_m is the stock market return (or the expected return on a stock market portfolio)
β is the beta coefficient (or the utility's relevant market risk).

Thus, assuming a stock market return of 13.9 percent, a risk-free return (Treasury bonds) of 7.8 percent, and a beta of 0.90, the total return or cost of equity capital would be 13.29 percent.[116]

Despite its appeal, the CAPM also has both theoretical and practical problems. The theoretical issues include the reliability of the model's basic assumptions[117] and the static nature of the model.[118] The practical problems surround the beta coefficient, "the only variable in the CAPM equation that is unique to the particular firm for which the cost of equity capital is being determined."[119] They include: How should beta be measured — stock market price alone or total return on investment (i.e., dividends plus capital gains)?

What period of time should be used for such measurement? What is the proper measure of stock market performance (e.g., Dow Jones index, Standard & Poor's index, etc.)? What is the proper measure of the risk-free return (e.g., Treasury notes or Treasury bonds)? Finally, the evidence suggests that betas are unstable over time and that they move in the opposite direction from investors' perceptions of risk.[120] These issues have led some to conclude that the CAPM, at least at this stage in its development, "is inaccurate, incomplete, and unreliable as a measure of a firm's equity cost of capital."[121]

Comparable Earnings Standard. The comparable earnings standard[122] recognizes a fundamental economic concept; namely, opportunity cost. This concept states that the cost of using any resource — land, labor and/or capital — for a specific purpose is the return that could have been earned in the next best alternative use. The opportunity cost of a farmer using his land for beef grazing is what the land would yield after expenses if used for raising tobacco or for growing wheat; the opportunity cost to a worker in accepting one job is what he forgoes by not accepting the next best alternative. Likewise, the opportunity cost to an investor in a utility's common stock is what that capital would yield in an alternative investment — in another utility's or industrial's common stock; in utility, corporate or government bonds; in real estate; etc. Stated another way, the opportunity cost of capital concept holds that "capital should not be committed to any venture unless it can earn a return commensurate with that prospectively available in alternative employments of similar risk."[123]

The relevance of the opportunity cost concept was recognized by Judge Hand in a 1920 case:

> The recurrent appeal to a just rate and a fair value assumes that the effort is to insure such a profit as would induce the venture originally and that the public will keep its faith so impliedly given. That, I think, involves a tacit comparison of the profit possible under the rate with profits available elsewhere; i.e., under those competitive enterprises which offer an alternative investment. The implication is that the original adventurer would compare future rates, varying as they would with the going profit, and would find them enough, but no more than enough, to induce him to choose this investment. By insuring such a return it is assumed that the supply of capital will be secured necessary to the public service. As the profits in the supposed alternative investment will themselves vary, so it is assumed to be a condition of the investors' bargain that their profit shall measurably follow the general rates. It is, of course, not relevant here to discuss these presuppositions, since they have now the support of authoritative law.[124]

The comparable earnings approach is implemented by examining earnings on book common equity for enterprises that have comparable risks *or* by examining earnings on book common equity for enterprises that have different risks and then making an allowance for those risk differences. Earnings on book common equity are used since the resulting cost of common equity is to be applied to an original cost rate base (in most jurisdictions).[125] The comparable earnings approach, further, requires that comparisons be made with both regulated and nonregulated alternatives, if the results are to have any validity, for two basic reasons. First, the alternatives confronting investors include both regulated and nonregulated enterprises. There is active competition for investor capital; no company enjoys a monopoly of the capital markets. Investors will seek the opportunity that provides the greatest profit, commensurate with the risks involved. Second, returns of regulated firms must always be used with extreme caution. At best, they reflect what the informed judgments of regulatory commissions have permitted such utilities to earn and may not be indicative of what could have been earned in the competitive market.[126]

The most difficult problem in applying the comparable earnings standard is the determination of relative risk. Prior to the 1970s, it was frequently argued that regulation tended to eliminate some of the risks to which nonregulated enterprises are subject, so that utilities' overall or business risk tended to be less than the corresponding business risk of industrial firms. As a result, utilities were financed with larger amounts of senior capital (i.e., they had significantly higher debt ratios). But there is clear evidence that the risk of public utilities has increased in more recent years, particularly with the introduction of competition and significant disallowances,[127] and there is also support for the proposition that regulation itself is a risk.[128] Yet, the fact remains that there is no accepted method of measuring relative risk. Some have argued that risk can be measured by instability of earnings; this may be derived statistically by use of the standard deviation or coefficient of variation. Some advocate the use of market price-book value ratios and/or market price-earnings ratios to reflect how investors appraise relative risk.[129] Beta has received attention in some cases, although, as noted earlier, betas tend to be unstable over time. Still others maintain that the higher debt ratios of utilities serve to offset their overall lower business risk, with the result that the financial or equity risks of utilities and industrials are similar under current economic conditions. And, finally, some rely upon the various indexes published by Merrill Lynch (Merrill Lynch Suitability Rating), Standard & Poor's (S&P's Quality Rating) and/or Value Line (Value Line Safety and Timeliness Ratings).[130]

Despite the difficulty of measuring relative risk, the comparable earnings standard is no harder to apply than is the market-determined standard. The DCF method, to illustrate, requires a subjective determination of the growth rate the market is contemplating. Moreover, as Leventhal has argued: "Unless the utility is permitted to earn a return comparable to that available elsewhere on similar risk, it will not be able in the long run to attract capital."[131]

PMA-R5

Arizona Water Company
Demonstration of the Inadequacy of
DCF Return Rate Related to Book Value
When Market Value Exceeds Book Value

		Based upon ACC Staff Witness Parcell's Proxy Group of Nine Water Companies		Based upon RUCO Witness Cassidy's Proxy Group of Nine Water Companies	
		[A]	[B]	[C]	[D]
Line No.		Market Value	Book Value	Market Value	Book Value
1.	Per Share	$ 33.56 (1)	$ 15.40 (2)	$ 33.56 (1)	$ 15.40 (2)
2.	DCF Cost Rate	8.60% (4)	8.60% (4)	8.63% (5)	8.63% (5)
3.	Return in Dollars	$ 2.886	$ 1.324	$ 2.896	$ 1.329
4.	Dividends	$ 0.906 (6)	$ 0.906 (6)	$ 0.909 (7)	$ 0.909 (7)
5.	Growth in Dollars	$ 1.980	$ 0.418	$ 1.987	$ 0.420
8.	Return on Market Value (8)	8.60%	3.95%	8.63%	3.96%
7.	Rate of Growth on Market Value (9)	5.90%	1.25%	5.92%	1.25%

Notes:
(1) Average market value derived from Exhibit DCP-7, Schedule 7, page 1 and Schedule JAC-3, page 3..
(2) From the water company Annual Forms 10 for the year 2015.
(4) Mean high DCF results for ACC Staff Witness Parcell's Proxy Group from page 22 of his Direct Testimony.
(5) RUCO Witness Cassidy's Composite-Mean DCF results based upon projected EPS growth from Schedule JAC-3, page 1 and page 32 of his Direct Testimony.
(6) Dividends per share based upon a 2.7% dividend yield. $0.906 = $33.56 * 2.7%.
(7) Dividends per share based upon a 2.71% dividend yield. $0.909 = $33.56 * 2.71%.
(8) Line 3 / market value per share (line 1 column (1).
(9) Line 6 / market value per share (line 1 column (1).

PMA-R6

Exhibit PMA-R6

Arizona Water Company
R-Squareds for
ACC Staff Witness Parcell's and RUCO Witness Cassidy Proxy Group

Proxy Group	Adjusted Beta	Unadjusted Beta	R-squared
American States Water Co.	0.70	0.49	0.1458
American Water Works Co., Inc.	0.70	0.50	0.2401
Aqua America, Inc.	0.70	0.52	0.2500
Artesian Resources Corp.	0.55	0.28	0.0548
California Water Service Group	0.70	0.52	0.2395
Connecticut Water Service, Inc.	0.65	0.44	0.1170
Middlesex Water Company	0.70	0.51	0.1971
SJW Corporation	0.85	0.70	0.2443
York Water Company	0.65	0.46	0.1522
Average	0.69	0.49	0.1823

Source of Information: Value Line, Inc., December 15, 2015

PMA-R7

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Key Credit Factors For The Regulated Utilities Industry

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Key Credit Factors For The Regulated Utilities Industry

***(Editor's Note:** This criteria article supersedes "Key Credit Factors: Business And Financial Risks In The Investor-Owned Utilities Industry," published Nov. 26, 2008, "Assessing U.S. Utility Regulatory Environments," Nov. 7, 2007, and "Revised Methodology For Adjusting Amounts Reported By U.K. GAAP Water Companies For Infrastructure Renewals Accounting," Jan. 27, 2010.)*

1. Standard & Poor's Ratings Services is refining and adapting its methodology and assumptions for its Key Credit Factors: Criteria For Regulated Utilities. We are publishing these criteria in conjunction with our corporate criteria (see "Corporate Methodology, published Nov. 19, 2013). This article relates to our criteria article, "Principles Of Credit Ratings," Feb. 16, 2011.

2. This criteria article supersedes "Key Credit Factors: Business And Financial Risks In The Investor-Owned Utilities Industry," Nov. 26, 2008, "Criteria: Assessing U.S. Utility Regulatory Environments," Nov. 7, 2007, and "Revised Methodology For Adjusting Amounts Reported By U.K. GAAP Water Companies For Infrastructure Renewals Accounting," Jan. 27, 2010.

SCOPE OF THE CRITERIA

3. These criteria apply to entities where regulated utilities represent a material part of their business, other than U.S. public power, water, sewer, gas, and electric cooperative utilities that are owned by federal, state, or local governmental bodies or by ratepayers. A regulated utility is defined as a corporation that offers an essential or near-essential infrastructure product, commodity, or service with little or no practical substitute (mainly electricity, water, and gas), a business model that is shielded from competition (naturally, by law, shadow regulation, or by government policies and oversight), and is subject to comprehensive regulation by a regulatory body or implicit oversight of its rates (sometimes referred to as tariffs), service quality, and terms of service. The regulators base the rates that they set on some form of cost recovery, including an economic return on assets, rather than relying on a market price. The regulated operations can range from individual parts of the utility value chain (water, gas, and electricity networks or "grids," electricity generation, retail operations, etc.) to the entire integrated chain, from procurement to sales to the end customer. In some jurisdictions, our view of government support can also affect the final rating outcome, as per our government-related entity criteria (see "General Criteria: Rating Government-Related Entities: Methodology and Assumptions," Dec. 9, 2010).

SUMMARY OF THE CRITERIA

4. Standard & Poor's is updating its criteria for analyzing regulated utilities, applying its corporate criteria. The criteria for evaluating the competitive position of regulated utilities amend and partially supersede the "Competitive Position" section of the corporate criteria when evaluating these entities. The criteria for determining the cash flow leverage

assessment partially supersede the "Cash Flow/Leverage" section of the corporate criteria for the purpose of evaluating regulated utilities. The section on liquidity for regulated utilities partially amends existing criteria. All other sections of the corporate criteria apply to the analysis of regulated utilities.

IMPACT ON OUTSTANDING RATINGS

5. These criteria could affect the issuer credit ratings of about 5% of regulated utilities globally due primarily to the introduction of new financial benchmarks in the corporate criteria. Almost all ratings changes are expected to be no more than one notch, and most are expected to be in an upward direction.

EFFECTIVE DATE AND TRANSITION

6. These criteria are effective immediately on the date of publication.

METHODOLOGY

Part I--Business Risk Analysis

Industry risk

7. Within the framework of Standard & Poor's general criteria for assessing industry risk, we view regulated utilities as a "very low risk" industry (category '1'). We derive this assessment from our view of the segment's low risk ('2') cyclicality and very low risk ('1') competitive risk and growth assessment.

8. In our view, demand for regulated utility services typically exhibits low cyclicality, being a function of such key drivers as employment growth, household formation, and general economic trends. Pricing is non-cyclical, since it is usually based in some form on the cost of providing service.

Cyclicality

9. We assess cyclicality for regulated utilities as low risk ('2'). Utilities typically offer products and services that are essential and not easily replaceable. Based on our analysis of global Compustat data, utilities had an average peak-to-trough (PTT) decline in revenues of about 6% during recessionary periods since 1952. Over the same period, utilities had an average PTT decline in EBITDA margin of about 5% during recessionary periods, with PTT EBITDA margin declines less severe in more recent periods. The PTT drop in profitability that occurred in the most recent recession (2007-2009) was less than the long-term average.

10. With an average drop in revenues of 6% and an average profitability decline of 5%, utilities' cyclicality assessment calibrates to low risk ('2'). We generally consider that the higher the level of profitability cyclicality in an industry, the higher the credit risk of entities operating in that industry. However, the overall effect of cyclicality on an industry's risk profile may be mitigated or exacerbated by an industry's competitive and growth environment.

Competitive risk and growth

11. We view regulated utilities as warranting a very low risk ('1') competitive risk and growth assessment. For competitive risk and growth, we assess four sub-factors as low, medium, or high risk. These sub-factors are:

- Effectiveness of industry barriers to entry;
- Level and trend of industry profit margins;
- Risk of secular change and substitution by products, services, and technologies; and
- Risk in growth trends.

Effectiveness of barriers to entry--low risk

12. Barriers to entry are high. Utilities are normally shielded from direct competition. Utility services are commonly naturally monopolistic (they are not efficiently delivered through competitive channels and often require access to public thoroughfares for distribution), and so regulated utilities are granted an exclusive franchise, license, or concession to serve a specified territory in exchange for accepting an obligation to serve all customers in that area and the regulation of its rates and operations.

Level and trend of industry profit margins--low risk

13. Demand is sometimes and in some places subject to a moderate degree of seasonality, and weather conditions can significantly affect sales levels at times over the short term. However, those factors even out over time, and there is little pressure on margins if a utility can pass higher costs along to customers via higher rates.

Risk of secular change and substitution of products, services, and technologies--low risk

14. Utility products and services are not overly subject to substitution. Where substitution is possible, as in the case of natural gas, consumer behavior is usually stable and there is not a lot of switching to other fuels. Where switching does occur, cost allocation and rate design practices in the regulatory process can often mitigate this risk so that utility profitability is relatively indifferent to the substitutions.

Risk in industry growth trends--low risk

15. As noted above, regulated utilities are not highly cyclical. However, the industry is often well established and, in our view, long-range demographic trends support steady demand for essential utility services over the long term. As a result, we would expect revenue growth to generally match GDP when economic growth is positive.

B. Country risk

16. In assessing "country risk" for a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology").

C. Competitive position

17. In the corporate criteria, competitive position is assessed as ('1') excellent, ('2') strong, ('3') satisfactory, ('4') fair, ('5') weak, or ('6') vulnerable.

18. The analysis of competitive position includes a review of:

- Competitive advantage,
- Scale, scope, and diversity,
- Operating efficiency, and
- Profitability.

19. In the corporate criteria we assess the strength of each of the first three components. Each component is assessed as either: (1) strong, (2) strong/adequate, (3) adequate, (4) adequate/weak, or (5) weak. After assessing these components, we determine the preliminary competitive position assessment by ascribing a specific weight to each component. The applicable weightings will depend on the company's Competitive Position Group Profile. The group profile for regulated utilities is "National Industries & Utilities," with a weighting of the three components as follows: competitive advantage (60%), scale, scope, and diversity (20%), and operating efficiency (20%). Profitability is assessed by combining two sub-components: level of profitability and the volatility of profitability.

20. "Competitive advantage" cannot be measured with the same sub-factors as competitive firms because utilities are not primarily subject to influence of market forces. Therefore, these criteria supersede the "competitive advantage" section of the corporate criteria. We analyze instead a utility's "regulatory advantage" (section 1 below).

Assessing regulatory advantage

21. The regulatory framework/regime's influence is of critical importance when assessing regulated utilities' credit risk because it defines the environment in which a utility operates and has a significant bearing on a utility's financial performance.

22. We base our assessment of the regulatory framework's relative credit supportiveness on our view of how regulatory stability, efficiency of tariff setting procedures, financial stability, and regulatory independence protect a utility's credit quality and its ability to recover its costs and earn a timely return. Our view of these four pillars is the foundation of a utility's regulatory support. We then assess the utility's business strategy, in particular its regulatory strategy and its ability to manage the tariff-setting process, to arrive at a final regulatory advantage assessment.

23. When assessing regulatory advantage, we first consider four pillars and sub-factors that we believe are key for a utility to recover all its costs, on time and in full, and earn a return on its capital employed:

24. Regulatory stability:

- Transparency of the key components of the rate setting and how these are assessed
- Predictability that lowers uncertainty for the utility and its stakeholders
- Consistency in the regulatory framework over time

25. Tariff-setting procedures and design:

- Recoverability of all operating and capital costs in full
- Balance of the interests and concerns of all stakeholders affected
- Incentives that are achievable and contained

26. Financial stability:

- Timeliness of cost recovery to avoid cash flow volatility
- Flexibility to allow for recovery of unexpected costs if they arise
- Attractiveness of the framework to attract long-term capital
- Capital support during construction to alleviate funding and cash flow pressure during periods of heavy investments

27. Regulatory independence and insulation:

- Market framework and energy policies that support long-term financeability of the utilities and that is clearly enshrined in law and separates the regulator's powers
- Risks of political intervention is absent so that the regulator can efficiently protect the utility's credit profile even during a stressful event

28 We have summarized the key characteristics of the assessments for regulatory advantage in table 1.

Table 1

Preliminary Regulatory Advantage Assessment

Qualifier	What it means	Guidance
Strong	The utility has a major regulatory advantage due to one or a combination of factors that support cost recovery and a return on capital combined with lower than average volatility of earnings and cash flows.	The utility operates in a regulatory climate that is transparent, predictable, and consistent from a credit perspective.
	There are strong prospects that the utility can sustain this advantage over the long term.	The utility can fully and timely recover all its fixed and variable operating costs, investments and capital costs (depreciation and a reasonable return on the asset base).
	This should enable the utility to withstand economic downturns and political risks better than other utilities.	The tariff set may include a pass-through mechanism for major expenses such as commodity costs, or a higher return on new assets, effectively shielding the utility from volume and input cost risks.
		Any incentives in the regulatory scheme are contained and symmetrical.
		The tariff set includes mechanisms allowing for a tariff adjustment for the timely recovery of volatile or unexpected operating and capital costs.
		There is a track record of earning a stable, compensatory rate of return in cash through various economic and political cycles and a projected ability to maintain that record.
		There is support of cash flows during construction of large projects, and pre-approval of capital investment programs and large projects lowers the risk of subsequent disallowances of capital costs.
		The utility operates under a regulatory system that is sufficiently insulated from political intervention to efficiently protect the utility's credit risk profile even during stressful events.
Adequate	The utility has some regulatory advantages and protection, but not to the extent that it leads to a superior business model or durable benefit.	It operates in a regulatory environment that is less transparent, less predictable, and less consistent from a credit perspective.
	The utility has some but not all drivers of well-managed regulatory risk. Certain regulatory factors support the business's long-term stability and viability but could result in periods of below-average levels of profitability and greater profit volatility. However, overall these regulatory drivers are partially offset by the utility's disadvantages or lack of sustainability of other factors.	The utility is exposed to delays or is not, with sufficient certainty, able to recover all of its fixed and variable operating costs, investments and capital costs (depreciation and a reasonable return on the asset base) within a reasonable time.
		Incentive ratemaking practices are asymmetrical and material, and could detract from credit quality.
		The utility is exposed to the risk that it doesn't recover unexpected or volatile costs in a full or less than timely manner due to lack of flexible reopeners or annual revenue adjustments.
		There is an uneven track record of earning a compensatory rate of return in cash through various economic and political cycles and a projected ability to maintain that record.

Table 1

Preliminary Regulatory Advantage Assessment (cont.)		
		There is little or no support of cash flows during construction, and investment decisions on large projects (and therefore the risk of subsequent disallowances of capital costs) rest mostly with the utility.
		The utility operates under a regulatory system that is not sufficiently insulated from political intervention and is sometimes subject to overt political influence.
Weak	The utility suffers from a complete breakdown of regulatory protection that places the utility at a significant disadvantage.	The utility operates in an opaque regulatory climate that lacks transparency, predictability, and consistency.
	The utility's regulatory risk is such that the long-term cost recovery and investment return is highly uncertain and materially delayed, leading to volatile or weak cash flows. There is the potential for material stranded assets with no prospect of recovery.	The utility cannot fully and/or timely recover its fixed and variable operating costs, investments, and capital costs (depreciation and a reasonable return on the asset base).
		There is a track record of earning minimal or negative rates of return in cash through various economic and political cycles and a projected inability to improve that record sustainably.
		The utility must make significant capital commitments with no solid legal basis for the full recovery of capital costs.
		Ratemaking practices actively harm credit quality.
		The utility is regularly subject to overt political influence.

29 After determining the preliminary regulatory advantage assessment, we then assess the utility's business strategy. Most importantly, this factor addresses the effectiveness of a utility's management of the regulatory risk in the jurisdiction(s) where it operates. In certain jurisdictions, a utility's regulatory strategy and its ability to manage the tariff-setting process effectively so that revenues change with costs can be a compelling regulatory risk factor. A utility's approach and strategies surrounding regulatory matters can create a durable "competitive advantage" that differentiates it from peers, especially if the risk of political intervention is high. The assessment of a utility's business strategy is informed by historical performance and its forward-looking business objectives. We evaluate these objectives in the context of industry dynamics and the regulatory climate in which the utility operates, as evaluated through the factors cited in paragraphs 24-27.

30 We modify the preliminary regulatory advantage assessment to reflect this influence positively or negatively. Where business strategy has limited effect relative to peers, we view the implications as neutral and make no adjustment. A positive assessment improves the preliminary regulatory advantage assessment by one category and indicates that management's business strategy is expected to bolster its regulatory advantage through favorable commission rulings beyond what is typical for a utility in that jurisdiction. Conversely, where management's strategy or businesses decisions result in adverse regulatory outcomes relative to peers, such as failure to achieve typical cost recovery or allowed returns, we adjust the preliminary regulatory advantage assessment one category worse. In extreme cases of poor strategic execution, the preliminary regulatory advantage assessment is adjusted by two categories worse (when possible; see table 2) to reflect management decisions that are likely to result in a significantly adverse regulatory outcome relative to peers.

Table 2

Determining The Final Regulatory Advantage Assessment

	--Strategy modifier--			
Preliminary regulatory advantage score	**Positive**	**Neutral**	**Negative**	**Very negative**
Strong	Strong	Strong	Strong/Adequate	Adequate
Strong/Adequate	Strong	Strong/Adequate	Adequate	Adequate/Weak
Adequate	Strong/Adequate	Adequate	Adequate/Weak	Weak
Adequate/Weak	Adequate	Adequate/Weak	Weak	Weak
Weak	Adequate/Weak	Weak	Weak	Weak

Scale, scope, and diversity

31. We consider the key factors for this component of competitive position to be primarily operational scale and diversity of the geographic, economic, and regulatory foot prints. We focus on a utility's markets, service territories, and diversity and the extent that these attributes can contribute to cash flow stability while dampening the effect of economic and market threats.

32. A utility that warrants a Strong or Strong/Adequate assessment has scale, scope, and diversity that support the stability of its revenues and profits by limiting its vulnerability to most combinations of adverse factors, events, or trends. The utility's significant advantages enable it to withstand economic, regional, competitive, and technological threats better than its peers. It typically is characterized by a combination of the following factors:

- A large and diverse customer base with no meaningful customer concentration risk, where residential and small to medium commercial customers typically provide most operating income.
- The utility's range of service territories and regulatory jurisdictions is better than others in the sector.
- Exposure to multiple regulatory authorities where we assess preliminary regulatory advantage to be at least Adequate. In the case of exposure to a single regulatory regime, the regulatory advantage assessment is either Strong or Strong/Adequate.
- No meaningful exposure to a single or few assets or suppliers that could hurt operations or could not easily be replaced.

33. A utility that warrants a Weak or Weak/Adequate assessment lacks scale, scope, and diversity such that it compromises the stability and sustainability of its revenues and profits. The utility's vulnerability to, or reliance on, various elements of this sub-factor is such that it is less likely than its peers to withstand economic, competitive, or technological threats. It typically is characterized by a combination of the following factors:

- A small customer base, especially if burdened by customer and/or industry concentration combined with little economic diversity and average to below-average economic prospects;
- Exposure to a single service territory and a regulatory authority with a preliminary regulatory advantage assessment of Adequate or Adequate/Weak; or
- Dependence on a single supplier or asset that cannot easily be replaced and which hurts the utility's operations.

34. We generally believe a larger service territory with a diverse customer base and average to above-average economic growth prospects provides a utility with cushion and flexibility in the recovery of operating costs and ongoing investment (including replacement and growth capital spending), as well as lessening the effect of external shocks (i.e.,

extreme local weather) since the incremental effect on each customer declines as the scale increases.

35. We consider residential and small commercial customers as having more stable usage patterns and being less exposed to periodic economic weakness, even after accounting for some weather-driven usage variability. Significant industrial exposure along with a local economy that largely depends on one or few cyclical industries potentially contributes to the cyclicality of a utility's load and financial performance, magnifying the effect of an economic downturn.

36. A utility's cash flow generation and stability can benefit from operating in multiple geographic regions that exhibit average to better than average levels of wealth, employment, and growth that underpin the local economy and support long-term growth. Where operations are in a single geographic region, the risk can be ameliorated if the region is sufficiently large, demonstrates economic diversity, and has at least average demographic characteristics.

37. The detriment of operating in a single large geographic area is subject to the strength of regulatory assessment. Where a utility operates in a single large geographic area and has a strong regulatory assessment, the benefit of diversity can be incremental.

Operating efficiency

38. We consider the key factors for this component of competitive position to be:

- Compliance with the terms of its operating license, including safety, reliability, and environmental standards;
- Cost management; and
- Capital spending: scale, scope, and management.

39. Relative to peers, we analyze how successful a utility management achieves the above factors within the levels allowed by the regulator in a manner that promotes cash flow stability. We consider how management of these factors reduces the prospect of penalties for noncompliance, operating costs being greater than allowed, and capital projects running over budget and time, which could hurt full cost recovery.

40. The relative importance of the above three factors, particularly cost and capital spending management, is determined by the type of regulation under which the utility operates. Utilities operating under robust "cost plus" regimes tend to be more insulated given the high degree of confidence costs will invariably be passed through to customers. Utilities operating under incentive-based regimes are likely to be more sensitive to achieving regulatory standards. This is particularly so in the regulatory regimes that involve active consultation between regulator and utility and market testing as opposed to just handing down an outcome on a more arbitrary basis.

41. In some jurisdictions, the absolute performance standards are less relevant than how the utility performs against the regulator's performance benchmarks. It is this performance that will drive any penalties or incentive payments and can be a determinant of the utilities' credibility on operating and asset-management plans with its regulator.

42. Therefore, we consider that utilities that perform these functions well are more likely to consistently achieve determinations that maximize the likelihood of cost recovery and full inclusion of capital spending in their asset bases. Where regulatory resets are more at the discretion of the utility, effective cost management, including of labor, may allow for more control over the timing and magnitude of rate filings to maximize the chances of a constructive outcome such as full operational and capital cost recovery while protecting against reputational risks.

43 A regulated utility that warrants a Strong or Strong/Adequate assessment for operating efficiency relative to peers generates revenues and profits through minimizing costs, increasing efficiencies, and asset utilization. It typically is characterized by a combination of the following:

- High safety record;
- Service reliability is strong, with a track record of meeting operating performance requirements of stakeholders, including those of regulators. Moreover, the utility's asset profile (including age and technology) is such that we have confidence that it could sustain favorable performance against targets;
- Where applicable, the utility is well-placed to meet current and potential future environmental standards;
- Management maintains very good cost control. Utilities with the highest assessment for operating efficiency have shown an ability to manage both their fixed and variable costs in line with regulatory expectations (including labor and working capital management being in line with regulator's allowed collection cycles); or
- There is a history of a high level of project management execution in capital spending programs, including large one-time projects, almost invariably within regulatory allowances for timing and budget.

44 A regulated utility that warrants an Adequate assessment for operating efficiency relative to peers has a combination of cost position and efficiency factors that support profit sustainability combined with average volatility. Its cost structure is similar to its peers. It typically is characterized by a combination of the following factors:

- High safety performance;
- Service reliability is satisfactory with a track record of mostly meeting operating performance requirements of stakeholders, including those of regulators. We have confidence that a favorable performance against targets can be mostly sustained;
- Where applicable, the utility may be challenged to comply with current and future environmental standards that could increase in the medium term;
- Management maintains adequate cost control. Utilities that we assess as having adequate operating efficiency mostly manage their fixed and variable costs in line with regulatory expectations (including labor and working capital management being mostly in line with regulator's allowed collection cycles); or
- There is a history of adequate project management skills in capital spending programs within regulatory allowances for timing and budget.

45 A regulated utility that warrants a weak or weak/adequate assessment for operating efficiency relative to peers has a combination of cost position and efficiency factors that fail to support profit sustainability combined with below-average volatility. Its cost structure is worse than its peers. It typically is characterized by a combination of the following:

- Poor safety performance;
- Service reliability has been sporadic or non-existent with a track record of not meeting operating performance requirements of stakeholders, including those of regulators. We do not believe the utility can consistently meet performance targets without additional capital spending;
- Where applicable, the utility is challenged to comply with current environmental standards and is highly vulnerable to more onerous standards;
- Management typically exceeds operating costs authorized by regulators;
- Inconsistent project management skills as evidenced by cost overruns and delays including for maintenance capital spending; or
- The capital spending program is large and complex and falls into the weak or weak/adequate assessment, even if

operating efficiency is generally otherwise considered adequate.

Profitability

46. A utility with above-average profitability would, relative to its peers, generally earn a rate of return at or above what regulators authorize and have minimal exposure to earnings volatility from affiliated unregulated business activities or market-sensitive regulated operations. Conversely, a utility with below-average profitability would generally earn rates of return well below the authorized return relative to its peers or have significant exposure to earnings volatility from affiliated unregulated business activities or market-sensitive regulated operations.

47. The profitability assessment consists of "level of profitability" and "volatility of profitability."

Level of profitability

48. Key measures of general profitability for regulated utilities commonly include ratios, which we compare both with those of peers and those of companies in other industries to reflect different countries' regulatory frameworks and business environments:

- EBITDA margin,
- Return on capital (ROC), and
- Return on equity (ROE).

49. In many cases, EBITDA as a percentage of sales (i.e., EBITDA margin) is a key indicator of profitability. This is because the book value of capital does not always reflect true earning potential, for example when governments privatize or restructure incumbent state-owned utilities. Regulatory capital values can vary with those of reported capital because regulatory capital values are not inflation-indexed and could be subject to different assumptions concerning depreciation. In general, a country's inflation rate or required rate of return on equity investment is closely linked to a utility company's profitability. We do not adjust our analysis for these factors, because we can make our assessment through a peer comparison.

50. For regulated utilities subject to full cost-of-service regulation and return-on-investment requirements, we normally measure profitability using ROE, the ratio of net income available for common stockholders to average common equity. When setting rates, the regulator ultimately bases its decision on an authorized ROE. However, different factors such as variances in costs and usage may influence the return a utility is actually able to earn, and consequently our analysis of profitability for cost-of-service-based utilities centers on the utility's ability to consistently earn the authorized ROE.

51. We will use return on capital when pass-through costs distort profit margins--for instance congestion revenues or collection of third-party revenues. This is also the case when the utility uses accelerated depreciation of assets, which in our view might not be sustainable in the long run.

Volatility of profitability

52. We may observe a clear difference between the volatility of actual profitability and the volatility of underlying regulatory profitability. In these cases, we could use the regulatory accounts as a proxy to judge the stability of earnings.

53. We use actual returns to calculate the standard error of regression for regulated utility issuers (only if there are at least

seven years of historical annual data to ensure meaningful results). If we believe recurring mergers and acquisitions or currency fluctuations affect the results, we may make adjustments.

Part II--Financial Risk Analysis

D. Accounting

54 Our analysis of a company's financial statements begins with a review of the accounting to determine whether the statements accurately measure a company's performance and position relative to its peers and the larger universe of corporate entities. To allow for globally consistent and comparable financial analyses, our rating analysis may include quantitative adjustments to a company's reported results. These adjustments also align a company's reported figures with our view of underlying economic conditions and give us a more accurate portrayal of a company's ongoing business. We discuss adjustments that pertain broadly to all corporate sectors, including this sector, in "Corporate Methodology: Ratios And Adjustments." Accounting characteristics and analytical adjustments unique to this sector are discussed below.

Accounting characteristics

55 Some important accounting practices for utilities include:

- For integrated electric utilities that meet native load obligations in part with third-party power contracts, we use our purchased power methodology to adjust measures for the debt-like obligation such contracts represent (see below).
- Due to distortions in leverage measures from the substantial seasonal working-capital requirements of natural gas distribution utilities, we adjust inventory and debt balances by netting the value of inventory against outstanding short-term borrowings. This adjustment provides an accurate view of the company's balance sheet by reducing seasonal debt balances when we see a very high certainty of near-term cost recovery (see below).
- We deconsolidate securitized debt (and associated revenues and expenses) that has been accorded specialized recovery provisions (see below).
- For water utilities that report under U.K. GAAP, we adjust ratios for infrastructure renewals accounting, which permits water companies to capitalize the maintenance spending on their infrastructure assets (see below). The adjustments aim to make those water companies that report under U.K. GAAP more comparable to those that report under accounting regimes that do not permit infrastructure renewals accounting.

56 In the U.S. and selectively in other regions, utilities employ "regulatory accounting," which permits a rate-regulated company to defer some revenues and expenses to match the timing of the recognition of those items in rates as determined by regulators. A utility subject to regulatory accounting will therefore have assets and liabilities on its books that an unregulated corporation, or even regulated utilities in many other global regions, cannot record. We do not adjust GAAP earnings or balance-sheet figures to remove the effects of regulatory accounting. However, as more countries adopt International Financial Reporting Standards (IFRS), the use of regulatory accounting will become more scarce. IFRS does not currently provide for any recognition of the effects of rate regulation for financial reporting purposes, but it is considering the use of regulatory accounting. We do not anticipate altering our fundamental financial analysis of utilities because of the use or non-use of regulatory accounting. We will continue to analyze the effects of regulatory actions on a utility's financial health.

Purchased power adjustment

57 We view long-term purchased power agreements (PPA) as creating fixed, debt-like financial obligations that represent substitutes for debt-financed capital investments in generation capacity. By adjusting financial measures to incorporate PPA fixed obligations, we achieve greater comparability of utilities that finance and build generation capacity and those that purchase capacity to satisfy new load. PPAs do benefit utilities by shifting various risks to the electricity generators, such as construction risk and most of the operating risk. The principal risk borne by a utility that relies on PPAs is recovering the costs of the financial obligation in rates. (See "Standard & Poor's Methodology For Imputing Debt for U.S. Utilities' Power Purchase Agreements," May 7, 2007, for more background and information on the adjustment.)

58 We calculate the present value (PV) of the future stream of capacity payments under the contracts as reported in the financial statement footnotes or as supplied directly by the company. The discount rate used is the same as the one used in the operating lease adjustment, i.e., 7%. For U.S. companies, notes to the financial statements enumerate capacity payments for the coming five years, and a thereafter period. Company forecasts show the detail underlying the thereafter amount, or we divide the amount reported as thereafter by the average of the capacity payments in the preceding five years to get an approximation of annual payments after year five.

59 We also consider new contracts that will start during the forecast period. The company provides us the information regarding these contracts. If these contracts represent extensions of existing PPAs, they are immediately included in the PV calculation. However, a contract sometimes is executed in anticipation of incremental future needs, so the energy will not flow until some later period and there are no interim payments. In these instances, we incorporate that contract in our projections, starting in the year that energy deliveries begin under the contract. The projected PPA debt is included in projected ratios as a current rating factor, even though it is not included in the current-year ratio calculations.

60 The PV is adjusted to reflect regulatory or legislative cost-recovery mechanisms when present. Where there is no explicit regulatory or legislative recovery of PPA costs, as in most European countries, the PV may be adjusted for other mitigating factors that reduce the risk of the PPAs to the utility, such as a limited economic importance of the PPAs to the utility's overall portfolio.The adjustment reduces the debt-equivalent amount by multiplying the PV by a specific risk factor.

61 Risk factors based on regulatory or legislative cost recovery typically range between 0% and 50%, but can be as high as 100%. A 100% risk factor would signify that substantially all risk related to contractual obligations rests on the company, with no regulatory or legislative support. A 0% risk factor indicates that the burden of the contractual payments rests solely with ratepayers, as when the utility merely acts as a conduit for the delivery of a third party's electricity. These utilities are barred from developing new generation assets, and the power supplied to their customers is sourced through a state auction or third parties that act as intermediaries between retail customers and electricity suppliers. We employ a 50% risk factor in cases where regulators use base rates for the recovery of the fixed PPA costs. If a regulator has established a separate adjustment mechanism for recovery of all prudent PPA costs, a risk factor of 25% is employed. In certain jurisdictions, true-up mechanisms are more favorable and frequent than the review of base rates, but still do not amount to pure fuel adjustment clauses. Such mechanisms may be triggered by financial thresholds or passage of prescribed periods of time. In these instances, a risk factor between 25% and 50% is

employed. Specialized, legislatively created cost-recovery mechanisms may lead to risk factors between 0% and 15%, depending on the legislative provisions for cost recovery and the supply function borne by the utility. Legislative guarantees of complete and timely recovery of costs are particularly important to achieving the lowest risk factors. We also exclude short-term PPAs where they serve merely as gap fillers, pending either the construction of new capacity or the execution of long-term PPAs.

62. Where there is no explicit regulatory or legislative recovery of PPA costs, the risk factor is generally 100%. We may use a lower risk factor if mitigating factors reduce the risk of the PPAs on the utility. Mitigating factors include a long position in owned generation capacity relative to the utility's customer supply needs that limits the importance of the PPAs to the utility or the ability to resell power in a highly liquid market at minimal loss. A utility with surplus owned generation capacity would be assigned a risk factor of less than 100%, generally 50% or lower, because we would assess its reliance on PPAs as limited. For fixed capacity payments under PPAs related to renewable power, we use a risk factor of less than 100% if the utility benefits from government subsidies. The risk factor reflects the degree of regulatory recovery through the government subsidy.

63. Given the long-term mandate of electric utilities to meet their customers' demand for electricity, and also to enable comparison of companies with different contract lengths, we may use an evergreening methodology. Evergreen treatment extends the duration of short- and intermediate-term contracts to a common length of about 12 years. To quantify the cost of the extended capacity, we use empirical data regarding the cost of developing new peaking capacity, incorporating regional differences. The cost of new capacity is translated into a dollars-per-kilowatt-year figure using a proxy weighted-average cost of capital and a proxy capital recovery period.

64. Some PPAs are treated as operating leases for accounting purposes--based on the tenor of the PPA or the residual value of the asset on the PPA's expiration. We accord PPA treatment to those obligations, in lieu of lease treatment; rather, the PV of the stream of capacity payments associated with these PPAs is reduced to reflect the applicable risk factor.

65. Long-term transmission contracts can also substitute for new generation, and, accordingly, may fall under our PPA methodology. We sometimes view these types of transmission arrangements as extensions of the power plants to which they are connected or the markets that they serve. Accordingly, we impute debt for the fixed costs associated with such transmission contracts.

66. Adjustment procedures:

- Data requirements:
- Future capacity payments obtained from the financial statement footnotes or from management.
- Discount rate: 7%.
- Analytically determined risk factor.

- Calculations:
- Balance sheet debt is increased by the PV of the stream of capacity payments multiplied by the risk factor.
- Equity is not adjusted because the recharacterization of the PPA implies the creation of an asset, which offsets the debt.
- Property, plant, and equipment and total assets are increased for the implied creation of an asset equivalent to the

debt.

- An implied interest expense for the imputed debt is determined by multiplying the discount rate by the amount of imputed debt (or average PPA imputed debt, if there is fluctuation of the level), and is added to interest expense.
- We impute a depreciation component to PPAs. The depreciation component is determined by multiplying the relevant year's capacity payment by the risk factor and then subtracting the implied PPA-related interest for that year. Accordingly, the impact of PPAs on cash flow measures is tempered.
- The cost amount attributed to depreciation is reclassified as capital spending, thereby increasing operating cash flow and funds from operations (FFO).
- Some PPA contracts refer only to a single, all-in energy price. We identify an implied capacity price within such an all-in energy price, to determine an implied capacity payment associated with the PPA. This implied capacity payment is expressed in dollars per kilowatt-year, multiplied by the number of kilowatts under contract. (In cases that exhibit markedly different capacity factors, such as wind power, the relation of capacity payment to the all-in charge is adjusted accordingly.)
- Operating income before depreciation and amortization (D&A) and EBITDA are increased for the imputed interest expense and imputed depreciation component, the total of which equals the entire amount paid for PPA (subject to the risk factor).
- Operating income after D&A and EBIT are increased for interest expense.

Natural gas inventory adjustment

67. In jurisdictions where a pass-through mechanism is used to recover purchased natural gas costs of gas distribution utilities within one year, we adjust for seasonal changes in short-debt tied to building inventories of natural gas in non-peak periods for later use to meet peak loads in peak months. Such short-term debt is not considered to be part of the utility's permanent capital. Any history of non-trivial disallowances of purchased gas costs would preclude the use of this adjustment. The accounting of natural gas inventories and associated short-term debt used to finance the purchases must be segregated from other trading activities.

68. Adjustment procedures:

- Data requirements:
- Short-term debt amount associated with seasonal purchases of natural gas devoted to meeting peak-load needs of captive utility customers (obtained from the company).

- Calculations:
- Adjustment to debt--we subtract the identified short-term debt from total debt.

Securitized debt adjustment

69. For regulated utilities, we deconsolidate debt (and associated revenues and expenses) that the utility issues as part of a securitization of costs that have been segregated for specialized recovery by the government entity constitutionally authorized to mandate such recovery if the securitization structure contains a number of protective features:

- An irrevocable, non-bypassable charge and an absolute transfer and first-priority security interest in transition property;
- Periodic adjustments ("true-up") of the charge to remediate over- or under-collections compared with the debt service obligation. The true-up ensures collections match debt service over time and do not diverge significantly in the short run; and,
- Reserve accounts to cover any temporary short-term shortfall in collections.

70. Full cost recovery is in most instances mandated by statute. Examples of securitized costs include "stranded costs" (above-market utility costs that are deemed unrecoverable when a transition from regulation to competition occurs) and unusually large restoration costs following a major weather event such as a hurricane. If the defined features are present, the securitization effectively makes all consumers responsible for principal and interest payments, and the utility is simply a pass-through entity for servicing the debt. We therefore remove the debt and related revenues and expenses from our measures. (See "Securitizing Stranded Costs," Jan. 18, 2001, for background information.)

71. Adjustment procedures:

- Data requirements:
- Amount of securitized debt on the utility's balance sheet at period end;
- Interest expense related to securitized debt for the period; and
- Principal payments on securitized debt during the period.

- Calculations:
- Adjustment to debt: We subtract the securitized debt from total debt.
- Adjustment to revenues: We reduce revenue allocated to securitized debt principal and interest. The adjustment is the sum of interest and principal payments made during the year.
- Adjustment to operating income after depreciation and amortization (D&A) and EBIT: We reduce D&A related to the securitized debt, which is assumed to equal the principal payments during the period. As a result, the reduction to operating income after D&A is only for the interest portion.
- Adjustment to interest expense: We remove the interest expense of the securitized debt from total interest expense.

- Operating cash flows:
- We reduce operating cash flows for revenues and increase for the assumed interest amount related to the securitized debt. This results in a net decrease to operating cash flows equal to the principal repayment amount.

Infrastructure renewals expenditure

72. In England and Wales, water utilities can report under either IFRS or U.K. GAAP. Those that report under U.K. GAAP are allowed to adopt infrastructure renewals accounting, which enables the companies to capitalize the maintenance spending on their underground assets, called infrastructure renewals expenditure (IRE). Under IFRS, infrastructure renewals accounting is not permitted and maintenance expenditure is charged to earnings in the year incurred. This difference typically results in lower adjusted operating cash flows for those companies that report maintenance expenditure as an operating cash flow under IFRS, than for those that report it as capital expenditure under U.K. GAAP. We therefore make financial adjustments to amounts reported by water issuers that apply U.K. GAAP, with the aim of making ratios more comparable with those issuers that report under IFRS and U.S. GAAP. For example, we deduct IRE from EBITDA and FFO.

73. IRE does not always consist entirely of maintenance expenditure that would be expensed under IFRS. A portion of IRE can relate to costs that would be eligible for capitalization as they meet the recognition criteria for a new fixed asset set out in International Accounting Standard 16 that addresses property, plant, and equipment. In such cases, we may refine our adjustment to U.K. GAAP companies so that we only deduct from FFO the portion of IRE that would not be capitalized under IFRS. However, the information to make such a refinement would need to be of high quality, reliable, and ideally independently verified by a third party, such as the company's auditor. In the absence of this, we assume

that the entire amount of IRE would have been expensed under IFRS and we accordingly deduct the full expenditure from FFO.

74. Adjustment procedures:

- Data requirements:
- U.K. GAAP accounts typically provide little information on the portion of capital spending that relates to renewals accounting, or the related depreciation, which is referred to as the infrastructure renewals charge. The information we use for our adjustments is, however, found in the regulatory cost accounts submitted annually by the water companies to the Water Services Regulation Authority, which regulates all water companies in England and Wales.

- Calculations:
- EBITDA: Reduced by the value of IRE that was capitalized in the period.
- EBIT: Adjusted for the difference between the adjustment to EBITDA and the reduction in the depreciation expense, depending on the degree to which the actual cash spending in the current year matches the planned spending over the five-year regulatory review period.
- Cash flow from operations and FFO: Reduced by the value of IRE that was capitalized in the period.
- Capital spending: Reduced by the value of infrastructure renewals spending that we reclassify to cash flow from operations.
- Free operating cash flow: No impact, as the reduction in operating cash flows is exactly offset by the reduction in capital spending.

E. Cash flow/leverage analysis

75. In assessing the cash flow adequacy of a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology"). We assess cash flow/leverage on a six-point scale ranging from ('1') minimal to ('6') highly leveraged. These scores are determined by aggregating the assessments of a range of credit ratios, predominantly cash flow-based, which complement each other by focusing attention on the different levels of a company's cash flow waterfall in relation to its obligations.

76. The corporate methodology provides benchmark ranges for various cash flow ratios we associate with different cash flow leverage assessments for standard volatility, medial volatility, and low volatility industries. The tables of benchmark ratios differ for a given ratio and cash flow leverage assessment along two dimensions: the starting point for the ratio range and the width of the ratio range.

77. If an industry's volatility levels are low, the threshold levels for the applicable ratios to achieve a given cash flow leverage assessment are less stringent, although the width of the ratio range is narrower. Conversely, if an industry has standard levels of volatility, the threshold levels for the applicable ratios to achieve a given cash flow leverage assessment may be elevated, but with a wider range of values.

78. We apply the "low-volatility" table to regulated utilities that qualify under the corporate criteria and with all of the following characteristics:

- A vast majority of operating cash flows come from regulated operations that are predominantly at the low end of the utility risk spectrum (e.g., a "network," or distribution/transmission business unexposed to commodity risk and with very low operating risk);
- A "strong" regulatory advantage assessment;

- An established track record of normally stable credit measures that is expected to continue;
- A demonstrated long-term track record of low funding costs (credit spread) for long-term debt that is expected to continue; and
- Non-utility activities that are in a separate part of the group (as defined in our group rating methodology) that we consider to have "nonstrategic" group status and are not deemed high risk and/or volatile.

79. We apply the "medial volatility" table to companies that do not qualify under paragraph 78 with:

- A majority of operating cash flows from regulated activities with an "adequate" or better regulatory advantage assessment; or
- About one-third or more of consolidated operating cash flow comes from regulated utility activities with a "strong" regulatory advantage and where the average of its remaining activities have a competitive position assessment of '3' or better.

80. We apply the "standard-volatility" table to companies that do not qualify under paragraph 79 and with either:

- About one-third or less of its operating cash flow comes from regulated utility activities, regardless of its regulatory advantage assessment; or
- A regulatory advantage assessment of "adequate/weak" or "weak."

Part III--Rating Modifiers

F. Diversification/portfolio effect

81. In assessing the diversification/portfolio effect on a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology").

G. Capital structure

82. In assessing the quality of the capital structure of a regulated utility, we use the same methodology as with other corporate issuers (see "Corporate Methodology").

H. Liquidity

83. In assessing a utility's liquidity/short-term factors, our analysis is consistent with the methodology that applies to corporate issuers (See "Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers," Nov. 19, 2013) except for the standards for "adequate" liquidity set out in paragraph 84 below.

84. The relative certainty of financial performance by utilities operating under relatively predictable regulatory monopoly frameworks make these utilities attractive to investors even in times of economic stress and market turbulence compared to conventional industrials. For this reason, utilities with business risk profiles of at least "satisfactory" meet our definition of "adequate" liquidity based on a slightly lower ratio of sources to uses of funds of 1.1x compared with the standard 1.2x. Also, recognizing the cash flow stability of regulated utilities we allow more discretion when calculating covenant headroom. We consider that utilities have adequate liquidity if they generate positive sources over uses, even if forecast EBITDA declines by 10% (compared with the 15% benchmark for corporate issuers) before covenants are breached.

I. Financial policy

85 In assessing financial policy on a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology").

J. Management and governance

86 In assessing management and governance on a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology").

K. Comparable ratings analysis

87 In assessing the comparable ratings analysis on a regulated utility, our analysis uses the same methodology as with other corporate issuers (see "Corporate Methodology").

Appendix--Frequently Asked Questions

Does Standard & Poor's expect that the business strategy modifier to the preliminary regulatory advantage will be used extensively?

88 Globally, we expect management's influence will be neutral in most jurisdictions. Where the regulatory assessment is "strong," it is less likely that a negative business strategy modifier would be used due to the nature of the regulatory regime that led to the "strong" assessment in the first place. Utilities in "adequate/weak" and "weak" regulatory regimes are challenged to outperform due to the uncertainty of such regulatory regimes. For a positive use of the business strategy modifier, there would need to be a track record of the utility consistently outperforming the parameters laid down under a regulatory regime, and we would need to believe this could be sustained. The business strategy modifier is most likely to be used when the preliminary regulatory advantage assessment is "strong/adequate" because the starting point in the assessment is reasonably supportive, and a utility has shown it manages regulatory risk better or worse than its peers in that regulatory environment and we expect that advantage or disadvantage will persist. An example would be a utility that can consistently earn or exceed its authorized return in a jurisdiction where most other utilities struggle to do so. If a utility is treated differently by a regulator due to perceptions of poor customer service or reliability and the "operating efficiency" component of the competitive position assessment does not fully capture the effect on the business risk profile, a negative business strategy modifier could be used to accurately incorporate it into our analysis. We expect very few utilities will be assigned a "very negative" business strategy modifier.

Does a relatively strong or poor relationship between the utility and its regulator compared with its peers in the same jurisdiction necessarily result in a positive or negative adjustment to the preliminary regulatory advantage assessment?

89 No. The business strategy modifier is used to differentiate a company's regulatory advantage within a jurisdiction where we believe management's business strategy has and will positively or negatively affect regulatory outcomes beyond what is typical for other utilities in that jurisdiction. For instance, in a regulatory jurisdiction where allowed returns are negotiated rather than set by formula, a utility that is consistently authorized higher returns (and is able to earn that return) could warrant a positive adjustment. A management team that cannot negotiate an approved capital spending program to improve its operating performance could be assessed negatively if its performance lags behind peers in the same regulatory jurisdiction.

What is your definition of regulatory jurisdiction?

90. A regulatory jurisdiction is defined as the area over which the regulator has oversight and could include single or multiple subsectors (water, gas, and power). A geographic region may have several regulatory jurisdictions. For example, the Office of Gas and Electricity Markets and the Water Services Regulation Authority in the U.K. are considered separate regulatory jurisdictions. In Ontario, Canada, the Ontario Energy Board represents a single jurisdiction with regulatory oversight for power and gas. Also, in Australia, the Australian Energy Regulator would be considered a single jurisdiction given that it is responsible for both electricity and gas transmission and distribution networks in the entire country, with the exception of Western Australia.

Are there examples of different preliminary regulatory advantage assessments in the same country or jurisdiction?

91. Yes. In Israel we rate a regulated integrated power utility and a regulated gas transmission system operator (TSO). The power utility's relationship with its regulator is extremely poor in our view, which led to significant cash flow volatility in a stress scenario (when terrorists blew up the gas pipeline that was then Israel's main source of natural gas, the utility was unable to negotiate compensation for expensive alternatives in its regulated tariffs). We view the gas TSO's relationship with its regulator as very supportive and stable. Because we already reflected this in very different preliminary regulatory advantage assessments, we did not modify the preliminary assessments because the two regulatory environments in Israel differ and were not the result of the companies' respective business strategies.

How is regulatory advantage assessed for utilities that are a natural monopoly but are not regulated by a regulator or a specific regulatory framework, and do you use the regulatory modifier if they achieve favorable treatment from the government as an owner?

92. The four regulatory pillars remain the same. On regulatory stability we look at the stability of the setup, with more emphasis on the historical track record and our expectations regarding future changes. In tariff-setting procedures and design we look at the utility's ability to fully recover operating costs, investments requirements, and debt-service obligations. In financial stability we look at the degree of flexibility in tariffs to counter volume risk or commodity risk. The flexibility can also relate to the level of indirect competition the utility faces. For example, while Nordic district heating companies operate under a natural monopoly, their tariff flexibility is partly restricted by customers' option to change to a different heating source if tariffs are significantly increased. Regulatory independence and insulation is mainly based on the perceived risk of political intervention to change the setup that could affect the utility's credit profile. Although political intervention tends to be mostly negative, in certain cases political ties due to state ownership might positively influence tariff determination. We believe that the four pillars effectively capture the benefits from the close relationship between the utility and the state as an owner; therefore, we do not foresee the use of the regulatory modifier.

In table 1, when describing a "strong" regulatory advantage assessment, you mention that there is support of cash flows during construction of large projects, and preapproval of capital investment programs and large projects lowers the risk of subsequent disallowances of capital costs. Would this preclude a "strong" regulatory advantage assessment in jurisdictions where those practices are absent?

93. No. The table is guidance as to what we would typically expect from a regulatory framework that we would assess as "strong." We would expect some frameworks with no capital support during construction to receive a "strong" regulatory advantage assessment if in aggregate the other factors we analyze support that conclusion.

RELATED CRITERIA AND RESEARCH

- Corporate Methodology, Nov. 19, 2013
- Group Rating Methodology, Nov. 19, 2013
- Methodology: Industry Risk, Nov. 19, 2013
- Corporate Methodology: Ratios And Adjustments, Nov. 19, 2013
- Ratings Above The Sovereign--Corporate And Government Ratings: Methodology And Assumptions, Nov. 19, 2013
- Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers, Nov. 19, 2013
- Collateral Coverage And Issue Notching Rules For '1+' And '1' Recovery Ratings On Senior Bonds Secured By Utility Real Property, Feb. 14, 2013
- Methodology: Management And Governance Credit Factors For Corporate Entities and Insurers, Nov. 13, 2012
- General Criteria: Principles Of Credit Ratings, Feb. 16, 2011
- General Criteria: Rating Government-Related Entities: Methodology And Assumptions, Dec. 9, 2010

These criteria represent the specific application of fundamental principles that define credit risk and ratings opinions. Their use is determined by issuer- or issue-specific attributes as well as Standard & Poor's Ratings Services' assessment of the credit and, if applicable, structural risks for a given issuer or issue rating. Methodology and assumptions may change from time to time as a result of market and economic conditions, issuer- or issue-specific factors, or new empirical evidence that would affect our credit judgment.

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Market Results for
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2015 Ibbotson® Stocks, Bonds, Bills, and Inflation® (SBBI®) Classic Yearbook

Published by:
Morningstar, Inc.
22 W. Washington Street
Chicago, IL 60602 U.S.A.
corporate.morningstar.com

Main +1 312 696-6000
Product Sales +1 888 298-3647
Fax +1 312 696-6010

ISBN 978-0-9849500-5-8
ISSN 1047-2436

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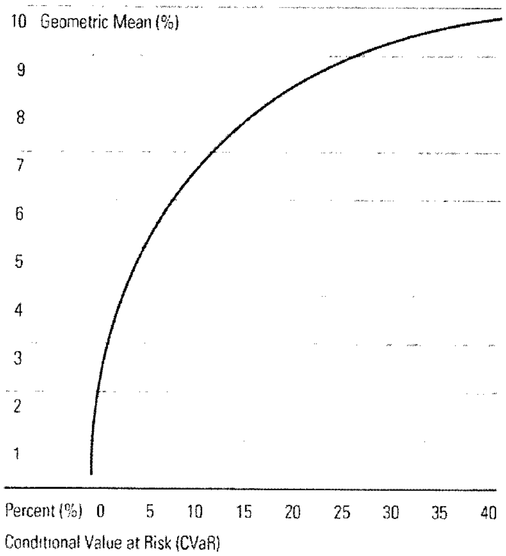
Finale: The New Efficient Frontier

Putting it all together, we form an efficient frontier of forecasted geometric mean and conditional value at risk as shown in Graph 11-7,[9] incorporating our scenario approach to covariance and new statistical technology. We believe that this efficient frontier is more relevant to investors than the traditional expected return vs. standard deviation frontier of MVO because it shows the trade-off between reward and risk that is meaningful to investors; namely, long-term potential growth vs. short-term potential loss.

Graph 11-7: Geometric Mean – Conditional Value at Risk Efficient Frontier



Approaches to Calculating the Equity Risk Premium

Researchers have estimated the expected outperformance of stocks over risk-free bonds—the equity risk premium—using many approaches. Such studies can be categorized into four groups based on the approaches they have taken, using:

1. historical returns between stocks and bonds;
2. fundamental information such as earnings, dividends, or overall productivity (supply-side models);
3. payoffs demanded by equity investors for bearing the additional risk (demand-side models); and
4. broad surveys of opinions of financial professionals.

The rest of this chapter will focus on the historical and supply-side methods.

The Historical Equity Risk Premium

The expected equity risk premium can be defined as the additional return an investor expects to receive to compensate for the additional risk associated with investing in equities as opposed to investing in riskless assets.

Unfortunately, the expected equity risk premium is unobservable in the market and therefore must be estimated. Typically, this estimation is arrived at through the use of historical data. The historical equity risk premium can be calculated by subtracting the long-term average of the income return on the riskless asset (Treasuries) from the long-term average stock market return (measured over the same period as that of the riskless asset).

In using a historical measure of the equity risk premium, one assumes that what has happened in the past is representative of what might be expected in the future. In other words, the assumption one makes when using historical data to measure the expected equity risk premium is that the relationship between the returns of the risky asset (equities) and the riskless asset (Treasuries) is stable.

The Stock Market Benchmark

The stock market benchmark chosen should be a broad index that reflects the behavior of the market as a whole. Commonly used indexes include the S&P 500 and the Russell 3000. Although the Dow Jones Industrial Average is a popular index, it would be inappropriate for calculating the equity risk premium because it is too narrow.

We use the total return of our large-cap stock index (currently represented by the S&P 500) as our market benchmark when calculating the equity risk premium. The S&P 500 was selected as the appropriate market benchmark because it is representative of a large sample of companies across a large number of industries. The S&P 500 is also one of the most widely accepted market benchmarks and is a good measure of the equity market as a whole.

Table 11-4 illustrates the equity risk premium calculation using several different market indexes and the income return on three government bonds of different horizons.

Table 11-4: Equity Risk Premium with Different Market Indexes

	Equity Risk Premium		
	Long-Horizon (%)	Intermediate-Horizon (%)	Short-Horizon (%)
S&P 500	7.00	7.57	8.57
Total Value-Weighted NYSE	6.79	7.37	8.37
NYSE Deciles 1-2	6.32	6.90	7.90

Data from 1926–2014.

The equity risk premium is calculated by subtracting the arithmetic mean of the government bond income return from the arithmetic mean of the stock market total return. Table 11-5 demonstrates this calculation for the long-horizon equity risk premium.

Table 11-5: Long-Horizon Equity Risk Premium Calculation

	Arithmetic Mean				
Long-Horizon	Market Total Return (%)		Risk-Free Rate (%)		Equity Risk Premium (%)
SBBI Large-Cap Stocks	12.07	-	5.07	=	7.00
Total Value-Weighted NYSE	11.87	-	5.07	=	6.79
NYSE Deciles 1-2	11.40	-	5.07	=	6.32

Data from 1926–2014.

Data for the New York Stock Exchange is obtained from Morningstar and the Center for Research in Security Prices at the University of Chicago Booth School of Business. The "Total" series is a capitalization-weighted index and includes all stocks traded on the NYSE except closed-end mutual funds, real estate investment trusts, foreign stocks, and Americus Trusts. Cap-weighted means that the weight of each stock in the index, for a given month, is proportionate to its market capitalization (price times number of shares outstanding) at the beginning of that month. The "Decile 1–2" series includes all stocks with capitalizations that rank within the upper 20% of companies traded on the NYSE; it is therefore a large-cap index. For more information on the CRSP data methodology, see Chapter 7.

The Market Benchmark and Firm Size

Although not restricted to the 500 largest companies, the S&P 500 is considered a large-cap index. The returns of the S&P 500 are cap-weighted. The larger companies in the index therefore receive the majority of the weight. The use of the "NYSE Deciles 1–2" series results in an even purer large-cap index. However, if using a large-cap index to calculate the equity risk premium, an adjustment is usually needed to account for the different risk and return characteristics of small stocks. This was discussed further in Chapter 7 on the size premium.

The Risk-Free Asset

The equity risk premium can be calculated for a variety of time horizons when given the choice of risk-free asset to be used in the calculation. Chapter 3 provides equity risk premium calculations for short-, intermediate-, and long-term horizons. The short-, intermediate-, and long-horizon equity risk premiums are calculated using the income return from a 30-day Treasury bill, a 5-year Treasury bond, and a 20-year Treasury bond, respectively.

20-Year vs. 30-Year Treasuries

Our methodology for estimating the long-horizon equity risk premium makes use of the income return on a 20-year Treasury bond; however, the Treasury stopped issuing 20-year bonds in 1986. The 30-year bond that the Treasury returned to issuing in 2006 is theoretically more correct when dealing with the long-term nature of business valuation, yet Ibbotson Associates instead creates a series of returns using bonds on the market with approximately 20 years to maturity. The reason for the use of a 20-year maturity bond is that 30-year Treasury securities have only been issued over the relatively recent past, starting in February of 1977, and were suspended from 2002 to 2006.

The same reason applies to why we do not use the 10-year Treasury bond—a long history of market data is not available for 10-year bonds. We have persisted in using a 20-year bond to keep the basis of the time series consistent.

Income Return

Another point to keep in mind when calculating the equity risk premium is that the income return on the appropriate-horizon Treasury security, rather than the total return, is used in the calculation.

The total return comprises three return components: the income return, the capital appreciation return, and the reinvestment return. The income return is defined as the portion of the total return that results from a periodic cash flow or, in this case, the bond coupon payment. The capital appreciation return results from the price change of a bond over a specific period. Bond prices generally change in reaction to unexpected fluctuations in yields. Reinvestment return is the return on a given month's investment income when reinvested into the same asset class in the subsequent months of the year. The income return is thus used in the estimation of the equity risk premium because it represents the truly riskless portion of the return.

Arithmetic vs. Geometric Mean

The equity risk premium data presented in this book are arithmetic average risk premiums as opposed to geometric average risk premiums. The arithmetic average equity risk premium can be demonstrated to be most appropriate when discounting future cash flows. For use as the expected equity risk premium in either the CAPM or the building- block approach, the arithmetic mean or the simple difference of the arithmetic means of stock market returns and riskless rates is the relevant number. This is because both the CAPM and the building-block approach are additive models, in which the cost of capital is the sum of its parts. The geometric average is more appropriate for reporting past performance because it represents the compound average return.

Appropriate Historical Period

The equity risk premium can be estimated using any historical time period. For the U.S., market data exist at least as far back as the late 1800s. Therefore, it is possible to estimate the equity risk premium using data that covers roughly the past 125 years.

Our equity risk premium covers 1926 to the present. The original data source for the time series comprising the equity risk premium is the Center for Research in Security Prices. CRSP chose to begin its analysis of market returns with 1926 for two main reasons. CRSP determined that 1926 was approximately when quality financial data became available. They also made a conscious effort to include the period of extreme market volatility from the late 1920s and early 1930s; 1926 was chosen because it includes one full business cycle of data before the market crash of 1929.

Implicit in using history to forecast the future is the assumption that investors' expectations for future outcomes conform to past results. This method assumes that the price of taking on risk changes only slowly, if at all, over time. This "future equals the past" assumption is most applicable to a random time-series variable. A time-series variable is random if its value in one period is independent of its value in other periods.

Choosing an Appropriate Historical Period

The estimate of the equity risk premium depends on the length of the data series studied. A proper estimate of the equity risk premium requires a data series long enough to give a reliable average without being unduly influenced by very good and very poor short-term returns. When calculated using a long data series, the historical equity risk premium is relatively stable. Furthermore, because an average of the realized equity risk premium is quite volatile when calculated using a short history, using a long series makes it less likely that the analyst can justify any number he or she wants. The magnitude of how shorter periods can affect the result will be explored later in this chapter.

Some analysts estimate the expected equity risk premium using a shorter, more recent period on the basis that recent events are more likely to be repeated in the near future; furthermore, they believe that the 1920s, 1930s, and 1940s contain too many unusual events. This view is suspect because all periods contain unusual events. Some of the most unusual events of the last 100 years took place quite recently, including the inflation of the late 1970s and early 1980s, the October 1987 stock market crash, the collapse of the high-yield bond market, the major contraction and consolidation of the thrift industry, the collapse of the Soviet Union, the development of the

European Economic Community, the attacks of Sept. 11, 2001, and the more recent global financial crisis of 2008-2009.

It is even difficult for economists to predict the economic environment of the future. For example, if one were analyzing the stock market in 1987 before the crash, it would be statistically improbable to predict the impending short-term volatility without considering the stock market crash and market volatility of the 1929–1931 period.

Without an appreciation of the 1920s and 1930s, no one would believe that such events could happen. The 89-year period starting with 1926 represents what can happen: It includes high and low returns, volatile and quiet markets, war and peace, inflation and deflation, and prosperity and depression. Restricting attention to a shorter historical period underestimates the amount of change that could occur in a long future period. Finally, because historical event-types (not specific events) tend to repeat themselves, long-run capital market return studies can reveal a great deal about the future. Investors probably expect unusual events to occur from time to time, and their return expectations reflect this.

A Look at the Historical Results

It is interesting to look at the realized returns and realized equity risk premium in the context of the above discussion. Table 11-6 shows the average stock market return and the average (arithmetic mean) realized long-horizon equity risk premium over various historical periods. The table shows that using a longer historical period provides a more stable estimate of the equity risk premium. The reason is that any unique period will not be weighted heavily in an average covering a longer historical period. It better represents the probability of these unique events occurring over a long period of time.

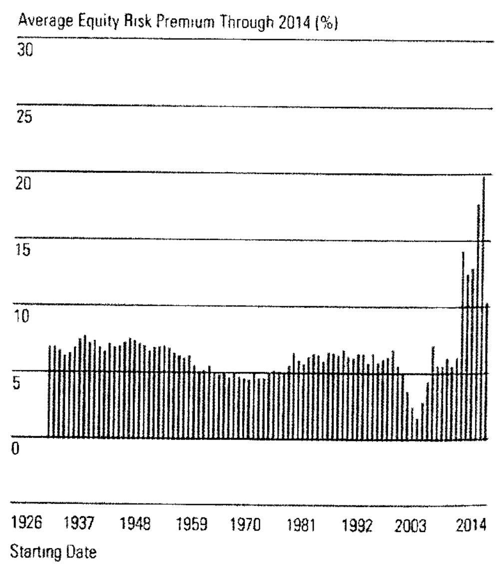
Table 11-6: Stock Market Return and Equity Risk Premium Over Time

Length (Yrs.)	Period Dates	Large-Cap Stock Arithmetic Mean Total Return (%)	Long-Horizon Equity Risk Premium (%)
89	1926-2014	12.1	7.0
80	1935-2014	12.7	7.4
70	1945-2014	12.7	7.1
60	1955-2014	11.8	5.6
50	1965-2014	11.3	4.6
40	1975-2014	13.6	6.6
30	1985-2014	12.8	6.8
20	1995-2014	11.7	6.8
15	2000-2014	6.1	1.7
10	2005-2014	9.5	5.6
5	2010-2014	15.9	12.5

Data from 1926–2014

Looking carefully at Graph 11-8 will clarify this point. The graph shows the realized equity risk premium for a series of periods through 2014, starting with 1926. In other words, the first value on the graph represents the average realized equity risk premium over the period 1926–2014. The next value on the graph represents the average realized equity risk premium over the period 1927–2014, and so on, with the last value representing the average over the most recent five years, 2010–2014.

Graph 11-8: Equity Risk Premium Using Different Starting Dates



Data from 1926–2014

Correlation Coefficients: Serial and Cross-Correlations

The behavior of an asset return series over time reveals its predictability. For example, a series may be random or unpredictable, or it may be subject to trends, cycles, or other patterns, making the series predictable to some degree. The serial correlation coefficient of a series determines its predictability given knowledge of the last observation. The cross-correlation coefficient (often shortened to "correlation") between two series determines the predictability of one series, conditional on knowledge of the other.

Serial Correlations

The serial correlation of a return series, also known as the first-order autocorrelation, describes the extent to which the return in one period is related to the return in the next period. A return series with a high (near one) serial correlation is very predictable from one period to the next, while one with a low (near zero) serial correlation is random and unpredictable.

The serial correlation of a series is closely approximated by the equation for the cross-correlation between two series, which is given in equation (26). The data, however, are the series and its "lagged" self. For example, the lagged series is the series of one-period-old returns:

Year	Return Series (X)	Lagged Return Series (Y)
1	0.10	undefined
2	-0.10	0.10
3	0.15	-0.10
4	0.00	0.15

Cross-Correlations

The cross-correlation between two series measures the extent to which they are linearly related.[3] The correlation coefficient measures the sensitivity of return on one asset class or portfolio to the return of another. The correlation equation between return series **X** and **Y** is:

$$\rho_{X,Y} = \left[\frac{Cov(X,Y)}{\sigma_X \sigma_Y}\right] \tag{26}$$

where,

Cov (X,Y) = the covariance of **X** and **Y**, defined below;
σ_X = the standard deviation of **X**, and,
σ_Y = the standard deviation of **Y**.

The covariance equation is:

$$Cov(X,Y) = \frac{1}{n-1}\sum_{t=1}^{n}(r_{X,t} - r_{X,A})(r_{Y,t} - r_{Y,A}) \tag{27}$$

where,

$r_{X,t}$ = the return for series **X** in period **t**,
$r_{Y,t}$ = the return for series **Y** in period **t**,
$r_{X,A}$ = the arithmetic mean of series **X**,
$r_{Y,A}$ = the arithmetic mean of series **Y**; and,
n = the number of periods.

Correlations of the Basic Series

Table 6-3 presents the annual cross-correlations and serial correlations for the seven basic series. Long-term government and long-term corporate bond returns are highly correlated with each other but negatively correlated with inflation. If inflation is unanticipated, it has a negative effect on fixed-income securities. In addition, U.S. Treasury bills and inflation are reasonably highly correlated, a result of the post-1951 "tracking" described in Chapter 2. Lastly, both the U.S. Treasury bills and inflation series display high serial correlations.

Table 6-3: Basic Series
Serial and Cross Correlations of Historical Annual Returns

Series	Large-Cap Stocks	Small-Cap Stocks	LT-Corp Bonds	LT-Govt Bonds	Inter Govt Bonds	U.S T-Bills	Inflation
Large-Cap Stocks	1.00						
Small-Cap Stocks	0.79	1.00					
LT-Corp Bonds	0.14	0.04	1.00				
LT-Govt Bonds	-0.01	-0.11	0.89	1.00			
IT-Govt Bonds	-0.03	-0.12	0.86	0.86	1.00		
U.S. Treasury Bills	-0.02	-0.09	0.15	0.17	0.46	1.00	
Inflation	-0.01	0.05	-0.15	-0.14	0.01	0.41	1.00
Serial Correlation	0.02	0.06	0.05	-0.14	0.13	0.91	0.64

Data from 1926–2014

Correlations of the Derived Series

The annual cross-correlations and serial correlations for the four risk premium series and inflation are presented in Table 6-4. Notice that inflation is negatively correlated with the horizon premium. Increasing inflation causes long-term bond yields to rise and prices to fall; therefore, a negative horizon premium is observed in times of rising inflation.

Table 6-5 presents annual cross-correlations and serial correlations for the inflation-adjusted asset return series. It is interesting to observe how the relationship between the asset returns are substantially different when these returns are expressed in inflation-adjusted terms (as compared with nominal terms). In general, the cross-correlations between asset classes are higher when one accounts for inflation (i.e., subtracts inflation from the nominal return.)

Table 6-4: Risk Premiums and Inflation
Serial and Cross Correlations of Historical Annual Returns

Series	Equity Risk Premium	Small-Cap Premium	Default Premium	Horizon Premium	Inflation
Equity Risk Premium	1.00				
Small-Cap Premium	0.28	1.00			
Default Premium	0.29	0.18	1.00		
Horizon Premium	0.01	-0.10	-0.51	1.00	
Inflation	-0.07	0.11	0.00	-0.27	1.00
Serial Correlation	0.03	0.36	-0.31	-0.16	0.64

Data from 1926–2014.

Table 6-5: Inflation-Adjusted Series
Serial and Cross Correlations of Historical Annual Returns

Inflation Adjusted Series	Inflation-Adjusted Large-Cap Stocks	Small-Cap Stocks	LT-Corp Bonds	LT-Gov't Bonds	Inter-Gov't Bonds	T-Bills*	Inflation
Large-Cap Stocks	1.00						
Small-Cap Stocks	0.79	1.00					
LT-Corp Bonds	0.21	0.07	1.00				
LT-Govt Bonds	0.08	-0.06	0.92	1.00			
IT-Govt Bonds	0.07	-0.07	0.91	0.90	1.00		
T-Bills*	0.09	-0.06	0.53	0.50	0.70	1.00	
Inflation	-0.19	-0.07	-0.55	-0.49	-0.59	-0.71	1.00
Serial Correlation	0.01	0.03	0.16	-0.05	0.21	0.67	0.64

Data from 1926–2014
*Real Interest Rates

Is Serial Correlation in the Derived Series Random?

The risk/return relationships in the historical data are represented in the equity risk premium, the small-cap premium, the bond horizon premium, and the bond default premium. The real/nominal historical relationships are represented in the inflation rates and the real interest rates. The objective is to uncover whether each series is random or is subject to any trends, cycles, or other patterns.

The one-year serial correlation coefficients measure the degree of correlation between returns from each year and the previous year for the same series, as seen in Table 6-6. Highly positive (near 1) serial correlations indicate trends, while highly negative (near -1) serial correlations indicate cycles. There is strong evidence that both inflation rates and real riskless rates follow trends. Serial correlations near zero suggest no patterns (i.e., random behavior); equity risk premiums and bond horizon premiums are random variables. Small stock premiums and bond default premiums fall into a middle range where it cannot be determined that they either follow a trend or behave randomly.

Table 6-6: Interpretation of the Annual Serial Correlations

Series	Serial Correlation	Interpretation
Equity Risk Premium	0.03	Random
Small-Cap Premium	0.36	Likely Trend
Bond Default Premium	-0.31	Likely Trend
Bond Horizon Premium	-0.16	Random
Inflation Rates	0.64	Trend
Real Interest Rates	0.91	Trend

Data from 1926–2014

Basic and Inflation-Adjusted Series Summary Data

Table 6-7 presents summary statistics of annual total return, and where applicable, income and capital appreciation, for each asset class. The summary statistics presented here are arithmetic mean, geometric mean, standard deviation, and serial correlation. Table 6-8 presents summary statistics for the six inflation-adjusted total return series.

Table 6-7: Total Return, Income Return, and Capital Appreciation of the SBBI Asset Classes: Summary Statistics of Annual Returns

Series	Geometric Mean	Arithmetic Mean	Standard Deviation	Serial Correlation
Large-Cap Stocks				
Total Return	10.1	12.1	20.1	0.02
Income	4.0	4.0	1.6	0.91
Capital Appreciation	5.9	7.8	19.4	0.02
Small-Cap Stocks (Tot. Return)	12.2	16.7	32.1	0.06
LT-Corp Bonds (Total Return)	6.1	6.4	8.4	0.05
LT-Gov't Bonds				
Total Return	5.7	6.1	10.0	-0.14
Income	5.0	5.1	2.6	0.96
Capital Appreciation	0.4	0.8	9.0	-0.25
Intermediate-Term Gov't Bonds				
Total Return	5.3	5.4	5.6	0.13
Income	4.5	4.5	2.9	0.96
Capital Appreciation	0.6	0.7	4.5	-0.17
Treasury Bills (Total Return)	3.5	3.5	3.1	0.91
Inflation	2.9	3.0	4.1	0.64

Data from 1926–2014

Total return is equal to the sum of three component returns, income return, capital appreciation return, and reinvestment return. Annual reinvestment returns for select asset classes are provided in Table 2-2.

PMA-R9

Arizona Water Company
ACC Staff Witness Parcell's and RUCO Witness Cassidy's CAPM Cost Rates
Corrected to Reflect a Prospective Risk-Free Rate. Prospective Market Equity Risk Premium and
Properly Calculated Historical Market Equity Risk Premium

	Traditional Capital Asset Pricing Model (1)				ECAPM Results	Average of Traditional CAPM & ECAPM Results
	1	2	3	4	5	6
Company	Risk-Free Rate (1)	Beta (2)	Market Premium (3)	CAPM Rates	ECAPM Rates	Average (4)
Proxy Group						
American States Water Co.	3.68%	0.70	8.52%	9.64%	10.28%	9.96%
American Water Works Co., Inc.	3.68%	0.70	8.52%	9.64%	10.60%	10.12%
Aqua America, Inc.	3.68%	0.75	8.52%	10.07%	9.32%	9.70%
Artesian Resources Corp.	3.68%	0.55	8.52%	8.37%	10.60%	9.49%
California Water Service Group	3.68%	0.75	8.52%	10.07%	9.96%	10.02%
Connecticut Water Service, Inc.	3.68%	0.65	8.52%	9.22%	10.28%	9.75%
Middlesex Water Company	3.68%	0.70	8.52%	9.64%	10.60%	10.12%
SJW Corporation	3.68%	0.75	8.52%	10.07%	9.32%	9.70%
York Water Company	3.68%	0.75	8.52%	10.07%	10.60%	10.34%
Mean				9.64%	10.28%	9.96%
Median				9.64%	10.28%	9.96%

See page 3 for notes.

Arizona Water Company
ACC Staff Witness Parcell's and RUCO Witness Cassidy's CAPM Cost Rates
Corrected to Reflect a Prospective Risk-Free Rate. Prospective Market Equity Risk Premium and
Properly Calculated Historical Market Equity Risk Premium

Empirical Capital Asset Pricing Model (5)

	1	2	3	4
Company	Risk-Free Rate (1)	Beta (2)	Market Premium (3)	ECAPM Rates
Proxy Group				
American States Water Co.	3.68%	0.70	8.52%	10.28%
American Water Works Co., Inc.	3.68%	0.70	8.52%	10.28%
Aqua America, Inc.	3.68%	0.75	8.52%	10.60%
Artesian Resources Corp.	3.68%	0.55	8.52%	9.32%
California Water Service Group	3.68%	0.75	8.52%	10.60%
Connecticut Water Service, Inc.	3.68%	0.65	8.52%	9.96%
Middlesex Water Company	3.68%	0.70	8.52%	10.28%
SJW Corporation	3.68%	0.75	8.52%	10.60%
York Water Company	3.68%	0.75	8.52%	10.60%
Mean				10.28%
Median				10.28%

See page 3 for notes

Arizona Water Company
ACC Staff Witness Parcell's and RUCO Witness Cassidy's CAPM Cost Rates
Corrected to Reflect a Prospective Risk-Free Rate. Prospective Market Equity Risk Premium and
Properly Calculated Historical Market Equity Risk Premium

Notes:

(1) For reasons explained in the direct testimony, the appropriate risk-free rate for cost of capital purposes is the average forecast of 30 year Treasury Bonds per the consensus of nearly 50 economists reported in Blue Chip Financial Forecasts. (See pages 4 and 5 of this Exhibit). The projection of the

First Quarter 2016	3.00 %
Second Quarter 2016	3.10
Third Quarter 2016	3.30
Fourth Quarter 2016	3.40
First Quarter 2017	3.60
Second Quarter 2017	3.70
2017-2021	4.50
2022-2026	4.80
	3.68 %

(2) From ACC Witness Parcell's Exhibit DCP-9, Schedule 9 and RUCO Witness Cassidy's Schedule JAC-4, page 1.

(3) The market risk premium (MRP) is an average of four different measures. The first measure of the MRP derives the total return on the market by adding the thirteen-week average forecasted 3-5 year capital appreciation to the thirteen-week average expected dividend yield from Value Line Summary and Index. The projected risk-free rate (developed in Note 2) is then subtracted from the total return to arrive at the projected MRP. The second measure of MRP is based on the arithmetic mean of historical monthly return data of large company stocks less the income return on long-term government bonds from 1926-2014 as published by Morningstar, Inc. The third measure applies the PRPM to the Ibbotson historical data to derive a projected MRP. The fourth measure uses data from Bloomberg Professional Services to derive a total projected return on the S&P 500 by using expected dividend yields and long-term growth estimates as a proxy for capital appreciation. The projected risk-free rate is then subtracted from the projected total return on the S&P500 to arrive at the projected MRP. The four measures of MRP are illustrated below:

Measure 1: Value Line Projected MRP (Thirteen weeks ending February 5, 2016)	
Total projected return on the market 3 -5 years hence:	12.83 %
Projected Risk-Free Rate (described in Note 2):	3.68
MRP based on Value Line Summary & Index:	9.15 %
Measure 2: Ibbotson Arithmetic Mean MRP (1926-2014)	
Arithmetic Mean Monthly Returns for Large Stocks 1926-2014:	12.07 %
Arithmetic Mean Income Returns on Long-Term Government Bonds:	5.23
MRP based on Ibbotson Historical Data:	6.84 %
Measure 3: Application of the PRPM to Ibbotson Historical Data: (January 1926 - December 2015)	8.32 %
Measure 4: Bloomberg Projected MRP	
Total return on the Market based on the S&P 500:	13.46 %
Projected Risk-Free Rate (described in Note 2):	3.68
MRP based on Bloomberg data	9.78 %
Average MRP:	8.52 %

(3) Average of Column 4 and Column 5.

Sources of Information:
Value Line Summary and Index
Blue Chip Financial Forecasts, February 1, 2016 and December 1, 2015
Stocks, Bonds, Bills, and Inflation - Ibbotson® SBBI® 2015 Market Report, Morningstar, Inc., 2015 Chicago, IL.
Bloomberg Professional Services

Consensus Forecasts Of U.S. Interest Rates And Key Assumptions[1]

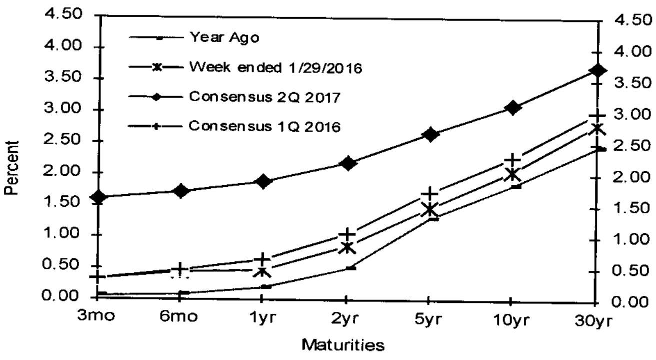
Interest Rates	History: Average For Week Ending Jan. 29	Jan. 22	Jan. 15	Jan. 8	History: Average For Month Dec.	Nov.	Oct.	Latest Qtr 4Q2015	Consensus Forecasts-Quarterly Avg. 1Q 2016	2Q 2016	3Q 2016	4Q 2016	1Q 2017	2Q 2017
Federal Funds Rate	0.38	0.36	0.36	0.27	0.16	0.12	0.12	0.16	**0.4**	**0.6**	**0.9**	**1.1**	**1.3**	**1.6**
Prime Rate	3.50	3.50	3.50	3.50	3.29	3.25	3.25	3.29	**3.5**	**3.7**	**3.9**	**4.1**	**4.4**	**4.7**
LIBOR, 3-mo.	0.62	0.62	0.62	0.61	0.41	0.37	0.32	0.41	**0.7**	**0.9**	**1.1**	**1.3**	**1.6**	**1.9**
Commercial Paper, 1-mo.	0.33	0.34	0.35	0.33	0.17	0.11	0.11	0.17	**0.4**	**0.6**	**0.9**	**1.1**	**1.4**	**1.7**
Treasury bill, 3-mo.	0.31	0.28	0.23	0.21	0.13	0.13	0.02	0.13	**0.3**	**0.5**	**0.8**	**1.0**	**1.3**	**1.6**
Treasury bill, 6-mo.	0.42	0.38	0.44	0.47	0.31	0.33	0.11	0.31	**0.5**	**0.7**	**0.9**	**1.1**	**1.4**	**1.7**
Treasury bill, 1 yr.	0.46	0.46	0.58	0.65	0.25	0.48	0.26	0.46	**0.6**	**0.9**	**1.1**	**1.3**	**1.6**	**1.9**
Treasury note, 2 yr.	0.86	0.86	0.91	0.99	0.83	0.88	0.64	0.83	**1.0**	**1.2**	**1.5**	**1.7**	**1.9**	**2.2**
Treasury note, 5 yr.	1.46	1.47	1.52	1.66	1.59	1.67	1.39	1.59	**1.7**	**1.9**	**2.1**	**2.2**	**2.5**	**2.7**
Treasury note, 10 yr.	2.03	2.04	2.10	2.19	2.19	2.26	2.07	2.19	**2.3**	**2.4**	**2.6**	**2.8**	**2.9**	**3.1**
Treasury note, 30 yr.	2.80	2.80	2.88	2.95	2.96	3.03	2.89	2.96	**3.0**	**3.1**	**3.3**	**3.4**	**3.6**	**3.7**
Corporate Aaa bond	4.04	4.03	3.95	3.98	3.99	4.06	3.95	3.99	**4.0**	**4.2**	**4.4**	**4.6**	**4.7**	**4.9**
Corporate Baa bond	5.48	5.45	5.42	5.46	5.42	5.46	5.34	5.42	**5.4**	**5.5**	**5.6**	**5.8**	**5.9**	**6.1**
State & Local bonds	n.a.	3.37	3.45	3.45	3.64	3.68	3.67	3.64	**3.6**	**3.8**	**4.0**	**4.1**	**4.3**	**4.4**
Home mortgage rate	n.a.	3.81	3.92	3.97	3.90	3.94	3.80	3.90	**4.0**	**4.2**	**4.4**	**4.6**	**4.7**	**4.9**

Key Assumptions	History: 1Q 2014	2Q 2014	3Q 2014	4Q 2014	1Q 2015	2Q 2015	3Q 2015	4Q 2015	Consensus Forecasts-Quarterly 1Q 2016	2Q 2016	3Q 2016	4Q 2016	1Q 2017	2Q 2017
Major Currency Index	77.1	76.6	77.8	82.6	89.4	89.9	91.8	93.1	**94.8**	**95.6**	**95.8**	**95.6**	**95.3**	**94.8**
Real GDP	-0.9	4.6	4.3	2.1	0.6	3.9	2.0	0.7	**2.3**	**2.5**	**2.5**	**2.5**	**2.4**	**2.5**
GDP Price Index	1.5	2.2	1.6	0.1	0.1	2.1	1.3	0.8	**1.2**	**1.9**	**1.9**	**1.9**	**2.0**	**2.1**
Consumer Price Index	2.1	2.4	1.2	-0.9	-3.1	3.0	1.6	0.2	**0.5**	**2.2**	**2.2**	**2.2**	**2.3**	**2.5**

Forecasts for interest rates and the Federal Reserve's Major Currency Index represent averages for the quarter. Forecasts for Real GDP, GDP Price Index and Consumer Price Index are seasonally-adjusted annual rates of change (saar). Individual panel members' forecasts are on pages 4 through 9. Historical data for interest rates except LIBOR is from Federal Reserve Release (FRSR) H.15. LIBOR quotes available from *The Wall Street Journal*. Interest rate definitions are same as those in FRSR H.15. Treasury yields are reported on a constant maturity basis. Historical data for Fed's Major Currency Index is from FRSR H.10 and G.5. Historical data for Real GDP and GDP Chained Price Index are from the Bureau of Economic Analysis (BEA). Consumer Price Index (CPI) history is from the Department of Labor's Bureau of Labor Statistics (BLS).

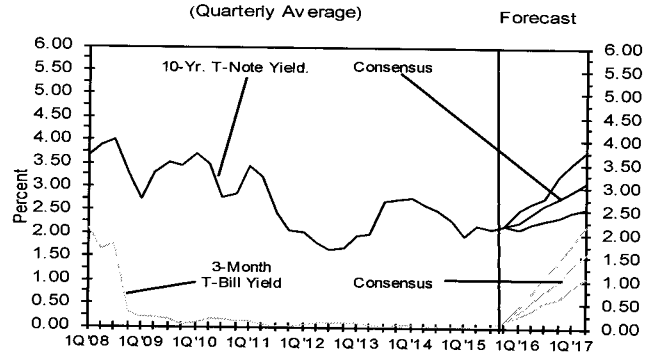
U.S. Treasury Yield Curve

Week ended January 29, 2016 and Year Ago vs. 1Q 2016 and 2Q 2017 Consensus Forecasts



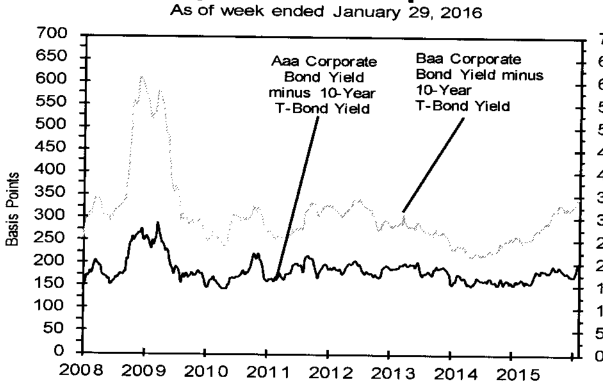
U.S. 3-Mo. T-Bills & 10-Yr. T-Note Yield

(Quarterly Average)



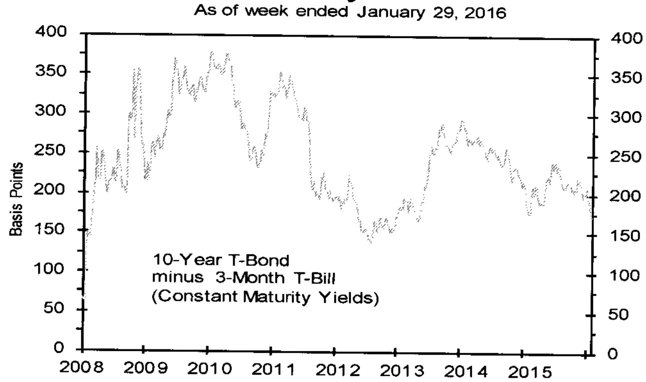
Corporate Bond Spreads

As of week ended January 29, 2016



U.S. Treasury Yield Curve

As of week ended January 29, 2016



Long-Range Estimates:

The table below contains the results of our twice-annual long-range CONSENSUS survey. There are also Top 10 and Bottom 10 averages for each variable. Shown are consensus estimates for the years 2017 through 2021 and averages for the five-year periods 2017-2021 and 2022-2026. Apply these projections cautiously. Few if any economic, demographic and political forces can be evaluated accurately over such long time spans.

Interest Rates		Average For The Year					Five-Year Averages	
		2017	2018	2019	2020	2021	2017-2021	2022-2026
1. Federal Funds Rate	**CONSENSUS**	**2.0**	**2.8**	**3.2**	**3.3**	**3.4**	**2.9**	**3.3**
	Top 10 Average	2.7	3.6	4.0	4.0	4.0	3.7	3.8
	Bottom 10 Average	1.4	2.1	2.3	2.4	2.7	2.2	2.7
2. Prime Rate	**CONSENSUS**	**5.0**	**5.8**	**6.2**	**6.4**	**6.4**	**6.0**	**6.3**
	Top 10 Average	5.7	6.5	7.0	7.1	7.0	6.7	6.8
	Bottom 10 Average	4.4	5.2	5.5	5.7	5.8	5.3	5.7
3. LIBOR, 3-Mo.	**CONSENSUS**	**2.3**	**3.1**	**3.3**	**3.4**	**3.6**	**3.1**	**3.5**
	Top 10 Average	2.8	3.7	4.0	4.2	4.1	3.8	4.0
	Bottom 10 Average	1.8	2.4	2.6	2.7	3.0	2.5	3.0
4. Commercial Paper, 1-Mo.	**CONSENSUS**	**2.2**	**3.0**	**3.4**	**3.5**	**3.4**	**3.1**	**3.4**
	Top 10 Average	2.6	3.5	3.9	4.1	4.0	3.6	3.8
	Bottom 10 Average	1.7	2.4	2.9	2.9	2.9	2.6	2.9
5. Treasury Bill Yield, 3-Mo.	**CONSENSUS**	**2.0**	**2.8**	**3.2**	**3.3**	**3.3**	**2.9**	**3.2**
	Top 10 Average	2.8	3.5	3.9	4.0	3.9	3.6	3.7
	Bottom 10 Average	1.4	2.1	2.5	2.7	2.7	2.3	2.6
6. Treasury Bill Yield, 6-Mo.	**CONSENSUS**	**2.1**	**2.9**	**3.3**	**3.4**	**3.4**	**3.0**	**3.3**
	Top 10 Average	3.0	3.6	4.0	4.1	4.0	3.7	3.8
	Bottom 10 Average	1.5	2.2	2.6	2.8	2.8	2.4	2.7
7. Treasury Bill Yield, 1-Yr.	**CONSENSUS**	**2.3**	**3.1**	**3.4**	**3.5**	**3.5**	**3.2**	**3.4**
	Top 10 Average	3.2	3.8	4.1	4.2	4.2	3.9	4.0
	Bottom 10 Average	1.6	2.3	2.7	2.9	2.9	2.5	2.8
8. Treasury Note Yield, 2-Yr.	**CONSENSUS**	**2.5**	**3.2**	**3.5**	**3.6**	**3.7**	**3.3**	**3.7**
	Top 10 Average	3.4	4.0	4.4	4.4	4.4	4.1	4.3
	Bottom 10 Average	1.8	2.4	2.6	2.7	3.0	2.5	3.0
10. Treasury Note Yield, 5-Yr.	**CONSENSUS**	**3.0**	**3.6**	**3.8**	**3.9**	**4.0**	**3.6**	**4.0**
	Top 10 Average	3.8	4.4	4.7	4.8	4.8	4.5	4.7
	Bottom 10 Average	2.3	2.7	2.8	2.9	3.2	2.8	3.3
11. Treasury Note Yield, 10-Yr.	**CONSENSUS**	**3.4**	**3.8**	**4.1**	**4.2**	**4.3**	**4.0**	**4.3**
	Top 10 Average	4.2	4.7	5.0	5.2	5.2	4.9	5.1
	Bottom 10 Average	2.8	2.9	3.0	3.2	3.5	3.1	3.5
12. Treasury Bond Yield, 30-Yr.	**CONSENSUS**	**4.0**	**4.4**	**4.6**	**4.8**	**4.9**	**4.5**	**4.8**
	Top 10 Average	4.9	5.3	5.7	5.9	5.9	5.5	5.7
	Bottom 10 Average	3.3	3.6	3.5	3.7	3.9	3.6	3.9
13. Corporate Aaa Bond Yield	**CONSENSUS**	**5.1**	**5.5**	**5.7**	**5.8**	**5.8**	**5.6**	**5.8**
	Top 10 Average	5.7	6.2	6.5	6.6	6.6	6.3	6.5
	Bottom 10 Average	4.5	4.9	5.0	5.0	4.9	4.9	5.2
13. Corporate Baa Bond Yield	**CONSENSUS**	**6.0**	**6.5**	**6.7**	**6.8**	**6.7**	**6.5**	**6.8**
	Top 10 Average	6.8	7.2	7.6	7.7	7.6	7.4	7.5
	Bottom 10 Average	5.2	5.7	5.9	6.0	5.8	5.7	6.0
14. State & Local Bonds Yield	**CONSENSUS**	**4.5**	**4.9**	**5.0**	**5.1**	**5.1**	**4.9**	**5.1**
	Top 10 Average	5.0	5.5	5.7	5.8	5.8	5.6	5.8
	Bottom 10 Average	4.0	4.3	4.3	4.4	4.4	4.3	4.4
15. Home Mortgage Rate	**CONSENSUS**	**5.1**	**5.6**	**5.8**	**5.9**	**6.0**	**5.7**	**6.0**
	Top 10 Average	5.8	6.3	6.7	6.8	6.8	6.5	6.7
	Bottom 10 Average	4.4	4.8	4.9	5.0	5.1	4.9	5.2
A. FRB - Major Currency Index	**CONSENSUS**	**92.8**	**91.7**	**91.2**	**90.8**	**91.1**	**91.5**	**90.1**
	Top 10 Average	96.9	96.6	96.4	96.4	96.4	96.5	96.0
	Bottom 10 Average	88.4	86.6	85.7	85.1	85.7	86.3	84.2

		Year-Over-Year, % Change					Five-Year Averages	
		2017	2018	2019	2020	2021	2017-2021	2022-2026
B. Real GDP	**CONSENSUS**	**2.5**	**2.4**	**2.2**	**2.2**	**2.3**	**2.3**	**2.2**
	Top 10 Average	2.9	2.8	2.6	2.6	2.6	2.7	2.5
	Bottom 10 Average	2.2	1.8	1.8	1.9	1.9	1.9	2.0
C. GDP Chained Price Index	**CONSENSUS**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.0**
	Top 10 Average	2.3	2.5	2.4	2.3	2.2	2.3	2.2
	Bottom 10 Average	1.8	1.8	1.9	1.9	1.9	1.9	1.9
D. Consumer Price Index	**CONSENSUS**	**2.3**	**2.4**	**2.3**	**2.3**	**2.3**	**2.3**	**2.2**
	Top 10 Average	2.8	2.8	2.7	2.6	2.5	2.7	2.5
	Bottom 10 Average	2.0	2.0	2.0	2.0	2.1	2.0	2.0

PMA-R10

Essentials of Managerial Finance third edition

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THE DRYDEN PRESS / HINSDALE, ILLINOIS

Library of Congress Cataloging in Publication Data

Weston, John Frederick.
Essentials of managerial finance.

Includes bibliographical references.
1. Corporations—Finance. I. Brigham, Eugene F.,
1930- joint author. II. Title.
HG4011.W42 1974 658.1'5 73-13936
ISBN 0-03-008146-7

Printed in the United States of America
6789 071 987

This book was set in Helvetica by Ruttle, Shaw & Wetherill, Inc.
The designer was Mel Haber.
The production manager was Elizabeth Millo.
The drawings were done by Vantage Art Inc.
The printer and binder was Kingsport Press.

RISK IN FINANCIAL ANALYSIS

The riskiness of an asset is defined in terms of the likely variability of future returns from the asset. For example, if one buys a $1 million short-term government bond expected to yield 5 percent, then the return on the investment, 5 percent, can be estimated quite precisely, and the investment is defined to be relatively risk free. However, if the $1 million is invested in the stock of a company just being organized to prospect for uranium in Central Africa, then the probable return cannot be estimated precisely. The rate of return on the $1 million investment could range from minus 100 percent to some extremely large figure; because of this high variability, the project is defined to be relatively risky. Similarly, sales forecasts for different products of a single firm might exhibit differing degrees of riskiness. For example, the Union Carbide Company might be quite sure that sales of its Eveready batteries will range between 50 and 60 million for the coming year, but be highly uncertain about how many units of a new laser measuring device will be sold during the year.

Risk, then, is associated with project variability—the more variable the expected future returns, the riskier the investment. However, we can define risk more precisely, and it is useful to do so. This more precise definition requires a step-by-step development, which constitutes the remainder of this section.

Probability Distributions

Any investment decision—or, for that matter, almost *any* kind of business decision—implies a forecast of future events, with the forecast being either explicit or implicit. Ordinarily, the forecast of annual cash flow is a single figure, or point estimate, frequently called the "most likely" or "best" estimate. For example, one might forecast that the cash flows from a particular project will be $500 a year for three years.

How good is this point estimate; that is, how confident is the forecaster of his predicted return? Is he very certain, very uncertain, or somewhere in between? This degree of uncertainty can be defined and measured in terms of the forecaster's "probability distribution"—the probability estimates associated with each possible outcome. In its simplest form, a probability distribution could consist of just a few potential outcomes. For example, in forecasting cash flows, we could make an optimistic estimate, a pessimistic estimate, and a most likely estimate; or, alternatively, we could make high, low, and "best guess" estimates. We might expect our high, or optimistic, PMA-R11

F I F T H E D I T I O N

PRINCIPLES OF CORPORATE FINANCE

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The McGraw-Hill Companies, Inc.
New York St. Louis San Francisco Auckland Bogotá Caracas
Lisbon London Madrid Mexico City Milan Montreal New Delhi
San Juan Singapore Sydney Tokyo Toronto

McGraw-Hill
A Division of the McGraw-Hill Companies

Principles of Corporate Finance

This book is printed on acid-free paper.

234567890 DOC DOC 90987

ISBN 0-07-007417-8

This book was set in Janson by York Graphic Services, Inc.
The editors were Michelle E. Cox and Elaine Rosenberg; the production supervisor was Kathryn Porzio.
The design manager was Charles Carson.
The text was designed by Blake Logan.
The cover was designed by Danielle Conlon.
New drawings were done by Dartmouth Publishing, Inc.
R. R. Donnelley & Sons Company was printer and binder.

Cover photograph by Joshua Sheldon.
Library of Congress Cataloging-in-Publication Data is available:
LC Card # 96-76441.

INTERNATIONAL EDITION

When ordering this title, use ISBN 0-07-114053-0.

TABLE 7-1

Average rates of return on Treasury bills, government bonds, corporate bonds, and common stocks, 1926–1994 (figures in percent per year)

Portfolio	AVERAGE ANNUAL RATE OF RETURN Nominal	Real	Average Risk Premium (Extra Return versus Treasury Bills)
Treasury bills	3.7	.6	0
Government bonds	5.2	2.1	1.4
Corporate bonds	5.7	2.7	2.0
Common stocks (S&P 500)	12.2	8.9	8.4
Small-firm common stocks	17.4	13.9	13.7

Source: Ibbotson Associates, Inc., *1995 Yearbook.*

You may ask why we look back over such a long period to measure average rates of return. The reason is that annual rates of return for common stocks fluctuate so much that averages taken over short periods are meaningless. Our only hope of gaining insights from historical rates of return is to look at a very long period.[3]

Arithmetic Averages and Compound Annual Returns

Notice that the average returns shown in Table 7-1 are arithmetic averages. In other words, Ibbotson Associates simply added the 69 annual returns and divided by 69. The arithmetic average is higher than the compound annual return over the period. The 69-year compound annual return for the S&P index was 10.2 percent.[4]

The proper uses of arithmetic and compound rates of return from past investments are often misunderstood. Therefore, we call a brief time-out for a clarifying example.

Example: Suppose that the price of Big Oil's common stock is $100. There is an equal chance that at the end of the year the stock will be worth $90, $110, or $130. Therefore, the return could be −10 percent, +10 percent, or +30 percent (we assume that Big Oil does not pay a dividend). The *expected* return is $\frac{1}{3}(-10 + 10 + 30) = +10$ percent.

If we run the process in reverse and discount the expected cash flow by the expected rate of return, we obtain the value of Big Oil's stock:

[3]Even with 69 years of data we cannot be sure that this period is truly representative and that the average is not distorted by a few unusually high or low returns. The reliability of an estimate of the average is usually measured by its *standard error*. For example, the standard error of our estimate of the average risk premium on common stocks is 2.5 percent. There is a 95 percent chance that the *true* average is within plus or minus 2 standard errors of the 8.4 percent estimate. In other words, if you said that the true average was between 3.5 and 13.4 percent, you would have a 95 percent chance of being right. (*Technical note:* The standard error of the mean is equal to the standard deviation divided by the square root of the number of observations. In our case the standard deviation is 20.6 percent, and therefore the standard error is $20.6/\sqrt{69} = 2.5$.)

[4]This was calculated from $(1 + r)^{69} = 811$, which implies $r = .102$. (*Technical note*: For lognormally distributed returns the annual compound return is equal to the arithmetic average return minus half the variance. For example, the annual standard deviation of returns on the U.S. market was about .20, or 20 percent. Variance was therefore $.20^2$, or .04. The compound annual return is $.04/2 = .02$, or 2 percentage points less than the arithmetic average.)

$$PV = \frac{110}{1.10} = \$100$$

The expected return of 10 percent is therefore the correct rate at which to discount the expected cash flow from Big Oil's stock. It is also the opportunity cost of capital for investments which have the same degree of risk as Big Oil.

Now suppose that we observe the returns on Big Oil stock over a large number of years. If the odds are unchanged, the return will be −10 percent in a third of the years, +10 percent in a further third, and +30 percent in the remaining years. The arithmetic average of these yearly returns is

$$\frac{-10 + 10 + 30}{3} = +10\%$$

Thus the arithmetic average of the returns correctly measures the opportunity cost of capital for investments of similar risk to Big Oil stock.

The compound annual return on Big Oil stock is

$$(.9 \times 1.1 \times 1.3)^{1/3} - 1 = .088, \text{ or } 8.8\%,$$

less than the opportunity cost of capital. Investors would not be willing to invest in a project that offered an 8.8 percent expected return if they could get an expected return of 10 percent in the capital markets. The net present value of such a project would be

$$NPV = 100 + \frac{108.8}{1.1} = -1.1$$

Moral: If the cost of capital is estimated from historical returns or risk premiums, use arithmetic averages, not compound annual rates of return.

Using Historical Evidence to Evaluate Today's Cost of Capital

Suppose there is an investment project which you *know*—don't ask how—has the same risk as Standard and Poor's Composite Index. We will say that it has the same degree of risk as the *market portfolio,* although this is speaking somewhat loosely, because the index does not include all risky securities. What rate should you use to discount this project's forecasted cash flows?

Clearly you should use the currently expected rate of return on the market portfolio; that is the return investors would forgo by investing in the proposed project. Let us call this market return r_m. One way to estimate r_m is to assume that the future will be like the past and that today's investors expect to receive the same "normal" rates of return revealed by the averages shown in Table 7-1. In this case, you would set r_m at 12.2 percent, the average of past market returns.

Unfortunately, this is *not* the way to do it: r_m is not likely to be stable over time. Remember that it is the sum of the risk-free interest rate r_f and a premium for risk. We know that r_f varies. For example, as we finish this chapter in early 1995, Treasury bills yield about 6 percent, more than 2 percentage points above the 3.7 percent average return of Treasury bills.

What if you were called upon to estimate r_m in 1995? Would you have said 12.2 percent? That would have squeezed the risk premium by 2.2 percentage points. A more sensible procedure takes the current interest rate on Treasury bills plus 8.4 percent, the average *risk premium* shown in Table 7-1. With a rate of 6 percent for Treasury bills, that gives

$$r_m(1995) = r_f(1995) + \text{normal risk premium}$$
$$= .06 + .084 = .144, \text{ or } 14.4\%$$

9

Capital Budgeting and Risk

Long before the development of modern theories linking risk and expected return, smart financial managers adjusted for risk in capital budgeting. They realized intuitively that, other things being equal, risky projects are less desirable than safe ones. Therefore financial managers demanded a higher rate of return from risky projects, or they based their decisions on conservative estimates of the cash flows.

Various rules of thumb are often used to make these risk adjustments. For example, many companies estimate the rate of return required by investors in their securities and use the **company cost of capital** to discount the cash flows on all new projects. Since investors require a higher rate of return from a very risky company, such a firm will have a higher company cost of capital and will set a higher discount rate for its new investment opportunities. For example, in Table 8-1 we estimated that investors expected a rate of return of .163 or about 16.5 percent from Microsoft common stock. Therefore, according to the company cost of capital rule, Microsoft should have been using a 16.5 percent discount rate to compute project net present values.[1]

This is a step in the right direction. Even though we can't measure risk or the expected return on risky securities with absolute precision, it is still reasonable to assert that Microsoft faced more risk than the average firm and, therefore, should have demanded a higher rate of return from its capital investments.

But the company cost of capital rule can also get a firm into trouble if the new projects are more or less risky than its existing business. Each project should be evaluated at its *own* opportunity cost of capital. This is a clear implication of the value-additivity principle introduced in Chapter 7. For a firm composed of assets A and B, the firm value is

$$\text{Firm value} = PV(AB) = PV(A) + PV(B) = \text{sum of separate asset values}$$

Here PV(A) and PV(B) are valued just as if they were mini-firms in which stockholders could invest directly. Investors would value A by discounting its forecasted cash flows at a rate reflecting the risk of A. They would value B by discounting at a rate reflecting the risk of B. The two discount rates will, in general, be different.

[1]Microsoft did not use any significant amount of debt financing. Thus its cost of capital is the rate of return investors expect on its common stock. The complications caused by debt are discussed later in this chapter.

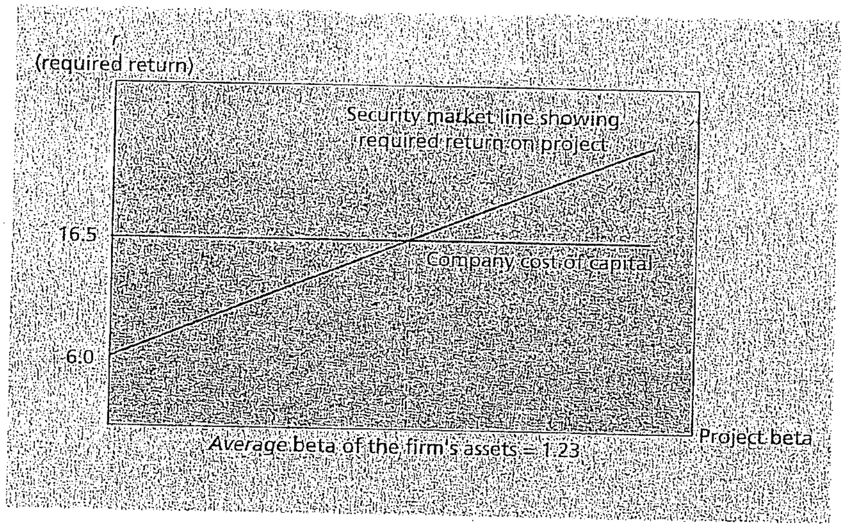

Figure 9-1 A comparison between the company cost of capital rule and the required return under the capital asset pricing model. Microsoft's company cost of capital is about 16.5 percent. This is the correct discount rate only if the project beta is 1.23. In general, the correct discount rate increases as project beta increases. Microsoft should accept projects with rates of return above the security market line relating required return to beta.

If the firm considers investing in a third project C, it should also value C as if C were a mini-firm. That is, the firm should discount the cash flows of C at the expected rate of return that investors would demand to make a separate investment in C. *The true cost of capital depends on the use to which the capital is put.*

This means that Microsoft should accept any project that more than compensates for the *project's beta*. In other words, Microsoft should accept any project lying above the upward-sloping line that links expected return to risk in Figure 9-1. If the project has a high risk, Microsoft needs a higher prospective return than if the project has a low risk. Now contrast this with the company cost of capital rule, which is to accept any project *regardless of its risk* as long as it offers a higher return than the *company's* cost of capital. In terms of Figure 9-1, the rule tells Microsoft to accept any project above the horizontal cost-of-capital line, i.e., any project offering a return of more than 16.5 percent.

It is clearly silly to suggest that Microsoft should demand the same rate of return from a very safe project as from a very risky one. If Microsoft used the company cost of capital rule, it would reject many good low-risk projects and accept many poor high-risk projects. It is also silly to suggest that just because Duke Power has a low company cost of capital, it is justified in accepting projects that Microsoft would reject. If you followed such a rule to its seemingly logical conclusion, you would think it possible to enlarge the company's investment opportunities by investing a large sum in Treasury bills. That would make the common stock safe and create a low company cost of capital.[2]

The notion that each company has some individual discount rate or cost of capital is widespread, but far from universal. Many firms require different returns from different categories of investment. For example, discount rates might be set as follows:

[2]If the present value of an asset depended on the identity of the company that bought it, present values would not add up. Remember, a good project is a good project is a good project.

Category	Discount Rate
Speculative ventures	30%
New products	20%
Expansion of existing business	15% (company cost of capital)
Cost improvement, known technology	10%

The capital asset pricing model is widely used by large corporations to estimate the discount rate. It states

$$\text{Expected project return} = r = r_f + (\text{project beta})(r_m - r_f)$$

To calculate this, you have to figure out the project beta. Before thinking about the betas of individual projects, we will look at some problems you would encounter in using beta to estimate a company's cost of capital. It turns out that beta is difficult to measure accurately for an individual firm: Much greater accuracy can be achieved by looking at an average of similar companies. But then we have to define *similar*. Among other things, we will find that a firm's borrowing policy affects its stock beta. It would be misleading, e.g., to average the betas of Chrysler, which has been a heavy borrower, and General Motors, which has generally borrowed less.

The company cost of capital is the correct discount rate for projects that have the same risk as the company's existing business but *not* for those projects that are safer or riskier than the company's average. The problem is to judge the relative risks of the projects available to the firm. To handle that problem, we will need to dig a little deeper and look at what features make some investments riskier than others. After you know *why* AT&T stock has less market risk than, say, Ford Motor, you will be in a better position to judge the relative risks of capital investment opportunities.

There is still another complication: Project betas can shift over time. Some projects are safer in youth than in old age; others are riskier. In this case, what do we mean by *the* project beta? There may be a separate beta for each year of the project's life. To put it another way, can we jump from the capital asset pricing model, which looks out one period into the future, to the discounted-cash-flow formula that we developed in Chapters 2 and 6 for valuing long-lived assets? Most of the time it is safe to do so, but you should be able to recognize and deal with the exceptions.

We will use the capital asset pricing model, or CAPM, throughout this chapter. But don't infer that the CAPM is the last word on risk and return. The principles and procedures covered in this chapter work just as well with other models such as arbitrage pricing theory (APT). For example, we could have started with an APT estimate of the expected rate of return on Microsoft stock; the discussion of company and project costs of capital would have followed exactly.

9.1 MEASURING BETAS

Suppose that you were considering an across-the-board expansion by your firm. Such an investment would have about the same degree of risk as the existing business. Therefore you should discount the projected flows at the company cost of capital. To estimate that, you could begin by estimating the beta of the company's stock.

An obvious way to measure the beta of the stock is to look at how its price has responded in the past to market movements. For example, in Figure 9-2*a* and *b* we have plotted monthly rates of return from AT&T and Hewlett-Packard against mar-

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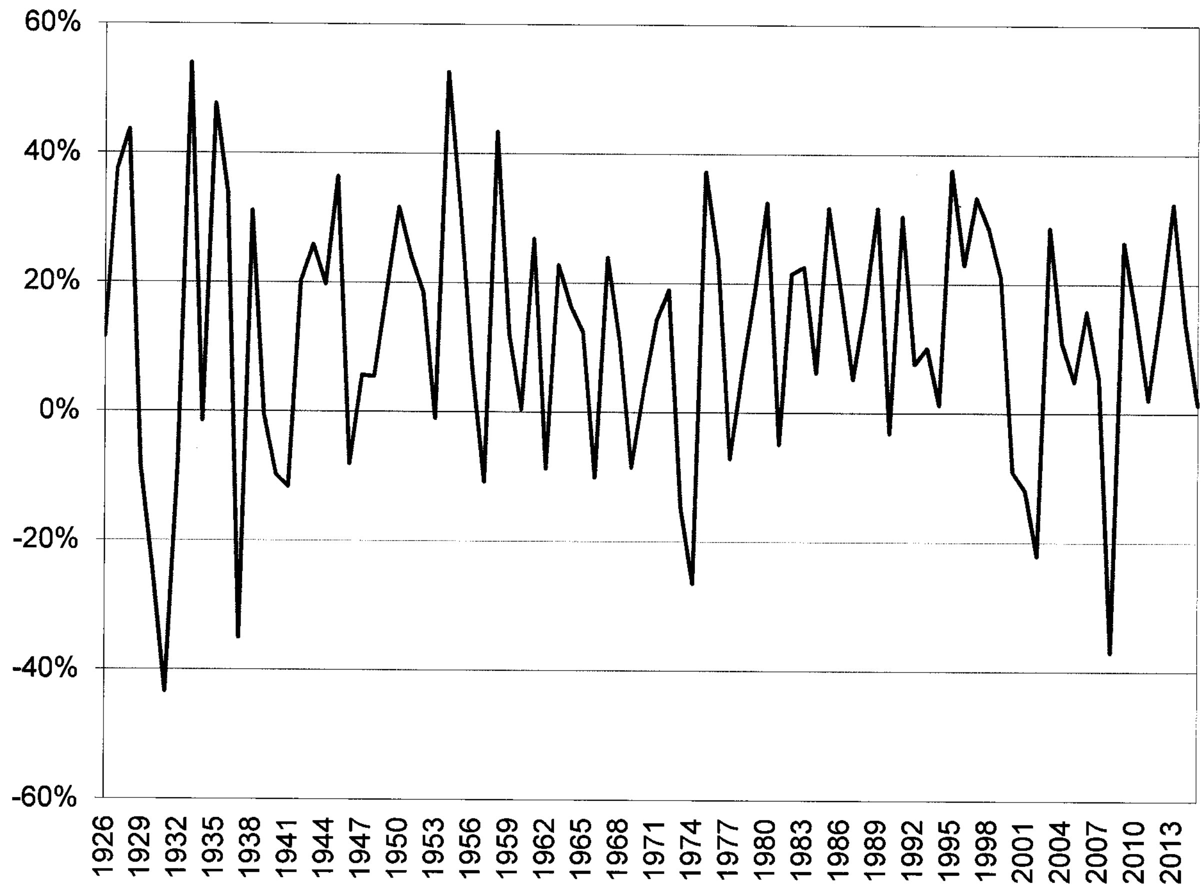
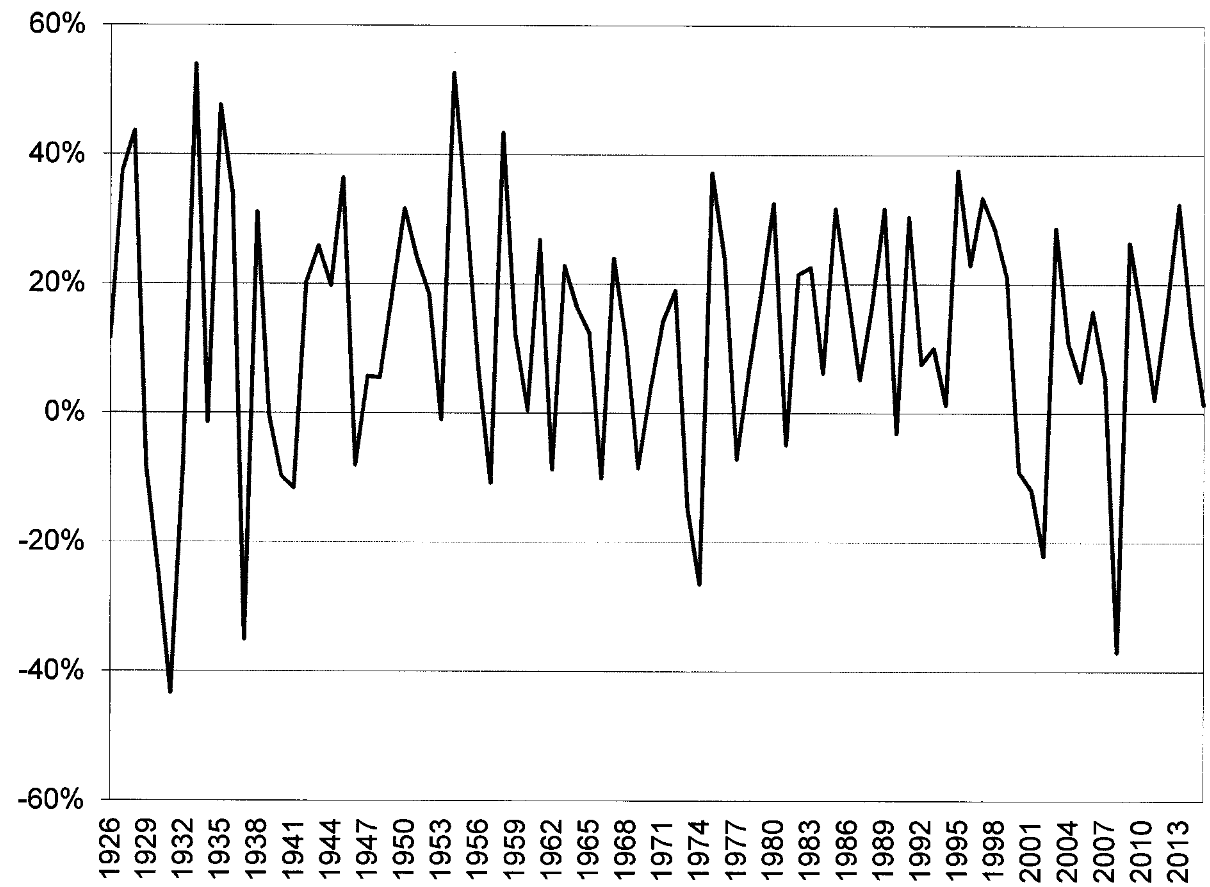
U.S. Large Company Stock Returns
1926 to 2015



Source of Information:

Morningstar SBBI Appendix A Tables: Morningstar Stocks, Bonds, Bills, and Inflation - 1926-2015, Table A-1 Large Company Staocks: Total Returns (Jan 1926 - Dec 2015) Morningstar, Inc., 2016 Chicago, IL

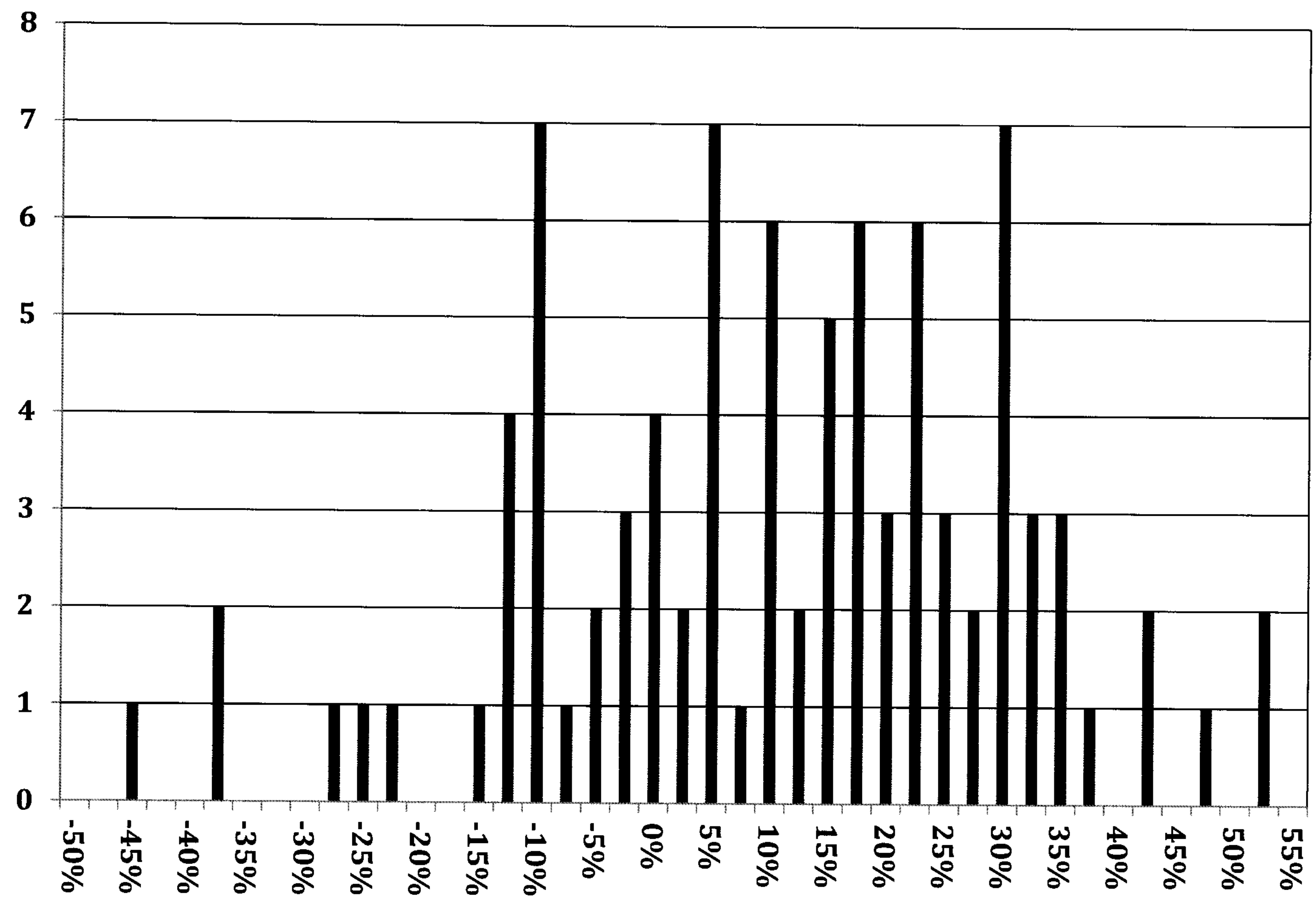
U.S. Large Company Stock Returns
1926 to 2015



Source of Information:

Morningstar SBBI Appendix A Tables: Morningstar Stocks, Bonds, Bills, and Inflation - 1926-2015, Table A-1 Large Company Staocks: Total Returns (Jan 1926 - Dec 2015) Morningstar, Inc., 2016 Chicago, IL

Frequency Distribution of Observed US Market Returns
1926 to 2015



Source of Information:
Ibbotson® SBBI® - 2015 Classic Yearbook , Market Results for Stocks, Bonds, Bills, and Inflation - 1926-2015, p. 44, Morningstar, Inc., 2015 Chicago, IL

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Journal of Economic Perspectives—Volume 18, Number 3—Summer 2004—Pages 25–46

The Capital Asset Pricing Model: Theory and Evidence

Eugene F. Fama and Kenneth R. French

The capital asset pricing model (CAPM) of William Sharpe (1964) and John Lintner (1965) marks the birth of asset pricing theory (resulting in a Nobel Prize for Sharpe in 1990). Four decades later, the CAPM is still widely used in applications, such as estimating the cost of capital for firms and evaluating the performance of managed portfolios. It is the centerpiece of MBA investment courses. Indeed, it is often the only asset pricing model taught in these courses.[1]

The attraction of the CAPM is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected return and risk. Unfortunately, the empirical record of the model is poor—poor enough to invalidate the way it is used in applications. The CAPM's empirical problems may reflect theoretical failings, the result of many simplifying assumptions. But they may also be caused by difficulties in implementing valid tests of the model. For example, the CAPM says that the risk of a stock should be measured relative to a comprehensive "market portfolio" that in principle can include not just traded financial assets, but also consumer durables, real estate and human capital. Even if we take a narrow view of the model and limit its purview to traded financial assets, is it

[1] Although every asset pricing model is a capital asset pricing model, the finance profession reserves the acronym CAPM for the specific model of Sharpe (1964), Lintner (1965) and Black (1972) discussed here. Thus, throughout the paper we refer to the Sharpe-Lintner-Black model as the CAPM.

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legitimate to limit further the market portfolio to U.S. common stocks (a typical choice), or should the market be expanded to include bonds, and other financial assets, perhaps around the world? In the end, we argue that whether the model's problems reflect weaknesses in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid.

We begin by outlining the logic of the CAPM, focusing on its predictions about risk and expected return. We then review the history of empirical work and what it says about shortcomings of the CAPM that pose challenges to be explained by alternative models.

The Logic of the CAPM

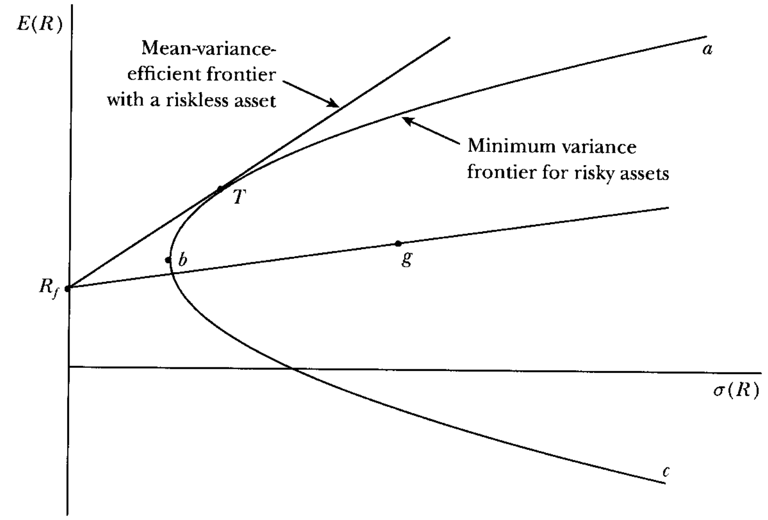
The CAPM builds on the model of portfolio choice developed by Harry Markowitz (1959). In Markowitz's model, an investor selects a portfolio at time $t - 1$ that produces a stochastic return at t. The model assumes investors are risk averse and, when choosing among portfolios, they care only about the mean and variance of their one-period investment return. As a result, investors choose "mean-variance-efficient" portfolios, in the sense that the portfolios 1) minimize the variance of portfolio return, given expected return, and 2) maximize expected return, given variance. Thus, the Markowitz approach is often called a "mean-variance model."

The portfolio model provides an algebraic condition on asset weights in mean-variance-efficient portfolios. The CAPM turns this algebraic statement into a testable prediction about the relation between risk and expected return by identifying a portfolio that must be efficient if asset prices are to clear the market of all assets.

Sharpe (1964) and Lintner (1965) add two key assumptions to the Markowitz model to identify a portfolio that must be mean-variance-efficient. The first assumption is *complete agreement*: given market clearing asset prices at $t - 1$, investors agree on the joint distribution of asset returns from $t - 1$ to t. And this distribution is the true one—that is, it is the distribution from which the returns we use to test the model are drawn. The second assumption is that there is *borrowing and lending at a risk-free rate*, which is the same for all investors and does not depend on the amount borrowed or lent.

Figure 1 describes portfolio opportunities and tells the CAPM story. The horizontal axis shows portfolio risk, measured by the standard deviation of portfolio return; the vertical axis shows expected return. The curve *abc*, which is called the minimum variance frontier, traces combinations of expected return and risk for portfolios of risky assets that minimize return variance at different levels of expected return. (These portfolios do not include risk-free borrowing and lending.) The tradeoff between risk and expected return for minimum variance portfolios is apparent. For example, an investor who wants a high expected return, perhaps at point *a*, must accept high volatility. At point *T*, the investor can have an interme-

Figure 1
Investment Opportunities



diate expected return with lower volatility. If there is no risk-free borrowing or lending, only portfolios above *b* along *abc* are mean-variance-efficient, since these portfolios also maximize expected return, given their return variances.

Adding risk-free borrowing and lending turns the efficient set into a straight line. Consider a portfolio that invests the proportion *x* of portfolio funds in a risk-free security and $1 - x$ in some portfolio *g*. If all funds are invested in the risk-free security—that is, they are loaned at the risk-free rate of interest—the result is the point R_f in Figure 1, a portfolio with zero variance and a risk-free rate of return. Combinations of risk-free lending and positive investment in *g* plot on the straight line between R_f and *g*. Points to the right of *g* on the line represent borrowing at the risk-free rate, with the proceeds from the borrowing used to increase investment in portfolio *g*. In short, portfolios that combine risk-free lending or borrowing with some risky portfolio *g* plot along a straight line from R_f through *g* in Figure 1.[2]

[2] Formally, the return, expected return and standard deviation of return on portfolios of the risk-free asset *f* and a risky portfolio *g* vary with *x*, the proportion of portfolio funds invested in *f*, as

$$R_p = xR_f + (1 - x)R_g,$$

$$E(R_p) = xR_f + (1 - x)E(R_g),$$

$$\sigma(R_p) = (1 - x)\sigma(R_g),\ x \leq 1.0,$$

which together imply that the portfolios plot along the line from R_f through *g* in Figure 1.

To obtain the mean-variance-efficient portfolios available with risk-free borrowing and lending, one swings a line from R_f in Figure 1 up and to the left as far as possible, to the tangency portfolio T. We can then see that all efficient portfolios are combinations of the risk-free asset (either risk-free borrowing or lending) and a single risky tangency portfolio, T. This key result is Tobin's (1958) "separation theorem."

The punch line of the CAPM is now straightforward. With complete agreement about distributions of returns, all investors see the same opportunity set (Figure 1), and they combine the same risky tangency portfolio T with risk-free lending or borrowing. Since all investors hold the same portfolio T of risky assets, it must be the value-weight market portfolio of risky assets. Specifically, each risky asset's weight in the tangency portfolio, which we now call M (for the "market"), must be the total market value of all outstanding units of the asset divided by the total market value of all risky assets. In addition, the risk-free rate must be set (along with the prices of risky assets) to clear the market for risk-free borrowing and lending.

In short, the CAPM assumptions imply that the market portfolio M must be on the minimum variance frontier if the asset market is to clear. This means that the algebraic relation that holds for any minimum variance portfolio must hold for the market portfolio. Specifically, if there are N risky assets,

$$\text{(Minimum Variance Condition for } M) \quad E(R_i) = E(R_{ZM}) + [E(R_M) - E(R_{ZM})]\beta_{iM}, \quad i = 1, \ldots, N.$$

In this equation, $E(R_i)$ is the expected return on asset i, and β_{iM}, the market beta of asset i, is the covariance of its return with the market return divided by the variance of the market return,

$$\text{(Market Beta)} \quad \beta_{iM} = \frac{\text{cov}(R_i, R_M)}{\sigma^2(R_M)}.$$

The first term on the right-hand side of the minimum variance condition, $E(R_{ZM})$, is the expected return on assets that have market betas equal to zero, which means their returns are uncorrelated with the market return. The second term is a risk premium—the market beta of asset i, β_{iM}, times the premium per unit of beta, which is the expected market return, $E(R_M)$, minus $E(R_{ZM})$.

Since the market beta of asset i is also the slope in the regression of its return on the market return, a common (and correct) interpretation of beta is that it measures the sensitivity of the asset's return to variation in the market return. But there is another interpretation of beta more in line with the spirit of the portfolio model that underlies the CAPM. The risk of the market portfolio, as measured by the variance of its return (the denominator of β_{iM}), is a weighted average of the covariance risks of the assets in M (the numerators of β_{iM} for different assets).

Thus, β_{iM} is the covariance risk of asset i in M measured relative to the average covariance risk of assets, which is just the variance of the market return.[3] In economic terms, β_{iM} is proportional to the risk each dollar invested in asset i contributes to the market portfolio.

The last step in the development of the Sharpe-Lintner model is to use the assumption of risk-free borrowing and lending to nail down $E(R_{ZM})$, the expected return on zero-beta assets. A risky asset's return is uncorrelated with the market return—its beta is zero—when the average of the asset's covariances with the returns on other assets just offsets the variance of the asset's return. Such a risky asset is riskless in the market portfolio in the sense that it contributes nothing to the variance of the market return.

When there is risk-free borrowing and lending, the expected return on assets that are uncorrelated with the market return, $E(R_{ZM})$, must equal the risk-free rate, R_f. The relation between expected return and beta then becomes the familiar Sharpe-Lintner CAPM equation,

$$\text{(Sharpe-Lintner CAPM)} \quad E(R_i) = R_f + [E(R_M) - R_f)]\beta_{iM}, \; i = 1, \ldots, N.$$

In words, the expected return on any asset i is the risk-free interest rate, R_f, plus a risk premium, which is the asset's market beta, β_{iM}, times the premium per unit of beta risk, $E(R_M) - R_f$.

Unrestricted risk-free borrowing and lending is an unrealistic assumption. Fischer Black (1972) develops a version of the CAPM without risk-free borrowing or lending. He shows that the CAPM's key result—that the market portfolio is mean-variance-efficient—can be obtained by instead allowing unrestricted short sales of risky assets. In brief, back in Figure 1, if there is no risk-free asset, investors select portfolios from along the mean-variance-efficient frontier from a to b. Market clearing prices imply that when one weights the efficient portfolios chosen by investors by their (positive) shares of aggregate invested wealth, the resulting portfolio is the market portfolio. The market portfolio is thus a portfolio of the efficient portfolios chosen by investors. With unrestricted short selling of risky assets, portfolios made up of efficient portfolios are themselves efficient. Thus, the market portfolio is efficient, which means that the minimum variance condition for M given above holds, and it is the expected return-risk relation of the Black CAPM.

The relations between expected return and market beta of the Black and Sharpe-Lintner versions of the CAPM differ only in terms of what each says about $E(R_{ZM})$, the expected return on assets uncorrelated with the market. The Black version says only that $E(R_{ZM})$ must be less than the expected market return, so the

[3] Formally, if x_{iM} is the weight of asset i in the market portfolio, then the variance of the portfolio's return is

$$\sigma^2(R_M) = Cov(R_M, R_M) = Cov\left(\sum_{i=1}^{N} x_{iM}R_i, R_M\right) = \sum_{i=1}^{N} x_{iM}Cov(R_i, R_M).$$

premium for beta is positive. In contrast, in the Sharpe-Lintner version of the model, $E(R_{ZM})$ must be the risk-free interest rate, R_f, and the premium per unit of beta risk is $E(R_M) - R_f$.

The assumption that short selling is unrestricted is as unrealistic as unrestricted risk-free borrowing and lending. If there is no risk-free asset and short sales of risky assets are not allowed, mean-variance investors still choose efficient portfolios—points above *b* on the *abc* curve in Figure 1. But when there is no short selling of risky assets and no risk-free asset, the algebra of portfolio efficiency says that portfolios made up of efficient portfolios are not typically efficient. This means that the market portfolio, which is a portfolio of the efficient portfolios chosen by investors, is not typically efficient. And the CAPM relation between expected return and market beta is lost. This does not rule out predictions about expected return and betas with respect to other efficient portfolios—if theory can specify portfolios that must be efficient if the market is to clear. But so far this has proven impossible.

In short, the familiar CAPM equation relating expected asset returns to their market betas is just an application to the market portfolio of the relation between expected return and portfolio beta that holds in any mean-variance-efficient portfolio. The efficiency of the market portfolio is based on many unrealistic assumptions, including complete agreement and either unrestricted risk-free borrowing and lending or unrestricted short selling of risky assets. But all interesting models involve unrealistic simplifications, which is why they must be tested against data.

Early Empirical Tests

Tests of the CAPM are based on three implications of the relation between expected return and market beta implied by the model. First, expected returns on all assets are linearly related to their betas, and no other variable has marginal explanatory power. Second, the beta premium is positive, meaning that the expected return on the market portfolio exceeds the expected return on assets whose returns are uncorrelated with the market return. Third, in the Sharpe-Lintner version of the model, assets uncorrelated with the market have expected returns equal to the risk-free interest rate, and the beta premium is the expected market return minus the risk-free rate. Most tests of these predictions use either cross-section or time-series regressions. Both approaches date to early tests of the model.

Tests on Risk Premiums

The early cross-section regression tests focus on the Sharpe-Lintner model's predictions about the intercept and slope in the relation between expected return and market beta. The approach is to regress a cross-section of average asset returns on estimates of asset betas. The model predicts that the intercept in these regressions is the risk-free interest rate, R_f, and the coefficient on beta is the expected return on the market in excess of the risk-free rate, $E(R_M) - R_f$.

Two problems in these tests quickly became apparent. First, estimates of beta for individual assets are imprecise, creating a measurement error problem when they are used to explain average returns. Second, the regression residuals have common sources of variation, such as industry effects in average returns. Positive correlation in the residuals produces downward bias in the usual ordinary least squares estimates of the standard errors of the cross-section regression slopes.

To improve the precision of estimated betas, researchers such as Blume (1970), Friend and Blume (1970) and Black, Jensen and Scholes (1972) work with portfolios, rather than individual securities. Since expected returns and market betas combine in the same way in portfolios, if the CAPM explains security returns it also explains portfolio returns.[4] Estimates of beta for diversified portfolios are more precise than estimates for individual securities. Thus, using portfolios in cross-section regressions of average returns on betas reduces the critical errors in variables problem. Grouping, however, shrinks the range of betas and reduces statistical power. To mitigate this problem, researchers sort securities on beta when forming portfolios; the first portfolio contains securities with the lowest betas, and so on, up to the last portfolio with the highest beta assets. This sorting procedure is now standard in empirical tests.

Fama and MacBeth (1973) propose a method for addressing the inference problem caused by correlation of the residuals in cross-section regressions. Instead of estimating a single cross-section regression of average monthly returns on betas, they estimate month-by-month cross-section regressions of monthly returns on betas. The times-series means of the monthly slopes and intercepts, along with the standard errors of the means, are then used to test whether the average premium for beta is positive and whether the average return on assets uncorrelated with the market is equal to the average risk-free interest rate. In this approach, the standard errors of the average intercept and slope are determined by the month-to-month variation in the regression coefficients, which fully captures the effects of residual correlation on variation in the regression coefficients, but sidesteps the problem of actually estimating the correlations. The residual correlations are, in effect, captured via repeated sampling of the regression coefficients. This approach also becomes standard in the literature.

Jensen (1968) was the first to note that the Sharpe-Lintner version of the

[4] Formally, if x_{ip}, $i = 1, \ldots, N$, are the weights for assets in some portfolio p, the expected return and market beta for the portfolio are related to the expected returns and betas of assets as

$$E(R_p) = \sum_{i=1}^{N} x_{ip}E(R_i), \text{ and } \beta_{pM} = \sum_{i=1}^{N} x_{ip}\beta_{pM}.$$

Thus, the CAPM relation between expected return and beta,

$$E(R_i) = E(R_f) + [E(R_M) - E(R_f)]\beta_{iM},$$

holds when asset i is a portfolio, as well as when i is an individual security.

relation between expected return and market beta also implies a time-series regression test. The Sharpe-Lintner CAPM says that the expected value of an asset's excess return (the asset's return minus the risk-free interest rate, $R_{it} - R_{ft}$) is completely explained by its expected CAPM risk premium (its beta times the expected value of $R_{Mt} - R_{ft}$). This implies that "Jensen's alpha," the intercept term in the time-series regression,

$$\text{(Time-Series Regression)} \quad R_{it} - R_{ft} = \alpha_i + \beta_{iM}(R_{Mt} - R_{ft}) + \varepsilon_{it},$$

is zero for each asset.

The early tests firmly reject the Sharpe-Lintner version of the CAPM. There is a positive relation between beta and average return, but it is too "flat." Recall that, in cross-section regressions, the Sharpe-Lintner model predicts that the intercept is the risk-free rate and the coefficient on beta is the expected market return in excess of the risk-free rate, $E(R_M) - R_f$. The regressions consistently find that the intercept is greater than the average risk-free rate (typically proxied as the return on a one-month Treasury bill), and the coefficient on beta is less than the average excess market return (proxied as the average return on a portfolio of U.S. common stocks minus the Treasury bill rate). This is true in the early tests, such as Douglas (1968), Black, Jensen and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973) and Fama and MacBeth (1973), as well as in more recent cross-section regression tests, like Fama and French (1992).

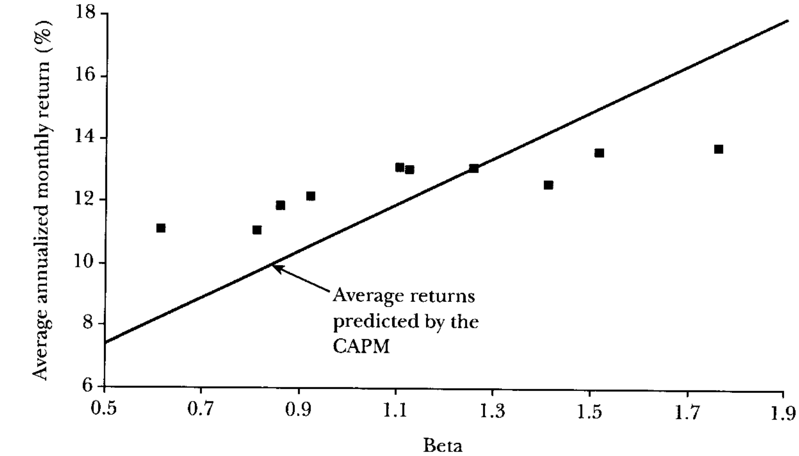
The evidence that the relation between beta and average return is too flat is confirmed in time-series tests, such as Friend and Blume (1970), Black, Jensen and Scholes (1972) and Stambaugh (1982). The intercepts in time-series regressions of excess asset returns on the excess market return are positive for assets with low betas and negative for assets with high betas.

Figure 2 provides an updated example of the evidence. In December of each year, we estimate a preranking beta for every NYSE (1928–2003), AMEX (1963–2003) and NASDAQ (1972–2003) stock in the CRSP (Center for Research in Security Prices of the University of Chicago) database, using two to five years (as available) of prior monthly returns.[5] We then form ten value-weight portfolios based on these preranking betas and compute their returns for the next twelve months. We repeat this process for each year from 1928 to 2003. The result is 912 monthly returns on ten beta-sorted portfolios. Figure 2 plots each portfolio's average return against its postranking beta, estimated by regressing its monthly returns for 1928–2003 on the return on the CRSP value-weight portfolio of U.S. common stocks.

The Sharpe-Lintner CAPM predicts that the portfolios plot along a straight

[5] To be included in the sample for year t, a security must have market equity data (price times shares outstanding) for December of $t - 1$, and CRSP must classify it as ordinary common equity. Thus, we exclude securities such as American Depository Receipts (ADRs) and Real Estate Investment Trusts (REITs).

Figure 2
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003



line, with an intercept equal to the risk-free rate, R_f, and a slope equal to the expected excess return on the market, $E(R_M) - R_f$. We use the average one-month Treasury bill rate and the average excess CRSP market return for 1928–2003 to estimate the predicted line in Figure 2. Confirming earlier evidence, the relation between beta and average return for the ten portfolios is much flatter than the Sharpe-Lintner CAPM predicts. The returns on the low beta portfolios are too high, and the returns on the high beta portfolios are too low. For example, the predicted return on the portfolio with the lowest beta is 8.3 percent per year; the actual return is 11.1 percent. The predicted return on the portfolio with the highest beta is 16.8 percent per year; the actual is 13.7 percent.

Although the observed premium per unit of beta is lower than the Sharpe-Lintner model predicts, the relation between average return and beta in Figure 2 is roughly linear. This is consistent with the Black version of the CAPM, which predicts only that the beta premium is positive. Even this less restrictive model, however, eventually succumbs to the data.

Testing Whether Market Betas Explain Expected Returns

The Sharpe-Lintner and Black versions of the CAPM share the prediction that the market portfolio is mean-variance-efficient. This implies that differences in expected return across securities and portfolios are entirely explained by differences in market beta; other variables should add nothing to the explanation of expected return. This prediction plays a prominent role in tests of the CAPM. In the early work, the weapon of choice is cross-section regressions.

In the framework of Fama and MacBeth (1973), one simply adds predetermined explanatory variables to the month-by-month cross-section regressions of returns on beta. If all differences in expected return are explained by beta, the average slopes on the additional variables should not be reliably different from zero. Clearly, the trick in the cross-section regression approach is to choose specific additional variables likely to expose any problems of the CAPM prediction that, because the market portfolio is efficient, market betas suffice to explain expected asset returns.

For example, in Fama and MacBeth (1973) the additional variables are squared market betas (to test the prediction that the relation between expected return and beta is linear) and residual variances from regressions of returns on the market return (to test the prediction that market beta is the only measure of risk needed to explain expected returns). These variables do not add to the explanation of average returns provided by beta. Thus, the results of Fama and MacBeth (1973) are consistent with the hypothesis that their market proxy—an equal-weight portfolio of NYSE stocks—is on the minimum variance frontier.

The hypothesis that market betas completely explain expected returns can also be tested using time-series regressions. In the time-series regression described above (the excess return on asset i regressed on the excess market return), the intercept is the difference between the asset's average excess return and the excess return predicted by the Sharpe-Lintner model, that is, beta times the average excess market return. If the model holds, there is no way to group assets into portfolios whose intercepts are reliably different from zero. For example, the intercepts for a portfolio of stocks with high ratios of earnings to price and a portfolio of stocks with low earning-price ratios should both be zero. Thus, to test the hypothesis that market betas suffice to explain expected returns, one estimates the time-series regression for a set of assets (or portfolios) and then jointly tests the vector of regression intercepts against zero. The trick in this approach is to choose the left-hand-side assets (or portfolios) in a way likely to expose any shortcoming of the CAPM prediction that market betas suffice to explain expected asset returns.

In early applications, researchers use a variety of tests to determine whether the intercepts in a set of time-series regressions are all zero. The tests have the same asymptotic properties, but there is controversy about which has the best small sample properties. Gibbons, Ross and Shanken (1989) settle the debate by providing an F-test on the intercepts that has exact small-sample properties. They also show that the test has a simple economic interpretation. In effect, the test constructs a candidate for the tangency portfolio T in Figure 1 by optimally combining the market proxy and the left-hand-side assets of the time-series regressions. The estimator then tests whether the efficient set provided by the combination of this tangency portfolio and the risk-free asset is reliably superior to the one obtained by combining the risk-free asset with the market proxy alone. In other words, the Gibbons, Ross and Shanken statistic tests whether the market proxy is the tangency portfolio in the set of portfolios that can be constructed by combining the market portfolio with the specific assets used as dependent variables in the time-series regressions.

Enlightened by this insight of Gibbons, Ross and Shanken (1989), one can see a similar interpretation of the cross-section regression test of whether market betas suffice to explain expected returns. In this case, the test is whether the additional explanatory variables in a cross-section regression identify patterns in the returns on the left-hand-side assets that are not explained by the assets' market betas. This amounts to testing whether the market proxy is on the minimum variance frontier that can be constructed using the market proxy and the left-hand-side assets included in the tests.

An important lesson from this discussion is that time-series and cross-section regressions do not, strictly speaking, test the CAPM. What is literally tested is whether a specific proxy for the market portfolio (typically a portfolio of U.S. common stocks) is efficient in the set of portfolios that can be constructed from it and the left-hand-side assets used in the test. One might conclude from this that the CAPM has never been tested, and prospects for testing it are not good because 1) the set of left-hand-side assets does not include all marketable assets, and 2) data for the true market portfolio of all assets are likely beyond reach (Roll, 1977; more on this later). But this criticism can be leveled at tests of any economic model when the tests are less than exhaustive or when they use proxies for the variables called for by the model.

The bottom line from the early cross-section regression tests of the CAPM, such as Fama and MacBeth (1973), and the early time-series regression tests, like Gibbons (1982) and Stambaugh (1982), is that standard market proxies seem to be on the minimum variance frontier. That is, the central predictions of the Black version of the CAPM, that market betas suffice to explain expected returns and that the risk premium for beta is positive, seem to hold. But the more specific prediction of the Sharpe-Lintner CAPM that the premium per unit of beta is the expected market return minus the risk-free interest rate is consistently rejected.

The success of the Black version of the CAPM in early tests produced a consensus that the model is a good description of expected returns. These early results, coupled with the model's simplicity and intuitive appeal, pushed the CAPM to the forefront of finance.

Recent Tests

Starting in the late 1970s, empirical work appears that challenges even the Black version of the CAPM. Specifically, evidence mounts that much of the variation in expected return is unrelated to market beta.

The first blow is Basu's (1977) evidence that when common stocks are sorted on earnings-price ratios, future returns on high E/P stocks are higher than predicted by the CAPM. Banz (1981) documents a size effect: when stocks are sorted on market capitalization (price times shares outstanding), average returns on small stocks are higher than predicted by the CAPM. Bhandari (1988) finds that high debt-equity ratios (book value of debt over the market value of equity, a measure of leverage) are associated with returns that are too high relative to their market betas.

Finally, Statman (1980) and Rosenberg, Reid and Lanstein (1985) document that stocks with high book-to-market equity ratios (B/M, the ratio of the book value of a common stock to its market value) have high average returns that are not captured by their betas.

There is a theme in the contradictions of the CAPM summarized above. Ratios involving stock prices have information about expected returns missed by market betas. On reflection, this is not surprising. A stock's price depends not only on the expected cash flows it will provide, but also on the expected returns that discount expected cash flows back to the present. Thus, in principle, the cross-section of prices has information about the cross-section of expected returns. (A high expected return implies a high discount rate and a low price.) The cross-section of stock prices is, however, arbitrarily affected by differences in scale (or units). But with a judicious choice of scaling variable X, the ratio X/P can reveal differences in the cross-section of expected stock returns. Such ratios are thus prime candidates to expose shortcomings of asset pricing models—in the case of the CAPM, shortcomings of the prediction that market betas suffice to explain expected returns (Ball, 1978). The contradictions of the CAPM summarized above suggest that earnings-price, debt-equity and book-to-market ratios indeed play this role.

Fama and French (1992) update and synthesize the evidence on the empirical failures of the CAPM. Using the cross-section regression approach, they confirm that size, earnings-price, debt-equity and book-to-market ratios add to the explanation of expected stock returns provided by market beta. Fama and French (1996) reach the same conclusion using the time-series regression approach applied to portfolios of stocks sorted on price ratios. They also find that different price ratios have much the same information about expected returns. This is not surprising given that price is the common driving force in the price ratios, and the numerators are just scaling variables used to extract the information in price about expected returns.

Fama and French (1992) also confirm the evidence (Reinganum, 1981; Stambaugh, 1982; Lakonishok and Shapiro, 1986) that the relation between average return and beta for common stocks is even flatter after the sample periods used in the early empirical work on the CAPM. The estimate of the beta premium is, however, clouded by statistical uncertainty (a large standard error). Kothari, Shanken and Sloan (1995) try to resuscitate the Sharpe-Lintner CAPM by arguing that the weak relation between average return and beta is just a chance result. But the strong evidence that other variables capture variation in expected return missed by beta makes this argument irrelevant. If betas do not suffice to explain expected returns, the market portfolio is not efficient, and the CAPM is dead in its tracks. Evidence on the size of the market premium can neither save the model nor further doom it.

The synthesis of the evidence on the empirical problems of the CAPM provided by Fama and French (1992) serves as a catalyst, marking the point when it is generally acknowledged that the CAPM has potentially fatal problems. Research then turns to explanations.

One possibility is that the CAPM's problems are spurious, the result of data dredging—publication-hungry researchers scouring the data and unearthing contradictions that occur in specific samples as a result of chance. A standard response to this concern is to test for similar findings in other samples. Chan, Hamao and Lakonishok (1991) find a strong relation between book-to-market equity (B/M) and average return for Japanese stocks. Capaul, Rowley and Sharpe (1993) observe a similar B/M effect in four European stock markets and in Japan. Fama and French (1998) find that the price ratios that produce problems for the CAPM in U.S. data show up in the same way in the stock returns of twelve non-U.S. major markets, and they are present in emerging market returns. This evidence suggests that the contradictions of the CAPM associated with price ratios are not sample specific.

Explanations: Irrational Pricing or Risk

Among those who conclude that the empirical failures of the CAPM are fatal, two stories emerge. On one side are the behavioralists. Their view is based on evidence that stocks with high ratios of book value to market price are typically firms that have fallen on bad times, while low B/M is associated with growth firms (Lakonishok, Shleifer and Vishny, 1994; Fama and French, 1995). The behavioralists argue that sorting firms on book-to-market ratios exposes investor overreaction to good and bad times. Investors overextrapolate past performance, resulting in stock prices that are too high for growth (low B/M) firms and too low for distressed (high B/M, so-called value) firms. When the overreaction is eventually corrected, the result is high returns for value stocks and low returns for growth stocks. Proponents of this view include DeBondt and Thaler (1987), Lakonishok, Shleifer and Vishny (1994) and Haugen (1995).

The second story for explaining the empirical contradictions of the CAPM is that they point to the need for a more complicated asset pricing model. The CAPM is based on many unrealistic assumptions. For example, the assumption that investors care only about the mean and variance of one-period portfolio returns is extreme. It is reasonable that investors also care about how their portfolio return covaries with labor income and future investment opportunities, so a portfolio's return variance misses important dimensions of risk. If so, market beta is not a complete description of an asset's risk, and we should not be surprised to find that differences in expected return are not completely explained by differences in beta. In this view, the search should turn to asset pricing models that do a better job explaining average returns.

Merton's (1973) intertemporal capital asset pricing model (ICAPM) is a natural extension of the CAPM. The ICAPM begins with a different assumption about investor objectives. In the CAPM, investors care only about the wealth their portfolio produces at the end of the current period. In the ICAPM, investors are concerned not only with their end-of-period payoff, but also with the opportunities they will have to consume or invest the payoff. Thus, when choosing a portfolio at time $t - 1$, ICAPM investors consider how their wealth at t might vary with future *state variables*, including labor income, the prices of consumption goods and the nature of portfolio opportunities at t, and expectations about the labor income, consumption and investment opportunities to be available after t.

Like CAPM investors, ICAPM investors prefer high expected return and low return variance. But ICAPM investors are also concerned with the covariances of portfolio returns with state variables. As a result, optimal portfolios are "multifactor efficient," which means they have the largest possible expected returns, given their return variances and the covariances of their returns with the relevant state variables.

Fama (1996) shows that the ICAPM generalizes the logic of the CAPM. That is, if there is risk-free borrowing and lending or if short sales of risky assets are allowed, market clearing prices imply that the market portfolio is multifactor efficient. Moreover, multifactor efficiency implies a relation between expected return and beta risks, but it requires additional betas, along with a market beta, to explain expected returns.

An ideal implementation of the ICAPM would specify the state variables that affect expected returns. Fama and French (1993) take a more indirect approach, perhaps more in the spirit of Ross's (1976) arbitrage pricing theory. They argue that though size and book-to-market equity are not themselves state variables, the higher average returns on small stocks and high book-to-market stocks reflect unidentified state variables that produce undiversifiable risks (covariances) in returns that are not captured by the market return and are priced separately from market betas. In support of this claim, they show that the returns on the stocks of small firms covary more with one another than with returns on the stocks of large firms, and returns on high book-to-market (value) stocks covary more with one another than with returns on low book-to-market (growth) stocks. Fama and French (1995) show that there are similar size and book-to-market patterns in the covariation of fundamentals like earnings and sales.

Based on this evidence, Fama and French (1993, 1996) propose a three-factor model for expected returns,

$$\text{(Three-Factor Model)} \quad E(R_{it}) - R_{ft} = \beta_{iM}[E(R_{Mt}) - R_{ft}] + \beta_{is}E(SMB_t) + \beta_{ih}E(HML_t).$$

In this equation, SMB_t (small minus big) is the difference between the returns on diversified portfolios of small and big stocks, HML_t (high minus low) is the difference between the returns on diversified portfolios of high and low B/M stocks, and the betas are slopes in the multiple regression of $R_{it} - R_{ft}$ on $R_{Mt} - R_{ft}$, SMB_t and HML_t.

For perspective, the average value of the market premium $R_{Mt} - R_{ft}$ for 1927–2003 is 8.3 percent per year, which is 3.5 standard errors from zero. The average values of SMB_t, and HML_t are 3.6 percent and 5.0 percent per year, and they are 2.1 and 3.1 standard errors from zero. All three premiums are volatile, with annual standard deviations of 21.0 percent $(R_{Mt} - R_{ft})$, 14.6 percent (SMB_t) and 14.2 percent (HML_t) per year. Although the average values of the premiums are large, high volatility implies substantial uncertainty about the true expected premiums.

One implication of the expected return equation of the three-factor model is that the intercept α_i in the time-series regression,

$$R_{it} - R_{ft} = \alpha_i + \beta_{iM}(R_{Mt} - R_{ft}) + \beta_{is}SMB_t + \beta_{ih}HML_t + \varepsilon_{it},$$

is zero for all assets i. Using this criterion, Fama and French (1993, 1996) find that the model captures much of the variation in average return for portfolios formed on size, book-to-market equity and other price ratios that cause problems for the CAPM. Fama and French (1998) show that an international version of the model performs better than an international CAPM in describing average returns on portfolios formed on scaled price variables for stocks in 13 major markets.

The three-factor model is now widely used in empirical research that requires a model of expected returns. Estimates of α_i from the time-series regression above are used to calibrate how rapidly stock prices respond to new information (for example, Loughran and Ritter, 1995; Mitchell and Stafford, 2000). They are also used to measure the special information of portfolio managers, for example, in Carhart's (1997) study of mutual fund performance. Among practitioners like Ibbotson Associates, the model is offered as an alternative to the CAPM for estimating the cost of equity capital.

From a theoretical perspective, the main shortcoming of the three-factor model is its empirical motivation. The small-minus-big (SMB) and high-minus-low (HML) explanatory returns are not motivated by predictions about state variables of concern to investors. Instead they are brute force constructs meant to capture the patterns uncovered by previous work on how average stock returns vary with size and the book-to-market equity ratio.

But this concern is not fatal. The ICAPM does not require that the additional portfolios used along with the market portfolio to explain expected returns "mimic" the relevant state variables. In both the ICAPM and the arbitrage pricing theory, it suffices that the additional portfolios are well diversified (in the terminology of Fama, 1996, they are multifactor minimum variance) and that they are sufficiently different from the market portfolio to capture covariation in returns and variation in expected returns missed by the market portfolio. Thus, adding diversified portfolios that capture covariation in returns and variation in average returns left unexplained by the market is in the spirit of both the ICAPM and the Ross's arbitrage pricing theory.

The behavioralists are not impressed by the evidence for a risk-based explanation of the failures of the CAPM. They typically concede that the three-factor model captures covariation in returns missed by the market return and that it picks up much of the size and value effects in average returns left unexplained by the CAPM. But their view is that the average return premium associated with the model's book-to-market factor—which does the heavy lifting in the improvements to the CAPM—is itself the result of investor overreaction that happens to be correlated across firms in a way that just looks like a risk story. In short, in the behavioral view, the market tries to set CAPM prices, and violations of the CAPM are due to mispricing.

The conflict between the behavioral irrational pricing story and the rational risk story for the empirical failures of the CAPM leaves us at a timeworn impasse. Fama (1970) emphasizes that the hypothesis that prices properly reflect available information must be tested in the context of a model of expected returns, like the CAPM. Intuitively, to test whether prices are rational, one must take a stand on what the market is trying to do in setting prices—that is, what is risk and what is the relation between expected return and risk? When tests reject the CAPM, one cannot say whether the problem is its assumption that prices are rational (the behavioral view) or violations of other assumptions that are also necessary to produce the CAPM (our position).

Fortunately, for some applications, the way one uses the three-factor model does not depend on one's view about whether its average return premiums are the rational result of underlying state variable risks, the result of irrational investor behavior or sample specific results of chance. For example, when measuring the response of stock prices to new information or when evaluating the performance of managed portfolios, one wants to account for known patterns in returns and average returns for the period examined, whatever their source. Similarly, when estimating the cost of equity capital, one might be unconcerned with whether expected return premiums are rational or irrational since they are in either case part of the opportunity cost of equity capital (Stein, 1996). But the cost of capital is forward looking, so if the premiums are sample specific they are irrelevant.

The three-factor model is hardly a panacea. Its most serious problem is the momentum effect of Jegadeesh and Titman (1993). Stocks that do well relative to the market over the last three to twelve months tend to continue to do well for the next few months, and stocks that do poorly continue to do poorly. This momentum effect is distinct from the value effect captured by book-to-market equity and other price ratios. Moreover, the momentum effect is left unexplained by the three-factor model, as well as by the CAPM. Following Carhart (1997), one response is to add a momentum factor (the difference between the returns on diversified portfolios of short-term winners and losers) to the three-factor model. This step is again legitimate in applications where the goal is to abstract from known patterns in average returns to uncover information-specific or manager-specific effects. But since the momentum effect is short-lived, it is largely irrelevant for estimates of the cost of equity capital.

Another strand of research points to problems in both the three-factor model and the CAPM. Frankel and Lee (1998), Dechow, Hutton and Sloan (1999), Piotroski (2000) and others show that in portfolios formed on price ratios like book-to-market equity, stocks with higher expected cash flows have higher average returns that are not captured by the three-factor model or the CAPM. The authors interpret their results as evidence that stock prices are irrational, in the sense that they do not reflect available information about expected profitability.

In truth, however, one can't tell whether the problem is bad pricing or a bad asset pricing model. A stock's price can always be expressed as the present value of expected future cash flows discounted at the expected return on the stock (Campbell and Shiller, 1989; Vuolteenaho, 2002). It follows that if two stocks have the same price, the one with higher expected cash flows must have a higher expected return. This holds true whether pricing is rational or irrational. Thus, when one observes a positive relation between expected cash flows and expected returns that is left unexplained by the CAPM or the three-factor model, one can't tell whether it is the result of irrational pricing or a misspecified asset pricing model.

The Market Proxy Problem

Roll (1977) argues that the CAPM has never been tested and probably never will be. The problem is that the market portfolio at the heart of the model is theoretically and empirically elusive. It is not theoretically clear which assets (for example, human capital) can legitimately be excluded from the market portfolio, and data availability substantially limits the assets that are included. As a result, tests of the CAPM are forced to use proxies for the market portfolio, in effect testing whether the proxies are on the minimum variance frontier. Roll argues that because the tests use proxies, not the true market portfolio, we learn nothing about the CAPM.

We are more pragmatic. The relation between expected return and market beta of the CAPM is just the minimum variance condition that holds in any efficient portfolio, applied to the market portfolio. Thus, if we can find a market proxy that is on the minimum variance frontier, it can be used to describe differences in expected returns, and we would be happy to use it for this purpose. The strong rejections of the CAPM described above, however, say that researchers have not uncovered a reasonable market proxy that is close to the minimum variance frontier. If researchers are constrained to reasonable proxies, we doubt they ever will.

Our pessimism is fueled by several empirical results. Stambaugh (1982) tests the CAPM using a range of market portfolios that include, in addition to U.S. common stocks, corporate and government bonds, preferred stocks, real estate and other consumer durables. He finds that tests of the CAPM are not sensitive to expanding the market proxy beyond common stocks, basically because the volatility of expanded market returns is dominated by the volatility of stock returns.

One need not be convinced by Stambaugh's (1982) results since his market proxies are limited to U.S. assets. If international capital markets are open and asset prices conform to an international version of the CAPM, the market portfolio should include international assets. Fama and French (1998) find, however, that betas for a global stock market portfolio cannot explain the high average returns observed around the world on stocks with high book-to-market or high earnings-price ratios.

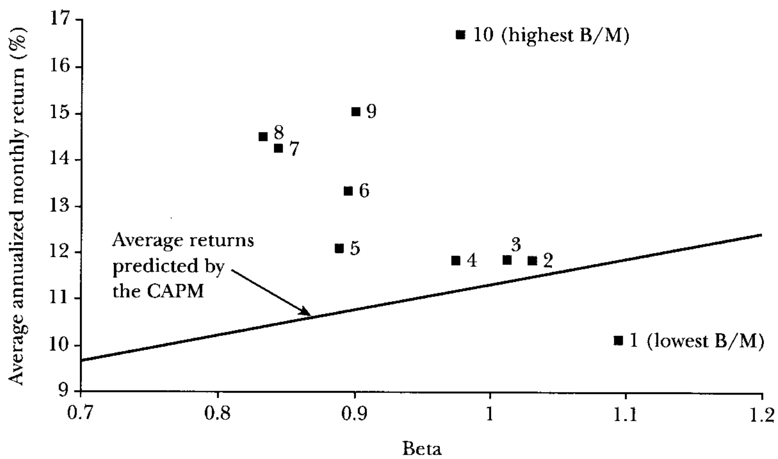
A major problem for the CAPM is that portfolios formed by sorting stocks on price ratios produce a wide range of average returns, but the average returns are not positively related to market betas (Lakonishok, Shleifer and Vishny, 1994; Fama and French, 1996, 1998). The problem is illustrated in Figure 3, which shows average returns and betas (calculated with respect to the CRSP value-weight portfolio of NYSE, AMEX and NASDAQ stocks) for July 1963 to December 2003 for ten portfolios of U.S. stocks formed annually on sorted values of the book-to-market equity ratio (B/M).[6]

Average returns on the B/M portfolios increase almost monotonically, from 10.1 percent per year for the lowest B/M group (portfolio 1) to an impressive 16.7 percent for the highest (portfolio 10). But the positive relation between beta and average return predicted by the CAPM is notably absent. For example, the portfolio with the lowest book-to-market ratio has the highest beta but the lowest average return. The estimated beta for the portfolio with the highest book-to-market ratio and the highest average return is only 0.98. With an average annualized value of the riskfree interest rate, R_f, of 5.8 percent and an average annualized market premium, $R_M - R_f$, of 11.3 percent, the Sharpe-Lintner CAPM predicts an average return of 11.8 percent for the lowest B/M portfolio and 11.2 percent for the highest, far from the observed values, 10.1 and 16.7 percent. For the Sharpe-Lintner model to "work" on these portfolios, their market betas must change dramatically, from 1.09 to 0.78 for the lowest B/M portfolio and from 0.98 to 1.98 for the highest. We judge it unlikely that alternative proxies for the market portfolio will produce betas and a market premium that can explain the average returns on these portfolios.

It is always possible that researchers will redeem the CAPM by finding a reasonable proxy for the market portfolio that is on the minimum variance frontier. We emphasize, however, that this possibility cannot be used to justify the way the CAPM is currently applied. The problem is that applications typically use the same

[6] Stock return data are from CRSP, and book equity data are from Compustat and the Moody's Industrials, Transportation, Utilities and Financials manuals. Stocks are allocated to ten portfolios at the end of June of each year t (1963 to 2003) using the ratio of book equity for the fiscal year ending in calendar year $t - 1$, divided by market equity at the end of December of $t - 1$. Book equity is the book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Depending on availability, we use the redemption, liquidation or par value (in that order) to estimate the book value of preferred stock. Stockholders' equity is the value reported by Moody's or Compustat, if it is available. If not, we measure stockholders' equity as the book value of common equity plus the par value of preferred stock or the book value of assets minus total liabilities (in that order). The portfolios for year t include NYSE (1963–2003), AMEX (1963–2003) and NASDAQ (1972–2003) stocks with positive book equity in $t - 1$ and market equity (from CRSP) for December of $t - 1$ and June of t. The portfolios exclude securities CRSP does not classify as ordinary common equity. The breakpoints for year t use only securities that are on the NYSE in June of year t.

Figure 3
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on B/M, 1963–2003



market proxies, like the value-weight portfolio of U.S. stocks, that lead to rejections of the model in empirical tests. The contradictions of the CAPM observed when such proxies are used in tests of the model show up as bad estimates of expected returns in applications; for example, estimates of the cost of equity capital that are too low (relative to historical average returns) for small stocks and for stocks with high book-to-market equity ratios. In short, if a market proxy does not work in tests of the CAPM, it does not work in applications.

Conclusions

The version of the CAPM developed by Sharpe (1964) and Lintner (1965) has never been an empirical success. In the early empirical work, the Black (1972) version of the model, which can accommodate a flatter tradeoff of average return for market beta, has some success. But in the late 1970s, research begins to uncover variables like size, various price ratios and momentum that add to the explanation of average returns provided by beta. The problems are serious enough to invalidate most applications of the CAPM.

For example, finance textbooks often recommend using the Sharpe-Lintner CAPM risk-return relation to estimate the cost of equity capital. The prescription is to estimate a stock's market beta and combine it with the risk-free interest rate and the average market risk premium to produce an estimate of the cost of equity. The typical market portfolio in these exercises includes just U.S. common stocks. But empirical work, old and new, tells us that the relation between beta and average return is flatter than predicted by the Sharpe-Lintner version of the CAPM. As a result, CAPM estimates of the cost of equity for high beta stocks are too high (relative to historical average returns) and estimates for low beta stocks are too low (Friend and Blume, 1970). Similarly, if the high average returns on value stocks (with high book-to-market ratios) imply high expected returns, CAPM cost of equity estimates for such stocks are too low.[7]

The CAPM is also often used to measure the performance of mutual funds and other managed portfolios. The approach, dating to Jensen (1968), is to estimate the CAPM time-series regression for a portfolio and use the intercept (Jensen's alpha) to measure abnormal performance. The problem is that, because of the empirical failings of the CAPM, even passively managed stock portfolios produce abnormal returns if their investment strategies involve tilts toward CAPM problems (Elton, Gruber, Das and Hlavka, 1993). For example, funds that concentrate on low beta stocks, small stocks or value stocks will tend to produce positive abnormal returns relative to the predictions of the Sharpe-Lintner CAPM, even when the fund managers have no special talent for picking winners.

The CAPM, like Markowitz's (1952, 1959) portfolio model on which it is built, is nevertheless a theoretical tour de force. We continue to teach the CAPM as an introduction to the fundamental concepts of portfolio theory and asset pricing, to be built on by more complicated models like Merton's (1973) ICAPM. But we also warn students that despite its seductive simplicity, the CAPM's empirical problems probably invalidate its use in applications.

■ *We gratefully acknowledge the comments of John Cochrane, George Constantinides, Richard Leftwich, Andrei Shleifer, René Stulz and Timothy Taylor.*

[7] The problems are compounded by the large standard errors of estimates of the market premium and of betas for individual stocks, which probably suffice to make CAPM estimates of the cost of equity rather meaningless, even if the CAPM holds (Fama and French, 1997; Pastor and Stambaugh, 1999). For example, using the U.S. Treasury bill rate as the risk-free interest rate and the CRSP value-weight portfolio of publicly traded U.S. common stocks, the average value of the equity premium $R_{Mt} - R_{ft}$ for 1927–2003 is 8.3 percent per year, with a standard error of 2.4 percent. The two standard error range thus runs from 3.5 percent to 13.1 percent, which is sufficient to make most projects appear either profitable or unprofitable. This problem is, however, hardly special to the CAPM. For example, expected returns in all versions of Merton's (1973) ICAPM include a market beta and the expected market premium. Also, as noted earlier the expected values of the size and book-to-market premiums in the Fama-French three-factor model are also estimated with substantial error.

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PMA-R14

Arizona Water Company
Market-to-Book Ratios, Earnings / Book Ratios and
Inflation for Standard & Poor's Industrial Index and
the Standard & Poor's 500 Composite Index
from 1947 through 2014

Year	Market-to-Book Ratio (1)		Earnings/ Book Ratio (2)				
	S&P Industrial Index (3)	S&P 500 Composite Index (3)	S&P Industrial Index (3)	S&P 500 Composite Index (3)	Inflation (4)	Earnings / Book Ratio - Net of Inflation	
1947	1.23	NA	13.0 %	NA	9.0 %	4.0 %	NA
1948	1.13	NA	17.3	NA	2.7	14.6	NA
1949	1.00	NA	16.3	NA	(1.8)	18.1	NA
1950	1.16	NA	18.3	NA	5.8	12.5	NA
1951	1.27	NA	14.4	NA	5.9	8.5	NA
1952	1.29	NA	12.7	NA	0.9	11.8	NA
1953	1.21	NA	12.7	NA	0.6	12.1	NA
1954	1.45	NA	13.5	NA	(0.5)	14.0	NA
1955	1.81	NA	16.0	NA	0.4	15.6	NA
1956	1.92	NA	13.7	NA	2.9	10.8	NA
1957	1.71	NA	12.5	NA	3.0	9.5	NA
1958	1.70	NA	9.8	NA	1.8	8.0	NA
1959	1.94	NA	11.2	NA	1.5	9.7	NA
1960	1.82	NA	10.3	NA	1.5	8.8	NA
1961	2.01	NA	9.8	NA	0.7	9.1	NA
1962	1.83	NA	10.9	NA	1.2	9.7	NA
1963	1.94	NA	11.4	NA	1.7	9.7	NA
1964	2.18	NA	12.3	NA	1.2	11.1	NA
1965	2.21	NA	13.2	NA	1.9	11.3	NA
1966	2.00	NA	13.2	NA	3.4	9.8	NA
1967	2.05	NA	12.1	NA	3.0	9.1	NA
1968	2.17	NA	12.6	NA	4.7	7.9	NA
1969	2.10	NA	12.1	NA	6.1	6.0	NA
1970	1.71	NA	10.4	NA	5.5	4.9	NA
1971	1.99	NA	11.2	NA	3.4	7.8	NA
1972	2.16	NA	12.0	NA	3.4	8.6	NA
1973	1.96	NA	14.6	NA	8.8	5.8	NA
1974	1.39	NA	14.8	NA	12.2	2.6	NA
1975	1.34	NA	12.3	NA	7.0	5.3	NA
1976	1.51	NA	14.5	NA	4.8	9.7	NA
1977	1.38	NA	14.6	NA	6.8	7.8	NA
1978	1.25	NA	15.3	NA	9.0	6.3	NA
1979	1.23	NA	17.2	NA	13.3	3.9	NA
1980	1.31	NA	15.6	NA	12.4	3.2	NA
1981	1.24	NA	14.9	NA	8.9	6.0	NA
1982	1.17	NA	11.3	NA	3.9	7.4	NA
1983	1.45	NA	12.2	NA	3.8	8.4	NA
1984	1.46	NA	14.6	NA	4.0	10.6	NA
1985	1.67	NA	12.2	NA	3.8	8.4	NA
1986	2.02	NA	11.5	NA	1.1	10.4	NA
1987	2.50	NA	15.7	NA	4.4	11.3	NA
1988	2.13	NA	19.0	NA	4.4	14.6	NA
1989	2.56	NA	18.5	NA	4.7	13.8	NA
1990	2.63	NA	16.3	NA	6.1	10.2	NA
1991	2.77	NA	10.8	NA	3.1	7.7	NA
1992	3.29	NA	13.0	NA	2.9	10.1	NA
1993	3.72	NA	15.7	NA	2.8	12.9	NA
1994	3.73	NA	23.0	NA	2.7	20.3	NA
1995	4.06	2.64	22.9	16.0 %	2.5	20.4	13.5 %
1996	4.79	3.00	24.8	16.8	3.3	21.5	13.5
1997	5.88	3.53	24.6	16.3	1.7	22.9	14.6
1998	7.13	4.16	21.3	14.5	1.6	19.7	12.9
1999	8.27	4.76	25.2	17.1	2.7	22.5	14.4
2000	7.51	4.51	23.9	16.2	3.4	20.5	12.8
2001	NA	3.50	NA	7.4	1.6	NA	5.8
2002	NA	2.93	NA	8.3	2.4	NA	5.9
2003	NA	2.78	NA	14.1	1.9	NA	12.2
2004	NA	2.91	NA	15.3	3.3	NA	12.0
2005	NA	2.78	NA	16.4	3.4	NA	13.0
2006	NA	2.77	NA	17.0	2.5	NA	14.5
2007	NA	2.84	NA	12.8	4.1	NA	8.7
2008	NA	2.24	NA	3.0	0.1	NA	2.9
2009	NA	1.87	NA	10.6	2.7	NA	7.9
2010	NA	2.09	NA	14.2	1.5	NA	12.7
2011	NA	2.07	NA	14.6	3.0	NA	11.6
2012	NA	2.14	NA	13.5	1.7	NA	11.8
2013	NA	2.39	NA	14.5	1.5	NA	13.0
2014	NA	2.66	NA	14.2	0.8	NA	13.4
Average	2.34	2.93	14.9 %	13.6 %	2.3 %	10.9 %	11.4 %

Notes: (1) Market-to-Book Ratio equals average of the high and low market price for the year divided by the average book value.

(2) Earnings/Book equals earnings per share for the year divided by the average book value.

(3) On January 2, 2001 Standard & Poor's released Global Industry Classification Standard (GICS) price indexes for all Standard & Poor's U.S. indexes. As a result, all S&P Indexes have been calculated with a common base of 100 at a start date of December 31, 1994. Also, the GICS industrial sector is not comparable to the former S&P Industrial Index and data for the former S&P Industrial Index was discontinued.

(4) As measured by the Consumer Price Index (CPI).

Source of Information: Standard & Poor's Security Price Index Record, 2000 Edition, p. 40
Standard & Poor's Statistical Service, Current Statistics, March 2013, p. 30
Standard & Poor's Compustat Services, Inc. PC Plus Research Insight Database
Morningstar SBBI Appendix A Tables, Morningstar Stocks, Bonds, Bills, and Inflation | 1926-2015, © 2016 Morningstar.
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Comparable Earnings: New Life for an Old Precept

by
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Reprinted from the American Gas Association's *Financial Quarterly Review*
Summer 1994 edition, Arlington, Va.

Comparable Earnings: New Life for an Old Precept

Accelerating deregulation has greatly increased the investment risk of natural gas utilities. As a result, the authors believe it more appropriate than ever to employ the comparable earnings model. We believe our application of the model overcomes the greatest traditional objection to it — lack of comparability of the selected non-utility proxy firms. Our illustration focuses on a target gas pipeline company with a beta of 0.96 — almost equal to the market's beta of 1.00.

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Introduction

The comparable earnings model used to determine a common equity cost rate is deeply rooted in the standard of "corresponding risk" enunciated in the landmark *Bluefield* and *Hope* decisions of the U.S. Supreme Court.[1] With such solid grounding in the foundations of rate of return regulation, comparable earnings should be accepted as a principal model, along with the currently popular market-based models, provided that its most common criticism, non-comparability of the proxy companies, is overcome.

Our comparable earnings model overcomes the non-comparability issue of the non-utility firms selected as a proxy for the target utility, in this example, a gas pipeline company. We should note that in the absence of common stock prices for the target utility (as with a wholly-owned subsidiary), it is appropriate to use the average of a proxy group of similar risk gas pipeline companies whose common stocks are actively traded. As we will demonstrate, our selection process results in a group of domestic, non-utility firms that is comparable in total risk, the sum of business and financial risk, which reflects both non-diversifiable systematic, or market, risk as well as diversifiable unsystematic, or firm-specific, risk.

Embedded in the Landmark Decisions

As stated in *Bluefield* in 1922: "A public utility is entitled to such rates as will permit it to earn a return ... on investments in other business undertakings which are attended by corresponding risks and uncertainties ..."

In addition, the court stated in *Hope* in 1944: "By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks."

Thus, the "corresponding risk" precept of *Bluefield* and *Hope* predates the use of such market-based cost-of-equity models as the Discounted Cash Flow (DCF) and Capital Asset Pricing (CAPM), which were developed later and are currently popular in rate-base/rate-of-return regulation. Consequently, the comparable earnings model has a longer regulatory and judicial history. However, it has far greater relevance now than ever before in its history because significant deregulation has substantially increased natural gas utilities' investment risk to a level similar to that of non-utility firms. As a result, it is

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more important than ever to look to similar-risk non-utility firms for insight into common equity cost rate, especially in view of the deficiencies inherent in the currently popular market-based cost of common equity models, particularly the DCF model.

Despite the fact that the landmark decisions are still regarded as having set the standards for determining a fair rate of return, the comparable earnings model has experienced decreased usage by expert witnesses, as well as less regulatory acceptance over the years. We believe the decline in the popularity of the comparable earnings model, in large measure, is attributable to the difficulty of selecting non-utility proxy firms that regulators will accept as comparable to the target utility. Regulatory acceptance is difficult to gain when the selection process is arbitrary. Our application of the model is objective and consistent with fundamental financial tenets.

Principles of Comparable Earnings

Regulation is a substitute for the competition of the marketplace. Moreover, regulated public utilities compete in the capital markets with all firms, including unregulated non-utilities. The comparable earnings model is based upon the opportunity cost principle; i.e., that the true cost of an investment is the return that could have been earned on the next best available alternative investment of similar risk. Consequently, the comparable earnings model is consistent with regulatory and financial principles, as it is a surrogate for the competition of the marketplace, and investors seek the greatest available rate of return for bearing similar risk.

The selection of comparable firms is the most difficult step in applying the comparable earnings model, as noted by Phillips[2] as well as by Bonbright, Danielsen and Kamerschen.[3] The selection of non-utility proxy firms should result in a sufficiently broad-based group in order to minimize the effect of company-specific aberrations. However, if the selection process is arbitrary, it likely would result in a proxy group that is too broad-based, such as the Standard & Poor's 500 Composite Index or the Value Line Industrial Composite. The use of such groups would require subjective adjustments to the comparable earnings results to reflect risk differences between the group(s) and the target utility, a gas pipeline company in this example.

Authors' Selection Criteria

We base the selection of comparable non-utility firms on market-based, objective, quantitative measures of risk resulting from market prices that subsume investors' assessments of all elements of risk. Thus, our approach is based upon the principle of risk and return; namely, that firms of comparable risk should be expected to earn comparable returns. It is also consistent with the "corresponding risk" standard established in *Bluefield* and *Hope*. We measure total investment risk as the sum of non-diversifiable systematic and diversifiable unsystematic risk. We use the unadjusted beta as a measure of systematic risk and the standard error of the estimate (residual standard error) as a measure of unsystematic risk. Both the unadjusted beta and the residual standard error are derived from a regression of the target utility's security returns relative to the market's returns, which takes the general form:

$$r_{it} = a_i + b_i r_{mt} + e_{it}$$

where:

r_{it} = tth observation of the ith utility's rate of return

r_{mt} = tth observation of the market's rate of return

e_{it} = tth random error term

a_i = constant least-squares regression coefficient

b_i = least-squares regression slope coefficient, the unadjusted beta.

As shown by Francis,[4] the total variation or risk of a firm's return, Var (r_i), comes from two sources:

Var (r_i) = total risk of ith asset

$= \text{var}(a_i + b_i r_m + e)$ substituting $(a_i + b_i r_m + e)$ for r_i

$= \text{var}(b_i r_m) + \text{var}(e)$ since $\text{var}(a_i) = 0$

$= b_i^2 \text{var}(r_m) + \text{var}(e)$ since $\text{var}(b_i r_m) = b_i^2 \text{var}(r_m)$

= systematic + unsystematic risk

Francis[5] also notes: "The term $\sigma^2(r_i|r_m)$ is called the *residual variance around the regression line* in statistical terms or *unsystematic risk* in capital market theory language. $\sigma^2(r_i|r_m) = \ldots = \text{var}(e)$. The residual variance is the squared standard error in regression language, a measure of unsystematic risk." Application of these criteria results in a group of non-utility firms whose average total investment risk is indeed comparable to that of the target gas pipeline.

As a measure of systematic risk, we use the Value Line unadjusted beta. Beta measures the extent to which market-wide or macro-economic events affect a firm's stock price. We use the unadjusted beta of the target utility as a starting point because it results from the regression of the target utility's security returns relative to the market's returns. Thus, the resulting standard deviation of beta relates to the unadjusted beta. We use the standard deviation of the unadjusted beta to determine the range around it as the selection criterion based on systematic risk.

We use the residual standard error of the regression as a measure of unsystematic risk. The residual standard error reflects the extent to which events specific to the firm's operations affect a firm's stock price. Thus, it is a measure of diversifiable, unsystematic, firm-specific risk.

An Illustration of Authors' Approach

Step One: We begin our approach by establishing the selection criteria as a range of both unadjusted beta and residual standard error of the target gas

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pipeline company.

As shown in table 1, our target gas pipeline company has a Value Line unadjusted beta of 0.90, whose standard deviation is 0.1250. The selection criterion range of unadjusted beta is the unadjusted beta plus (+) and minus (-) three of its standard deviations. By using three standard deviations, 99.73 percent of the comparable unadjusted betas is captured.

Three standard deviations of the target utility's unadjusted beta equals 0.38 (0.1250 x 3 = 0.3750, rounded to 0.38). Consequently, the range of unadjusted betas to be used as a selection criteria is 0.52 - 1.28 (0.52 = 0.90 - 0.38) and (1.28 = 0.90 + 0.38).

Likewise, the selection criterion range of residual standard error equals the residual standard error plus (+) and minus (-) three of its standard deviations. The standard deviation of the residual standard error is defined as: $\sigma / \sqrt{2N}$.

As also shown in table 1, the target gas pipeline company has a residual standard error of 3.7867. According to the above formula, the standard deviation of the residual standard error would be 0.1664 ($0.1664 = 3.7867/\sqrt{2(259)} = 3.7867/22.7596$, where 259 = N, the number of weekly price change observations over a period of five years). Three standard deviations of the target utility's residual standard error would be 0.4992 (0.1664 x 3 = .4992). Consequently, the range of residual standard errors to be used as a selection criterion is 3.2875 - 4.2859 (3.2875 = 3.7867 - 0.4992) and (4.2859 = 3.7867 + 0.4992).

Step Two: The step one criteria are applied to Value Line's data base of nearly 4,000 firms for which Value Line derives unadjusted betas and residual standard errors on a weekly basis. All firms with unadjusted betas and residual standard errors within the criteria ranges are then selected.

Step Three: In the regulatory ratemaking environment, authorized common equity return rates are applied to a book-value rate base. Thus, the earnings rates on book common equity, or net worth, of competitive, non-utility firms are highly relevant provided those firms are indeed comparable in total risk to the target gas pipeline. The use of the return rates of other utilities has no relevance because their allowed, and hence subsequently achieved, earnings rates are dependent upon the regulatory

table 1

Summary of the Comparable Earnings Analysis for the Proxy Group of 248 Non-Utility Companies Comparable in Total Risk to the Target Gas Pipeline Company[1]

	1	2	3	4	5	6	7	8
			residual	rate of return on net worth				
	adj. beta	unadj. beta	standard error	3-year average[2]	4-year average[2]	5-year average[2]	5-year projected[3]	
average for the proxy group of 248 non-utility companies comparable in total risk to the target gas pipeline company	0.97	0.92	3.7705					
target gas pipeline company	0.96	0.90[4]	3.7867					
median				11.7%	12.0%	12.6%	15.5%	
average of the median historical returns					12.1%			
conclusion[5]								13.8%

[1]The criteria for selection of the non-utility group was that the non-utility companies be domestic and included in *Value Line Investment Survey*. The non-utility group was selected based on an unadjusted beta range of 0.52 to 1.28 and a residual standard error range of 3.2875 to 4.2859.
[2]Ending 1992.
[3]1996-1998/1997-1999.
[4]The average standard deviation of the target gas pipeline company's unadjusted beta is 0.1250.
[5]Equal weight given to both the average of the 3-, 4- and 5-year historical medians (12.1%) and 5-year projected median rate of return on net worth (15.5%). Thus, 13.8% = (12.1% + 15.5% / 2).
Source: Value Line Inc., March 15, 1994
Value Line Investment Survey

Comparable Earnings *from page 6*

process. Consequently, we believe all utilities must be eliminated to avoid circularity. Moreover, we believe non-domestic firms must be eliminated because their reporting methods differ significantly from U.S. firms.

Step Four: We then eliminated those firms for which Value Line does not publish a "Ratings & Report" in *Value Line Investment Survey* so that the historical and projected returns on net worth[6] are from a consistent source. We use historical returns on net worth for the most recent five years, as well as those projected three to five years into the future. We believe it is logical to evaluate both historical and projected return rates because it is reasonable to assume that investors avail themselves of both when they are available from widely disseminated information services, such as Value Line Inc. The use of Value Line's return rates on net worth understates the common equity return rates for two reasons. First, preferred stock is included in net worth. Second, the net worth return rates are as of the end of each period. Thus, the use of average common equity return rates would yield higher results.

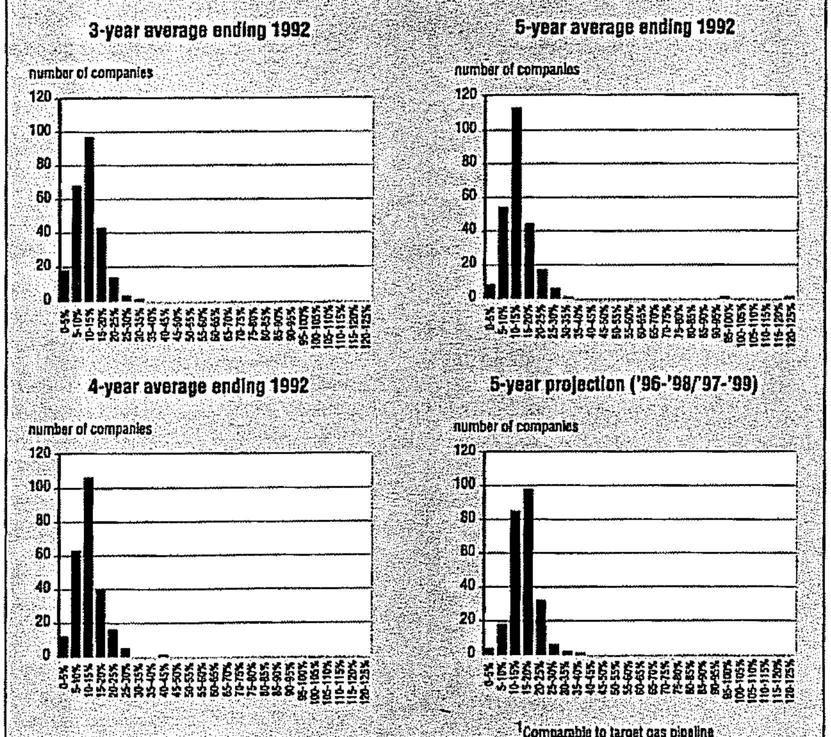
Step Five: Median returns based on the historical average three, four and five years ending 1992 and projected 1996-1998 or 1997-1999 rates of return on net worth are then determined as shown in columns 4 through 7 of table 1. The median is used due to the wide variations and skewness in rates of return on net worth for the non-utility firms as evidenced by the frequency distributions of those returns as shown in illustration 1.

However, we show the average unadjusted beta, 0.92, and residual standard error, 3.7705, for the proxy group in columns 2 and 3 of table 1 because their frequency distributions are not significantly skewed, as shown in illustration 2.

Step Six: Our conclusion of a com-

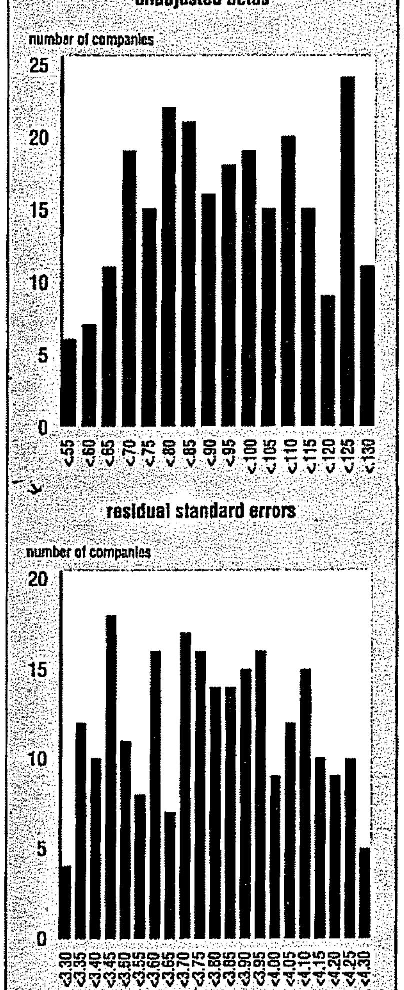
continued on page 8

Illustration 1
Rates of Return on Net Worth for the Proxy Group of 248 Non-Utility Companies[1]



[1]Comparable to target gas pipeline

Illustration 2
Unadjusted Betas and Residual Standard Errors for the Proxy Group of 248 Non-Utility Companies[1]



[1]Comparable to target gas pipeline

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parable earnings cost rate is based upon the mid-point of the average of the median three-, four- and five-year historical rates of return on net worth of 12.1 percent as shown in column 5 and the median projected 1996-1998/1997-1999 rate of return on net worth of 15.5 percent as shown in column 7 of table 1. As shown in column 8, it is 13.8 percent.

Summary

Our comparable earnings approach demonstrates that it is possible to select a proxy group of non-utility firms that is comparable in total risk to a target utility. In our example, the 13.8 percent comparable earnings cost rate is very conservative as it is an expected achieved rate on book common equity (a regulatory allowed rate should be greater) and because it is based on end-of-period net worth. A similar rate on average net worth would be about 20 to 40 basis points higher (i.e., 14.0 to 14.2 percent) and still understate the appropriate regulatory allowed rate of return on book common equity.

Our selection criteria are based upon measures of systematic and unsystematic risk, specifically unadjusted beta and residual standard error. They provide the basis for the objective selection of comparable non-utility firms. Our selection criteria rely on changes in market prices over approximately five years. We compare the aggregate total risk, or the sum of systematic and unsystematic risk, which reflects investors' aggregate assessment of both business and financial risk. Thus, no adjustments are necessary to the proxy group results to compensate for the differences in business risk and financial risk, such as accounting practices and debt/equity ratios. Moreover, it is inappropriate to attempt a comparison of the target utility with any individual firm, or subset of firms, in the proxy group because only the average firm of the group is relevant.

Because the comparable earnings model is firmly anchored in the "corresponding risk" precept established in the landmark court decisions, it is worthy of consideration as a principal model for use in estimating the cost rate of common equity capital of a regulated utility. Our approach to the comparable earnings model produces a proxy group that is indeed comparable in total risk because the selection process is objective and quantitative. It therefore overcomes criticism linked to arbitrary selection processes.

All cost-of-common-equity models, including the DCF and CAPM, are fraught with deficiencies, usually stemming from the many necessary but unrealistic assumptions that underlie them. The effects of the deficiencies of individual models can be mitigated by using more than one model when estimating a utility's common equity cost rate. Therefore, when the non-comparability issue is overcome, the comparable earnings model deserves to receive the same consideration as a primary model, as do the currently popular market-based models. ■

[1]*Bluefield Water Works Improvement Co. v. Public Service Commission*. 262 U.S. 679 (1922) and *Federal Power Commission v. Hope Natural Gas Co.*. 320 U.S. 519 (1944).

[2]Charles F. Phillips Jr., The Regulation of Public Utilities: Theory and Practice. Public Utilities Reports Inc., 1988. p. 379

[3]James C. Bonbright, Albert L. Danielsen and David R. Kamerschen. Principles of Public Utilities Rates. 2nd edition. Public Utilities Reports Inc. 1988, p. 329

[4]Jack Clark Francis, Investments: Analysis and Management, 3rd edition. McGraw-Hill Book Co., 1980, p. 363

[5]Id., p. 548

[6]Returns on net worth must be used when relying on Value Line data because returns on book common equity for non-utility firms are not available from Value Line

Report Lists Pipeline, Storage Projects

More than $9 billion worth of projects to expand the nation's natural gas pipeline network are in various stages of development, according to an A.G.A. report. These projects involve nearly 8,000 miles of new pipelines and capacity additions to existing lines and represent 15.3 billion cubic feet (Bcf) per day of new pipeline capacity.

During 1993 and early 1994, construction on 3,100 miles of pipeline was completed or under way, at a cost of nearly $4 billion, says A.G.A. These projects are adding 5.4 Bcf in daily delivery capacity nationwide.

Among the projects completed in 1993 were Pacific Gas Transmission Co.'s 805 miles of looping that allows increased deliveries of Canadian gas to the West Coast; Northwest Pipeline Corp.'s addition of 433 million cubic feet of daily capacity for customers in the Pacific Northwest and Rocky Mountain areas; and the 156-mile Empire State Pipeline in New York.

In addition, major construction projects were started on the systems of Texas Eastern Transmission Corp. and Algonquin Gas Transmission Co. — both subsidiaries of Panhandle Eastern Corp. — and along Florida Gas Transmission Co.'s pipeline.

The report goes on to discuss another $5 billion in proposed projects, which, if completed, will add nearly 5,000 miles of pipeline and 9.8 Bcf per day in capacity, much of it serving Florida and West Coast markets.

A.G.A. also identifies 47 storage projects and says that if all of them are built, existing storage capacity will increase by more than 500 Bcf, or 15 percent.

For a copy of *New Pipeline Construction: Status Report 1993-94* (#F00103), call A.G.A. at (703) 841-8490. Price per copy is $6 for employees of member companies and associates and $12 for other customers.

Arizona Water Company
Basis of Selection of the Group of Non-Price Regulated Companies
Comparable in Total Risk to the Proxy Group of Nine Water Companies

The criteria for selection of the proxy group of ten non-price regulated companies was that the non-price regulated companies be domestic and reported in Value Line Investment Survey (Standard Edition).

The proxy group of ten non-price regulated companies were then selected based on the unadjusted beta range of 0.37 – 0.63 and residual standard error of the regression range of 2.1093 – 2.5157 of the water proxy group.

These ranges are based upon plus or minus two standard deviations of the unadjusted beta and standard error of the regression. Plus or minus two standard deviations captures 95.50% of the distribution of unadjusted betas and residual standard errors of the regression.

The standard deviation of the water industry's residual standard error of the regression is 0.1016. The standard deviation of the standard error of the regression is calculated as follows:

$$\text{Standard Deviation of the Std. Err. of the Regr.} = \frac{\text{Standard Error of the Regression}}{\sqrt{2N}}$$

where: N = number of observations. Since Value Line betas are derived from weekly price change observations over a period of five years, N = 259

$$\text{Thus, } 0.1016 = \frac{2.3125}{\sqrt{518}} = \frac{2.3125}{22.7596}$$

Source of Information: Value Line, Inc., March 2016
Value Line Investment Survey (Standard Edition)

Arizona Water Company
Basis of Selection of Comparable Risk
Domestic Non-Price Regulated Companies

	[1]	[2]	[3]	[4]
The Proxy Group of Eight Water Companies	Value Line Adjusted Beta	Unadjusted Beta	Residual Standard Error of the Regression	Standard Deviation of Beta
American States Water Co.	0.75	0.55	2.4755	0.0718
American Water Works Company Inc	0.70	0.51	1.8032	0.0523
Aqua America Inc	0.75	0.57	1.9718	0.0572
Artesian Res Corp	0.55	0.28	2.6083	0.0756
California Water Service Group	0.75	0.58	2.1481	0.0623
Connecticut Water Service Inc	0.60	0.38	2.5512	0.0740
Middlesex Water Co.	0.70	0.52	2.2142	0.0642
SJW Corp	0.75	0.56	2.5700	0.0745
York Water Co.	0.70	0.53	2.4700	0.0716
Average	0.69	0.50	2.3125	0.0671

Beta Range (+/- 2 std. Devs. of Beta)	0.37	0.63
2 std. Devs. of Beta	0.13	
Residual Std. Err. Range (+/- 2 std. Devs. of the Residual Std. Err.)	2.1093	2.5157
Std. dev. of the Res. Std. Err.	0.1016	
2 std. devs. of the Res. Std. Err.	0.2032	

Source of Information: Valueline Proprietary Database March-2016

Arizona Water Company
Proxy Group of Non-Price Regulated Companies
Comparable in Total Risk to
The Proxy Group of Eight Water Companies

The Proxy Group of Ten Non-Price-Regulated Companies	[1] VL Adjusted Beta	[2] Unadjusted Beta	[3] Residual Standard Error of the Regression	[4] Standard Deviation of Beta
ConAgra Foods	0.75	0.55	2.4288	0.0704
Erie Indemnity	0.80	0.62	2.1752	0.0631
Kroger Co.	0.80	0.63	2.3555	0.0683
Lancaster Colony Corp.	0.80	0.62	2.2041	0.0639
Lilly (Eli)	0.75	0.62	2.2274	0.0646
Mercury General	0.70	0.53	2.4192	0.0702
Reynolds American	0.65	0.44	2.3062	0.0669
Smucker (J.M.)	0.75	0.56	2.1499	0.0623
Target Corp.	0.75	0.54	2.2244	0.0645
Verisk Analytics	0.75	0.61	2.3546	0.0683
Average	0.75	0.57	2.2800	0.0700
The Proxy Group of Eight Water Companies	0.69	0.50	2.3125	0.0671

Source of Information: Valueline Proprietary Database March-2016

Arizona Water Company
Summary of Cost of Equity Models Applied to The Proxy Group of Ten Non-Price-Regulated Companies Comparable in Total Risk to The Proxy Group of Eight Water Companies

Principal Methods	The Proxy Group of Ten Non-Price-Regulated Companies
Discounted Cash Flow Model (DCF) (1)	12.98 %
Risk Premium Model (RPM) (2)	11.46
Capital Asset Pricing Model (CAPM) (3)	10.61
Mean	11.68 %
Median	11.46 %
Average of Mean and Median	11.57 %

Notes:
(1) From page 5 of this Exhibit.
(2) From page 6 of this Exhibit.
(3) From page 9 of this Exhibit.

Arizona Water Company
DCF Results for the Proxy Group of Non-Price-Regulated Companies Comparable in Total Risk to
The Proxy Group of Eight Water Companies

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
The Proxy Group of Ten Non-Price-Regulated Companies	Average Dividend Yield	Value Line Projected Five Year Growth in EPS	Reuters Mean Consensus Projected Five Year Growth Rate in EPS	Zack's Five Year Projected Growth Rate in EPS	Yahoo! Finance Projected Five Year Growth in EPS	Average Projected Five Year Growth Rate in EPS	Adjusted Dividend Yield	Indicated Common Equity Cost Rate
ConAgra Foods	2.40	6.00	6.72	6.70	6.72	6.54	2.48	9.02
Erie Indemnity	3.10	11.00	10.00	10.00	10.00	10.25	3.26	13.51
Kroger Co.	1.09	10.50	10.00	9.80	10.00	10.08	1.14	11.22
Lancaster Colony Corp.	1.87	6.50	NA	NA	8.00	7.25	1.94	9.19
Lilly (Eli)	2.70	8.00	13.01	11.90	13.01	11.48	2.85	14.33
Mercury General	4.97	11.50	8.00	8.00	8.00	8.88	5.19	14.07
Reynolds American	3.42	12.50	11.90	12.10	11.90	12.10	3.63	15.73
Smucker (J.M.)	2.13	7.50	9.68	8.10	10.10	8.85	2.22	11.07
Target Corp.	2.97	9.50	11.23	11.10	11.23	10.77	3.13	13.90
Verisk Analytics	-	12.50	11.70	12.10	12.36	12.17	-	NA
							Mean	12.45 %
							Median	13.51 %
							Average of Mean and Median	12.98 %

N/A= Not Available

(1) The application of the DCF model to the domestic, non-price regluated comparable risk companies is identical to the application of the DCF to the proxy group of utility companies. The dividend yield is derived by useing the 60 day average price and the spot indicated dividend as of March 31, 2016. The dividend yield is then adjusted by 1/2 the average projected growth rate in EPS, which is calculated by averaging the 5 year projected growth in EPS provided by Value Line, www.reuters.com, www.zacks.com, and www.yahoo.com (excluding any negative growth rates) and then adding that growth rate to the adjusted dividend yield.

Source of Information:

Value Line Investment Survey:
www.reuters.com Downloaded on 03/31/2016
www.zacks.com Downloaded on 03/31/2016
www.yahoo.com Downloaded on 03/31/2016

Arizona Water Company
Indicated Common Equity Cost Rate
Through Use of a Risk Premium Model
Using an Adjusted Total Market Approach

Line No.		The Proxy Group of Ten Non-Price-Regulated Companies
1.	Prospective Yield on Baa Rated Corporate Bonds (1)	5.86 %
2.	Adjustment to Reflect Bond rating Difference of Non-Price Regulated Companies (2)	(0.35)
3.	Adjusted Prospective Bond Yield	5.51
4.	Equity Risk Premium (3)	5.95
5.	Risk Premium Derived Common Equity Cost Rate	11.46 %

Notes: (1) Average forecast of Baa corporate bonds based upon the consensus of nearly 50 economists reported in Blue Chip Financial Forecasts dated April 1, 2016 and December 1, 2015 (see pages 19-20 of Exhibit PMA-R32)). The estimates are detailed below.

Second Quarter 2016	5.30 %
Third Quarter 2016	5.40
Fourth Quarter 2016	5.50
First Quarter 2017	5.70
Second Quarter 2017	5.80
Third Quarter 2017	5.90
2017-2021	6.50
2022-2026	6.80
Average	5.86 %

(2) To reflect the Baa1 average rating of the non-utility proxy group, the prosepctive yield on A corporate bonds must be adjusted by 1/3 of the spread between A and Baa corporate bond yields as shown below:

	A Corp. Bond Yield	Baa Corp. Bond Yield	Spread
Mar-16	4.16 %	5.13 %	0.97 %
Feb-2016	4.22	5.34	1.12
Jan-2016	4.35	5.45	1.10
	Average yield spread		1.06 %
	1/3 of spread		0.35 %

(3) From page 8 of this Exhibit.

Arizona Water Company
Comparison of Long-Term Issuer Ratings for the
The Proxy Group of Ten Non-Price-Regulated Companies of comparable risk to
The Proxy Group of Eight Water Companies

	Moody's Long-Term Issuer Rating March 2016		Standard & Poor's Long-Term Issuer Rating March 2016	
The Proxy Group of Ten Non-Price-Regulated Companies	Long-Term Issuer Rating	Numerical Weighting (1)	Long-Term Issuer Rating	Numerical Weighting (1)
ConAgra Foods	Baa2	9.0	BBB-	10.0
Erie Indemnity	NR	--	NR	--
Kroger Co.	Baa2	9.0	BBB	9.0
Lancaster Colony Corp.	NR	--	NR	--
Lilly (Eli)	A2	6.0	AA-	4.0
Mercury General	WR	--	NR	--
Reynolds American	Baa3	10.0	BBB-	10.0
Smucker (J.M.)	Baa2	9.0	BBB	9.0
Target Corp.	A2	6.0	A	6.0
Verisk Analytics	Baa3	10.0	BBB-	10.0
Average	Baa1	8.4	BBB+	8.3

Notes:
(1) From page 16 of Exhibit PMA-R32.

Source of Information:
Bloomberg Professional Services

Arizona Water Company
Derivation of Equity Risk Premium Based on the Total Market Approach
Using the Beta for
The Proxy Group of Ten Non-Price-Regulated Companies of comparable risk to
The Proxy Group of Eight Water Companies

Line No.	Equity Risk Premium Measure	The Proxy Group of Ten Non-Price-Regulated Companies
1.	Ibbotson Equity Risk Premium (1)	5.52 %
2.	Ibbotson Equity Risk Premium based on PRPM (2)	7.33
3.	Equity Risk Premium Based on Value Line Summary and Index (3)	9.70
4.	Equity Risk Premium Based on S&P 500 Companies(4)	8.78
5.	Conclusion of Equity Risk Premium (5)	7.83 %
6.	Adjusted Beta (6)	0.76
7.	Forecasted Equity Risk Premium	5.95 %

Notes:
(1) From note 1 of page 18 of Exhibit PMA-R32.
(2) From note 2 of page 18 of Exhibit PMA-R32.
(3) From note 3 of page 18 of Exhibit PMA-R32.
(4) From note 4 of page 18 of Exhibit PMA-R32.
(5) Average of Lines 1 through 4.
(6) Average of mean and median beta from page 8 of this Exhibit.

Sources of Information:
Morningstar SBBI Appendix A tables, Morningstar Stocks, Bonds, Bills, and Inflation 1926-2015
Value Line Summary and Index
Blue Chip Financial Forecasts, April 1, 2016 and December 1, 2015
Bloomberg Professional Services

Arizona Water Company
Traditional CAPM and ECAPM Results for the Proxy Group of Non-Price-Regulated Companies Comparable in Total Risk to
The Proxy Group of Eight Water Companies

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
The Proxy Group of Ten Non-Price-Regulated Companies	Value Line Adjusted Beta	Bloomberg Beta	Average Beta	Market Risk Premium (1)	Risk-Free Rate (2)	Traditional CAPM Cost Rate	ECAPM Cost Rate	Indicated Common Equity Cost Rate (3)
ConAgra Foods	0.70	0.74	0.72	8.93	3.58	10.01	10.63	10.32
Erie Indemnity	0.80	0.72	0.76	8.93	3.58	10.37	10.90	10.63
Kroger Co.	0.75	0.81	0.78	8.93	3.58	10.55	11.04	10.79
Lancaster Colony Corp.	0.80	0.65	0.72	8.93	3.58	10.01	10.63	10.32
Lilly (Eli)	0.80	0.75	0.77	8.93	3.58	10.46	10.97	10.71
Mercury General	0.70	0.79	0.75	8.93	3.58	10.28	10.84	10.56
Reynolds American	0.70	0.76	0.73	8.93	3.58	10.10	10.70	10.40
Smucker (J.M.)	0.75	0.85	0.80	8.93	3.58	10.72	11.17	10.95
Target Corp.	0.70	0.80	0.75	8.93	3.58	10.28	10.84	10.56
Verisk Analytics	0.75	0.84	0.80	8.93	3.58	10.72	11.17	10.95
Mean			0.76			10.35 %	10.89 %	10.62 %
Median			0.76			10.32 %	10.87 %	10.60 %
Average of Mean and Median			0.76			10.34 %	10.88 %	10.61 %

Notes:
(1) From Exhibit PMA-R32, page 23, note 1.
(2) From Exhibit PMA-R32, page 23, note 2.
(3) Average of CAPM and ECAPM cost rates.

PMA-R17

Exhibit PMA-R17

Arizona Water Company
Interest Rates and Bond Spreads for Moody's Public Utility Bonds

Selected Bond Yields

	[1] A Rated Public Utility Bonds	[2] Baa Rated Public Utility Bonds	[3] Spread (1)
Jan-2016	4.27 %	5.49 %	
Dec-2015	4.35	5.55	
Nov-2015	4.40	5.57	
Average	4.34 %	5.54 %	1.20 %

Selected Bond Spreads

Notes:
(1) Column [2] - Column [1].

Source of Information:
Bloomberg Financial

PMA-R18

Capital Investment and Financial Decisions

Third Edition

HAIM LEVY & MARSHALL SARNAT
Hebrew University of Jerusalem

Prentice/Hall International

Englewood Cliffs, N.J. London Mexico New Delhi Rio de Janeiro
Singapore Sydney Tokyo Toronto Wellington

Library of Congress Cataloging-in-Publication Data

Levy, Haim.
Capital investment and financial decisions.

Bibliography: p.
Includes indexes.
1. Capital investments. 2. Business enterprises—Finance. I. Sarnat, Marshall. II. Title.
HG4028.C4L48 1986 658.1'5 85-16773
ISBN 0-13-114372-7

British Library Cataloguing in Publication Data

Levy, Haim
Capital investment and financial decisions.—3rd ed.
1. Capital investment—Decision making
I. Title II. Sarnat, Marshall
658.1'52 HG4028.C4

ISBN 0-13-114372-7
ISBN 0-13-114364-6 PBK

PRENTICE-HALL, INC., *Englewood Cliffs, New Jersey*
PRENTICE-HALL INTERNATIONAL, UK., LTD., *London*
PRENTICE-HALL OF AUSTRALIA PTY., LTD., *Sydney*
PRENTICE-HALL CANADA, INC., *Toronto*
PRENTICE-HALL OF INDIA PRIVATE LIMITED, *New Delhi*
PRENTICE-HALL OF JAPAN, INC., *Tokyo*
PRENTICE-HALL OF SOUTHEAST ASIA PTE., LTD., *Singapore*
EDITORA PRENTICE-HALL DO BRASIL LTDA., *Rio de Janeiro*
PRENTICE-HALL HISPANOAMERICANA, S.A., *Mexico*
WHITEHALL BOOKS LIMITED, *Wellington, New Zealand*

Printed in the United States of America

10 9 8 7 6 5 4 3 2

17

Defining the Cost of Capital

In the preceding chapter we concluded that, up to a limit, the use of financial leverage can potentially increase the value of the firm. If we denote the proportions of debt and equity which correspond to this limit by the letter L^*, the latter represents the firm's *optimal* capital structure. And as we have assumed that the goal of the firm is to maximize its market value (thereby maximizing the market value of the stockholders' equity as well), it follows that the firm should strive to achieve that financing mix which it believes to be optimal in the long run.

In this chapter we turn our attention to the problem of defining the cost of capital, that is a firm's minimum required rate of return on new investment. Initially we shall set out the theoretical arguments supporting the use of a *weighted average* of the various sources of financing as the measure of the cost of capital, the weights being determined by the proportion of each source in the optimal capital structure, L^*. In the following chapter we shall discuss the ways in which each individual type of financing (debt, preferred stock, common stock, retained earnings, etc.), can be measured, and conclude the discussion by setting out a practical method for calculating the cost of capital using General Motors Corporation and IBM as examples.

We concentrate in this chapter and in the next one on defining and measuring the cost of equity, debt and preferred stocks. The analysis of cost of other sources of funds (e.g., accounts payable) is left to the end-of-chapter problems.

FIRM'S COST OF CAPITAL VS INDIVIDUAL PROJECT'S COST OF CAPITAL

The cost of capital and the discount rate are two concepts which are used throughout the book interchangeably. However, there is a distinction between the *firm's* cost of capital and *specific project's* cost of capital. Let us elaborate:

Firm's Cost of Capital

The firm's cost of capital is the discount rate employed to discount the firm's average cash flow, hence obtaining the value of the firm. It is also the weighted average cost of capital, as we shall see below. The weighted average cost of capital should be employed for project evaluation (i.e., calculating the *NPV*) only in cases where the risk profile of the new project is a "carbon copy" of the risk profile of the firm.

Specific Project's Cost of Capital

In any case where the risk profile of the individual projects differ from that of the firm, an adjustment should be made in the required discount rate, to reflect this deviation in the risk profile. To illustrate, suppose that the firm's weighted average cost of capital is 20% and the risk-free interest rate is 10%. The firm should discount the project's average cash flows, in general, at the 20% discount rate. However, consider a case where the firm faces a project whose cash flow is certain. What is the minimum required rate of return on this certain project? In this case it is clearly the 10% rate which reflects the opportunity cost that the firm could earn by investing its money in other safe assets. Similarly, if the project under consideration is characterized by a very high risk, the 20% discount rate may be insufficient and a higher discount rate should be employed.

A Formal Analysis

For simplicity we assume a perpetual cash flow stream and no taxes. However, the same results can be obtained for a non-perpetual cash flow stream and when taxes exist. Let the firm's average cash flow be $\bar{X}$ and its market value be V. Hence there is some discount rate k which fulfills the following equality

$$V = \frac{\bar{X}}{k}$$

Suppose now that the firm is considering a new investment whose initial outlay is I. Should the firm accept the new project? The decision is, of course, dependent on the average additional cash flow $\Delta\bar{X}$ due to the new project as well as its risk profile. Suppose that as a result of accepting the new project, we obtain a new value for the firm V_1 given by,

$$V_1 = \frac{\bar{X}_1}{k_1} = \frac{\bar{X} + \Delta\bar{X}}{k + \Delta k}$$

where $\bar{X}_1 = \bar{X} + \Delta\bar{X}$ and $k_1 = k + \Delta k$ is the appropriate new average cash flow of the firm and its new discount rate.

PMA-R19

Arizona Water Company
Capitalization of Arizona Water Company and
ACC Staff Witness Parcell's and RUCO Witness Cassidy's Proxy Group

	2014 Total Capitalization
Arizona Water Company	$ 161.959
Proxy Group	
American States Water Co.	$ 832.891
American Water Works Co., Inc.	$ 10,874.927
Aqua America, Inc.	$ 3,293.051
Artesian Resources Corp.	$ 250.295
California Water Service Group	$ 1,131.581
Connecticut Water Service, Inc.	$ 390.053
Middlesex Water Company	$ 360.676
SJW Corporation	$ 758.304
York Water Company	$ 189.448
Average	$ 2,009.025

Source of Informaion: Exhibit PMA-3 accompanying Ms. Ahern's Direct Testimony
Company Annual Forms 10-K for the year 2014.

PMA-R20

MAINE PUBLIC UTILITIES COMMISSION
AUGUSTA, MAINE

IN RE: MAINE WATER COMPANY- CAMDEN/ROCKLAND	Docket No. 2013-362 January 14, 2014

Request for Approval of Rate Change - 307

APPEARANCES:

MATT KAPLY, Hearing Examiner
TOM WELCH, Maine Public Utilities Commission
DAVID LITTELL, Maine Public Utilities Commission
MARK VANNOY, Maine Public Utilities Commission
STEPHANI MORANCIE, Maine Public Utilities Commission
LUCRETIA SMITH, Maine Public Utilities Commission
CHRISTINE COOK, Maine Public Utilities Commission
WILLIAM BLACK, Office of the Public Advocate
STEPHEN HILL, consultant, Office of the Public Advocate
JERROLL CROUTER, Drummond Woodsum, Maine Water Company
JUDY WALLINGFORD, Maine Water Company
PAULINE AHERN, Maine Water Company
KEVIN BEAL, City of Rockland
WILLIAM HEWITT, Pierce Atwood, FMC Corporation

CONFERENCE COMMENCED (January 14, 2014, 12:02 p.m.)

MR. KAPLY: Good afternoon. Welcome to the Public Utilities Commission. My name is Matt Kaply. I'm the Hearing Examiner assigned to this case. We're here today on the docket -- on the record in docket number 2013-362 which is a rate proceeding pursuant to Section 307 for the Maine Water Company's Camden/Rockland division. We're joined today -- excuse me -- by Commissioners Littell and Vannoy, and I believe that we will also have Chairman Welch joining us shortly. Also from Commission staff are Christine Cook and Lucretia Smith. I'd like to begin --

MS. COOK: And Stephani.

MR. KAPLY: Oh, and Stephani Morancie who's behind us so I lost track of her. I'd like to begin by taking appearances from people in the room starting to my right.

MR. CROUTER: I'm Jerry Crouter from Drummond Woodsum, counsel for the company.

MS. WALLINGFORD: Judy Wallingford, president, Maine Water Company.

MR. BEAL: Kevin Beal, city attorney, city of Rockland.

MR. HEWITT: Good afternoon, Bill Hewitt of Pierce Atwood law firm appearing this afternoon on behalf of intervener FMC Corporation.

MR. BLACK: William Black on behalf of the Public

Advocate, and to my left is our -- the Public Advocate witness Stephen G. Hill.

MR. KAPLY: And I should also note that Pauline Ahern is here as a witness for -- for the company. By agreement of the parties, we're going to begin with the company and the company's witness, followed by cross.

MR. LITTELL: Before you do, I'd just note I've got a call a little after 1:00 that I apologize I can't move. So I'm going to have to duck out and take it and then come back.

MR. KAPLY: Without anything further, can we --

MR. BLACK: If --

MR. KAPLY: Oh.

MR. BLACK: If -- if -- just a suggestion, if Commissioner Littell's call is possibly short, we could take a -- a break for him to make the call. I don't know whether that would work.

MR. LITTELL: Yeah, it's not my call. It's a FERC Commissioner's call, but it probably would be half an hour or less.

MR. BLACK: Okay.

MR. LITTELL: But I'd suggest you keep going unless -- unless you otherwise have a reason to break.

MR. BLACK: Can I just -- may I check on time estimates? I probably -- my guess is maybe 20 -- 30 -- let's say 30 minutes of cross, 25 minutes of cross for Pauline Ahern.

Do you have any idea about the length of your cross for Steve?

MR. CROUTER: No longer than that, Bill.

MR. BLACK: Yeah? Okay. Steve would like to make, as we talked about and agreed, oral surrebuttal. That's going to go about 15 minutes.

MR. CROUTER: And --

MR. KAPLY: Roughly the same?

MR. CROUTER: -- Pauline is going to do oral rebuttal I would guess 15, 20 minutes.

MS. AHERN: Oh, definitely no longer than that.

MR. BLACK: Okay.

MR. CROUTER: Yeah.

MR. KAPLY: Are we ready?

MR. CROUTER: Yes.

MR. KAPLY: Would you raise your hand? Do you swear or affirm the testimony that you're about to give is wholly truthful?

MS. AHERN: Yes, I do.

MR. CROUTER: Good afternoon, Pauline. Do you have in front of you a document entitled the Pre-filed Testimony and the Pre-filed Exhibits of Pauline M. Ahern on behalf of Maine Water Company filed in December 2013?

MS. AHERN: Yes, I do.

MR. CROUTER: And was that -- that testimony and those exhibits prepared by you or under your direct supervision and control?

MS. AHERN: Yes.

MR. CROUTER: And do you have any corrections to the testimony or exhibits?

MS. AHERN: Yes, I have a few. I have none to the exhibits. The first one is on page one of the testimony. Can you hear me?

MR. CROUTER: Yes.

MS. AHERN: Okay. At line nine, it says 25. It should read 28. And on page three, line 16, in the far-right column under weighted cost rate, the 1.21 percent should be 2.71 percent. Page five, line 34, the word divisions should read company's; that's a possessive. And on line 36 the word financial should read credit.

MR. BLACK: Could you give me the line on that last one, please?

MR. CROUTER: Thirty-six.

MS. AHERN: Yes, line 36, third-to-last word.

MR. BLACK: Okay.

MS. AHERN: Page ten, line nine, the year 2005 should be 2013. Page 19 is something I said in response to a DR that I would correct on the stand. Page 19, lines 13 and 14, from the six in the parentheses through the rest of that line and all the way up to the word -- or up to the seven should be replaced with the word and, and the seven should be replaced with the number six. And the final correction is on page 51, line nine, 10.75 should read 10.15 percent.

MS. SMITH: Excuse me. On --

MR. CROUTER: I have 10.85 --

MS. COOK: Yes, too.

MS. AHERN: So it should be 10.15. If you -- I have 10.75. It should be 10.15.

MR. BLACK: And I'm confused as to the lines. We're on page 51.

MS. AHERN: Oh, I'm -- wait a minute, I'm sorry, it should be 10.85. You're correct. So on page 51 never mind the correction.

MR. CROUTER: Okay.

MR. BLACK: So no correction on page 51?

MS. AHERN: Correct.

MR. BLACK: Okay.

MR. CROUTER: And does that complete the corrections?

MS. AHERN: Yes.

MR. CROUTER: And with those corrections, do you adopt this testimony and exhibits as your sworn direct testimony and exhibits in this proceeding?

MS. AHERN: Yes, I do.

MR. CROUTER: Now, have you had an opportunity to read the direct testimony and exhibits of Stephen Hill?

MS. AHERN: Yes.

MR. CROUTER: And we have -- the parties have agreed, in the form of expediting this proceeding, to have live rebuttal and live surrebuttal. So let me ask you, do you have rebuttal comments on the testimony of Mr. Hill?

MS. AHERN: Yes, I have a few.

MR. CROUTER: Would you please proceed?

MS. AHERN: Okay. I'm going to address three specific areas. First, I'm going to discuss Mr. Hill's comments concerning the current expectations with regard to the economy and interest rates. He states on page 11, lines eight to 14, that investors have already incorporated the expectation of higher interest rates into the stock prices they're willing to pay for stocks. I agree with that. I'm not suggesting that investors have -- that their expectations for future capital cost levels are not incorporated in the stock prices. What I am suggesting is that forecasted interest rates be used in any risk premium analyses, including a capital asset pricing model. Mr. Hill concludes on page 11 that it's necessary to consider current interest rate levels and not projected levels because they, quote, best represent investors' current expectations for the future. And as a little aside, by that logic, analysts then should use the current dividend yield in discounted cash flow analysis, not the expected dividends as required by DCF theory. Both Mr. Hill and I have used expected dividend yields. He has used a projected dividend yield from ValueLine. I have grown a current dividend by one-half the growth rate.

In addition, cost of capital and ratemaking are both prospective, and investors need to know where capital costs are going or headed in the future in order to do a proper analysis and to develop their expectations. Investors are certainly aware of interest rate forecasts. They're published. They're out there in the public. And again, using interest rates is no different -- interest rate forecasts is no different than using a forecasted dividend or a forecasted growth rate. Therefore, they should be used in risk premium and capital asset pricing models.

Mr. Hill has also cited ValueLine investment surveys August 23rd, 2013, selection and opinion on pages 12 and 13 of his testimony. Curiously, that issue also published ValueLine's quarterly forecast for the U.S. economy which included interest rate forecasts. For example, for the U.S. 30-year U.S. Treasury bond, ValueLine is projecting 4.5 percent for 2015 and 4.8 percent for 2017. In contrast, Mr. Hill used a six-week average of three -- yield of 3.7 percent and I used a blended forecasted yield of 4.33 percent. ValueLine's projecting AAA corporate bonds to yield 5.7 percent in 2015, six percent in 2017. I used a corporate -- AAA corporate bond yield in my risk premium analysis of 5.11. Likewise, the prime rate is currently 3.25 percent and expected by ValueLine to rise to four percent in 2015 and six percent in 2017. Three-month Treasury bills are .1

percent, and they are expected to rise even more dramatically, if you think of it in terms of the percentage change, to .5 percent in 2015 and three percent in 2017. Similarly, the Federal funds rate currently .1 percent, expected to rise to .5 in 2015 in to 3.5 in 2017.

The point is the forecasts are publicly available, investors are aware of these forecasts, Mr. Hill relied upon ValueLine -- in fact, the very same issue -- and why wouldn't investors rely upon interest rate forecasts. ValueLine is not the only source of forecasts. Blue Chip Financial Forecasts, which is a monthly publication, publishes long-term interest rate forecasts twice a year in June and December. I'm not going to go through the same list of what the forecasts are, but the December issue had similar increases in interest rates as did the ValueLine of August 23rd.

The -- it's important that the current rising interest rate environment be reflected in the application of risk premium and capital asset pricing models, and they should not use current and historical interest rates. It is my opinion, given that the Federal Reserve has recently begun to taper off its quantitative easing, that interest rates will be rising sooner rather than later, and I think we see through these forecasts that it's going to come at a time when rates set in this proceeding will be in effect. Also interestingly, when Mr. Hill did his preliminary analysis -- which I believe is part of the record, the October 10th, 2013 analysis?

MR. CROUTER: Yes.

MS. AHERN: Okay. He included a 25-basis-point adjustment and said, "However, giving consideration to the potential for the tapering of Federal Reserve intervention in the long bond secondary market, an additional 25 basis points would not be unreasonable." His analysis -- his pre-filed testimony was filed based on market data, the market prices through November 1st. About three weeks after that was -- was filed, he did not include such an adjustment.

MR. WELCH: I have a question.

MS. AHERN: Yes.

MR. WELCH: Is it fair to characterize the DCF as an investor expectation model, roughly speaking? I mean, DCF is basically saying what does current stock price, growth expectation -- so -- so DCF, I sort of get the relationship between what investors expect and numbers that come out of that, is that --

MS. AHERN: Yes. I believe all the models we've -- well, the CAPM risk premium and the predictive risk premium, yes, they generally --

MR. WELCH: Well, I was -- but I was going to ask --

MS. AHERN: -- expectational.

MR. WELCH: Yeah, but expectational a different way, aren't they? I mean, when -- when -- the CAPM and risk premium, as I've seen them in the past, don't talk about modeling investor expectations based on what the market is telling you. They -- they calculate it based on -- I mean, they -- they maybe -- I understand your -- your point is that you should adjust them for what you think the CAPM and risk premium numbers will look like in the future and, therefore, you're asking the Commission to take into account some future changes. But that doesn't have anything to do with what investors expect one way or the other, does it?

MS. AHERN: Yes, it does because all of the models are trying to model how investors form those expectations. The DCF has several informities (phonetic) which I've delineated in my testimony, but it measures it by, like you said, looking at a dividend yield and the prices that include all of the investor expectations for the future, including their expectations of interest rates. They also -- the DCF also includes an expected growth rate. Now that expected growth rate --

MR. WELCH: Yeah, and I totally get that on the DCF.

MS. AHERN: Right, but what I was going to say is it is based on accounting measures of growth. They do not always -- can't always take into account investor expectations of interest rate forecasts.

MR. WELCH: Right. But I'm really asking -- I'm just -- I'm -- I'm not sure I understand the relevance of investor expectations when you're running a CAPM model. I can understand expectations of what the Treasury's going to do. I can understand historical data relating to what the relationship has been. I can understand the beta. None of those are drawn from investor expectations, unlike the DCF.

MS. AHERN: Well, I don't agree because the CAPM, in theory, calls for use of an expected -- investor expected market risk premium which is then multiplied by the beta, and it calls for an expected risk-free rate.

MR. WELCH: But -- but isn't the expected -- I mean, that's the product of the model, not the input to the model.

MS. AHERN: No, those are -- the input -- no, those are the inputs. The -- the inputs are an expected risk-free rate plus a beta multiplied by an expected risk premium.

MS. COOK: May I ask a clarifying question? I believe I hear what you're saying is that with respect to using a risk premium model or a CAPM model, the input that's required, the risk-free rate --

MS. AHERN: Uh-huh.

MS. COOK: -- that your position is that that rate should be a forecasted rate, not a current risk-free rate, a current Treasury rate --

MS. AHERN: Correct.

MS. COOK: -- if you will.

MS. AHERN: Correct. And the same with a public utility bond yield or a corporate bond yield in a risk premium model.

MS. COOK: Okay.

MS. AHERN: Does -- does that help?

MR. WELCH: I don't know, maybe I'm being obtuse. I mean, the -- the DCF tries to identify what is the market telling us about what investors actually expect. So you go through the math, you go through the, you know, whose G are you going to take, things like that.

MS. AHERN: Uh-huh.

MR. WELCH: And I guess -- I guess, the -- I'm trying to -- to figure out why there's a difference. It may not be a relevant difference, but it does seem to me in the CAPM and risk premium, you're not -- you're not identifying this is what investors expect the CAPM or risk premium method to tell you. Aren't you saying -- we're using some data points to -- to figure out what those numbers would be in some future period, right? I mean, is it the expectation or the reality that's important? In DCF, it's the expectation that is important, but in the CAPM and risk premium, it seems to me it's -- it's what the Commission concludes will be the future state, not what investors think will be the future state, or are you saying the Commission should be guided by what investors think will be the future state?

MS. AHERN: Correct to the last. The three -- all three of those models, in theory, are estimating investors' expectations of their return. They do them in different ways based on different assumptions. And if the DCF is expectation because you're using, you know -- well, we don't use a current market price in regulation. We typically use some historical, recent historical, average. But we do use a forecasted expected dividend which may or may not come -- come true. We're expecting dividends to grow, but they may or may not. We're using an expected growth rate, but we're using a proxy for the expected market appreciation of that particular stock. The other models, in order to be expectational, and they are estimating the expected return based on a different set of parameters, what I'm saying is to be correctly expectational, they need to include expected interest rate forecasts in them and not current or historical forecasts.

MS. COOK: Can I follow up? The -- and maybe this is a very fundamental question that might be helpful to explore. In a risk premium model or a CAPM model, you are -- and correct me if I'm -- if I'm misstating -- you are taking historical observations of market conditions, concluding something like a risk premium or a beta, and using that historical observation and the differences between, you know, the -- the market performance of the -- of -- of a stock compared to a risk-free rate and then projecting the risk-free rate and holding the -- holding the historical relationship the same.

MS. AHERN: It's stated correctly. The historical relationship, especially if one uses an arithmetic mean historic relationship, that is statistically expectational. I use the predictive risk premium model which predicts an expected risk premium. I also use a ValueLine expected risk premium. No matter what data we use, Mr. Hill and I use, in any of our models, even if one is relying on historical growth rates, when one uses them in a DCF, one, the analyst is making the assumption that that reflects investor expectations. So even though one use -- may use historical information, the analyst is saying that this historical information represents expectations. With regard to interest rates, Mr. Hill is saying that market prices -- excuse me -- reflect investors' current expectations for interest rate movements going forward, and I would not disagree with that. What I'm saying is because of that, you need to use forecasted interest rates when applying a risk premium or capital asset pricing model.

MS. COOK: And if you are using a long-term interest rate for your risk-free rate in these models, can you comment on whether a long-term rate includes, in any way -- a current long-term 30-year Treasury rate includes in any way a market expectation of the future direction of interest rates?

MS. AHERN: Can you repeat just the beginning of that? What is the rate we're using, the --

MS. COOK: With respect to today's 30-year Treasury rate --

MS. AHERN: Okay.

MS. COOK: -- does that rate today include, in your view, any market expectation with respect to the future direction of interest rates?

MS. AHERN: Theoretically, it should, but the current interest rate levels are being tampered down, held artificially low, because of the Federal Reserve intervention. These forecasts that I've just relayed to you reflect those forecasters' expectation of what is going to happen as the tapering off continues and eventually, sooner rather than later, the Federal Reserve begins to move the Fed funds and the -- lost my -- the three-month -- the Treasury bill rate up. Hang on, had a little senior moment. The -- yeah, the three-month Treasury bill and the Fed funds rate up.

MS. COOK: But -- but we're not using a short-term rate.

MS. AHERN: But all of the other rates are based off of them. One of the reasons the corporate rates are going to -- are projected to go up higher is that the corporate rates are generally influenced more by the market. The market kind of prices the bonds, and the rates fall from that. But they too are depressed currently because of the Federal Reserve's intervention.

MS. COOK: Just one more follow up on the --

MS. AHERN: Uh-huh.

MS. COOK: -- on the -- on your view of long-term Treasury rates. Do you believe that the market -- the market currently understands what the Fed's intention is with respect to monetary policy?

MS. AHERN: Yes, I do. It's in the Federal Reserve minutes. It's in their press release. It's in the literature -- not the literature, I mean, it's all over the press. It's in the Wall Street Journal.

MS. COOK: And what is that? What -- what has the Fed said with respect to its monetary policy?

MS. AHERN: Okay, after the December meeting, the Federal Reserve said it was going to begin tapering its quantitative easing and then increase it. You know, I think they're tapering ten million per month. I'm not sure when they're going to begin to increase it. They're going to hold interest rates low for the time being, but as the economy shows greater strength, as the unemployment rate falls further, as inflation is held in check, and as GDP begins to show stronger growth, then they're going to begin to consider raising interest rates. Those who forecast -- and Blue Chip is provided by 50 economists, their forecasts come from 50 contributing economists -- they see, these professionals, see that happening within the next year or two.

MS. COOK: And they've reflected that in their forecasts?

MS. AHERN: In their -- correct. That's why they're -- they're showing significantly higher than current yields.

MR. WELCH: Let me ask another somewhat basic question. So we have three models, and as you described, each of them uses investor expectations as inputs, and each of them produces what the Commission should conclude is investor expectation of return. Am I right so far?

MS. AHERN: Yes.

MR. WELCH: What explains the variance? I mean, if the inputs are based on the same sources and the output is supposed to be the same, I mean, the obvious answer is, well, the models are different, but shouldn't they converge?

MS. AHERN: Ideally they should. They don't converge partly because they're based on -- on different theory, different assumptions of investor behavior. They use different inputs. They are all market based in that in one way or another they are all based on market information, on interest rates or dividend yields. One of the biggest problems with the DCF is that it is a market model and we're applying it to a book value rate base, and that causes a problem when, as my testimony says, market to books are greater than one. And Mr. Hill argues with that. The -- as I said --

MR. WELCH: Let me -- let me -- I apologize for this.

MS. AHERN: Okay.

MR. WELCH: And hold on to the thought, continue when

I want to explore that.

MS. AHERN: Okay.

MR. WELCH: I mean, if the -- and this is sort of a fundamental question that you may want to have counsel brief as opposed to answering it yourself but --

MS. AHERN: Do I get the choice? No.

MR. WELCH: Well, yeah, you do get a choice. In the context in which the market to base is greater than one, and let's assume we're there, is it the Commission's responsibility to provide a return to the amount of -- relative to the amount of money paid by people who happen to have bought it on the market or is it the responsibility to return -- to provide a return of and on capital that is actually invested? I mean, the -- the pejorative way of describing this is that should the Commission act to drive the ratio back and, if not, why not?

MS. AHERN: I'm going to work backwards to that. Regulation in the DCF presumes a market-to-book ratio of one. That has not happened. You know, over time it -- it diverges. The DCF presumes that all the interest -- I'm sorry, all the growth rates are equal: dividend, book value, sustainable growth, and the capital market appreciation. All of the growth rates that we use, that we have available to us to use, are proxies for the capital market appreciation. What I believe -- not what I believe -- what the Supreme Court says Commissions should do is that utilities are entitled to a fair rate of return on their invested property, that is both Hope and Blue Field, that are -- that is commensurate with the returns earned by other firms of similar risk. So the Commission is determining a return on the invested property which is at book value.

We -- regulation has defined that return as the cost of equity as the expected, you know, market cost of equity. There is a little bit of disconnect there. In your judgment, you need to -- I think -- dictating to the Commission -- but a Commission needs to review all the evidence of record, mine, Mr. Hill's, and determine -- it's your judgment to determine what that fair rate of return is in the context of the entire case including, you know, the expenses and what the rate base is, etc. If you're going to strictly define it as the market-based cost of common equity, that is not directly observable, and we have these -- finances develop these models to estimate how investors behave. And yes, you're right, you come up with ranges that literally you could drive a truck through. And in your judgment, you have to listen to all our support, you know, for our various positions and then determine a fair return. In my mind, they can be two different things. For example, I have to testify next week about the reasonableness of a settled position which is far below what I recommended, but given the current economic environments in that state, the unemployment rate, the ability of those ratepayers to pay and the fact that all parties have agreed to this rate of return, the company believes that that's a fair rate of return, as does the staff and the consumer advocate. And the way I testify to things like that is say it's a fair rate of return, but I cannot testify that it's the market-based rate of return. I know that's a roundabout answer, but I mean --

MR. WELCH: It is, yeah, but --

MS. AHERN: But --

MR. WELCH: -- this is sort of --

MS. AHERN: But it's a definitional thing and --

MR. WELCH: I was asking a somewhat narrower question, and it may be one you just want to defer to briefing or -- or how you want to deal with it there --

MS. AHERN: But one more --

MR. WELCH: But --

MS. AHERN: Okay.

MR. WELCH: The narrow question is as I understand your testimony, you have indicated that the market-to-book ratio ought to be taken into account because with the higher than 1:1 market-to-book ratio, the DCF understates the cost of equity.

MS. AHERN: No, I don't believe the market-to-book ratio should be taken into account. I make no adjustment for it.

MR. WELCH: Okay.

MS. AHERN: What my conclusion is that one must look at the other models and one must consider all of the evidence and not blindly, you know, rely exclusively or primarily upon a DCF.

MR. WELCH: Okay. Thank you.

MR. CROUTER: So when we started, you said you had three areas for rebuttal. Let me take you to the second one and ask you if you'd comment on Mr. Hill with respect to that second area.

MS. AHERN: It's a good segué because my second area is regarding the use of forecasted earnings per share in a DCF analysis. Mr. Hill spends some -- I spent some time discussing the superiority of earnings growth forecast in my testimony, and that's not what I'm going to discuss now. But Mr. Hill spends some time on page 25, lines 11 through 19, discussing the -- what he calls the rosiness of analysts' forecasts. And he says it's not a new phenomenon and it's recognized in academia. One point about all of these forecasts, even the interest rate forecasts or even a risk premium forecast, the accuracy of any forecast by definition cannot be known until well after the fact, just like the accuracy of a weather forecast for a significant snowfall or rainfall can't be known until it's over and you find out you have 27 inches and not the three they predicted which has happened to me once. But it's also recognized in academia that investors take any perceived bias in those forecasts, any of that rosiness, into account and they discount them, no pun intended, in the market prices they pay. They are not deceived by perceived biases. The specific academic article I'm thinking of was written by Agrawal, that's A G R A W A L, and Chen, C H E N, and the title is Do Analysts' Conflicts Matter? Evidence from Stock Recommendations. It appeared in 2008 in the Journal of Law & Economics. And their conclusion was, quote, "Overall, our findings do not support the view that conflicted analysts are able to systematically mislead investors with optimistic stock recommendations." The rosiness and optimism of such forecasts is not relevant. What is relevant is whether they are investor influencing and they help form investor expectations and help them in their pricing decisions. And academic does say that earning forecasts are influential.

And my final area has to do with the data requests. There were a lot of -- there was a heavy --

MR. WELCH: Can I -- can I just translate that last bit?

MS. AHERN: Sure.

MR. WELCH: I mean, if it's -- if investors -- if the analysts' forecasts are, in fact, rosy, and investors discount that because investors understand they're rosy, what would the implications of that be for stock prices? Does that mean that the DCF is self-correcting because the stock price will reflect the over-rosy analysis?

MS. AHERN: It would, yes.

MR. WELCH: But that would mean a lower stock price and a higher yield, right? I'm just thinking of how mathematically this fits together.

MS. AHERN: Well, under the assumption -- and this is where I was going to go before -- that earnings are the sole driver of market prices -- and they are not, they are but one -- if they were the sole driver, yes. They are not. There are many, many other reasons for the market to do what it does. They do not always, according -- even though according to theory they should, recommend -- reflect the fundamentals of the company in question. You know, it's like the -- the herd mentality, as soon as something happens globally, there's an effect.

MR. WELCH: Right, but --

MS. AHERN: But it's not -- go ahead.

MR. WELCH: Yeah, I mean, I understood Mr. Hill's point to be that Gs are inflated so you should have a lower G, short version. Your responses is Gs -- yeah, maybe Gs are inflated, maybe they're not, but the fact is investors understand that Gs may be inflated and investor behavior, according to that article, that's recognized. But if -- and I'm just thinking through the math of the DCF --

MS. AHERN: Uh-huh.

MR. WELCH: -- if investors think that Gs are inflated, wouldn't that cause them to bid lower rather than higher? If they bid lower rather than higher, all else equal, dividend yield is up. It actually -- I mean, I'm just wondering how they -- I understand your point to be that the DCF is sort of self-correcting because of the way investors behave. My point is that if the G is inflated, they discount the G, the stock price is bid down, dividend stays the same, yield is up.

MS. COOK: And then you use an analysts' G --

MR. WELCH: Yeah, and use the analysts' G, you're actually -- you're actually increasing two variables in the equation, both of which serve to increase the result.

MS. AHERN: They only said discount. They didn't say the price is going down or up. Logically, one would think it would go down, but as I said, earnings are the only thing. That's in the pure world where earnings are the only driver of market prices. There is other -- and I cite in my testimony, there is other literature which shows that the investors are heavily influenced by the earnings forecast, that that is what -- you know, the earnings -- earnings is what dividends are going to come from. They're not going to get their dividend yield if you don't have, you know, positive earning -- theoretically, positive earnings growth. But it has been shown that earnings forecasts influence stock market appreciation, stock prices, more -- maybe minimally, but more than book value growth, more than dividend growth rates, more than sustainable growth rates.

That's -- that's the point.

MR. WELCH: Okay.

MS. COOK: I have two follow-up questions on -- on that point that I believe you just made. One is could you provide a copy of that article --

MS. AHERN: Yes, I can.

MS. COOK: -- please? And the second is when -- when you refer to the analysts' EPS forecast being discounted, what does that mean? What does it mean to discount? Do -- do investors adjust it downward or do they disregard it?

MS. AHERN: I -- I would interpret it to mean that they take it into account in their pricing decisions. But as I said -- and discount would typically mean that, yes, they would -- would reduce their -- their price expectation. But as I said earlier, earnings are but a small part of what influences stock prices. So whether or not you can measure the reduction in dividend yield, that I don't -- that I don't know. Let me see if their summary says anything further.

MR. CROUTER: Why she's looking, I have a copy of the article that I can give you now and then I can email electronically it to the parties.

MR. KAPLY: Okay.

MS. COOK: I won't -- I won't ask you to go through that. We can --

MS. AHERN: Okay. And I'm the one who used discount, but their -- the quote I used from them was that their findings do not support the view that conflicted analysts' or rosy or -- they discuss the optimism of analysts' forecasts, to systematically mislead investors with optimistic stock recommendations, forecasts. Discount may be my term. I may never use it again.

MR. CROUTER: So you were -- you were just about to begin the third and final topic.

MS. AHERN: Right. That has to do with the kind of heavy concentration in the DRs on the predictive risk premium model. I just want to point out that the mathematics and the statistics underlying the model are not mine or my co-authors'. They belong to Dr. Engle, Robert Engle, who shared the Nobel Prize in economics in 2003 for discovering, one, the tendency of the volatility of historical returns, historically-observed returns and risk premiums, the actual outcomes of investor behavior to cluster over time, and for one period's volatility to be related to another period's. They also developed the statistical methodology with which to analyze historical risk premiums and returns and to develop a prediction of risk premiums. And, yes, the consumption asset pricing model is -- is a -- is formulated -- I went back and read the original article -- is formulated to determine returns. I and the co-authors used this methodology similarly to the way that Dr. Gordon used the original DCF methodology which was a stock valuation methodology, not a cost of common equity methodology. And Dr. Gordon turned it into an estimation of the cost of equity for public utility stocks. We used the methodology and the pattern of behavior that Dr. Engle discovered and applied it to common stock equity risk premiums as a means to estimate a predicted or forward-looking equity risk premium which could be added to a bond yield or risk-free rate in either a risk premium model or a capitalized asset model. One thing that distinguishes this model from the DCF CAPM and other risk premium models is that, as I said before, it uses the actual outcomes of investor decisions, the investor decision-making process, actual observations of their pricing decisions by looking at historical returns and the resulting equity risk premiums. It doesn't require the analysts to estimate, or guesstimate, how they make those decisions, on whether they earnings growth, historical, forecasted, geometric means, arithmetic means, historical equity risk premiums, etc. It, again, uses the actual observed historical data, the outcomes of their actual investor behavior. It also has not as many restrictive assumptions. Its basic assumption is that investors will behave and make their pricing decisions as they always have. Just like human behavior, it's not going to change. One thing it does do is it prices all risk, doesn't rely on the investor holding a fully-diversified portfolio like the CAPM does which causes CAPM to have some, you know, mis-estimation there too, just like the DCF. And with that, I conclude my rebuttal.

MR. CROUTER: And with that, I tender the witness for cross examination.

MR. BLACK: Thank you. Good morning, Ms. Ahern.

MS. AHERN: Good afternoon.

MR. BLACK: Good afternoon, right, thank you. Could you please turn to page two of two of your -- your first schedule, PMA-1?

MS. AHERN: Two of two. Okay.

MR. BLACK: And that -- that schedule displays the results of each of your cost of capital estimates, correct?

MS. AHERN: Yes.

MR. BLACK: You see the discounted flow, the risk premium, the CAPM. And what's the shorthand name for the fourth number? Is that --

MS. AHERN: -- one. I don't have one.

MR. BLACK: Say again?

MS. AHERN: We call it the OCM, the opportunity cost model I guess.

MR. BLACK: And that involves a cost of equity estimate for unregulated companies?

MS. AHERN: Correct.

MR. BLACK: Okay. And you refer to it as OCM?

MS. AHERN: Well, that's --

MR. BLACK: I just want to --

MS. AHERN: Around the office, yes. You can use that.

MR. BLACK: Okay, how about if I -- how about if I use cost of equity for unregulated companies?

MS. AHERN: Sure.

MR. BLACK: Okay. So -- so each -- each of those are different methodologies, those four, correct? Obviously, and the -- at line five the one -- the 10.5 -- the 10.15 number, is that number an average of those four results?

MS. AHERN: No, it's a median.

MR. BLACK: Okay. So since there are four estimates or an even number of estimates, a median will lie halfway between the middle two of your estimates, correct?

MS. AHERN: Correct.

MR. BLACK: And the middle two numbers are the 9.8 CAPM number and the 10.5 cost of estimate -- cost of equity estimate for unregulated companies, correct?

MS. AHERN: Correct.

MR. BLACK: So that means your cost of equity estimate in this case, the 10.15 number, is the average of your 9.8 CAPM result and your 10.5 cost of equity estimate for unregulated companies, correct?

MS. AHERN: Mathematically, yes. I use the median for the same reason I use the median specifically of the DCF results, because of the -- the range of results. We go from

11.3 to 11.39.

MR. BLACK: Okay.

MS. AHERN: And sometimes, when the DCFs were high, the DCF was included in that average.

MR. BLACK: It depends on the relative size? You take the median --

MS. AHERN: Well, the -- yes, that's what the median does, yeah.

MR. BLACK: Right, right. And in a four -- four-digit sample, it's -- it's the average between the two middle digits -- the middle numbers?

MS. AHERN: Correct.

MR. BLACK: Okay, thank you. Focusing on -- on line two which is your risk premium cost of equity result, is it fair to say there are actually several parts to your risk premium analysis, and -- and they consist, for instance, of the historical return difference between stocks and bonds and the new statistical analysis that you used -- that you've introduced called the PRPM?

MS. AHERN: Correct.

MR. BLACK: And PRPM stands for the predictive risk premium model?

MS. AHERN: Correct.

MR. BLACK: And most times we see those four letters, there's a trademark sign right after them, right?

MS. AHERN: Yes.

MR. BLACK: Now, on -- can we turn to page one of PM-6 -- PMA-6, please?

MS. AHERN: Okay.

MR. BLACK: There you show the results of that new method, the PRPM, as 11.77 percent?

MS. AHERN: Correct. Now, that's the PRPM for each individual -- or the median of those for the individual companies.

MR. BLACK: Right.

MS. AHERN: But the PRPM is also included in the 9.86 --

MR. BLACK: Okay.

MS. AHERN: -- estimating the market premium and the holding period return --

MR. BLACK: Right. So it's included in both?

MS. AHERN: Correct.

MR. BLACK: Okay. And the third number you show there is 11.29?

MS. AHERN: Correct.

MR. BLACK: And that's the average of those two results?

MS. AHERN: No, it's a weighted average.

MR. BLACK: I see. And weighted based on?

MS. AHERN: Well, as it says in my testimony, I give greater weight to the predictive risk premium model precisely because it's based on direct observations -- no, of observed investor behavior and its less restrictive assumptions. However, I also note if I had used the average -- if I had used the average, the resulting risk premium model results would be 10.83 and my conclusion still would have been 10.15.

MR. BLACK: Okay. For a moment, let's focus on the lower risk premium result.

MS. AHERN: The 9.86?

MR. BLACK: Yes. You've already said that you include the PRPM analysis in that cost, right?

MS. AHERN: Yes.

MR. BLACK: And the risk premium is the difference between stock returns and bond returns, is that right?

MS. AHERN: Yes.

MR. BLACK: So let's compare the risk premium -- so -- so both of them have -- but both of them have the higher -- the PRPM figure in them, right, both the 11.77 and the 9.86?

MS. AHERN: Right.

MR. BLACK: Okay.

MS. AHERN: The 9.86, though, has several other risk premiums included.

MR. BLACK: Okay.

MS. AHERN: So the PRPM risk premium is tempered somewhat.

MR. BLACK: Okay. Let's turn to page eight, line one of the same exhibit.

MS. AHERN: Okay.

MR. BLACK: There you show the Ibbotson -- at line one you show the Ibbotson historical return difference between stocks and Moody's AA corporate bonds, correct?

MS. AHERN: Correct. That's based on a monthly arithmetic mean.

MR. BLACK: Okay. And that result is 5.6 percent, correct?

MS. AHERN: Correct.

MR. BLACK: And line two is the same data run through the PRPM algorithm, correct?

MS. AHERN: Correct.

MR. BLACK: And the result of that data is 9.26 percent?

MS. AHERN: Correct.

MR. BLACK: And that 9.26 percent figure is nearly double the 5.6 historical return difference, correct?

MS. AHERN: Correct, and that's because it picks up the -- what Dr. Engle discovered, the clustering of volatility and the inter-dependence of volatility between periods that the arithmetic mean does not.

MR. BLACK: Is it fair to say that in your testimony here, in each situation here, your new PRPM analysis produces risk premium results that are higher than the historical difference between stock and bond returns?

MS. AHERN: Yes, for the reasons I just stated.

MR. BLACK: Okay. Now let's -- let's turn to the other part of your risk premium which is the PRPM estimate of cost of equity. Please turn to page two of your PMA-6, please.

MS. AHERN: Okay.

MR. BLACK: That page shows your estimate of the equity -- that's sort of a landscape view, am I right?

MS. AHERN: Yes, it is.

MR. BLACK: And that page shows your estimate of the equity cost rate of water utilities in your sample group using your PRPM equity cost analysis?

MS. AHERN: Yes.

MR. BLACK: And using this PRPM analysis, it's -- by the way, is this the first time you've introduced this analysis in Maine?

MS. AHERN: Yes, I haven't been in Maine in 20 years. Or, I'm sorry, about ten years.

MR. BLACK: Ten years. Okay. For vacation purposes or at the PUC?

MS. AHERN: At the PUC, maybe 10, 15 years.

MR. BLACK: Great. Using your PRPM analysis, you estimate the cost of equity capital for American Water Works, which is the largest water utility in the United States, to be

25.93 percent, correct?

MS. AHERN: Correct, and the reason is it has a very short history of trading.

MR. BLACK: So that -- that makes it an -- you would agree that is an outlying result that -- that's --

MS. AHERN: Why I rely -- why I rely on the median.

MR. BLACK: Right, okay. Still focusing on your PRPM results for American Water Works on that schedule, your analysis shows that G A R C H coefficient for American Water Works and the PRPM risk premium for that company are much, much higher than for any of the other water utilities, correct?

MS. AHERN: Correct.

MR. BLACK: And G A R C H is an acronym for generalized autoregressive conditional heteroscedasticity, is that correct?

MS. AHERN: Correct.

MR. BLACK: And this G A R C H -- or is it sometimes said GARCH?

MS. AHERN: We always say GARCH.

MR. BLACK: GARCH, okay. This GARCH coefficient is a key component of -- of your new PRPM equity cost analysis?

MS. AHERN: Yes, because as it says in the footnote, the GARCH coefficient in that first line is multiplied by the average variance to get the PRPM derived equity risk premium --

MR. BLACK: Okay. So --

MS. AHERN: -- after --

MR. BLACK: Sorry.

MS. AHERN: -- on an annualized basis.

MR. BLACK: Thank you. You've been testifying on the cost -- on the subject of cost of capital for about 20 years, is that correct?

MS. AHERN: Uh-huh, yes.

MR. BLACK: And according to your response to MPA 3-15 -- or OPA 3-15, you first began to use this PRPM method in the year 2012?

MS. AHERN: Yes. I began in 2012. One of my colleague -- in the spring. One of my colleagues began earlier in the year. The article was published in the Journal of Regulatory Economics in -- the first article in December 2011. We had been working on it for four or five years. We did not include -- the first article only looked at the historical market returns and the public utility -- S&P public utility index returns and a sampling of two electrics, two waters, two gas and two combination companies. And we at AUS did not feel comfortable including it in a cost of equity analysis until we did the comparable analysis for every single publicly-traded utility in the country, which we did. The results confirmed -- they were consistent with the results in the original article. That second article was published in May of 2013. Once we had completed that research and felt comfortable that the results were consistent across the industry, we began to include it in our cost of equity testimonies.

MR. BLACK: Right. And you outline some of that in your response to OPA 3-17 where you refer to the two articles, correct?

MS. AHERN: Correct.

MR. BLACK: And those articles, there are four authors of each, is that correct?

MS. AHERN: There are three of the first and there are four of the second.

MR. BLACK: Okay. And are each of those authors members of the AUS firm?

MS. AHERN: At the time -- well, Frank Hanley is now semi-retired. I'm still a member of the term at the -- of the firm. Richard Michelfelder at the time was an associate with us, managing associate, who -- and a professor of finance at Rutgers University. He is now just a professor at Rutgers University. Frank Hanley is semi-retired. Dylan D'Ascendis is the fourth author on that second article. He is a principal with AUS and a cost of capital witness. He was the fellow who did all the analysis on the first article.

MR. BLACK: Great, thank you. But is it -- is it fair to say that prior to 2012, you relied simply on DCF CAPM and the risk premium analyses methods for --

MS. AHERN: That would be accurate, yes.

MR. BLACK: Yes, okay. Now, according to your response to OPA 3-16, only you and the AUS utility cost of capital witnesses currently use this PRPM methodology.

MS. AHERN: To the best of my knowledge. It is now gaining some exposure. It is being published in a cost of capital manual or book, textbook, by Grabowski (phonetic). It's being -- he is also publishing a book which is intended for regulatory attorneys. He's putting the cost of capital -- I'm sorry, he's putting the PRPM in there. It's been presented at the Center for Research in Regulatory Industries of Rutgers University a couple of times. Dr. Roger Morin is -- has begun to include it in his cost of capital workshops through RRA, and he has requested permission to include it in the revision of New Regulatory Finance which he is in the process of revising.

MR. BLACK: Thank you for that answer. Your first parts of that answer were to the best of your knowledge. Would a yes follow that?

MS. AHERN: A yes would, and I think that's the reason why it's new and it's -- it's gaining exposure.

MR. BLACK: Okay. And according to your response to OPA 3-17, you're not aware of any regulatory body that expressly accepts the PRPM methodology in any regulatory proceeding in which it's been presented, is that correct?

MS. AHERN: I am not aware of any regulatory proceeding where -- well, most of my cases were settled -- where it has been specifically included where they have stated that it helped from their opinion. However, there was an Arizona decision in which it was used to -- I had used it on rebuttal to show that -- I was not the cost of capital witness, but I was asked to comment on the recommendations of staff and the consumer counsel, and it was used by the Commission to corroborate that their recommendations were too low.

MR. BLACK: You have presented it in approximately 15 jurisdictions, is that fair to say?

MS. AHERN: Yeah, I'd say approximately, yeah.

MR. BLACK: Yeah. Let's turn back to your summary page, Schedule PMA-1, page two, if we could, please. Are you there?

MS. AHERN: I'm here -- I'm there, yes.

MR. BLACK: Okay, great. And do you have your response to MPA -- or OPA 4-1?

MS. AHERN: I do. It's --

MR. BLACK: If necessary, I have copies that we can pass out. I don't think it's going to be necessary.

MS. AHERN: Yeah, I've got it.

MR. BLACK: Okay. And in that response we asked and you responded indicating how your -- some of your analysis would work excluding the PRPM analysis. For instance, in that response -- I think, on page -- a page that's entitled -- actually it refers to Attachment 10 to OPA's third set, question ten. And then in that Attachment 10, there's something that's entitled Brief Summary of Common Equity Cost Rate. Do you have that page?

MS. AHERN: I don't have a copy of that with me.

MR. BLACK: Okay. May I approach the witness and put it in front of her?

MR. KAPLY: You may.

MR. BLACK: So if I could refer you -- direct your attention to the page which I would think is -- if I count, it's the fourth page in. Are you there?

MS. AHERN: Yes.

MR. BLACK: And that's the one entitled Brief Summary of Common Equity Cost Rate?

MS. AHERN: Yes.

MR. BLACK: Okay. And in that response and on that page, you indicate that your risk premium result in this case, excluding the PRPM analysis, would have been 9.11, 9.11, correct?

MS. AHERN: Yes.

MR. BLACK: Okay. Rather than the 11.29 that you show on Schedule PMA-1, page two of two?

MS. AHERN: Yes.

MR. BLACK: Could you mark that, mark your page two and put right opposite the 11.29 the 9.11 figure?

MS. AHERN: Yes.

MR. BLACK: Okay. In that same page, on that same page, you also indicate that without including the PRPM analysis, your CAPM analysis would indicate an equity cost of 8.71 rather than the 9.80 that you show in your page two?

MS. AHERN: Yes.

MR. BLACK: And could you please write down for later reference the 8.71 next to the CAPM number of 9.80?

MS. AHERN: Okay.

MR. BLACK: Now, you've also used the PRMP [sic] analysis with its GARCH statistics in the calculation of the cost of equity estimate for the unregulated companies, correct?

MS. AHERN: Yes.

MR. BLACK: And according to that same response, if the results of response to -- the page that we were looking at entitled Brief Summary of Common Cost Equity Rate -- Common Equity Cost Rate, your estimate of cost of equity of the unregulated companies would decline from 10.5 shown at line four on page two to 9.81 percent?

MS. AHERN: Yes.

MR. BLACK: And can we write that down also, the 9.81 percent, opposite the 10.5?

MS. AHERN: Yes.

MR. BLACK: Okay. Now, if we were to average your DCF, the 8.3, the risk premium and CAPM and the unregulated company results, excluding your new PRPM analysis, would that average -- can you accept that that average would be 8.98 percent?

MS. AHERN: Yes.

MR. BLACK: Okay. And that would be opposite where the -- well, that would be -- would be the average, 8.98, correct?

MS. AHERN: Yeah.

MR. BLACK: If we were to find the median of those results, again, still including the -- excluding the impact of your PRPM analysis, we'd average the two middle most numbers, the 9.11 risk premium and the 8.71 CAPM, right?

MS. AHERN: Yes.

MR. BLACK: And the arithmetic produces a median result, without the PRPM analysis, of 8.91 percent?

MS. AHERN: Yes, the math is correct.

MR. BLACK: Okay. And that would be opposite the 10.15?

MS. AHERN: Yes.

MR. BLACK: Okay. Now, let's assume that this Commission, for whatever reason, elected not to rely on cost of capital estimates for unregulated companies to estimate the cost of capital for a utility operation. In that case if we rely only on your estimates for utilities, again without the PRPM, would you accept that the arithmetic indicates that both the average and the median of your DCF of those three methods, remaining methods -- DCF, risk premium, and CAPM -- would be 8.71 percent?

MS. AHERN: The math is correct, but I certainly wouldn't recommend any of your scenarios.

MR. BLACK: But the outcome is 8.71 percent?

MS. AHERN: The math -- yes, the average of those three models is 8.71.

MR. BLACK: Thank you very much.

MR. KAPLY: Mr. Hewitt, do you have any questions?

MR. HEWITT: I have none for the witness, thank you.

MR. KAPLY: Mr. Beal, do you?

MS. COOK: I have a couple. Hi.

MS. AHERN: Hi.

MS. COOK: I have a couple scattered questions throughout your testimony. The first is, I believe, on pages eight and nine where you discuss the business risk of water utilities --

MS. AHERN: Okay.

MS. COOK: -- as compared to gas utilities.

MS. AHERN: Yeah, I believe it's to, you know, all other energy utilities, but yes, gas.

MS. COOK: Okay. I'm wondering if you could comment, in light of what appears to be increasing activity to require gas utilities, particularly gas LDCs, to replace their aging infrastructure and the adoption of both transmission and distribution integrity management programs which could very much lead to gas utilities making significant capital investments in non-revenue-producing infrastructure, whether you could comment on what that -- those trends in -- in a gas utility industry would mean with respect to your points on capital investment and the business regulatory risk of water utilities compared to others.

MS. AHERN: I think it would close the gap because I think their capital intensity would increase. This is a single year, and I think as they make more of those investments with current dollars, I think that it would -- would probably increase somewhat. But then again, their plant in ground is also going to increase except for the non-revenue-generating plant. Non-revenue-generating capital expenditures you're talking about? So I would expect that the -- the 156 for the gas companies to increase.

MS. COOK: And that --

MS. AHERN: How, I don't know. I think it would -- you know, it would take time before it did that.

MS. COOK: And at a very high level, does that make a gas utility proxy group more like a water utility proxy group?

MS. AHERN: In that one respect.

MS. COOK: Okay. I'm wondering if you could summarize for us your 40-basis-point business risk adjustment that you make in the cost of equity.

MS. AHERN: Okay. It is strictly based on the small size of Maine Water relative to the size of the proxy companies.

MS. COOK: And how do you get to 40 basis points?

MS. AHERN: I -- well, first I use the -- I estimate the market capitalization of the proxy group, and then I use their market-to-book ratio to estimate the market cap of Maine Water if -- under the premise that the -- if the market data, the market cost of common equity, of those companies is applicable to Maine Water, the company's similar enough in risk, then their market-to-book ratio can be used to estimate -- we can't estimate -- we don't know directly because Maine Water's not publicly traded. Then what I did was I compared or determined which size premium -- I'm sorry, which decile from Ibbotson Associates' size premium study that Maine would fall in and that the proxy group would fall in. There are size premiums associated with each decile. I took the difference between the size premiums associated with the two deciles and, based on that mathematically, a size premium of 431 basis points is indicated based on Ibbotson's study. And that's calculated on PMA -- Schedule PMA-9, page one.

MS. COOK: And the -- and the basis for the size premium, is that -- the underlying studies that suggest a size premium is appropriate, are they -- are those studies limited to regulated utilities?

MS. AHERN: No, but they do include all the companies in this -- in our proxy groups.

MS. COOK: So if it's -- if it's not limited to regulated utilities, what -- what is the -- what is the universe of folks that are in that study?

MS. AHERN: All publicly-traded stocks on the New York Stock Exchange, the NASDAQ, and the American Exchange. The way Ibbotson does it is they take ten deciles out of the New York Stock Exchange companies and then they fit the other companies into it which is why, when you look at the bottom of page one, they show that -- there's a small table there. In column B they show the number of companies in the deciles, and there's an increasing number as you move down to the smallest decile which is number ten. And that's because that includes -- you know, the NASDAQ and the American Exchange, American Stock Exchange, tend to fall in the -- in the lower deciles.

MS. COOK: So your business risk adjustment which is based on the small size --

MS. AHERN: Uh-huh.

MS. COOK: -- of Maine Water Company -- and I don't -- I don't believe you've identified any other factor that would cause you to make a 40-basis-point adjustment other than size --

MS. AHERN: That's correct.

MS. COOK: Right. Is based on adjustments that are not -- it's based on -- on analytical information that is not limited to public utilities. Is there -- is there -- do you see any difference in a small, competitive company in -- operating in a market place and a small regulated utility?

MS. AHERN: Size is a factor that theoretically needs to be taken into account no matter for whom you're estimating the cost of common equity. All else equal, size needs to be reflected. One thing I do is I do not take the full 431 basis points. 431 is indicated for market. I only take a portion of that. I don't take the entire -- entire amount.

MS. COOK: So 431 is the entire amount of the size adjustment, but you only took 40?

MS. AHERN: Correct.

MS. COOK: How did you get from 431 to 40?

MS. AHERN: That is my judgment based on the relative size of the regulated company to the proxy company. I believe that regulation can temper -- can help mitigate the effect of small size. It doesn't remove the size. It is basic financial theory that it's the use of the funds that are invested, like not the source of the funds or not, you know, whether it's part -- you know, stand alone or it's part of a larger company like Connecticut Water Service. The fact is that utilities, notwithstanding the fact that they're regulated, compete for capital with every company, not just in the United States, but, you know, globally. The competition for capital is throughout the market; it's not strictly within the regulated environment.

MR. KAPLY: Did I understand you to say -- I may have misunderstood you. You said that when you deviated from the 431 to 40 basis points, you did that not as an adjustment on the basis of whether the company is in a regulated environment versus non-regulated, you did it on the basis of size versus the proxy group size?

MS. AHERN: The 431 is based on the size of Maine Water relative to the proxy group.

MR. KAPLY: The 40 is based on what?

MS. AHERN: It's based on my -- my informed expert opinion.

MR. KAPLY: And it -- well, what does it reflect? Does it reflect that Maine Water Company as -- in terms of its size versus the proxy group?

MS. AHERN: Yes, it reflects its size. I personally think 431 basis points is excessive. It would have resulted in a, you know, recommendation of 14 or 15 percent which I think is -- is --

MS. COOK: I'm sorry, before you go ahead, the 431 is -- is based on the Maine Water size compared to the New York Stock Exchange?

MS. AHERN: No, compared to the proxy companies --

MS. COOK: Okay.

MS. AHERN: -- because what I've done is I've taken the difference.

MS. COOK: Okay.

MS. AHERN: If you look on -- on Schedule PMA-9-1, for the companies in the tenth decile, Ibbotson reports a 603-basis-point size premium. That is relative to the market as a whole. For companies whose average size is the 1.7 billion like the proxy companies, Ibbotson's -- they would -- they would be in the sixth decile. Ibbotson has a 172-basis-point size premium relative to the market as a whole. I take the difference.

MS. COOK: Okay.

MS. AHERN: Some analysts would add the, you know -- but, no, I take the difference, and then I generally use a smaller amount.

MS. COOK: I'm sorry, Matt. Did you --

MR. WELCH: And that -- and your adjustment, that takes into account the fact that Maine Water is part of a bigger company? Is that one of the factors?

MS. AHERN: That's one of the factors, yes. Like I said, even that, that mitigates their size. What it does is it, you know, allows access to, you know, maybe shared services, they can have lower expenses because of it, maybe greater access to capital because they can rely on the size of the -- the parent holding company. But it does not eliminate it. It helps the effects of it.

MR. WELCH: I have one question back on page eight. You indicate that increasingly stringent environmental standards -- begins line 16 --

MS. AHERN: Eight of my testimony?

MR. WELCH: Yes, eight of your testimony. Are you aware of what -- what the situation is for Maine Water in particular as opposed to water companies in general?

MS. AHERN: No. This -- this whole section is a general discussion of the -- the relative risk of the industry in general relative to the other -- to energy companies except for specific numbers regarding capital -- as I can get them, capital intensity and depreciation and possibly capital expenditures. But I've not -- if they are more stringent or less stringent, I've not taken that into specific account.

MR. WELCH: But again, all else equal, you would -- you would -- well, would you agree that if it turned out that Maine Water Company had a greater exposure, then one would err on -- you know, you'd move up the estimate and if they had a lesser exposure than average, you'd move down the estimate?

MS. AHERN: Theoretically. One of the things I do when I begin a case for any client is I always ask for any specific unique risk factors that they think sort of impinge on their operations and their revenues and --

MR. WELCH: Did the company identify any to you?

MS. AHERN: No.

REPORTER: Did you have an answer?

MS. AHERN: I said no. Many times companies will identify risk factors which really are facing, you know, the proxy companies as well. And to the extent the proxy companies face similar risks, they are not to be taken into account.

MR. WELCH: And I take it -- you know, again, turning to page 16, and this may be covered by your prior answer, you indicate that there's a -- size risk has, in part, something to do with liquidity. But if you're a small component of a bigger company, wouldn't the liquidity issue be one that would be relevant -- or calculated relevant to the size of the parent, not the size of the --

MS. AHERN: No, it could be because the subsidiary would be -- one, if they had debt out in the public market, that would be an issue. As for -- many have debt in the public market and also get debt, you know, sometimes from their parent. But they're also competing with other subsidiaries for debt and for -- for equity. My point was many times a -- a holding company can issue a large amount, a bigger amount of debt, say 500 to 600 million, when a smaller company needs ten million. And on the basis of that, they can generally get it at a lower cost.

MR. WELCH: Okay.

MS. COOK: And I just have one other question. I probably should have jumped in at the point you were talking about it, but I think in your discussion with Chairman Welch about your risk premium model, you referred to the model as pricing all risk.

MS. AHERN: Correct.

MS. COOK: And can you explain what that means to me?

MS. AHERN: Yes. In contrast -- I'll work backwards again. The capital asset pricing model presumes that the market does not compensate the investor for diversifiable risk, only for non-diversifiable or beta risk. In order for that to be accurate, every single investor has to be -- have a perfectly-diversified portfolio. That doesn't hold in reality. The betas of the capital -- in the capital asset pricing model only have something called R squares or correlation coefficients of about .20 for the water companies. That's only -- that means they only reflect about 20 percent of the total risk of the company. However, the model says it's not -- the other risk is not going to be compensating.

Because the predictive risk premium model, when you're looking at a single company stock, you're just looking at that stock -- its movements relative to itself, its volatility relative to itself. We know that some investors, there may be Aunt Bessie sitting somewhere -- I know some people who only own PSG&E stock, own no other stock, and I -- maybe they have a 401(k) and an IRA and stuff. Then there are some large investors who will hold a utility's stock in a very well-diversified portfolio. So when we say all risk, we're not -- we're very careful not to say total risk meaning business and financial risk or non-diversifiable and diversifiable. It reflects the risk of the aggregate portfolio, the aggregate investor in that particular company's stock. That may be -- if you have a -- holdings where there -- you have a preponderance of perfectly-diversified portfolios, then you're probably -- you're going to be reflecting that. If you have a small company that is very closely held, say, you know, there are only a few shareholders, then you're going to reflect the stock that they face in a non-diversified portfolio. Or I should say if you have -- if you have an investor who only holds a few stocks, then you're going to reflect their risk. And this model will compensate for that.

MS. COOK: Thank you.

MR. BLACK: Before -- are you -- are you -- before we move to redirect, can I ask a question right here? Thank you, thank you. Mr. Crouter?

MR. CROUTER: Pauline, what I've done is put in front of you the initial Examiner's data request in the case, and attached to that response is a chart that has AUS consultants or a -- it's a two -- one-page document showing ROEs approved by either stipulation or litigated case. Do you see that?

MS. AHERN: Yes, I do.

MR. CROUTER: Was that prepared by you or your - your -- people who work with you?

MS. AHERN: Yes, it was.

MR. CROUTER: And that -- at the time that was prepared, that had information through May 13 of 2013, is that right?

MS. AHERN: Correct.

MR. CROUTER: Are you able to update that for us?

MS. AHERN: I can. Right now we have it updated through September 24th, and related to another case, I sent texts this morning to my associates to update it further, through December. So it's being worked on right now, but not in response to this. But I can get it for you.

MR. CROUTER: Sure. And can you -- would you just describe for the Commissioners what information you have that is updated just generally speaking?

MS. AHERN: Generally speaking -- I really can't recall off the top of my head how many decisions there have been between the end of May and the end of September. I do know the one at the end of December was -- I think it was 9.63 for Aquarium Water in Connecticut. But on -- I know I calculated the average a couple of days ago, and the average, including the two very small ones which happen to be in Illinois, the 8.97, the two 8.97s, the average for the year is somewhere between 9.7 and 9.8 so far, and we'll augment it as we can. The way this was put together, many of these are my own rate cases, the outcomes of those rate cases, and we took it upon ourselves to actually search every single Commission where we could get information. There are several Commissions that do not regulate water ROEs, and there are a couple of Commissions that do not put on their online sites access to decisions. But this is -- is -- it is as comprehensive as we -- we could be in our search.

MR. CROUTER: And it's your testimony that the average for the year for water for 2013 is -- is what?

MS. AHERN: Through September is in the 9.7 range to maybe 9.8. Around -- let's just say around 9.7. And also one has to keep in mind that all of these are based on evidence of record that significantly predates the -- the time of the decisions which do not necessarily reflect the -- all the interest rate expectations, the capital cost rising expectations now.

MR. CROUTER: Thank you. That's my only question.

MR. BLACK: I'm not so sure how that related to my cross examination, but we're not objecting.

MR. CROUTER: That's it.

MS. COOK: The reported ROEs that you have in -- in this information, there's no adjustment on these for the discussion we had earlier about the difference between market value and book value, is that correct?

MS. AHERN: There are none in my cases. I am not -- I don't believe so in the others because I believe every time I've seen it recommended, it's been rejected, whether somebody uses like an after-tax weighted average cost of capital based on market value capital structures or they -- Pennsylvania stopped doing its financial leverage based on the difference between market capital structures and book value. I believe only in Canada is that allowed. I don't believe there's -- Mr. Hill might corroborate it too, but I don't believe any Commission makes an -- I'm not recommending -- I don't believe one should do one. But I do believe one needs to take it into consideration when giving any -- you know, when considering how much weight to give to a DCF analysis.

MS. COOK: Thank you.

MR. KAPLY: Thank you very much. We'll recess for 15 minutes and we'll come back and begin with Mr. Hill.

MR. BLACK: Thank you.

CONFERENCE RECESSED (January 14, 2014, 1:27 p.m.)

CONFERENCE RESUMED (January 14, 2014, 1:46 p.m.)

MR. KAPLY: Okay, let's go back on the record. Beginning now with Mr. Hill. Mr. Hill, would you raise your hand? Do you swear and affirm that the testimony you're about to give is wholly truthful?

MR. HILL: Yes, I do.

MR. KAPLY: Mr. Black, you can begin.

MR. BLACK: Thank you. Mr. Hill, for this proceeding, have you prepared direct testimony and exhibits?

MR. HILL: Yes, I have.

MR. BLACK: And do you have a copy of that direct testimony and exhibits in front of you?

MR. HILL: I do.

MR. BLACK: And that direct testimony consists of 41 pages?

MR. HILL: That's correct.

MR. BLACK: Plus an appendix -- appendices and exhibits or Schedules 1 through 9?

MR. HILL: One through ten, I believe.

MR. BLACK: One through ten, thank you. If you were asked these -- would you have any corrections to your exhibits or testimony?

MR. HILL: Yes, I do have some typographical corrections. Page 32, line eight, after the word of, the second word on the line, I would insert water and so that the line reads sample of water and gas companies. In line 15, after the word equity, I would insert the phrase "for the gas distributors" so that sentence reads the CAPM cost of equity for the gas distributors shown on page 2 of Schedule 6 is, etc. All right, the next changes are on page 36, changing gas distributor to water distributor. On line four, the word gas distributor should be replaced with water utility. Line six, the average gas utility market to book should be the average water utility market to book. And on that same line, the sample gas changed to water, the sample water companies. And then continuing on line seven, for the entire gas sample should be changed to read for the entire water sample. And then one more of those on line

11, it now reads the gas utilities over; it should read the water utilities over. And those are all the changes I have.

MR. BLACK: Thank you. If you were asked these questions in your testimony today, would your answers be the same as they appear here?

MR. HILL: Yes, they would.

MR. BLACK: And do you have some rebuttal to the direct testimony of the Maine Water Company witness, Pauline Ahern?

MR. HILL: Yes, I do.

MR. BLACK: And is it focusing on three specific areas?

MR. HILL: Yes, it is focusing on three specific areas, one of which is some comments that she made about the DCF and the reliability of the DCF. The second area I'd like to address is her risk adjustments to the cost of equity capital for this company. And the third, and probably the most important, area I'd like to address is this new predictive risk premium. I believe that's the primary source of overstatement in her equity cost estimate. So those are the three areas.

MR. BLACK: Would you please address the first area?

MR. HILL: All right. Starting first with the -- Ms. Ahern's concerns about the DCF, at page 28 she says -- 28 of her direct testimony, she says the DCF assumes market to book equal to one. I'm very familiar with Professor Myron Gordon's work on the DCF, his original 1962 book and his 1974 cost of capital public utilities. There is no such assumption in the DCF. There's no basic assumption that the market price has to be equal to book in order for the DCF to be valid. DCF will estimate the correct cost of equity no matter what the market-to-book ratio is. It worked just fine in the earlier 1980s when market price was well below book. It'll work just fine now with market price well above book.

One thing that Professor Gordon did say about the relationship between market and book is something I'm sure this Commission, which has been a DCF Commission for a long time, is well aware of. And that is that when the market price is greater than book value like it is today, then the expected book return, the ROE, is greater than the cost of capital. And that can be seen in a simple example. If -- a utility's allowed and earns a ten percent ROE on a $10 book value so the expected earnings will be a dollar a year. Now if you're an investor and you require a ten percent return, then you're going to pay $10 for that stock because it's going to earn you a dollar and that fulfills your return. And in that situation, the market price, $10, what you pay for the stock, is equal to the book value, $10. Well, if you're an investor that requires eight percent and this stock is -- this utility has ten percent return is paying a dollar, then -- and it -- but you only require an eight percent return, then you'll be willing to pay $12 and a half for that stock because with the $12 and a half price and a dollar return, you're going to make your eight percent. So there's a situation that we have similar to today which is the market price, 12 and a half, is greater than the book value, ten, and the cost of capital, what the investor requires, eight, is below the allowed return, ten.

Now that situation pretty closely mirrors what's going on in the water industry today. The current expected return on equity and the current allowed return on equity for water utilities is around ten percent. It's a little bit low like -- little bit lower than that like Ms. Ahern said. But in order to get a ten percent return on the book value of those stocks, investors are paying a great deal more than book value for those stocks which means that their cost of capital, the return they require, is well below ten percent. And in that case, confirmed by Professor Gordon's DCF, the current cost of capital shown by the DCF, about eight and a half percent, is reasonable. Now Ms. Ahern's PMA-4 shows that her average DCF is 8.8 percent, very similar to mine, and her median DCF is 8.3. That's the number she reports because she's using medians in all of her averaging, if I can say that. So my point is the DCF is reliable. It doesn't depend -- it's not conditional on the market price equaling book value as she said, and 8.5 percent is a very reasonable number in this -- in this market.

The second point I'd like to discuss is Ms. Ahern's risk adjustments. We mentioned -- they were mentioned just a minute ago. There's a 17-basis-point increase for credit risk. I don't believe that's necessary because Camden and Rockland's ratemaking common equity ratio in this proceeding is 55 percent of total capital. That's relatively high. The average for the water industry is 50 percent, and the average for Ms. Ahern's sample companies is 47 percent. And also the five-year average for Camden and Rockland is only 50 percent. So this higher common equity ratio signifies lower financial risk for Camden and Rockland. So I don't believe a credit basis point risk increase of 17 basis points is called for.

Second of all, the largest risk adjustment Ms. Ahern applied was a 40-basis-point increment for size risk. That was also discussed a moment ago. Now, I have a problem with the size risk adjustment, several problems actually. I believe the size risk adjustment that she references coming from Ibbotson suffers a great deal from something called survivor bias. Now what -- what Ibbotson is measuring are the returns, historical returns for the companies on the New York Stock Exchange. Well, it's -- it's not called the big board for no reason. I mean, you've -- the company's got to be very successful to get to the New York Stock Exchange. My point is -- is that in order to even be counted in Ibbotson's sample, the company has to be very, very successful, and the companies that aren't counted are the ones that never make it, the small companies that -- that do badly or the big companies that do badly and never get counted or get on the board and fall off the board. Those -- those failures, if you will, are simply -- those small company failures are simply not counted in Ibbotson's analysis. So there's -- the problem with the small companies earning more than large companies is exacerbated by this -- something called this survivor bias. All they're counting are the very successful firms.

The second and actually very interesting aspect of the size risk is that it's also called the January effect because 90 -- more than 95 percent of the size risk happens in January. Now, if it were -- if it were a -- an across-the-board ubiquitous kind of risk, there's no rational explanation for it happening in January. But it does happen in January, and the research I've seen indicates that it's a product of tax law selling, selling your losers at the end of the year and buying them back at the beginning of the year. And so all the advantage that small stocks have over large stocks happens in January. So that tells me it's not an endemic phenomenon. It occurs because of particular market activity in the month of January.

Finally, this measurement of the size risk premium has been extremely variable over history. It's most prominent in the '50s and '60s and early '70s. before that, it's not prominent, and after that, it ceases to exist. Large companies have out earned small companies over the past 20, 25 years. So not only is it not accurate, it's not there. If you take a very long period and look at it, then there is some small-term effect. But again, it's January, not any other month. So there's a lot of noise in that aspect of the size risk adjustment.

And finally, the -- the only study that I'm aware of that looks specifically at utilities in this regard is one performed by Wong in the Midwest Financial Association Journal, and that showed that there was no size effect looking only at regulated utilities. So a small utility effectively has the same return as a larger utility. So I don't believe the size risk is a reliable risk indicator and that 40 basis points is unnecessary.

The final risk adjustment is flotation costs. I realize this Commission has allowed flotation costs in the past. I don't believe it's called for in this case, but it's 14 basis points. This Commission's used it before. I'm not going to discuss it any further.

The -- the final aspect of Ms. Ahern's direct testimony I would like to devote a little bit of time to and that is the new predictive risk premium model. As she noted, it was developed and, I think, first published in 2011, developed by members of Associated Utility Services, her firm, that represents utilities. So far it's been only used by AUS witnesses. It's a new model, and although she likens it to Professor Gordon's DCF and some of the other models, it's a very, very different economic model. It's -- it's based on behavioral economics, not financial economics, and I'll explain what that is in a minute. But financial economics, DCF is financial economics, it's based on the dollar returns. CAPM, risk premium, those are based on historical dollar returns. That's financial economics, and we're almost familiar with that.

The PRPM is based on behavioral economics. It's very different. That model also relies heavily on what I believe are pretty complicated statistical techniques called, it's even hard to say, generalized autoregressive conditional heteroscedasticity. And basically once the data is gathered, the numbers are put into a black box and -- and here's your result, here's your GARCH number. Well, it's difficult to talk about the GARCH number and know really what it is, and I think that's a problem for a regulatory body being asked to rely on it. And before I get to what I believe are the -- are the technical problems of this model, there's kind of a threshold question when you introduce a new cost of capital method. I mean, there's got to be a threshold question, and that is, I think I this case, does the PRPM provide a reasonable estimate of the cost of capital? I mean, that's kind of the -- what we're doing here. And so if you can't answer that question, then you're in just real trouble. And fortunately for me, Ms.

Ahern and her other AUS colleagues in this year published a paper that shows what the cost of capital estimates of this methodology are. And I maintain, and we'll see here in just a minute, that what they produced is a methodology that overstates the cost of capital. If you look at this handout that I've provided which is an article by --

MR. BLACK: Is that marked OPA-1?

MR. HILL: I'm sorry?

MR. BLACK: Is that marked OPA-1 at the top of the front page.

MR. HILL: Yes, thank you, thank you very much.

MR. BLACK: Okay.

MR. HILL: OPA-1 is marked -- is an article by Michelfelder, Ahern, D'Ascendis, and Hanley, all the folks that work for AUS as I mentioned earlier. Granted, Mr. Michelfelder is a -- now working at Rutgers and no longer at AUS. If you turn to page thereof that, you'll see that they have provided cost of equity estimates for electric companies, combination gas and electric, LDCs, and water utilities. And you see it ranges from, in January 2006, an ROE of 17 percent for the water industry to about -- and most recently to about 11 and a half or the midpoint of all those lines is somewhere around 12. Well, if you'll -- if you would take a pencil or some writing implement and on January 6 at about ten and a half percent start a line and then run it through October 11th down below ten percent a little bit, what you'll have there is the allowed cost of capital in the United States for utilities on average. In -- in 2006 it was about ten and a half percent, and since we've gotten to 2012, it's dipped finally below double digits, below ten percent.

My point is that everywhere during this period, the PRPM estimates a cost of equity that's significantly above the allowed return on common equity capital. And it's been my experience that the allowed return on common equity capital for utilities has lagged the actual cost of capital. Over the past almost 20 years, there has been a secular downward trend in interest rates, and allowed returns have followed that trend. They've followed it downward but at a slower pace. And I think that's because of human nature. I think regulators are naturally cautious, and that's a good thing. But I think that what you're seeing here in this graph on page three is that the PRPM estimates cost of capital well above the allowed return which is, itself, in my view, above the actual cost of capital.

So let's turn over further and you'll see the PRPM compared to the CAPM and DCF for each of the industries, electric companies, the combination companies. On page five you'll see at the top of the page the PRPM and the solid line at the top solidly above the DCF and CAPM estimates for gas companies. And if we look in the middle column, the authors even state very clearly that Figures 2 through 5 clearly show that for the most part the PRPM produces a higher average indicated ROE than both the DCF and the CAPM. So, in my view, the PRPM fails the -- the basic test of does it provide a reasonable estimate of the cost of equity capital. I believe these -- these graphs show very clearly that it does not. It overstates the cost of equity capital.

Now, I'd like to turn to the next page of OPA-1, my handout, and this is a -- this is a schematic of Ms. Ahern's testimony. And I'm not going to go into -- into this in detail --

MR. LITTELL: Which page?

MR. HILL: The next page of this --

MR. BLACK: Is that on a landscaped sheet?

MR. HILL: I'm sorry?

MR. BLACK: Is that displayed across the sheet lengthwise?

MR. HILL: Yes, it is in a landscaped arrangement here. And I just wanted to use this to show what the impact of the PRPM is on her equity cost estimate. And we've been over this so I'm not going to into this in detail, but in the box on the left are her four methodologies: the DCF, the risk premium, the capital asset pricing model, and I've just said unregulated companies for the -- for the fourth method. And I've tried -- what I've tried to show here is, for example, in the risk premium spread out to the right are the different inputs that go into Ms. Ahern's analysis. You see the first two numbers to the right of her 11.29 are 11.77 and 9.86. those are the two risk premiums that she weights to get the 11.29. And if you go back, you'll see that the -- the lower risk premium, the -- the actual risk premium is based on two different methodologies, and each one of those is several different estimates. But I've bold faced the PRPM with the trademark every place that she's used it, and you can see in each place the PRPM result is significantly above the historical average market risk premium. So without Ms. Ahern's PRPM, her equity cost estimates for utilities averaged 8.71, and my estimate in this proceeding is -- ranges from 8.5 to nine and a quarter. and her non-PRPM results are exactly in the middle of my range. So except for the PRPM, we're pretty much in agreement.

All right, let me turn now to -- to the direct problems I have with that methodology. I said earlier that it's behavioral economics, not financial economics, and what I mean by that, it's not a dollar return function. It's a utility function. Now, let me give you an example. At -- at -- I don't know when you eat dinner. Let's assume you eat dinner at six o'clock. At six o'clock a steak dinner is $40 and you're willing to pay $40 because the utility for dinner, steak dinners, is high at that point. Well, right after you eat dinner, a steak dinner is still $40, but you're not going to pay $40 for it because you just ate. So the utility is low. So the value to you of that steak dinner is much less than $40. But that's an idea of what a utility function is. It's not a dollar function. It's not a return function like we're -- we're used to dealing with. It's a -- it's a measure of your utility, what is the utility to you of that good, of consuming that good at that moment. So that's a very different kind of economics than the financial economics that -- that we deal with here. I'm not saying it's not valid. It's a valid field of economics. I just want you to understand that this model is a very different kettle of fish than the CAPM or the DCF or anything else that we normally deal with.

The big debate that's gone on between the financial economists and the behavioral economists over the past 20 years is -- has to do with the risk premium, actually, and it's been an interesting discussion. It was brought up -- it was initiated in 1989 by Professors Prescott and Mehera, M E H E R A. They pose that -- a -- what they called a risk premium puzzle based on -- based on marginal utilities, the usefulness of bonds and stocks. They said that the risk premium ought to be only about one or two percent at the most. But if you look at Ibbotson data historically over the long term, it's been about six percent. And the behavioralists are going that's crazy, and the financial economists are going that's what it is, and so there's -- it's still a debate going on about -- about this issue. Now my point is that the behavioral economists are saying that the bonds have more utility in -- in bad economic times. They pay out when times are bad. Stocks don't do that. Stocks pay out when times are good. The economy's roaring, stocks are going strong, they -- they make good returns. So the difference in return is affected by the utility of -- of that return. That's a valid concept.

But what it -- but the debate that's been going on is that the behavioralists are saying the market risk premium is smaller than the financial economists are saying. Well, as -- as we saw looking at Ms. Ahern's testimony, her behavioral analysis shows that the market risk premium is much bigger. We saw that the Ibbotson historical risk premium between stocks and AA utility bonds was about 5.6. Ms. Ahern's number is nine something. So that's contrary to what's going on with -- with the -- the risk premium puzzle argument in -- in the -- in the financial economic literature.

As I said, this model is quite complex. It's based in theory on something called a stochastic discount factor which is defined in Ms. Ahern's paper as an inter-temporal marginal rate of substitution and consumption. And that is discounted at a ratio of the marginal utilities of consumption in time period T1 and time period T0. And then that information is subjected to a very complex statistical analysis which is the GARCH thing I was talking about earlier, or that we mentioned earlier.

Now there are assumptions that go into this -- this model. One is that monthly returns are used. Now any time you have a historical data set that uses monthly returns, what you, in effect, are doing is assuming that investors are buying and selling the market every month. Otherwise, they wouldn't -- they wouldn't receive the same return impact that you're modeling historically. And that same is true with Ibbotson as well, but if you take monthly data and you buy and sell the stock market every month to see what the return is, the only way an investor can mirror that return is to buy and sell the market every month. If they hold their stocks for a year or two years, they're not going to experience the same volatility. They're not going to experience the same return. So one of the big assumptions that's a part of this is that returns are -- monthly returns impact individual investors. That's a big assumption.

It also -- in order for this model to work, the authors also assume -- and this is also I think a difficult one to -- to accept. They also assume that utility stocks are not defensive stocks. Now, when I saw that, I was -- was -- I said, well, maybe my understanding of what defensive stocks is is incorrect. So I went to something on the -- on the web called Investopedia which is a simple little website that gives -- gives, you know, simple investor definitions, and I looked up the definition of a defensive stock. And this is a quote from Investopedia --

MR. BLACK: Are you referring to your exhibit again?

MR. HILL: Yes, I'm sorry, thank you. It's OPA-1. It's the last page. It's a printout from this website, Investopedia. Investopedia explains defensive stock, the last paragraph, that's all I'll read, says, "The utility industry is an example of defensive stocks because, during all phases of the business cycle, people need gas and electricity. Many active investors will invest in defensive stocks if a market downturn is expected." So I think -- I think we can all understand the rationale behind utilities being defensive stocks. That's why their betas are below the market beta. But Ms. Ahern and her colleagues assume that utilities are not defensive stocks in order to make this model work. They posit that utilities are not defensive stocks because they believe utilities are -- are subject to something called asymmetric regulation. Now, they define that as regulation that holds the return in good times when a utility could earn more which is probably true except that, in my experience, it's generally incumbent on the consumer advocate or some other agency to bring a show cause hearing or some kind of hearing to get the Commission to lower the allowed return if a company's consistently over earning, and that doesn't happen that often. So theoretically, yes, those returns are limited, but in reality, how often does -- are those returns actually limited? In my experience, not very much.

And the other side of that is Ms. Ahern and her colleagues believe that regulatory Commissions will allow a utility to under earn its cost of capital when times are bad, and that creates what they call asymmetric regulation and makes utilities non-defensive stocks. I don't think either one of those conditions hold. I think that utility regulators do a pretty good job of -- of -- I won't say coming to the rescue, but I will say supporting a utility that's -- that's in financial trouble. It's been my experience over the past 30 years that utilities -- utility Commissioners respond quickly for the utilities that are in financial difficulty. So I don't believe utility regulation is asymmetric, and I don't think it's a realistic assumption.

And finally I looked in the Handbook of Economics and Finance about -- regarding consumption-based asset pricing models which the PRPM is and, once again, it's behavioral economics. And there are three general problems with those kind of consumption-based asset pricing models that are subject to the statistical GARCH analysis, and they are this. Number one, changes in conditional variance are most dramatic in daily or monthly data and are much weaker at lower frequencies. Ms. Ahern has analyzed monthly data. Those volatilities of monthly data are much more advanced, much more powerful than they would be if she looked at yearly data. She hasn't looked at yearly data. Number two, forecasts of excess stock returns do not move proportionally with estimates of conditional variance. That's -- her PRPM analysis assumes that they do, that conditional variance determines stock price movements, but the research shows that that's not the case. And three, there's little evidence of cyclical variation and consumption volatility that could be -- that could explain the variation in stock market volatility. So there's another link between Ms. Ahern's PRPM and the actual stock movements that doesn't appear to be valid. So it's -- it's true that the PRPM statistics -- that they're measuring something, but to me it doesn't appear to be the cost of equity capital. The results are consistently above the cost of equity capital, and I don't believe the PRPM is a reliable indicator of the cost of equity capital.

So if we could -- in conclusion of my comments on her testimony, I'd like to turn to page 12 of my direct, if you would. And I'll just note that Ms. Ahern and I can dicker all day about what number's right and what growth rate is this and what heteroscedastic thing that is, but neither one of us will argue about this graph right here on page 12. It's the graph of BBB corporate bond yields from 1966 to 2013. This tells us that the cost of capital is currently very low. It hasn't been this low since 1966. That's the real issue here. Regardless of what we say, that the cost of capital experts quibble about, DCF or CAPM, it's unquestionable that interest rates and the cost of capital are very low. And so an eight and a half percent ROE for a water company in this environment is reasonable.

MR. WELCH: I've got a couple questions based on -- on your testimony. Going back to the beginning of what you were talking about dealing with the invested -- the market-to-book ratio issue, and just using a particular example you described --

MR. HILL: Yeah.

MR. WELCH: -- you say an investor -- the book value is ten, the allowed return is ten percent, it's earning one a year. Because the investor's cost of equity is actually eight and a half, bids the stock price up to 12. So the Commission relying on that says, okay, you're -- you're allowed eight and a half which is then applied to book --

MR. HILL: Right.

MR. WELCH: -- which means you're not earning one anymore, you earn something less than one.

MR. HILL: Right.

MR. WELCH: So I take it you would agree with the comment I made earlier that it is appropriate for regulation to set a cost of equity that will cause the stock price to migrate towards a 1:1 ratio, market to book?

MR. HILL: Right.

MR. HILL: I believe it's appropriate for the regulatory Commission to set a cost of equity that's -- that's equal to the cost of capital. And when they do that, there will be a tendency for --

MR. WELCH: It will trend back to --

MR. HILL: Yeah, for the market --

MR. WELCH: -- the answer to the question I posed Ms. Ahern that, you know, the -- the -- the return ought to be relative to the money that's been invested, not relative to what someone happens to have paid for the stock?

MR. HILL: Right. We determine the return on the stock price.

MR. WELCH: Turning -- turning to your discussion of this -- of the new methodology Ms. Ahern's described, it seems to me to make two principal -- well, several, but two arguments that I can recall at the moment. One of them is that it overstates the cost of equity capital, and your evidence for that is that the DCF and CAPM and risk premium methods that have been used to date show a lower number.

MR. HILL: That's not all the evidence.

MR. WELCH: Well, I was going to grant you the second piece too, but --

MR. HILL: Okay.

MR. WELCH: -- but you did come back to that a couple times. But it seems to me that if it -- if it were the case that the model were actually correct in describing cost of equity, all -- all that the evidence you described there would mean is that those other methods have been wrong and we've been wrong all these years.

MR. HILL: That would be true if, in relying on those methods, the -- the allowed returns had somehow prevented the utility industry from building the necessary plant, but the utility industry is very healthy.

MR. WELCH: So -- so your argument really is -- I mean, it seems to me that -- this is sort of reaction to the argument. Just saying that this is producing a different result than what we produced in the past, personally I don't find that very powerful because, you know, economics advances, sometimes people come up with good ideas. But your argument, I think, depends upon what you just said, says that this has, in fact, attracted capital over the years and, absent some systemic evidence that, you know, there's been under investment -- now someone might say there has been systemic under investment, but that's -- that latter is kind of an empirical question, right --

MR. HILL: Right.

MR. WELCH: -- it's not -- it's -- so the mere fact that these -- that awards or the DCF shows X and that this shows 1.1 X isn't, itself, what you're relying on --

MR. HILL: No, not alone, no. You have to look at the success of those -- those other methodologies. And I'm of the school -- and Ms. Ahern and I don't go to the same school. I believe the DCF and CAPM and risk premium work just fine.

MR. WELCH: I think you've made that clear.

MR. HILL: Right.

MR. WELCH: But -- but so -- so that in terms of the -

- the second piece of your argument is that basically you have articulated what you view as flaws either in the intelligibility of the new model or particular things that contradict other things that you've read, right? I mean, that's basically what you're saying. So that's -- that's the substantive flaw in it.

MR. HILL: Yes.

MR. WELCH: Okay.

MR. HILL: And it's -- you know, with any econometric model, there are going to be people disagreeing with it. You have to make assumptions to make it work. Some people will disagree with those assumptions. The other part of it that I have trouble is it's a black box pretty much.

MR. WELCH: Okay, thank you.

MR. LITTELL: Can you point to us in your testimony or in the record evidence on the proposition that the existing models have resulted in adequate investment in utilities?

MR. HILL: I think -- I think one sort of obvious thing to point to is that investors are paying a price for utilities now that is well above their book value. So the returns they're receiving are higher than the cost of capital. They are higher than they require to invest in those types of companies. It's -- it's not been my experience, and I don't have -- in direct answer to your question, I don't have any data in my testimony that would support the notion that the utility industry has been able to finance its -- its infrastructure.

But I -- I've done this sort of analysis in the past, I don't have it here with me, but I think if you look at the growth of assets, the growth of rate base in all industries, electric, gas, water, it's -- it's quite continuous. There's no -- an upward sloping, there's no dropping off. And in this environment which is a very low interest rate environment, it's almost -- it's kind of utopian for utilities. For capital -- for capital-intensive debt costs are very low, people are dying for yield. Over the past four years that I'm aware of, every utility issuance has been oversubscribed meaning there's more buyers out there than they got bonds to sell. So it's -- it's a very favorable environment for -- for utilities. I don't have the -- the data to answer your direct question. I'm sorry about that.

MR. LITTELL: Yeah, no, I -- could you easily put your hands on that data or some studies if we gave you an ODR on that?

MR. HILL: I can give you some data about the -- the expected build out in transmission that -- [EEI] publishes that kind of data. I can look at -- what I've done in the past is look at the ValueLine companies in the electric industry and track their capital investment or their -- their rate base over the years, and you'll see that those -- those increases are very strong and very -- very positive without fluctuation.

MR. LITTELL: I'd be particularly interested in anything related to their success in attracting capital.

MR. HILL: All right.

MR. BLACK: Can we treat that as an oral data request?

MR. LITTELL: Yes, but I'm looking at the -- oftentimes staff want to narrow my data requests so I'm looking over it now.

MR. KAPLY: Yes, let's treat it as an oral data request.

MR. LITTELL: My -- my sense may be to agree with you, but we'd like to rely on evidence in the record.

MR. HILL: All right. So you -- you want evidence of capital formation in the -- in the utility industry?

MR. LITTELL: Yeah. And, obviously, the more focused you can make it on this case, that would be helpful but success in attracting capital of the utility industry.

MR. HILL: Okay.

MR. WELCH: If -- along that line, and I -- I -- you mentioned your response might include electric. I think it would be helpful if there were any data on water. And one reason I ask the question is there is at least anecdotal suggestion that current water utility plant hasn't been replaced. It actually lags. There's a lot of it that needs to be put in place. And do you see any relationship between those things? Does that suggest that water yields haven't been sufficient to allow that kind of investment?

MR. HILL: I think -- no, I -- I don't think that's the case. I think that water -- water utility plant has a long life, and it's certainly expensive to -- to replace. It's my understanding that there's recently statutes passed in Maine to allow utilities with infrastructure requirements to make surcharges through the Commission for that kind of build out. And I think Commissions are sensitive to the need for -- for those kind of projects. So no, I don't believe that that's a reason for the need for infrastructure replacement. I think water -- water utility main lines are very long lived, and the question is when do you replace them, how much trouble is, do I want to dig up Main Street for eight weeks. Those kind of political things play into it.

MR. WELCH: All right. But I only raise the question because you were supporting your view that utility returns have been sufficient by referring to extensive build outs in the utility industry.

MR. HILL: Yes, sir.

MR. WELCH: And I will certainly grant your premise on electric transmission. But the question is whether there is similar evidence available on the water side, and if so, does that mean this doesn't apply to water or are, as you just pointed out, some other factors at play?

MR. HILL: Well, I'm happy to look at that information for water companies and provide that to you. I could just say that the market-to-book ratios of water companies are higher than any of the other utilities. So as far as the allowed returns go, investors believe they've been more than adequate.

MR. WELCH: Thank you.

MR. CROUTER: Want me to go?

MR. KAPLY: Go ahead. Why don't you go ahead?

MR. CROUTER: Sure.

MR. KAPLY: One second. Do you want to go first?

MS. COOK: If you don't mind, I just have two short follow ups. One is you referred to a study on the size --

MR. HILL: Wong?

MS. COOK: Wong?

MR. HILL: Yes.

MS. COOK: Can you provide a copy of that?

MR. HILL: Sure can.

MS. COOK: And I know that you did say that you weren't going to discuss the flotation cost adjustment, but I'm wondering if you could comment on the flotation cost adjustment.

MR. HILL: Okay. Flotation costs occur in a -- in the primary issue market. When a company wants to issue stock, they go to a broker, and the broker takes a cut of the action. They sell the stock -- if the stocks don't sell for $20, they'll sell it for 19 and a half and they'll keep 50 cents. And that's probably an over statement. They don't keep that much, but they keep some of it. So that's an expense that doesn't really --

it's not really an out-of-pocket expense for the utility. And that kind of -- that sort of slice off the top is well known by those investors that purchase that stock. They see that in the front page of the prospectus, 99.3 percent's going to the company and .7 percent's going to the underwriter. And they make the purchase with that in mind.

So the premise of -- of flotation costs is that investors expect -- expect to get a return on that .7 percent of the stock price. I believe they don't expect that because they know what the situation is when they buy the stock. Also, the much larger proportion of stock is sold in the secondary market. And if you count flotation costs in the primary market which supposedly take away from the stock price, then you ought to also count transaction costs in the secondary market which add to the stock price. By that, what I mean is if you want to buy stock, you go online to your broker and you buy stock, but you got to pay the broker something. And when we do DCF, we don't include that price. We include the lower price. So if you -- if you include both those prices and you weight them by the number of shares sold in the secondary market versus the primary market, it's a wash. So I don't think that's a necessary adjustment.

MS. COOK: Thank you.

MR. HILL: I've been overruled on that by this Commission before.

MR. WELCH: And we may get to a question that illustrates why. I mean, if -- if you posit a situation in which you're at a 1:1 market to book, and what you're concerned about is -- and this is not meant to be rhetorical, I'm just sort of working through the (inaudible). And -- and what you -- and you have correctly identified the cost of capital to the investor as eight percent, and the company issues stock to get another dollar of capital so it can invest, and it -- and there is some cost to getting that so it actually doesn't get -- you know, the investor pays a dollar, but the company gets less than that --

MR. HILL: Ninety cents.

MR. WELCH: Yeah, whatever.

MR. HILL: Yeah.

MR. WELCH: And the only thing the company had was regulated utilities so there's no noise there, I mean, don't you wind up in a situation where eventually -- I mean, the company will -- the -- the earnings that are allowed to the company will actually never fully compensate the investor who's bought that issuance?

MR. HILL: In that --

MR. WELCH: You're always going to be 50 cents short.

MR. HILL: In that limited example, in that rarefied atmosphere, yes --

MR. WELCH: Okay.

MR. HILL: -- I would agree with you.

MR. WELCH: All right. Thank you.

MR. LITTELL: Can I follow up? Your answer suggested a follow up which is why is that example limited? Why don't you think that's the --

MR. HILL: I'm sorry, I didn't understand you.

MR. LITTELL: Your answer to Chairman Welch was in that limited example, you'd agree with him. What's -- what's the limitation that you think makes that not the -- not the rule that should be followed?

MR. HILL: Well, in a situation certainly where the market price is -- is 90 percent -- 190 percent of book value like it is with water utilities today, that could never happen. So if the market price is -- is 1.05 times book value or higher, it's not a problem. I mean, if you're going to restrict it to exactly equal to book value --

MR. WELCH: But in a sense --

MR. HILL: -- surgical way -- I'm sorry.

MR. WELCH: I apologize for interrupting. Had you finished (inaudible)? Had you finished your answer?

MR. HILL: Yes.

MR. WELCH: I mean, it does -- again, this is -- this sort of gets into a universe that doesn't exist in the real world. But sort of the -- the overall logic of your position is that you award a return that ultimately drives the market price to 1:1 market to book. I mean, that's --

MR. HILL: Well --

MR. WELCH: So I guess what I'm saying is that if -- if the Commission accepts -- because I understand your answer that says one of the reasons you shouldn't allow flotation costs is because the market to book is greater than one. Okay. But if the Commission adopts a recommendation that drives the market price to 1:1, the return that it is allowing on the sort of assumed 1:1 universe does get back into this non-existent 1:1 ratio and you do wind up in that situation. I mean, is that --

MR. HILL: It could. You're right, it certainly could. And if that were the outcome --

MR. WELCH: Okay, thank you.

MR. HILL: I don't think things are quite that clean cut.

MR. WELCH: I -- I -- they never are here.

MR. HILL: Yeah, that's right.

MR. WELCH: I appreciate that. Thank you.

MS. COOK: I'm sorry, I just have a very precise question on your calculations in your DCF model.

MR. HILL: Okay.

MS. COOK: You used a closing -- a 30-day average market price?

MR. HILL: That's right.

MS. COOK: And why did you choose a 30-day average as opposed to something longer, particularly in light of what's going on in the equity markets?

MR. HILL: Well, it's something that I decided thirty years ago. I mean, in theory, the current price, today's price, contains all the information that is out there. And all the expectations that are out there is embodied in today's price. And -- and the theorists would all say, well, just use today's price if you want the current cost of capital. Well, I did that as a -- as a novice cost of capital expert and got seriously burned on that because the price change, by the time I went to hearing, oh, your cost of capital was nine but now it's 15. That's part of it. There are day-to-day fluctuations in stock prices. There's dividend stripping. There -- there are things that go on that -- that create abnormalities. I felt like that six weeks is -- is -- daily prices is close enough to current to -- to give an accurate measure of what the current cost of capital is. It's not too long to -- so that I get other information that's mixed in with it that's not current. So it's a judgment call. Some people use three months. Some people use six months; I think that's too long. I feel comfortable with -- with 60 days.

MR. WELCH: Is -- is the basic idea to get rid of the overall market noise?

MR. HILL: Yes, yes.

MR. WELCH: So it's just a question of judgment as to what time period you need to get rid of --

MR. HILL: Right. And if you use a one-day thing, there can definitely be --

MR. WELCH: Right --

MR. HILL: -- that can be troublesome down the road.

MS. COOK: I think my question was more directed toward why not a longer period of time.

MR. HILL: Yeah. It's because I think that you begin to -- like, if I used six months, I would -- I would begin to drag in sort of the leftover angst from the last Fed announcement about tapering and -- and things that aren't pertinent today that investors don't consider to be part of the cost of money.

MS. COOK: Thank you. That's all I have.

MR. KAPLY: Mr. Crouter?

MR. CROUTER: Yeah. Mr. Hill, I just wanted to ask you some questions about the debt-to-equity ratio.

MR. HILL: Okay.

MR. CROUTER: And on page 15 of your testimony, you talk about the fact that the Camden/Rockland division has a 55 percent common equity ratio and you -- you compare that to the industry average and then draw a conclusion that, because the equity ratio in this division is higher than average, that slides you along the -- your range toward the lower end. Is that fair enough?

MR. HILL: It moves it slightly from the midpoint to, I don't know what, 12 basis points lower or something like that.

MR. CROUTER: Have you looked at the overall debt-to-equity ratio for Maine Water as a whole?

MR. HILL: I don't believe I have.

MR. CROUTER: Okay.

MR. HILL: I just looked at the capital structure information that was -- that was given to us initially by the divisions.

MR. CROUTER: Okay. And let me just ask you to assume that the Maine Water Company's -- as a company as a whole, that its debt-to-equity ratio is, in fact, 50/50. Okay?

MR. HILL: Okay.

MR. CROUTER: Now, I -- I take it that you're not then aware of which or circumstances in other divisions where the equity ratio is -- would have to be necessarily lower than 50 percent, wouldn't it, for the company wide to get to that 50/50?

MR. HILL: I believe there was another division that was originally in the case that's not now that had a very low equity ratio.

MR. CROUTER: Right, that would be the Bucksport division which was --

MR. HILL: Yeah. I'll take your word for it. I think that sounds familiar.

MR. CROUTER: -- 21.63 percent equity ratio?

MR. HILL: Yes.

MR. CROUTER: Okay. And are you aware that the Hartland division of the company is at 29.2 percent?

MR. HILL: I'm not aware of that.

MR. CROUTER: Okay. Do you have any understanding as to what the historical reasons are that those two divisions have -- well, let me -- let me go back and ask the question. Would you agree with me that an equity ratio for a water utility division below 30 percent is unusually low?

MR. HILL: I would say it's low. I think it's lower -- definitely lower than average. I don't know how you define unusual, but it's definitely low. And if I were estimating the cost of equity for a division like that, I would definitely put it well above the average because the cost of equity should be higher.

MR. CROUTER: Right. In other words, the impact on those divisions would be that the cost of equity would move higher than a division with 50/50, all other things being equal?

MR. HILL: That's right.

MR. CROUTER: Okay. And I think I may have asked you this, but you're not -- you're not privy to some of the historical reasons as to why those divisions are lower?

MR. HILL: I don't know all the reasons. My understanding about Bucksport was that there was an agreement between the company and the city when there was a large construction project that needed to be undertaken and the company thought that was a more inexpensive way to finance the operations.

MR. CROUTER: Okay. And have -- I'm going to shift subjects for a minute here. Have you taken a look at the customer profile of the Camden/Rockland division, you know, residential, commercial, industrial?

MR. HILL: I have not.

MR. CROUTER: Okay. If a utility division has a large industrial customer that is responsible for 30 percent of daily load and about 12 percent annually of revenue, does that impact the risk -- the risk analysis for the division?

MR. HILL: It can.

MR. CROUTER: And how can it?

MR. HILL: If the industrial customer is a cyclical industry and would be subject to changes in production and changes in water usage, then that could be -- it -- it could raise -- it could raise the risk for the company. In that situation, I would expect to see the company have contingency plans drawn up about what to do if they -- if the company -- if their customer goes offline. But if it's -- it's a serious problem, yes.

MR. CROUTER: Okay. And, I mean, the risk that that large industrial customer will go offline then increases the overall risk of the division, fair enough?

MR. HILL: It does to some degree, and the overhang is that there will be fixed costs that will need to be recovered. If that customer goes offline, then the customer's [sic] no longer recovering. The question is what is the level of those fixed costs that the rest of the customers will have to absorb and, you know, what is the rate impact of that. There are a lot of moving parts to determine the degree of -- of increased risk.

MR. CROUTER: Okay. And along those same lines, if the industrial customer doesn't go offline but there's a pattern of declining consumption from that large industrial customer, that can have a similar impact on risk, although not as great as the offline situation. Is that true?

MR. HILL: I may have a little trouble agreeing with that simply because if it's -- if it's gradual and the company is able to project where you're going, you should be able to -- you should be able to work that so that it doesn't impact your operating risk to the degree of a big question mark. If you just, boom, chop it off, that's problematic and you can say that's definitely risky. If -- if the industrial is -- is husbanding his resources better and -- and just using less water, then if it's a gradual thing, then it doesn't seem to be so risky to me.

MR. CROUTER: Okay. And then the last area I want to ask you some questions about is a follow up to some of the questions that were asked by the Commissioners. With respect to obligations that water utilities have with respect to infrastructure changes, are you familiar with disinfection byproduct rules that will be effective in the third quarter of 2014 which will impose water purification issues on the Camden/Rockland division?

MR. HILL: I'm not familiar with those, no, but as -- as I said earlier, I am aware that the -- the legislature recently passed a law allowing the company to institute surcharges for infrastructure build out.

MR. CROUTER: And is it true that one of the components of that infrastructure build out process includes the return on equity? That is, the infrastructure build out incorporates the return on equity into the formula for assessing the amount of that infrastructure allowance?

MR. HILL: I'll take your representation. I assume that would be the case.

MR. CROUTER: Okay. I just need a second. That's all I have.

MR. WELCH: I did have one more from your testimony, and this is on Appendix B, page iii. And I was just trying to understand the sentence in your answer. It says, "Rates of growth derived from earnings or dividends alone can be unreliable ..." and then "... due to extraneous influences on those parameters, such as changes in the expected rate of return on common equity." Now, what I can't figure out, and I may just not be grasping what you're saying here, is why a rate of growth that's actually derived from historical record of earnings would be influenced at all by anybody's expectations about anything.

MR. HILL: It wouldn't be. A rate of growth derived exclusively from historical record of earnings is not going to be affected by a change in the -- in the allowed return.

MR. WELCH: Okay. So -- so -- so what you're -- so when you say rates of growth derived from earnings, you're not referring to rates of growth that are derived entirely from historical?

MR. HILL: No, I don't -- I don't --

MR. WELCH: Okay, that was my misunderstanding of your testimony.

MR. HILL: Okay. I don't derive growth rates entirely from historical information anyway.

MR. WELCH: No, I just -- I was trying to understand the sentence.

MR. HILL: Okay.

MR. WELCH: Thank you.

MS. SMITH: Looking at your peer group, you -- basically both parties use pretty much the same except that you did not use artesian or -- unless I -- unless I missed it when I was looking --

MR. HILL: No, I didn't use artesian.

MS. SMITH: Is there a particular reason you didn't?

MR. HILL: Artesian's not followed in the main ValueLine reporting. I believe it's followed in the midcap, small to midcap companies. I don't subscribe to that so it was just off my radar. But I did -- I think there were nine water utilities, and I did use gas utilities also to increase the sample size because generally physically those two -- two types of companies are similar.

MS. SMITH: Okay, thank you.

MR. KAPLY: Mr. Black, rebuttal? I mean do you have any redirect?

MR. BLACK: Redirect? No, I have none.

MR. HEWITT: Nothing for FMC, thank you.

MR. BEAL: Nor for Rockland.

MR. KAPLY: Looking around, seeing no further questions, I think we can conclude the hearing and go off the record.

CONFERENCE ADJOURNED (January 14, 2014, 2:53 p.m.)

CERTIFICATE

I hereby certify that this is a true and accurate transcript of the proceedings which have been electronically recorded in this matter on the aforementioned hearing date.

D. Noelle Forrest

D. Noelle Forrest, Transcriber

PMA-R21

Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation

Robert F. Engle

Econometrica, Volume 50, Issue 4 (Jul., 1982), 987-1008.

Stable URL:
http://links.jstor.org/sici?sici=0012-9682%28198207%2950%3A4%3C987%3AACHWEO%3E2.0.CO%3B2-3

Econometrica, Vol. 50, No. 4 (July, 1982)

AUTOREGRESSIVE CONDITIONAL HETEROSCEDASTICITY WITH ESTIMATES OF THE VARIANCE OF UNITED KINGDOM INFLATION[1]

BY ROBERT F. ENGLE

Traditional econometric models assume a constant one-period forecast variance. To generalize this implausible assumption, a new class of stochastic processes called autoregressive conditional heteroscedastic (ARCH) processes are introduced in this paper. These are mean zero, serially uncorrelated processes with nonconstant variances conditional on the past, but constant unconditional variances. For such processes, the recent past gives information about the one-period forecast variance.

A regression model is then introduced with disturbances following an ARCH process. Maximum likelihood estimators are described and a simple scoring iteration formulated. Ordinary least squares maintains its optimality properties in this set-up, but maximum likelihood is more efficient. The relative efficiency is calculated and can be infinite. To test whether the disturbances follow an ARCH process, the Lagrange multiplier procedure is employed. The test is based simply on the autocorrelation of the squared OLS residuals.

This model is used to estimate the means and variances of inflation in the U.K. The ARCH effect is found to be significant and the estimated variances increase substantially during the chaotic seventies.

1. INTRODUCTION

IF A RANDOM VARIABLE y_t is drawn from the conditional density function $f(y_t \mid y_{t-1})$, the forecast of today's value based upon the past information, under standard assumptions, is simply $E(y_t \mid y_{t-1})$, which depends upon the value of the conditioning variable y_{t-1}. The variance of this one-period forecast is given by $V(y_t \mid y_{t-1})$. Such an expression recognizes that the conditional forecast variance depends upon past information and may therefore be a random variable. For conventional econometric models, however, the conditional variance does not depend upon y_{t-1}. This paper will propose a class of models where the variance does depend upon the past and will argue for their usefulness in economics. Estimation methods, tests for the presence of such models, and an empirical example will be presented.

Consider initially the first-order autoregression

$$y_t = \gamma y_{t-1} + \epsilon_t$$

where ϵ is white noise with $V(\epsilon) = \sigma^2$. The conditional mean of y_t is γy_{t-1} while the unconditional mean is zero. Clearly, the vast improvement in forecasts due to time-series models stems from the use of the conditional mean. The conditional

[1]This paper was written while the author was visiting the London School of Economics. He benefited greatly from many stimulating conversations with David Hendry and helpful suggestions by Denis Sargan and Andrew Harvey. Special thanks are due Frank Srba who carried out the computations. Further insightful comments are due to Clive Granger, Tom Rothenberg, Edmond Malinvaud, Jean-Francois Richard, Wayne Fuller, and two anonymous referees. The research was supported by NSF SOC 78-09476 and The International Centre for Economics and Related Disciplines. All errors remain the author's responsibility.

variance of y_t is σ^2 while the unconditional variance is $\sigma^2/1-\gamma^2$. For real processes one might expect better forecast intervals if additional information from the past were allowed to affect the forecast variance; a more general class of models seems desirable.

The standard approach of heteroscedasticity is to introduce an exogenous variable x_t which predicts the variance. With a known zero mean, the model might be

$$y_t = \epsilon_t x_{t-1}$$

where again $V(\epsilon) = \sigma^2$. The variance of y_t is simply $\sigma^2 x_{t-1}^2$ and, therefore, the forecast interval depends upon the evolution of an exogenous variable. This standard solution to the problem seems unsatisfactory, as it requires a specification of the causes of the changing variance, rather than recognizing that both conditional means and variances may jointly evolve over time. Perhaps because of this difficulty, heteroscedasticity corrections are rarely considered in time-series data.

A model which allows the conditional variance to depend on the past realization of the series is the bilinear model described by Granger and Andersen [**13**]. A simple case is

$$y_t = \epsilon_t y_{t-1}.$$

The conditional variance is now $\sigma^2 y_{t-1}^2$. However, the unconditional variance is either zero or infinity, which makes this an unattractive formulation, although slight generalizations avoid this problem.

A preferable model is

$$y_t = \epsilon_t h_t^{1/2},$$

$$h_t = \alpha_0 + \alpha_1 y_{t-1}^2,$$

with $V(\epsilon_t) = 1$. This is an example of what will be called an autoregressive conditional heteroscedasticity (ARCH) model. It is not exactly a bilinear model, but is very close to one. Adding the assumption of normality, it can be more directly expressed in terms of ψ_t, the information set available at time t. Using conditional densities,

$$y_t \mid \psi_{t-1} \sim N(0, h_t), \tag{1}$$

$$h_t = \alpha_0 + \alpha_1 y_{t-1}^2. \tag{2}$$

The variance function can be expressed more generally as

$$h_t = h(y_{t-1}, y_{t-2}, \ldots, y_{t-p}, \alpha) \tag{3}$$

where p is the order of the ARCH process and α is a vector of unknown parameters.

The ARCH regression model is obtained by assuming that the mean of y_t is given as $x_t\beta$, a linear combination of lagged endogenous and exogenous variables included in the information set ψ_{t-1} with β a vector of unknown parameters. Formally,

$$\begin{aligned} & y_t \mid \psi_{t-1} \sim N(x_t\beta, h_t), \\ (4) \qquad & h_t = h(\epsilon_{t-1}, \epsilon_{t-2}, \ldots, \epsilon_{t-p}, \alpha), \\ & \epsilon_t = y_t - x_t\beta. \end{aligned}$$

The variance function can be further generalized to include current and lagged x's as these also enter the information set. The h function then becomes

$$(5) \qquad h_t = h(\epsilon_{t-1}, \ldots, \epsilon_{t-p}, x_t, x_{t-1}, \ldots, x_{t-p}, \alpha)$$

or simply

$$h_t = h(\psi_{t-1}, \alpha).$$

This generalization will not be treated in this paper, but represents a simple extension of the results. In particular, if the h function factors into

$$h_t = h_\epsilon(\epsilon_{t-1}, \ldots, \epsilon_{t-p}, \alpha) h_x(x_t, \ldots, x_{t-p}),$$

the two types of heteroscedasticity can be dealt with sequentially by first correcting for the x component and then fitting the ARCH model on the transformed data.

The ARCH regression model in (4) has a variety of characteristics which make it attractive for econometric applications. Econometric forecasters have found that their ability to predict the future varies from one period to another. McNees [17, p. 52] suggests that, "the inherent uncertainty or randomness associated with different forecast periods seems to vary widely over time." He also documents that, "large and small errors tend to cluster together (in contiguous time periods)." This analysis immediately suggests the usefulness of the ARCH model where the underlying forecast variance may change over time and is predicted by past forecast errors. The results presented by McNees also show some serial correlation during the episodes of large variance.

A second example is found in monetary theory and the theory of finance. By the simplest assumptions, portfolios of financial assets are held as functions of the expected means and variances of the rates of return. Any shifts in asset demand must be associated with changes in expected means and variances of the rates of return. If the mean is assumed to follow a standard regression or time-series model, the variance is immediately constrained to be constant over time. The use of an exogenous variable to explain changes in variance is usually not appropriate.

A third interpretation is that the ARCH regression model is an approximation to a more complex regression which has non-ARCH disturbances. The ARCH specification might then be picking up the effect of variables omitted from the estimated model. The existence of an ARCH effect would be interpreted as evidence of misspecification, either by omitted variables or through structural change. If this is the case, ARCH may be a better approximation to reality than making standard assumptions about the disturbances, but trying to find the omitted variable or determine the nature of the structural change would be even better.

Empirical work using time-series data frequently adopts *ad hoc* methods to measure (and allow) shifts in the variance over time. For example, Klein **[15]** obtains estimates of variance by constructing the five-period moving variance about the ten-period moving mean of annual inflation rates. Others, such as Khan [**14**], resort to the notion of "variability" rather than variance, and use the absolute value of the first difference of the inflation rate. Engle [**10**] compares these with the ARCH estimates for U.S. data.

2. THE LIKELIHOOD FUNCTION

Suppose y_t is generated by an ARCH process described in equations (1) and (3). The properties of this process can easily be determined by repeated application of the relation $Ex = E(Ex \mid \psi))$. The mean of y_t is zero and all autocovariances are zero. The unconditional variance is given by $\sigma_t^2 = Ey_t^2 = Eh_t$. For many functions h and values of α, the variance is independent of t. Under such conditions, y_t is covariance stationary; a set of sufficient conditions for this is derived below.

Although the process defined by (1) and (3) has all observations conditionally normally distributed, the vector of y is not jointly normally distributed. The joint density is the product of all the conditional densities and, therefore, the log likelihood is the sum of the conditional normal log likelihoods corresponding to (1) and (3). Let l be the average log likelihood and l_t be the log likelihood of the tth observation and T the sample size. Then

$$l = \frac{1}{T}\sum_{t=1}^{T} l_t,$$
(6)
$$l_t = -\tfrac{1}{2}\log h_t - \tfrac{1}{2} y_t^2 / h_t,$$

apart from some constants in the likelihood.

To estimate the unknown parameters α, this likelihood function can be maximized. The first-order conditions are

(7) $$\frac{\partial l_t}{\partial \alpha} = \frac{1}{2h_t}\frac{\partial h_t}{\partial \alpha}\left(\frac{y_t^2}{h_t} - 1\right)$$

and the Hessian is

$$\frac{\partial^2 l_t}{\partial\alpha\partial\alpha'} = -\frac{1}{2h_t^2}\frac{\partial h_t}{\partial\alpha}\frac{\partial h_t}{\partial\alpha'}\left(\frac{y_t^2}{h_t}\right) + \left[\frac{y_t^2}{h_t} - 1\right]\frac{\partial}{\partial\alpha'}\left[\frac{1}{2h_t}\frac{\partial h_t}{\partial\alpha}\right]. \tag{8}$$

The conditional expectation of the second term, given ψ_{t-m-1}, is zero, and of the last factor in the first, is just one. Hence, the information matrix, which is simply the negative expectation of the Hessian averaged over all observations, becomes

$$\mathcal{I}_{\alpha\alpha} = \sum_t \frac{1}{2T} E\left[\frac{1}{h_t^2}\frac{\partial h_t}{\partial\alpha'}\frac{\partial h_t}{\partial\alpha'}\right] \tag{9}$$

which is consistently estimated by

$$\hat{\mathcal{I}}_{\alpha\alpha} = \frac{1}{T}\sum_t\left[\frac{1}{2h_t^2}\frac{\partial h_t}{\partial\alpha}\frac{\partial h_t}{\partial\alpha'}\right]. \tag{10}$$

If the h function is pth order linear (in the squares), so that it can be written as

$$h_t = \alpha_0 + \alpha_1 y_{t-1}^2 + \cdots + \alpha_p y_{t-p}^2, \tag{11}$$

then the information matrix and gradient have a particularly simple form. Let $z_t = (1, y_{t-1}^2, \ldots, y_{t-p}^2)$ and $\alpha' = (\alpha_0, \alpha_1, \cdots, \alpha_p)$ so that (11) can be rewritten as

$$h_t = z_t\alpha. \tag{12}$$

The gradient then becomes simply

$$\frac{\partial l}{\partial\alpha} = \frac{1}{2h_t} z_t\left(\frac{y_t^2}{h_t} - 1\right) \tag{13}$$

and the estimate of the information matrix

$$\hat{\mathcal{I}}_{\alpha\alpha} = \frac{1}{2T}\sum_t (z_t' z_t / h_t^2). \tag{14}$$

3. DISTRIBUTION OF THE FIRST-ORDER LINEAR ARCH PROCESS

The simplest and often very useful ARCH model is the first-order linear model given by (1) and (2). A large observation for y will lead to a large variance for the next period's distribution, but the memory is confined to one period. If $\alpha_1 = 0$, of course y will be Gaussian white noise and if it is a positive number, successive observations will be dependent through higher-order moments. As shown below, if α_1 is too large, the variance of the process will be infinite.

To determine the conditions for the process to be stationary and to find the marginal distribution of the y's, a recursive argument is required. The odd moments are immediately seen to be zero by symmetry and the even moments are computed using the following theorem. In all cases it is assumed that the process begins indefinitely far in the past with $2r$ finite initial moments.

THEOREM 1: *For integer r, the $2r$th moment of a first-order linear ARCH process with $\alpha_0 > 0$, $\alpha_1 \geq 0$, exists if, and only if,*

$$\alpha_1^r \prod_{j=1}^{r} (2j-1) < 1.$$

A constructive expression for the moments is given in the proof.

PROOF: See Appendix.

The theorem is easily used to find the second and fourth moments of a first-order process. Letting $w_t = (y_t^4, y_t^2)'$,

$$E(w_t \mid \psi_{t-1}) = \begin{pmatrix} 3\alpha_0^2 \\ \alpha_0 \end{pmatrix} + \begin{pmatrix} 3\alpha_1^2 & 6\alpha_0\alpha_1 \\ 0 & \alpha_1 \end{pmatrix} w_{t-1}.$$

The condition for the variance to be finite is simply that $\alpha_1 < 1$, while to have a finite fourth moment it is also required that $3\alpha_1^2 < 1$. If these conditions are met, the moments can be computed from (A4) as

$$(15) \qquad E(w_t) = \begin{bmatrix} \left[\dfrac{3\alpha_0^2}{(1-\alpha_1)^2} \right] \left[\dfrac{1-\alpha_1^2}{1-3\alpha_1^2} \right] \\ \dfrac{\alpha_0}{1-\alpha_1} \end{bmatrix}.$$

The lower element is the unconditional variance, while the upper product gives the fourth moment. The first expression in square brackets is three times the squared variance. For $\alpha_1 \neq 0$, the second term is strictly greater than one implying a fourth moment greater than that of a normal random variable.

The first-order ARCH process generates data with fatter tails than the normal density. Many statistical procedures have been designed to be robust to large errors, but to the author's knowledge, none of this literature has made use of the fact that temporal clustering of outliers can be used to predict their occurrence and minimize their effects. This is exactly the approach taken by the ARCH model.

4. GENERAL ARCH PROCESSES

The conditions for a first-order linear ARCH process to have a finite variance and, therefore, to be covariance stationary can directly be generalized for pth-order processes.

THEOREM 2: *The pth-order linear ARCH processes, with* $\alpha_0 > 0$, $\alpha_1, \ldots, \alpha_p \geq 0$, *is covariance stationary if, and only if, the associated characteristic equation has all roots outside the unit circle. The stationary variance is given by* $E(y_t^2) = \alpha_0/(1 - \sum_{j=1}^{p} \alpha_j)$.

PROOF: See Appendix.

Although the pth-order linear model is a convenient specification, it is likely that other formulations of the variance model may be more appropriate for particular applications. Two simple alternatives are the exponential and absolute value forms:

$$h_t = \exp(\alpha_0 + \alpha_1 y_{t-1}^2), \tag{16}$$

$$h_t = \alpha_0 + \alpha_1 |y_{t-1}|. \tag{17}$$

These provide an interesting contrast. The exponential form has the advantage that the variance is positive for all values of alpha, but it is not difficult to show that data generated from such a model have infinite variance for any value of $\alpha_1 \neq 0$. The implications of this deserve further study. The absolute value form requires both parameters to be positive, but can be shown to have finite variance for any parameter values.

In order to find estimation results which are more general than the linear model, general conditions on the variance model will be formulated and shown to be implied for the linear process.

Let ξ_t be a $p \times 1$ random vector drawn from the sample space Ξ, which has elements $\xi_t' = (\xi_{t-1}, \ldots, \xi_{t-p})$. For any ξ_t, let ξ_t^* be identical, except that the mth element has been multiplied by -1, where m lies between 1 and p.

DEFINITION: The ARCH process defined by (1) and (3) is *symmetric* if

(a) $h(\xi_t) = h(\xi_t^*)$ for any m and $\xi_t \epsilon \Xi$,

(b) $\partial h(\xi_t)/\partial \alpha_i = \partial h(\xi_t^*)/\partial \alpha_i$ for any m, i and $\xi_t \epsilon \Xi$,

(c) $\partial h(\xi_t)/\partial \xi_{t-m} = -\partial h(\xi_t^*)/\partial \xi_{t-m}$ for any m and $\xi_t \epsilon \Xi$.

All the functions described have been symmetric. This condition is the main distinction between mean and variance models.

Another characterization of general ARCH models is in terms of regularity conditions.

DEFINITION: The ARCH model defined by (1) and (3) is *regular* if

(a) $\min h(\xi_t) \geq \delta$ for some $\delta > 0$ and $\xi_t \epsilon \Xi$,

(b) $E(|\partial h(\xi_t)/\partial \alpha_i||\partial h(\xi_t)/\partial \xi_{t-m}||\psi_{t-m-1})$ exists for all i, m, t.

The first portion of the definition is very important and easy to check, as it requires the variance always to be positive. This eliminates, for example, the log-log autoregression. The second portion is difficult to check in some cases, yet should generally be true if the process is stationary with bounded derivatives, since conditional expectations are finite if unconditional ones are. Condition (b) is a sufficient condition for the existence of some expectations of the Hessian used in Theorem 4. Presumably weaker conditions could be found.

THEOREM 3: *The pth-order linear ARCH model satisfies the regularity conditions, if* $\alpha_0 > 0$ *and* $\alpha_1, \ldots, \alpha_p \geq 0$.

PROOF: See Appendix.

In the estimation portion of the paper, a very substantial simplification results if the ARCH process is symmetric and regular.

5. ARCH REGRESSION MODELS

If the ARCH random variables discussed thus far have a non-zero mean, which can be expressed as a linear combination of exogenous and lagged dependent variables, then a regression framework is appropriate, and the model can be written as in (4) or (5). An alternative interpretation for the model is that the disturbances in a linear regression follow an ARCH process.

In the pth-order linear case, the specification and likelihood are given by

$$\begin{aligned} &y_t \mid \psi_{t-1} \sim N(x_t\beta, h_t), \\ &h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \cdots + \alpha_p \epsilon_{t-p}^2, \\ (18) \qquad &\epsilon_t = y_t - x_t\beta, \\ &l = \frac{1}{T}\sum_{t=1}^{T} l_t, \\ &l_t = -\tfrac{1}{2}\log h_t - \tfrac{1}{2}\epsilon_t^2/h_t, \end{aligned}$$

where x_t may include lagged dependent and exogenous variables and an irrelevant constant has been omitted from the likelihood. This likelihood function can be maximized with respect to the unknown parameters α and β. Attractive methods for computing such an estimate and its properties are discussed below.

Under the assumptions in (18), the ordinary least squares estimator of β is still consistent as x and ϵ are uncorrelated through the definition of the regression as a conditional expectation. If the x's can be treated as fixed constants then the least squares standard errors will be correct; however, if there are lagged dependent variables in x_t, the standard errors as conventionally computed will not be consistent, since the squares of the disturbances will be correlated with squares of the x's. This is an extension of White's [18] argument on heteroscedasticity and it suggests that using his alternative form for the covariance matrix would give a consistent estimate of the least-squares standard errors.

If the regressors include no lagged dependent variables and the process is stationary, then letting y and x be the $T \times 1$ and $T \times K$ vector and matrix of dependent and independent variables, respectively,

$$(19)\qquad \begin{aligned} E(y \mid x) &= x\beta, \\ \operatorname{Var}(y \mid x) &= \sigma^2 I, \end{aligned}$$

and the Gauss–Markov assumptions are statisfied. Ordinary least squares is the best linear unbiased estimator for the model in (18) and the variance estimates are unbiased and consistent. However, maximum likelihood is different and consequently asymptotically superior; ordinary least squares does not achieve the Cramer–Rao bound. The maximum-likelihood estimator is nonlinear and is more efficient than OLS by an amount calculated in Section 6.

The maximum likelihood estimator is found by solving the first order conditions. The derivative with respect to β is

$$(20)\qquad \frac{\partial l_t}{\partial \beta} = \frac{\epsilon_t x_t'}{h_t} + \frac{1}{2h_t}\frac{\partial h_t}{\partial \beta}\left(\frac{\epsilon_t^2}{h_t} - 1\right).$$

The first term is the familiar first-order condition for an exogenous heteroscedastic correction; the second term results because h_t is also a function of the β's, as in Amemiya [1]. Substituting the linear variance function gives

$$(21)\qquad \frac{\partial l}{\partial \beta} = \frac{1}{T}\sum\left[\frac{\epsilon_t x_t'}{h_t} - \frac{1}{h_t}\left(\frac{\epsilon_t^2}{h_t} - 1\right)\sum_j \alpha_j \epsilon_{t-j} x_{t-j}'\right],$$

which can be rewritten approximately by collecting terms in x and ϵ as

$$(22)\qquad \begin{aligned} \frac{\partial l}{\partial \beta} &= \frac{1}{T}\sum_t x_t'\epsilon_t\left[h_t^{-1} - \sum_{j=1}^{p} \alpha_j h_{t+j}^{-2}\left(\epsilon_{t+j}^2 - h_{t+j}\right)\right] \\ &\equiv \frac{1}{T}\sum_t x_t'\epsilon_t s_t. \end{aligned}$$

The Hessian is

$$\frac{\partial^2 l_t}{\partial \beta \partial \beta'} = -\frac{x_t' x_t}{h_t} - \frac{1}{2h_t^2}\frac{\partial h_t}{\partial \beta}\frac{\partial h_t}{\partial \beta'}\left(\frac{\epsilon_t^2}{h_t}\right) - \frac{2\epsilon_t x_t'}{h_t^2}\frac{\partial h_t}{\partial \beta} + \left(\frac{\epsilon_t^2}{h_t} - 1\right)\frac{\partial}{\partial \beta'}\left[\frac{1}{2h_t}\frac{\partial h_t}{\partial \beta}\right].$$

Taking conditional expectations of the Hessian, the last two terms vanish because h_t is entirely a function of the past. Similarly, ϵ_t^2/h_t becomes one, since it is the only current value in the second term. Notice that these results hold regardless of whether x_t includes lagged-dependent variables. The information matrix is the average over all t of the expected value of the conditional expectation and is, therefore, given by

$$\mathcal{I}_{\beta\beta} = \frac{1}{T}\sum_t E\left[E\left(\frac{\partial^2 l_t}{\partial\beta\,\partial\beta'} \mid \psi_{t-1}\right)\right] \tag{23}$$
$$= \frac{1}{T}\sum_t E\left[\frac{x_t'x_t}{h_t} + \frac{1}{2h_t^2}\frac{\partial h_t}{\partial\beta}\frac{\partial h_t}{\partial\beta'}\right].$$

For the pth order linear ARCH regression this is consistently estimated by

$$\hat{\mathcal{I}}_{\beta\beta} = \frac{1}{T}\sum\left[\frac{x_t'x_t}{h_t} + 2\sum_j \alpha_j^2\frac{\epsilon_{t-j}^2}{h_t^2}x_{t-j}'x_{t-j}\right]. \tag{24}$$

By gathering terms in $x_t'x_t$, (24) can be rewritten, except for end effects, as

$$\hat{\mathcal{I}}_{\beta\beta} = \frac{1}{T}\sum_t x_t'x_t\left[h_t^{-1} + 2\epsilon_t^2\sum_{j=1}^{p}\alpha_j^2 h_{t+j}^{-2}\right] \tag{25}$$
$$\equiv \frac{1}{T}\sum_t x_t'x_t r_t^2.$$

In a similar fashion, the off-diagonal blocks of the information matrix can be expressed as:

$$\mathcal{I}_{\alpha\beta} = \frac{1}{T}\sum_t E\left(\frac{1}{2h_t^2}\frac{\partial h_t}{\partial\alpha}\frac{\partial h_t}{\partial\beta'}\right). \tag{26}$$

The important result to be shown in Theorem 4 below is that this off-diagonal block is zero. The implications are far-reaching in that estimation of α and β can be undertaken separately without asymptotic loss of efficiency and their variances can be calculated separately.

THEOREM 4: *If an ARCH regression model is symmetric and regular, then* $\mathcal{I}_{\alpha\beta} = 0$.

PROOF: See Appendix.

6. ESTIMATION OF THE ARCH REGRESSION MODEL

Because of the block diagonality of the information matrix, the estimation of α and β can be considered separately without loss of asymptotic efficiency.

Furthermore, either can be estimated with full efficiency based only on a consistent estimate of the other. See, for example, Cox and Hinkley [6, p. 308]. The procedure recommended here is to initially estimate β by ordinary least squares, and obtain the residuals. From these residuals, an efficient estimate of α can be constructed, and based upon these $\hat{\alpha}$ estimates, efficient estimates of β are found. The iterations are calculated using the scoring algorithm. Each step for a parameter vector ϕ produces estimates ϕ^{i+1} based on ϕ^i according to

$$\phi^{i+1} = \phi^i + \left[\hat{\mathscr{I}}^i_{\phi\phi}\right]^{-1} \frac{1}{T} \sum_t \frac{\partial l^i_t}{\partial \phi}, \tag{27}$$

where $\hat{\mathscr{I}}^i$ and $\partial l^i_t/\partial\phi$ are evaluated at ϕ^i. The advantage of this algorithm is partly that it requires only first derivatives of the likelihood function in this case and partly that it uses the statistical properties of the problem to tailor the algorithm to this application.

For the pth-order linear model, the scoring step for α can be rewritten by substituting (12), (13), and (14) into (27) and interpreting y_t^2 as the residuals e_t^2. The iteration is simply

$$\alpha^{i+1} = \alpha^i + (\tilde{z}'\tilde{z})^{-1}\tilde{z}'f^i \tag{28}$$

where

$$\tilde{z}_t = \left(1, e^2_{t-1}, \ldots, e^2_{t-p}\right)/h^i_t,$$

$$\tilde{z}' = (\tilde{z}'_1, \ldots, \tilde{z}'_T),$$

$$f^i_t = (e^2_t - h^i_t)/h^i_t,$$

$$f^{i\prime} = (f^i_1, \ldots, f^i_T).$$

In these expressions, e_t is the residual from iteration i, h^i_t is the estimated conditional variance, and α^i is the estimate of the vector of unknown parameters from iteration i. Each step is, therefore, easily constructed from a least-squares regression on transformed variables. The variance-covariance matrix of the parameters is consistently estimated by the inverse of the estimate of the information matrix divided by T, which is simply $2(\tilde{z}'\tilde{z})^{-1}$. This differs slightly from $\hat{\sigma}^2(\tilde{z}'\tilde{z})^{-1}$ computed by the auxiliary regression. Asymptotically, $\hat{\sigma}^2 = 2$, if the distributional assumptions are correct, but it is not clear which formulation is better in practice.

The parameters in α must satisfy some nonnegativity conditions and some stationarity conditions. These could be imposed via penalty functions or the parameters could be estimated and checked for conformity. The latter approach is used here, although a perhaps useful reformulation of the model might employ squares to impose the nonnegativity constraints directly:

$$h_t = \alpha_0^2 + \alpha_1^2\epsilon^2_{t-1} + \cdots + \alpha_p^2\epsilon^2_{t-p}. \tag{29}$$

Convergence for such an iteration can be formulated in many ways. Following Belsley [3], a simple criterion is the gradient around the inverse Hessian. For a parameter vector, ϕ, this is

$$(30)\qquad \theta = \frac{\partial l'}{\partial \phi}\left(\frac{\partial^2 l}{\partial \phi \partial \phi'}\right)^{-1}\frac{\partial l}{\partial \phi}.$$

Using θ as the convergence criterion is attractive, as it provides a natural normalization and as it is interpretable as the remainder term in a Taylor-series expansion about the estimated maximum. In any case, substituting the gradient and estimated information matrix in (30), $\theta = R^2$ of the auxiliary regression.

For a given estimate of α, a scoring step can be computed to improve the estimate of beta. The scoring algorithm for β is

$$(31)\qquad \beta^{i+1} = \beta^i + \left[\hat{\mathcal{I}}_{\beta\beta}\right]^{-1}\frac{\partial l^i}{\partial \beta}.$$

Defining $\tilde{x}_t = x_t r_t$ and $\tilde{e}_t = e_t s_t / r_t$ with $\tilde{x}$ and $\tilde{e}$ as the corresponding matrix and vector, (31) can be rewritten using (22) and (24) and e_t for the estimate of ϵ_t on the ith iteration, as

$$(32)\qquad \beta^{i+1} = \beta^i + (\tilde{x}'\tilde{x})^{-1}\tilde{x}'\tilde{e}.$$

Thus, an ordinary least-squares program can again perform the scoring iteration, and $(\tilde{x}'\tilde{x})^{-1}$ from this calculation will be the final variance-covariance matrix of the maximum likelihood estimates of β.

Under the conditions of Crowder's [7] theorem for martingales, it can be established that the maximum likelihood estimators $\hat{\alpha}$ and $\hat{\beta}$ are asymptotically normally distributed with limiting distribution

$$(33)\qquad \begin{aligned} &\sqrt{T}(\hat{\alpha} - \alpha) \xrightarrow{D} N\left(0, \mathcal{I}_{\alpha\alpha}^{-1}\right), \\ &\sqrt{T}(\hat{\beta} - \beta) \xrightarrow{D} N\left(0, \mathcal{I}_{\beta\beta}^{-1}\right). \end{aligned}$$

7. GAINS IN EFFICIENCY FROM MAXIMUM LIKELIHOOD ESTIMATION

The gain in efficiency from using the maximum-likelihood estimation rather than OLS has been asserted above. In this section, the gains are calculated for a special case. Consider the linear stationary ARCH model with $p = 1$ and all x_t exogenous. This is the case where the Gauss–Markov theorem applies and OLS has a variance matrix $\sigma^2(x'x)^{-1} = E\epsilon_t^2(\sum_t x_t'x_t)^{-1}$. The stationary variance is $\sigma^2 = \alpha_0/(1-\alpha_1)$.

The information matrix for this case becomes, from (25),

$$E\left[\sum_t x_t'x_t\left(h_t^{-1} + 2\epsilon_t^2\alpha_1^2/h_{t+1}^2\right)\right].$$

With x exogenous, the expectation is only necessary over the scale factor. Because the disturbance process is stationary, the variance-covariance matrix is proportional to that for OLS and the relative efficiency depends only upon the scale factors. The relative efficiency of MLE to OLS is, therefore,

$$R = E(h_t^{-1} + 2\epsilon_t^2\alpha_1^2/h_{t+1}^2)\sigma^2.$$

Now substitute $h_t = \alpha_0 + \alpha_1\epsilon_{t-1}^2$, $\sigma^2 = \alpha_0/1 - \alpha_1$, and $\gamma = \alpha_1/1 - \alpha_1$. Recognizing that ϵ_{t-1}^2 and ϵ_t^2 have the same density, define for each

$$u = \epsilon\sqrt{(1-\alpha_1)/\alpha_0}\ .$$

The expression for the relative efficiency becomes

$$R = E\left(\frac{1+\gamma}{1+\gamma u^2}\right) + 2\gamma^2 E\frac{u^2}{(1+\gamma u^2)^2}, \tag{34}$$

where u has variance one and mean zero. From Jensen's inequality, the expected value of a reciprocal exceeds the reciprocal of the expected value and, therefore, the first term is greater than unity. The second is positive, so there is a gain in efficiency whenever $\gamma \neq 0$. Eu^{-2} is infinite because u^2 is conditionally chi squared with one degree of freedom. Thus, the limit of the relative efficiency goes to infinity with γ:

$$\lim_{\gamma\to\infty} R \to \infty.$$

For α_1 close to unity, the gain in efficiency from using a maximum likelihood estimator may be very large.

8. TESTING FOR ARCH DISTURBANCES

In the linear regression model, with or without lagged-dependent variables, OLS is the appropriate procedure if the disturbances are not conditionally heteroscedastic. Because the ARCH model requires iterative procedures, it may be desirable to test whether it is appropriate before going to the effort to estimate it. The Lagrange multiplier test procedure is ideal for this as in many similar cases. See, for example, Breusch and Pagan [**4**, **5**], Godfrey [**12**], and Engle [**9**].

Under the null hypothesis, $\alpha_1 = \alpha_2 \cdots = \alpha_p = 0$. The test is based upon the score under the null and the information matrix under the null. Consider the ARCH model with $h_t = h(z_t\alpha)$, where h is some differentiable function which, therefore, includes both the linear and exponential cases as well as lots of others and $z_t = (1, e_{t-1}^2, \ldots, e_{t-p}^2)$ where e_t are the ordinary least squares residuals. Under the null, h_t is a constant denoted h^0. Writing $\partial h_t/\partial\alpha = h'z_t'$, where h' is the scalar derivative of h, the score and information can be written as

$$\frac{\partial l}{\partial \alpha}\bigg|_0 = \frac{h'}{2h^0}\sum_t z_t'\left(\frac{e_t^2}{h^0}-1\right) = \frac{h^{0\prime}}{2h^0}z'f^0,$$

$$\mathcal{I}_{\alpha\alpha}^0 = \frac{1}{2}\left(\frac{h^{0\prime}}{h^0}\right)^2 Ez'z,$$

and, therefore, the LM test statistic can be consistently estimated by

$$\xi^* = \tfrac{1}{2} f^{0\prime}z(z'z)^{-1}z'f^0 \tag{35}$$

where $z' = (z_1', \ldots, z_T')$, f^0 is the column vector of

$$\left(\frac{e_t^2}{h^0}-1\right).$$

This is the form used by Breusch and Pagan **[4]** and Godfrey **[12]** for testing for heteroscedasticity. As they point out, all reference to the h function has disappeared and, thus, the test is the same for any h which is a function only of $z_t\alpha$.

In this problem, the expectation required in the information matrix could be evaluated quite simply under the null; this could have superior finite sample performance. A second simplification, which is appropriate for this model as well as the heteroscedasticity model, is to note that plim $f^{0\prime}f^0/T = 2$ because normality has already been assumed. Thus, an asymptotically equivalent statistic would be

$$\xi = Tf^{0\prime}z(z'z)^{-1}z'f^0/f^{0\prime}f^0 = TR^2 \tag{36}$$

where R^2 is the squared multiple correlation between f^0 and z. Since adding a constant and multiplying by a scalar will not change the R^2 of a regression, this is also the R^2 of the regression of e_t^2 on an intercept and p lagged values of e_t^2. The statistic will be asymptotically distributed as chi square with p degrees of freedom when the null hypothesis is true.

The test procedure is to run the OLS regression and save the residuals. Regress the squared residuals on a constant and p lags and test TR^2 as a χ_p^2. This will be an asymptotically locally most powerful test, a characterization it shares with likelihood ratio and Wald tests. The same test has been proposed by Granger and Anderson **[13]** to test for higher moments in bilinear time series.

9. ESTIMATION OF THE VARIANCE OF INFLATION

Economic theory frequently suggests that economic agents respond not only to the mean, but also to higher moments of economic random variables. In financial theory, the variance as well as the mean of the rate of return are determinants of portfolio decisions. In macroeconomics, Lucas **[16]**, for example, argues that the variance of inflation is a determinant of the response to various shocks. Furthermore, the variance of inflation may be of independent interest as it is the unanticipated component which is responsible for the bulk of the welfare loss due to inflation. Friedman [11] also argues that, as high inflation will generally be associated with high variability of inflation, the statistical relationship between inflation and unemployment should have a positive slope, not a negative one as in the traditional Phillips curve.

Measuring the variance of inflation over time has presented problems to various researchers. Khan [14] has used the absolute value of the first difference of inflation while Klein [15] has used a moving variance around a moving mean. Each of these approaches makes very simple assumptions about the mean of the distribution, which are inconsistent with conventional econometric approaches. The ARCH method allows a conventional regression specification for the mean function, with a variance which is permitted to change stochastically over the sample period. For a comparison of several measures for U.S. data, see Engle [10].

A conventional price equation was estimated using British data from 1958-II through 1977-II. It was assumed that price inflation followed wage increases; thus the model is a restricted transfer function.

Letting $\dot{p}$ be the first difference of the log of the quarterly consumer price index and w be the log of the quarterly index of manual wage rates, the model chosen after some experimentation was

$$\dot{p} = \beta_1 \dot{p}_{-1} + \beta_2 \dot{p}_{-4} + \beta_3 \dot{p}_{-5} + \beta_4 (p - w)_{-1} + \beta_5. \tag{37}$$

The model has typical seasonal behavior with the first, fourth, and fifth lags of the first difference. The lagged value of the real wage is the error correction mechanism of Davidson, et al. [8], which restricts the lag weights to give a constant real wage in the long run. As this is a reduced form, the current wage rate cannot enter.

The least squares estimates of this model are given in Table I. The fit is quite good, with less than 1 per cent standard error of forecast, and all t statistics greater than 3. Notice that $\dot{p}_{-4}$ and $\dot{p}_{-5}$ have equal and opposite signs, suggesting that it is the acceleration of inflation one year ago which explains much of the short-run behavior in prices.

TABLE I

ORDINARY LEAST SQUARES (36)[a]

Variable	$\dot{p}_{-1}$	$\dot{p}_{-4}$	$\dot{p}_{-5}$	$(p-w)_{-1}$	Const.	$\alpha_0\ (\times 10^{-6})$	α_1
Coeff.	0.334	0.408	−0.404	−0.0559	0.0257	89	0
St. Err.	0.103	0.110	0.114	0.0136	0.00572		
t Stat.	3.25	3.72	3.55	4.12	4.49		

[a] Dependent variable $p = \log(P) - \log(P_{-1})$ where P is quarterly U.K. consumer price index. $w = \log(W)$ where W is the U.K. index of manual wage rates. Sample period 1958-II to 1977-II.

To establish the reliability of the model by conventional criteria, it was tested for serial correlation and for coefficient restrictions. Godfrey's [12] Lagrange multiplier test, for serial correlation up to sixth order, yields a chi-squared statistic with 6 degrees of freedom of 4.53, which is not significant, and the square of Durbin's h is 0.57. Only the 9th autocorrelation of the least squares residuals exceeds two asymptotic standard errors and, thus, the hypothesis of white noise disturbances can be accepted. The model was compared with an unrestricted regression, including all lagged p and w from one quarter through six. The asymptotic F statistic was 2.04, which is not significant at the 5 per cent level. When (37) was tested for the exclusion of w_{-1} through w_{-6}, the statistic was 2.34, which is barely significant at the 5 per cent but not the 2.5 per cent level. The only variable which enters significantly in either of these regressions is w_{-6} and it seems unattractive to include this alone.

The Lagrange multiplier test for a first-order linear ARCH effect for the model in (37) was not significant. However, testing for a fourth-order linear ARCH process, the chi-squared statistic with 4 degrees of freedom was 15.2, which is highly significant. Assuming that agents discount past residuals, a linearly declining set of weights was formulated to give the model

$$h_t = \alpha_0 + \alpha_1(0.4\epsilon_{t-1}^2 + 0.3\epsilon_{t-2}^2 + 0.2\epsilon_{t-3}^2 + 0.1\epsilon_{t-4}^2) \tag{38}$$

which is used in the balance of the paper. A two-parameter variance function was chosen because it was suspected that the nonnegativity and stationarity constraints on the α's would be hard to satisfy in an unrestricted model. The chi-squared test for $\alpha_1 = 0$ in (38) was 6.1, which has one degree of freedom.

One step of the scoring algorithm was employed to estimate model (37) and (38). The scoring step on α was performed first and then, using the new efficient $\hat{\alpha}$, the algorithm obtains in one step, efficient estimates of β. These are given in Table II. The procedure was also iterated to convergence by doing three steps on α, followed by three steps on β, followed by three more steps on α, and so forth. Convergence, within 0.1 per cent of the final value, occurred after two sets of α and β steps. These results are given in Table III.

The maximum likelihood estimates differ from the least squares effects primarily in decreasing the sizes of the short-run dynamic coefficients and increasing

TABLE II
MAXIMUM LIKELIHOOD ESTIMATES OF ARCH MODEL (36) (37)
ONE-STEP SCORING ESTIMATES[a]

Variable	$\dot{p}_{-1}$	$\dot{p}_{-4}$	$\dot{p}_{-5}$	$(p-w)_{-1}$	Const.	$\alpha_0\ (\times 10^{-6})$	α_1
Coeff.	0.210	0.270	−0.334	−0.0697	0.0321	19	0.846
St. Err.	0.110	0.094	0.109	0.0117	0.00498	14	0.243
t Stat.	1.90	2.86	3.06	5.98	6.44	1.32	3.49

[a] Dependent variable $p = \log(P) - \log(P_{-1})$ where P is quarterly U.K. consumer price index. $w = \log(W)$ where W is the U.K. index of manual wage rates. Sample period 1958-II to 1977-II.

TABLE III

MAXIMUM LIKELIHOOD ESTIMATES OF ARCH MODEL (36) (37)
ITERATED ESTIMATES[a]

Variables	$\dot{p}_{-1}$	$\dot{p}_{-4}$	$\dot{p}_{-5}$	$(p-w)_{-1}$	Const.	$\alpha_0\ (\times 10^{-6})$	α_1
Coeff.	0.162	0.264	−0.325	−0.0707	0.0328	14	0.955
St. Err.	0.108	0.0892	0.0987	0.0115	0.00491	8.5	0.298
t Stat.	1.50	2.96	3.29	6.17	6.67	1.56	3.20

[a] Dependent variable $\dot{p} = \log(P) - \log(P_{-1})$ where P is quarterly U.K. consumer price index. $w = \log(W)$ where W is the U.K. index of manual wage rates. Sample period 1958-II to 1977-II.

the coefficient on the long run, as incorporated in the error correction mechanism. The acceleration term is not so clearly implied as in the least squares estimates. These seem reasonable results, since much of the inflationary dynamics are estimated by a period of very severe inflation in the middle seventies. This, however, is also the period of the largest forecast errors and, hence, the maximum likelihood estimator will discount these observations. By the end of the sample period, inflationary levels were rather modest and one might expect that the maximum likelihood estimates would provide a better forecasting equation.

The standard errors for ordinary least squares are generally greater than for maximum likelihood. The least squares standard errors are 15 per cent to 25 per cent greater, with one exception where the standard error actually falls by 5 per cent to 7 per cent. As mentioned earlier, however, the least squares estimates are biased when there are lagged dependent variables. The Wald test for $\alpha_1 = 0$ is also significant.

The final estimates of h_t are the one-step-ahead forecast variances. For the one-step scoring estimator, these vary from 23×10^{-6} to 481×10^{-6}. That is, the forecast standard deviation ranges from 0.5 per cent to 2.2 per cent, which is more than a factor of 4. The average of the h_t, since 1974, is 230×10^{-6}, as compared with 42×10^{-6} during the last four years of the sixties. Thus, the standard deviation of inflation increased from 0.6 per cent to 1.5 per cent over a few years, as the economy moved from the rather predictable sixties into the chaotic seventies.

In order to determine whether the confidence intervals arising from the ARCH model were superior to the least squares model, the outliers were examined. The expected number of residuals exceeding two (conditional) standard deviations is 3.5. For ordinary least squares, there were 5 while ARCH produced 3. For least squares these occurred in '74-I, '75-I, '75-II, '75-IV, and '76-II; they all occur within three years of each other and, in fact, three of them are in the same year. For the ARCH model, they are much more spread out and only one of the least squares points remains an outlier, although the others are still large. Examining the observations exceeding one standard deviation shows similar effects. In the seventies, there were 13 OLS and 12 ARCH residuals outside one sigma, which are both above the expected value of 9. In the sixties, there were 6 for OLS, 10 for ARCH and an expected number of 12. Thus, the number of outliers for ordinary least squares is reasonable; however, the timing of their occurrence is far from random. The ARCH model comes closer to truly random residuals after standardizing for their conditional distributions.

This example illustrates the usefulness of the ARCH model for improving the performance of a least squares model and for obtaining more realistic forecast variances.

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Manuscript received July, 1979; final revision received July, 1981.

APPENDIX

PROOF OF THEOREM 1: Let

(A2) $$w_t' = (y_t^{2r}, y_t^{2(r-1)}, \ldots, y_t^2).$$

First, it is shown that there is an upper triangular $r \times r$ matrix A and $r \times 1$ vector b such that

(A2) $$E(w_t \mid \psi_{t-1}) = b + Aw_{t-1}.$$

For any zero-mean normal random variable u, with variance σ^2,

$$E(u^{2r}) = \sigma^{2r} \prod_{j=1}^{r} (2j-1).$$

Because the conditional distribution of y is normal

(A3) $$E(y_t^{2m} \mid \psi_{t-1}) = h_t^{2m} \prod_{j=1}^{m} (2j-1)$$

$$= (\alpha_1 y_{t-1}^2 + \alpha_0)^m \prod_{j=1}^{m} (2j-1).$$

Expanding this expression establishes that the moment is a linear combination of w_{t-1}. Furthermore, only powers of y less than or equal to $2m$ are required; therefore, A in (A2) is upper triangular.

Now

$$E(w_t \mid \psi_{t-2}) = b + A(b + Aw_{t-2})$$

or in general

$$E(w_t \mid \psi_{t-k}) = (I + A + A^2 + \cdots + A^{k-1})b + A^k w_{t-k}.$$

Because the series starts indefinitely far in the past with $2r$ finite moments, the limit as k goes to infinity exists if, and only if, all the eigenvalues of A lie within the unit circle.

The limit can be written as

$$\lim_{k \to \infty} E(w_t \mid \psi_{t-k}) = (I - A)^{-1} b,$$

which does not depend upon the conditioning variables and does not depend upon t. Hence, this is an expression for the stationary moments of the unconditional distribution of y.

(A4) $$E(w_t) = (I - A)^{-1} b.$$

It remains only to establish that the condition in the theorem is necessary and sufficient to have all eigenvalues lie within the unit circle. As the matrix has already been shown to be upper triangular, the diagonal elements are the eigenvalues. From (A3), it is seen that the diagonal elements are simply

$$\alpha_1^m \prod_{j=1}^{m} (2j-1) = \prod_{j=1}^{m} \alpha_1(2j-1) \equiv \theta_m$$

for $m = 1, \ldots, r$. If θ_r exceeds or equals unity, the eigenvalues do not lie in the unit circle. It must also be shown that if $\theta_r < 1$, then $\theta_m < 1$ for all $m < r$. Notice that θ_m is a product of m factors which are monotonically increasing. If the mth factor is greater than one, then θ_{m-1} will necessarily be smaller than θ_m. If the mth factor is less than one, all the other factors must also be less than one and, therefore, θ_{m-1} must also have all factors less than one and have a value less than one. This establishes that a necessary and sufficient condition for all diagonal elements to be less than one is that $\theta_r < 1$, which is the statement in the theorem. *Q.E.D.*

PROOF OF THEOREM 2: Let

$$w_t' = \left(y_t^2, y_{t-1}^2, \ldots, y_{t-p}^2\right).$$

Then in terms of the companion matrix A,

$$E(w_t \mid \psi_{t-1}) = b + Aw_{t-1} \tag{A5}$$

where $b' = (\alpha_0, 0, \ldots, 0)$ and

$$A = \begin{bmatrix} \alpha_1 & \alpha_2 & \cdots & \alpha_p & 0 \\ 1 & 0 & \cdots & 0 & 0 \\ 0 & 1 & \cdots & 0 & 0 \\ 0 & 0 & \cdots & 1 & 0 \end{bmatrix}.$$

Taking successive expectations

$$E(w_t \mid \psi_{t-k}) = (I + A + A^2 + \cdots + A^{k-1})b + A^k w_{t-k}.$$

Because the series starts indefinitely far in the past with finite variance, if, and only if, all eigenvalues lie within the unit circle, the limit exists and is given by

$$\lim_{k\to\infty} E(w_t \mid \psi_{t-k}) = (I - A)^{-1}b. \tag{A6}$$

As this does not depend upon initial conditions or on t, this vector is the common variance for all t. As is well known in time series analysis, this condition is equivalent to the condition that all the roots of the characteristic equation, formed from the α's, lie outside the unit circle. See Anderson [2, p. 177]. Finally, the limit of the first element can be rewritten as

$$Ey_t^2 = \alpha_0 \bigg/ \left(1 - \sum_{j=1}^{p} \alpha_j\right). \qquad Q.E.D. \tag{A7}$$

PROOF OF THEOREM 3: Clearly, under the conditions, $h(\xi_t) \geq \alpha_0 > 0$, establishing part (a). Let

$$\phi_{i,m,t} = E(|\partial h(\xi_t)/\partial \alpha_i| \partial h(\xi_t)/\partial \xi_{t-m} \mid \psi_{t-m-1})$$

$$= 2\alpha_m E(|\xi_{t-i}|^2 |\xi_{t-m}| \psi_{t-m-1}).$$

Now there are three cases; $i > m$, $i = m$, and $i < m$. If $i > m$, then $\xi_{t-i} \in \psi_{t-m-1}$ and the conditional expectation of $|\xi_{t-m}|$ is finite, because the conditional density is normal. If $i = m$, then the expectation becomes $E(|\xi_{t-m}|^3 \mid \psi_{t-m-1})$. Again, because the conditional density is normal, all moments exist including the expectation of the third power of the absolute value. If $i < m$, the expectation is taken in two parts, first with respect to $t-i-1$:

$$\phi_{i,m,t} = 2\alpha_m E\left\{|\xi_{t-m}| E(\xi^2_{t-i} \mid \psi_{t-i-1}) \mid \psi_{t-m-1}\right\}$$

$$= 2\alpha_m E\left\{|\xi_{t-m}| \alpha_0 + \sum_{j=1}^{p} \alpha_j \xi^2_{t-i-j}) \mid \psi_{t-m-1}\right\}$$

$$= 2\alpha_m \alpha_0 E\left\{\xi_{t-m} \mid \psi_{t-m-1}\right\} + \sum_{j=1}^{p} \alpha_j \phi_{i+j,m,t}.$$

In the final expression, the initial index on ϕ is larger and, therefore, may fall into either of the preceding cases, which, therefore, establishes the existence of the term. If there remain terms with $i+j<m$, the recursion can be repeated. As all lags are finite, an expression for $\phi_{i,m,t}$ can be written as a constant times the third absolute moment of ξ_{t-m} conditional on ψ_{t-m-1}, plus another constant times the first absolute moment. As these are both conditionally normal, and as the constants must be finite as they have a finite number of terms, the second part of the regularity condition has been established. *Q.E.D.*

To establish Theorem 4, a careful symmetry argument is required, beginning with the following lemma.

LEMMA: *Let u and v be any two random variables. $E(g(u,v) \mid v)$ will be an anti-symmetric function of v if g is anti-symmetric in v, the conditional density of $u \mid v$ is symmetric in v, and the expectation exists.*

PROOF:

$$E(g(u,-v) \mid -v) = -E(g(u,v) \mid -v) \qquad \text{because } g \text{ is anti-symmetric in } v$$

$$= -E(g(u,v) \mid v) \qquad \text{because the conditional density is symmetric.}$$

Q.E.D.

PROOF OF THEOREM 4: The i,j element of $I_{\alpha\beta}$ is given by

$$(I_{\alpha\beta})_{ij} = \frac{1}{2T}\sum_t E\left(\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \beta_j}\right)$$

$$= -\frac{1}{2T}\sum_t \sum_{m=1}^{p} E\left[\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \epsilon_{t-m}} x_{jt-m}\right] \qquad \text{by the chain rule.}$$

If the expectation of the term in square brackets, conditional on ψ_{t-m-1}, is zero for all i, j, t, m, then the theorem is proven.

$$E\left(\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \epsilon_{t-m}} x_{jt-m} \mid \psi_{t-m-1}\right) = x_{jt-m} E\left(\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \epsilon_{t-m}} \mid \psi_{t-m-1}\right)$$

because x_{jt-m} is either exogenous or it is a lagged dependent variable, in which case it is included in ψ_{t-m-1}.

$$\left|E\left(\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \epsilon_{t-m}} \mid \psi_{t-m-1}\right)\right| \le E\left(\frac{1}{h_t^2}\left|\frac{\partial h_t}{\partial \alpha_i}\right|\left|\frac{\partial h_t}{\partial \epsilon_{t-m}}\right| \mid \psi_{t-m-1}\right)$$

$$\le \frac{1}{\delta^2} E\left(\left|\frac{\partial h_t}{\partial \alpha_i}\right|\left|\frac{\partial h_t}{\partial \epsilon_{t-m}}\right| \mid \psi_{t-m-1}\right)$$

by part (a) of the regularity conditions and this integral is finite by part (b) of the condition. Hence, each term is finite. Now take the expectation in two steps, first with respect to ψ_{t-m}. This must therefore also be finite.

$$E\left(\frac{1}{h_t^2}\frac{\partial h_t}{\partial \alpha_i}\frac{\partial h_t}{\partial \epsilon_{t-m}} \mid \psi_{t-m}\right) \equiv g(\epsilon_{t-m}).$$

By the symmetry assumption, h_t^{-1} is symmetric in ϵ_{t-m}, $\partial h_t/\partial \epsilon_{t-m}$ is anti-symmetric. Therefore, the whole expression is anti-symmetric in ϵ_{t-m}, which is part of the conditioning set ψ_{t-m}. Because h is symmetric, the conditional density must be symmetric in ϵ_{t-m} and the lemma can be invoked to show that $g(\epsilon_{t-m})$ is anti-symmetric.

Finally, taking expectations of g conditional on ψ_{t-m-1} gives zero, because the density of ϵ_{t-m} conditional on the past is a symmetric (normal) density and the theorem is established. *Q.E.D.*

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PMA-R22

Econometrica, Vol. 55, No. 2 (March, 1987), 391-407

ESTIMATING TIME VARYING RISK PREMIA IN THE TERM STRUCTURE: THE ARCH-M MODEL[1]

BY ROBERT F. ENGLE, DAVID M. LILIEN, AND RUSSELL P. ROBINS

The expectation of the excess holding yield on a long bond is postulated to depend upon its conditional variance. Engle's (1982a) ARCH model is extended to allow the conditional variance to be a determinant of the mean and is called ARCH-M. Estimation and inference procedures are proposed and the model is applied to three interest rate data sets. In most cases the ARCH process and the time varying risk premium are highly significant. A collection of LM diagnostic tests reveals the robustness of the model to various specification changes such as alternative volatility or ARCH measures, regime changes, and interest rate formulations. The model explains and interprets the recent econometric failures of the expectations hypothesis of the term structure.

KEYWORDS: Term structure, financial models, ARCH, risk premium, heteroskedasticity, nonlinear models.

1. INTRODUCTION

ALTHOUGH THE VALUATION of risk is the central feature of financial economics, the standard methods for measuring and predicting risk are extraordinarily simple and unsuited for time series analysis. As the degree of uncertainty in asset returns varies over time, the compensation required by risk averse economic agents for holding these assets, must also be varying. Time series models of asset prices must therefore both measure risk and its movement over time, and include it as a determinant of price. Any increase in the expected rate of return of an asset as it becomes more risky will be identified as a risk premium.

The importance of such risk premia in the term structure of interest rates has been highlighted by a series of papers which all find the traditional expectations hypothesis inadequate to explain the observed data. For some recent examples see Shiller (1979, 1981), Sargent (1979, 1972), Shiller, Campbell, and Schoenholtz (1983), Mankiw and Summers (1984), and Campbell (1984). Some of these are based upon tests which find the variance of long term rates too large to be consistent with the expectations hypothesis. Others are based on regression tests which essentially show that the implicit predictors of future interest rates, derivable from the term structure, are inefficient and biased. Information available at the time could have improved the accuracy of the forecasts. Stated another way, these tests find that the one period rate of return which should, ex ante, be unforecastable, could have been predicted using available information.

These findings are generally interpreted as implying either some form of less than fully rational expectations, or time varying premia on different term debt. Attempts by Shiller, Campbell, and Schoenholtz (1983) and Mankiw and Summers (1984) to model particular forms of irrational expectations were unsuccessful.

[1] The authors are indebted to many for helpful comments including Bob Shiller, Larry Summers, Clive Granger, Ross Starr, Ken Wallis, David Hendry, Larry Weiss, and James Tobin, but retain responsibility for remaining errors. Computations were carefully carried out by Tim Bolleralev and Yoahi Baba.

Consequently, the main thrust of this literature is to introduce the possibility of time varying term premia. Amsler (1984) and Pesando (1983) have extended Shiller's variance bounds to allow time varying term premia. Campbell (1984) and Mankiw and Summers (1984) estimate or derive statistics about the required properties of time varying term premia. The latter conclude: "Most of the changes in the slope of the yield curve reflect these changing liquidity premiums or expectations that do not satisfy the standard postulates of rationality. These results suggest the importance of developing models capable of explaining fluctuating liquidity premiums."

The key postulate in the current paper is that time varying premia on different term debt instruments can be well modeled as risk premia where the risk is due to unanticipated interest rate movements and is measured by the conditional variance of the one period holding yield. While this is in the spirit of Bodie, Kane, and McDonald (1983) and Fama (1976), new econometric techniques are needed to estimate and test this model and these are developed here.

The autoregressive conditional heteroscedasticity (ARCH) model introduced by Engle (1982a), explicitly models time varying conditional variances by relating them to variables known from previous periods. In its standard form the ARCH model expresses the conditional variance as a linear function of past squared innovations; in markets where price is a Martingale, price changes are innovations, and this corresponds precisely to the Mandlebroit (1963) observation: "Large changes tend to be followed by large changes—of either sign—and small changes tend to be followed by small changes . . ." The ARCH model is used to provide a rich class of possible parameterizations of heteroscedasticity.

This paper introduces the ARCH-M model which extends the ARCH model to allow the conditional variance to affect the mean. In this way changing conditional variances directly affect the expected return on a portfolio. This resolves many of the empirical paradoxes in the term structure. Variables which apparently were useful in forecasting excess returns are correlated with the risk premia and lose their significance when a function of the conditional variance is included as a regressor. Furthermore, the heteroscedasticity in the disturbances had biased the test statistics, leading to the false finding of significant variables.

This model is applied to six month treasury bills, to two month treasury bills, and to 20 years Aaa corporate bonds to determine whether there appear to be time varying risk premia and how large they are. Section 2 develops a theoretical model of the relationship between means and variances which is formulated as a statistical model in Section 3. Section 4 describes the ARCH-M model and Sections 5 and 6 present the applications. Section 7 is a summary.

2. A MODEL OF THE RELATION BETWEEN RISK AND RETURN

Risk averse economic agents require compensation for holding risky assets. In the simplest set-up of one risky asset with normally distributed returns and one riskless asset, the risk is measured by the variance of the returns from holding the asset, and the compensation by a rise in the expectation of the return. The relation between the mean and the variance of the returns which will insure that the asset is fully held in equilibrium will depend upon the utility function of the agents and the supply conditions of the assets.

To investigate this relation we now suppose that in this two asset economy the variance of the payoff of the risky asset may change over time and consequently the price offered by risk averse agents will change over time. This equilibrium price determines the relation between the mean and variance of the excess returns from holding the risky asset and therefore how the risk premium is related to the variance of the returns.

Consider a world with two assets, one has price 1 and is perfectly elastically supplied at a sure total rate of return r. The other has a price p and yields a random total return q (denominated in units of the numeraire) which has mean θ and variance ϕ. Wealth W, measured in units of the riskless asset, is therefore allocated between shares of the sure asset x, and shares of the risky asset s, so that

$$W = ps + x. \tag{1}$$

The excess return per dollar invested in shares of the risky asset is given by

$$y = (q/p) - r,$$

so that the mean and variance of the excess returns is given by

$$E(y) = \mu = (\theta/p) - r, \qquad V(y) = \sigma^2 = \phi/p^2. \tag{2}$$

Agents maximize expected utility of the end-of-period wealth, which, assuming normality of the returns, means that only the first two moments of the distribution matter. Under constant absolute risk aversion, expected utility can be expressed by:

$$EU = 2E(qs + rx) - bV(qs + rx)$$

and it will be maximized by choosing

$$sp = \mu/(b\sigma^2). \tag{3}$$

Now suppose ϕ has a time subscript and is known to agents although not to the econometrician. Then the equilibrium values of p, μ, σ^2, and s will also vary over time. If in equilibrium the *value* of the outstanding shares of the risky asset remains constant, then the mean return will be proportional to the variance of returns since $s_t p_t$ in (3) is a constant.

A convenient assumption is that the riskless asset is held in zero net supply so that r becomes endogenous. The value of the outstanding shares of the risky asset is simply W. The mean and variance will therefore be proportional regardless of the supply elasticity of s if both wealth and b are constant. Such a model, however, leaves no role for price in evaluating risk.

If, instead, the physical number of shares is fixed so that $s_t = s$ and r is fixed, then in equilibrium (4) can be rewritten

$$\mu_t^2 + \mu_t r_t = bs\sigma_t^2 \theta$$

and, suppressing time subscripts,

$$\mu = [-r + \sqrt{r^2 + 4bs\sigma^2\theta}]/2 \tag{4}$$

so that the mean will be zero when the variance is zero, the slope is always positive, and for large variance the mean is proportional to the standard deviation. Thus if ϕ varies over time, but r, s, and θ do not, the econometrician should expect to see a relation between observed means and variances of returns which makes them move in the same direction but not proportionally.

For more general utility functions b will itself be a function of other variables such as σ^2. Thus we can replace b in (4) with $b(\sigma^2)$. Furthermore, there may be some elasticity of supply of the risky asset so that

$$s = f(p) = f(\theta/(\mu + r))$$

can be substituted for s. With these two flexible functions it is possible to find a wide range of relationships between observed means and variances.

Thus in general, one might expect the mean to increase less than in proportion to the variance with the precise relation determined by the supply elasticity of the risky (and possibly the riskless) asset and the risk preferences of agents. This paper introduces some empirical evidence on this relationship.

3. FORMULATION OF THE MODEL

Letting μ_t be the risk premium, y_t the excess holding yield on a long bond relative to a one period treasury bill, and ε_t the difference between the ex ante and ex post rate of return which in efficient markets would be unforecastable,

$$y_t = \mu_t + \varepsilon_t, \qquad \text{Var}(\varepsilon_t | \text{all available information}) = h_t^2. \tag{5}$$

It is assumed that the risk in holding a long bond is not diversifiable so that only the variance matters. The initial specification takes the mean as a linear function of the standard deviation:

$$\theta_t = \beta + \delta h_t. \tag{6}$$

A nonzero value of β might reflect the linearization of a nonlinear function such as that derived above, or a preferred habitat argument. The choice of the standard deviation represents the assumption that changes in variance are reflected less than proportionally in the mean. Empirically, the log of h_t is found to be even better.

A complication in the interpretation of θ_t arises from the differential tax treatment of capital gains and interest income. Under the tax laws, long term capital gains are taxed at a lower rate than ordinary interest income and short term capital gains. This feature of the tax system makes a strategy of investing in long term bonds more desirable than rolling over short term paper. Investors can, to a large extent, treat one period capital losses as ordinary income for tax purposes by selling the bond and realizing their losses. Short term capital gains can be turned into long term capital gains for tax purposes by holding the bond for a year or longer. Because this choice can be made ex post, after Y_t is observable, risk neutral investors should be willing to hold long term bonds at a lower expected pre tax yield than is paid on treasury bills. This tax advantage may explain the fact that the average value of Y_t for many types of long term bonds, has been below the average short term treasury bill rate over the last 30 years. We might therefore expect $\beta < 0$.

To complete the specification of the model, h_t^2, the conditional variance, must be parameterized as a function of the information set available to investors. We assume that the most useful information to agents are the previous innovations or surprises ε_t. If these have been large in absolute value then, extending Mandlebroit's observation, they are likely to be large in the future. In its simplest form we postulate that

$$(7) \qquad h_t^2 = \alpha_0 + \alpha_1 \sum_{i=1}^{p} w_i \varepsilon^2_{t-i}.$$

The conditional variance as observed by both the economic agents and the econometrician is a weighted sum of past squared surprises. One can discount older innovations in this weighting scheme.

Other variables which are in the information set at time t could also be introduced into (7) in the fashion of more traditional heteroscedasticity corrections. One such suggestion would be to use the squared changes in price as analyzed by Mandlebroit. Such a specification misses the fact that in the bond market a portion of the price change may be anticipated and this information is unlikely to be useful in forecasting changes in variance.

In the next section, the estimation and testing of the model in (5), (6), and (7) is considered in a more general context. In the following three empirical analyses, many of the caveats discussed above are then put to test.

4. ESTIMATING AND TESTING THE ARCH-M MODEL

The economic model described in the previous section incorporates an important extension of Engle's (1982a) ARCH model or in fact any heteroscedastic model; not only are the disturbances heteroscedastic, but the standard deviation of each observation affects the mean of that observation. In this section the estimation and testing of such models, called ARCH in mean or ARCH-M models, is discussed.

The general setup is given by

$$(8) \qquad Y_t \mid X_t, \Pi_t \sim N(\beta' X_t + \delta h_t, h_t^2),$$

$$(9) \qquad h_t^2 = \alpha' W_{\eta t} + \gamma' Z_t,$$

where X_t and Z_t are $k \times 1$ and $j \times 1$ vectors of weakly exogenous and lagged dependent variables, as in Engle, Hendry, and Richard (1983). The vector Z_t includes a constant whose coefficient represents the constant variance component of h_t. The $p \times 1$ vector $\eta_t' = (\varepsilon^2_{t-1}, \ldots, \varepsilon^2_{t-p})$ where ε_t are the disturbances given by $Y_t - \beta' X_t - \delta h_t$. The matrix W is a $q \times p$ array of fixed constants which may be used to impose restricted parameterizations on the response of the conditional variance to past squared residuals. In the most unrestricted case, W would be the identity matrix. The variance parameter vectors α and γ are therefore $q \times 1$ and $j \times 1$ respectively while the mean parameter vectors β and δ are $k \times 1$ and 1×1. These parameters can be combined into $\phi' = (\alpha', \gamma', \beta', \delta)$, an $m \times 1$ vector where $m = q + j + k + 1$.

Conditional on the initial values of all the data, the log likelihood function can be expressed as

$$(10) \qquad L(\phi) = \sum_t L_t(\phi); \quad L_t(\phi) = -\log h_t - \varepsilon_t^2 / 2h_t^2.$$

In practice, the presample values of the disturbances are set to their expectation, zero. The first order conditions for a maximum of this likelihood are given by:

$$(11) \qquad \partial L_t / \partial \phi = \sum ([\varepsilon_t^2 - h_t^2 - h_t \delta \varepsilon_t] h_t^{-4}) \, \partial h_t^2 / \partial \phi / 2 \\ - \sum [\varepsilon_t / h_t^2][\partial \beta' / \partial \phi$$

The derivatives of the parameters with respect to ϕ are simply matrices with zeros and ones which select which terms to include for each derivative. The second line of (11) is the term relevant for GLS estimation of the regression coefficients without ARCH complications, that is when $\alpha = 0$. The expression in (11) gives the standard ARCH model when δ is zero.

The primary complexity introduced in this model comes in evaluating $\partial h^2 / \partial \phi$. From (9) this depends upon the derivatives of previous innovations with respect to the parameters. Yet these derivatives in turn depend upon the past derivatives of h with respect to the parameters if δ is nonzero. The desired derivatives must be computed recursively from an assumption that the initial values do not depend upon the parameters.

In the early analyses presented in Engle, Lilien, and Robins (1982) summarized in Section 5, analytical derivatives were calculated recursively and used to evaluate (11). However, numerical derivatives gave similar results, were simpler to compute and gave added flexibility to changes in specification. They therefore are probably the preferred approach for the ARCH-M model.

Estimation and testing can simply be carried out in terms of these derivatives. $\partial L / \partial \phi$ can be written compactly in terms of the $T \times m$ array S with typical element

$$[S]_{ti} = \partial L_t / \partial \phi_i$$

as

$$(12) \qquad \partial L / \partial \phi = S' i$$

where i is a $T \times 1$ unit vector so the first order condition is simply

$$S' i = 0.$$

The Hessian of the log likelihood is the sum of the Hessians of the t conditional log likelihoods, L_t. Under the assumption that the likelihood function is correctly specified,

$$\mathcal{I}_t = E[\partial L_t/\partial \phi \; \partial L_t/\partial \phi'] = -E[\partial^2 L_t/\partial \phi \; \partial \phi']$$

where $\mathcal{I}_t$ is the information matrix of the tth observation. Defining the information in the sample $\mathcal{I}$ is the average of the information over each observation,

$$\mathcal{I} = E[S'S/T].$$

Under slightly stronger conditions, $S'S/T$ is also consistent for $\mathcal{I}$.

A ready solution to the maximization of this likelihood function is to adopt the Berndt, Hall, Hall, Hausman (1974) approach using the iteration

$$\phi^{i+1} = \phi^i + \lambda (S'S)^{-1} S'i \tag{13}$$

with λ as a step length which is adjusted from its a priori value of unity by a simple line search, and S as the matrix of first derivatives evaluated at ϕ^i.

The likelihood is in the form analyzed by Crowder (1976). Under sufficient regularity conditions, a solution to (13) will have the property that

$$(S'S)^{1/2}(\phi^* - \phi^0) \overset{A}{\sim} N(0, I) \tag{14}$$

where ϕ^* is the maximum likelihood estimator obtained from (13) and ϕ^0 is the true value of the parameters. Unlike the simple ARCH model, this information matrix is not block diagonal between the parameters of the mean and the parameters of the variance.

Pantula (1984) has carefully investigated regularity conditions sufficient to guarantee (14) in the simple first order ARCH case. His conditions are stronger than can be accepted for this study in that he requires the existence of eighth order moments of the disturbance which are only finite for very small values of the ARCH parameter. Weiss (1986) has suggested some slightly weaker conditions; however, neither has addressed the ARCH-M model. Thus the appropriateness of the asymptotic distribution theory for this analysis remains a conjecture at this point.

Subject to the above caveat, inference procedures are available directly from (14). In particular, Wald tests can be computed in standard fashion. Lagrange multiplier tests can be simpler if the model has already been estimated under the null hypothesis and are easily constructed from the matrix of scores, S. Suppose the null hypothesis specifies that $\phi \in \Phi^0$ which is a proper subset of Φ. Denote by S^0 the matrix of scores calculated assuming the more general model to be true, but evaluated at the parameter estimates under the null. The scores corresponding to the restricted parameters are the Lagrange multipliers, and their variances are given by the information matrix. The LM test can be constructed as

$$\begin{aligned} \Phi_{LM} &= i'S^0(S^{0\prime}S^0)^{-1}S^{0\prime}i \\ &= TR_0^2 \end{aligned} \tag{15}$$

where R_0^2 is the uncentered R^2 achieved by regressing the unit vector on the matrix of scores under the null. This statistic will asymptotically be chi squared with the number of degrees of freedom of the restriction when the null is true. This is easily computed from the R^2 of the first iteration of (13) starting from the estimates found under the null. Thus the tests take a form familiar from Engle (1982b, 1984) and it is recommended to construct a battery of diagnostics to convey information on the validity of the model both to the user and the reader.

The LM tests are convenient for testing restrictions in either the mean or the variance specification since reestimation may be costly and convergence is sometimes unsure. Tests are easily constructed for variables excluded from the mean such as interest rates or other functional forms. It is just as simple to test variance restrictions such as $\alpha = 0$, α is a set of linearly declining weights, or elements of γ are equal to zero (thereby testing for variables excluded from h). Many of the variance tests, however, may be interpreted as being on the boundary of the admissible parameter space so that one-tailed tests or other adjustments may be appropriate.

For the preferred models in this study h_t depended only on the intercept and a weighted average of past squared innovations where the weights are assumed to be linearly declining. These strong restrictions are subjected to a great variety of tests which allow changes in slope, seasonal spikes, freely estimated coefficients, and a wide variety of observable variables such as interest rates, volatility, and dummy variables for policy regimes. The models generally accept the more parsimonious specification at reasonable significance levels either because they are close to the true specification or because there is little power in the data to discriminate between alternative variance formulations. If the models with less restricted parameterizations are iterated toward convergence (for example to calculate a Wald or a likelihood ratio test) we found it difficult to prevent nonnegativities in the parameters regardless of the types of penalty functions or transformations considered. In this case there were likely to be many local maxima and generally the likelihood was ill-behaved. Thus the imposition of a parsimonious specification for the variance function such as linearly declining weights appears to be statistically supportable, computationally useful, and economically sensible.

5. THE RESULTS FOR SHORT TERM T-BILLS

Using Salomon Brothers data from the Analytical Record of Yields from 1960 through 1984 II on 3 and 6 month treasury bills, the excess holding yield, y_t, was calculated as:

$$y_t = [(1+R_t)^2/(1+r_{t+1})] - (1+r_t)$$

which is approximately

$$y_t \approx 2R_t - r_{t+1} - r_t$$

where R_t is the yield on a six month bill and r_t is the three month yield, each measured at the beginning of the quarter.

Regressing the excess holding yield on a constant gives

$$(16)\qquad \underset{(4.04)}{y_t = .142} + e_t, \qquad s = .351,$$

$$L = 51.1.$$

Thus, the mean of the excess holding yield over the sample period is .142 per cent at quarterly rates or .568 per cent at annual rates. The standard deviation is .35 at quarterly rates. From the linearized expression for the excess holding yield above, the average yield spread was half .568 per cent or .284 per cent at annual rates. The maximum return on a three month balanced portfolio obtained by borrowing at the three month rate and lending at the six, was 8.2 per cent at annual rates. The worst return occurred in the subsequent quarter and was −3.1 per cent. The rates of return from such portfolios are quite erratic and, as expected, are not large especially if transaction costs are important in forming these portfolios.

A glance at the solid line in Figure 1 confirms the changes in variance which are hypothesized by the ARCH-M model to account for the changing risk premia. The vertical axis is measured in quarterly percentage rates of return. Clearly, the period subsequent to the 1979 change in operating procedures shows substantially more variability than earlier periods; however, there are also earlier episodes of increased variability. Regressing the squared residuals on a fourth order linearly declining weighted average of past squared residuals gives the ARCH test as $TR^2 = 10.1$ which would be X_1^2 if there were no ARCH. There is clearly strong evidence of heteroscedasticity in the errors.

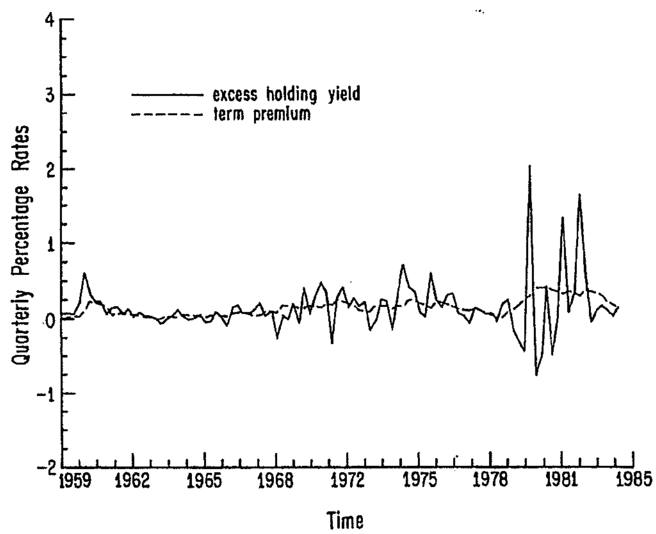

FIGURE 1—Excess hold yield of 6 month Treasury Bills and estimated risk premia.

Regressing the excess holding yield on a constant and allowing ARCH disturbances of fourth order gives:

$$(17)\qquad \underset{(3.77)}{y_t = .048} + e_t, \qquad h_t^2 = \underset{(.95)}{.004} + \underset{(7.3)}{1.90} \sum_{\tau=1,4} w_\tau \varepsilon_{t-\tau}^2$$

$$L = 85.17, \qquad w_\tau = (5-\tau)/10 \qquad (\tau = 1, \ldots, 4).$$

The ARCH effect is very strong, showing a t statistic of 7.3. The magnitude is also very large as values over 1 imply nonstationary variance processes. The estimate of the mean changes dramatically when the high variance periods are given less weight in the regression; the constant term premium falls to .048 per cent at a quarterly rate or .2 per cent at annual rates.

The time varying risk premium has been swept into the disturbance term in (17) and represents misspecification. The hypothesized true model, as presented in Section 2, can be formalized as:

$$(18)\qquad y_t = \beta + \delta h_t + \varepsilon_t,$$

$$\varepsilon_t/\text{past information} \sim N(0, h_t^2),$$

$$h_t^2 = \gamma + \alpha \sum_{\tau=1,4} w_\tau \varepsilon_{t-\tau}^2, \qquad w_\tau = (5-\tau)/10 \qquad (\tau = 1, \ldots, 4).$$

The maximum likelihood estimates and their t statistics are:

$$(19)\qquad y_t = \underset{(-1.29)}{-.0241} + \underset{(5.15)}{.687}\, h_t + e_t,$$

$$h_t^2 = \underset{(1.08)}{.0023} + \underset{(6.30)}{1.64} \sum w_\tau \varepsilon_{t-\tau}^2,$$

$$L = 96.34, \qquad w_\tau = (5-\tau)/10 \qquad (\tau = 1, \ldots, 4).$$

As can be easily seen, all the slope coefficients are highly significant, indicating that there is not only an ARCH effect ($\alpha \neq 0$), but also a time varying risk premium ($\delta \neq 0$). The expected riskless return is negative but not significantly so and the minimum possible expected return which would be achieved if all recent forecasts had been precisely correct, is very small and positive (.0009). The risk premium is two thirds of the standard deviation of the return, which is quite substantial, indicating stronger risk aversion by the borrowers than the lenders in this market.

The parameter in the ARCH equation is above one which implies that the unconditional variance of the excess holding yield is infinite with a fat tailed distribution. The conditional distribution,which for most purposes is the relevant distribution, is of course still normal with a finite variance. An arbitrarily large return could occur if a sufficiently long string of innovations were all large. Such an episode would be easily reversed by a number of innovations near their median value of zero. Simulations of this situation show rather sensibly behaved series with larger bursts of volatility than would be expected from a marginally normal random variable. It is possible that the maximum likelihood estimates will not have their standard properties, but, as in the unit root case, they may have superior convergence rates and correctly calculated standard errors. As mentioned in the previous section, the asymptotic distribution theory for this problem remains to be solved. The infinite unconditional variance may be related to the frequent failures of the variance bounds tests for interest rates.

A series of diagnostic tests were calculated for the model in (19). Although several were significant, the tests for the functional relationship between the risk and rate of return are of particular interest. LM tests for omitted variables h_t^2, $\exp(h_t)$, and $\log(h_t)$ were computed to test the assumed linearity between the standard deviation and mean of returns. Economic theory has little to say on the nature of this trade-off as it presumably depends on the risk preferences of the traders. Only the log variable was significant with a test statistic of 4.13. Estimating the model with both h_t and $\log(h_t)$ produced t statistics of 2.0 on the log and $-.4$ on the level and a log likekihood of $L=101.62$, thereby confirming that the model with the log of standard deviation is superior to that in the level of the standard deviation.

The final preferred model is therefore:

$$(20)\qquad \begin{aligned} y_t &= \underset{(4.38)}{.355} + \underset{(3.36)}{.135} \log h_t + e_t, \\ h_t^2 &= \underset{(2.22)}{.005} + \underset{(5.56)}{1.48} \sum_{\tau=1,4} w_\tau \varepsilon_{t-\tau}^2, \\ L &= 101.35, \qquad w_\tau = (5-\tau)/10. \end{aligned}$$

In this model all the coefficients are significant and the log likelihood is substantially above that of (19). The minimum term premium occurring when all past innovations are zero is now a very small negative value of $-.008$ per cent at quarterly rates.

Several sets of diagnostic tests were performed with this model as well. These are summarized in Table I. Volatility is defined by:

$$\text{Volatility} = \sum_{\tau=1,4} w_\tau y_{t-\tau}^2, \qquad w_\tau = (5-\tau)/10,$$

so that it differs from the ARCH variance by the time varying risk premium. One would expect that the weighted average of residuals would give a better estimate of the true residual variance than the same function of the dependent variable; however there is no guarantee. Table I shows the robustness of the model in (20) to a variety of types of misspecification. None of the tests is significant at the 5 per cent level. The tests check for nonlinearities in the risk premium, volatility, structural shifts in October 1979, and misspecifications of the ARCH process through omitted variables or inappropriately applied constraints. The ARCH model with log Volatility alone achieves only log likelihood $L=98.4$ although the significance and size of the variables is nearly the same as in (20).

The economically most interesting test is that for the yield spread and we turn to a more careful analysis of this model. Mankiw and Summers (1984) (MS) find that the yield spread is a significant and positive determinant of the excess holding

TABLE I
DIAGNOSTIC TESTS FOR ARCH-M MODEL (20)

Variable	TR^2		Distribution
Variables Omitted from the Mean			
h_t	.31	~	χ_1^2
h_t^2	1.67	~	χ_1^2
Volatility	1.44	~	χ_1^2
Log Volatility	.50	~	χ_1^2
Post October 1979 Dummy	.38	~	χ_1^2
r_t	.60	~	χ_1^2
R_t	.83	~	χ_1^2
$R_t - r_t$	2.92	~	χ_1^2
y_{t-1}	.14	~	χ_1^2
y_{t-4}	3.38	~	χ_1^2
Variables Omitted from the Variance			
Volatility	.27	~	χ_1^2
Post October 1979 Dummy	.07	~	χ_1^2
r_t	1.64	~	χ_1^2
R_t	1.60	~	χ_1^2
$R_t - r_t$	.90	~	χ_1^2
ε_{t-1}^2	.31	~	χ_1^2
ε_{t-4}^2	.62	~	χ_1^2
$\varepsilon_{t-1}^2, \varepsilon_{t-2}^2, \varepsilon_{t-3}^2$	3.11	~	χ_3^2
$\sum w_\tau \varepsilon_{t-\tau}^2$, $w_\tau = (13-\tau)/78$, $\tau = 1, \ldots, 12$	.76	~	χ_1^2

yield. This implies a failure in the expectations hypothesis and a failure of an alternative hypothesis that long rates are overly sensitive to short rates. Our data set gives the following least squares estimate for this model:

$$y_t = -.50 + 2.44\,(R_t - r_t) + e_t, \qquad \sigma = .312. \tag{21}$$
$$(-1.10)\,(5.46)$$

The corresponding coefficient and t statistic in MS for the yield spread are 1.72 and 3.1 respectively. Their data set is a little shorter, from a different source and embodies the Shiller linearizations.

Adding the yield spread to model (20) gives:

$$y_t = .325 + .130 \log h_t + .392\,(R_t - r_t) + e_t, \tag{22}$$
$$(4.28)\,(3.59) \qquad (2.58)$$
$$h_t = .004 + 1.64 \sum w_\tau \varepsilon_{t-\tau}^2,$$
$$(1.38)\quad(4.86)$$
$$L = 103.48, \qquad w_\tau = (5-\tau)/10 \qquad (\tau = 1, \ldots, 4).$$

It now can be seen that by both Wald and LR tests the yield spread is a significant determinant at the 5 per cent but not 1 per cent level and by the LM test it is significant at the 10 per cent but not 5 per cent level. By economic standards the size of the coefficient on the yield spread has fallen dramatically from the least

TABLE II
ESTIMATES OF VARIOUS ARCH-M MODELS
EXCESS HOLDING YIELD OF 6 MONTH T-BILLS

Indep	59.1–84.2	59.1–71.3	71.4–84.2	59.1–79.3	61.3–74.1
Log h_t	.135 (3.36)	.092 (3.88)	.196 (2.40)	.177 (2.96)	.093 (2.01)
Const.	.355 (4.38)	.272 (4.31)	.455 (3.36)	.446 (3.72)	.261 (2.52)
ARCH α	1.48 (5.56)	1.67 (5.15)	1.49 (3.57)	1.25 (4.60)	1.20 (2.84)

squares fit. The rest of the parameter estimates are very close to those obtained before in (20). Economically, it is not surprising to find some residual effect in the yield spread. The expected value of the spread is approximately proportional to the risk premium this period. Since it is highly autocorrelated, it will be a very good predictor of the risk premium next period. If information other than past innovations is useful in forecasting risk premia, then one might expect to find a significant coefficient on the past yield spread. A useful extension would be to allow the yield spread to directly influence the variance and consequently to indirectly influence the risk premium.

As much of the variance in interest rates is concentrated at the end of the sample period, the model was reestimated using subsets of the data. Surprisingly, the results are relatively insensitive to the sample period both in magnitude and in significance. See Table II.

Figure 1 plots the excess holding yield and the estimated risk premium. The scale is in quarterly percentage rates of return. The term premium rises to its highest value (.41 per cent quarterly or 1.64 per cent annual rates) in the fourth quarter of 1980. Over the sample period there are two values which are very slightly negative. On average, the term premium is .14 per cent. Although the most interesting and noticeable rise in the term premium is 1979–1984, there are also relative increases in 1960, 1972, and 1975, each of which is accompanied by an increase in volatility of the excess holding yield.

6. MODELLING OTHER INTEREST RATES

Two additional interest rate series have been modelled using the ARCH-M model and more are in progress. The first is the monthly data set constructed by Fama (1976) on two month vs. one month treasury bills from 1953.1 to 1971.7. The data set differs from that used above in the sampling interval and in the sample period. In this case the holding period is naturally taken to be one month rather than one quarter and consequently the riskless asset is the one month treasury bill rather than two or three month treasury bills. If a quarter is the correct interval, then shorter lived assets must be rolled over at uncertain rates and therefore, the short term asset would be the risky one. For a theoretical discussion of these issues see Woodward (1983).

The model in (18) was estimated directly although a longer lag was allowed in the ARCH process to give a comparable memory to the variance estimator. The results are:

$$(23) \qquad \underset{(-1.2)}{y_t = -.00052} + \underset{(4.7)}{.80}\, h_t, \qquad h_t^2 = c_0 + \underset{(8.6)}{1.13} \sum_{\tau=1,12} w_\tau \varepsilon_{t-\tau}^2,$$

$$w_\tau = (13-\tau)/78 \qquad (\tau = 1, \ldots, 12).$$

These are quite similar to those in equation (19) where in both cases the ARCH parameters are in the explosive range and the coefficient of the standard deviation is highly significant with a value of .69 before and .8 here. The estimated risk premium is plotted in Figure 2.

A somewhat different result was obtained using 20 year AAA corporate bonds from 1953.1 to 1980.2. Assuming that the bonds are effectively infinitely lived, the one quarter excess holding yield can be expressed in terms of the quarterly yield to maturity, R_t, and the three month treasury bill rate, r_t:

$$y_t = R_t - r_t - 1 + R_t / R_{t+1}.$$

The average return from holding long term bonds and borrowing at the t-bill rate is $-.75$ per cent at quarterly rates or -3 per cent at annual rates. Thus bond holders have taken a loss over this sample period in spite of the fact that the average long term rate was 5.9 per cent while the short term rate was only 4.6 per cent. This is a consequence of unexpected increases in interest rates possibly due to unexpected acceleration of inflation.

Maximum likelihood estimation of (18) produced:

$$(24) \qquad y_t = \underset{(-2.2)}{-2.8} + \underset{(1.6)}{.505}\, h_t, \qquad h_t^2 = c_0 + \underset{(2.6)}{.75} \sum_{\tau=1,4} w_\tau \varepsilon_{t-\tau}^2,$$

$$w_\tau = (5-\tau)/10 \qquad (\tau = 1, \ldots, 4),$$

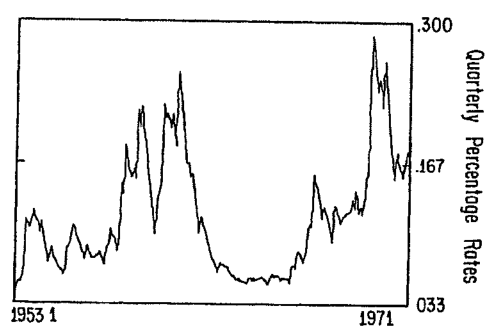

FIGURE 2—Conditional standard errors of one month forward rates.

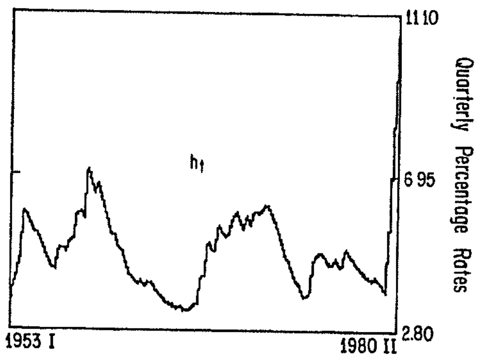

FIGURE 3—Conditional standard errors of quarterly holding yields for Moody's Aaa bond.

for the fourth order ARCH-M model, and

$$(25)\qquad \underset{(-2.4)(1.9)}{y_t = -3.3 + .651\, h_t}, \qquad h_t^2 = c_0 + \underset{(3.4)}{.86} \sum_{\tau=1,12} w_\tau \varepsilon_{t-\tau}^2,$$

$$w_\tau = (13-\tau)/78 \qquad (\tau = 1, \dots, 12),$$

for the twelfth order model.

These estimates differ from the short end of the spectrum in that they no longer exhibit the explosive ARCH parameter, the coefficient on the risk premium is roughly the same size but has a larger standard error, and the intercept is considerably more negative. When (25) is estimated on data prior to 1978, the coefficient on h_t rises slightly to .84 but the t statistic falls to 1.7. Thus the same model appears to be appropriate; however, the significance falls due to the omission of the highly volatile period of 1979 and 1980. The estimated risk premium is plotted in Figure 3.

Further analysis of these two series is contained in Engle, Lilien, and Robins (1982).

7. CONCLUSIONS

The precision with which agents can predict the future varies significantly over time. In relatively quiet periods, like the mid-1960's, relatively accurate forecasts can be made and agents can speculate on the future without absorbing large risks. In volatile periods, like the early 1970's and early 1980's, forecasts are less certain and speculation is riskier. Risk premia therefore adjust to induce investors to absorb the greater uncertainty associated with holding the risky asset.

In this paper we have extended the simple ARCH technique of measuring conditional variances to the ARCH-M model where the conditional variance is a determinant of the current risk premium, and thus enters the forecasting equation of expected financial returns. Our results from applying this model to three different data sets of bond holding yields are quite promising. ARCH was clearly present in the forecast errors of bond holding yields indicating substantial variation in the degree of uncertainty over time. This measure of uncertainty proved very significant in explaining the expected returns in two of the data sets, and was significant only at slightly more than the 5 per cent level for the third. We therefore conclude that risk premia are not time invariant; rather they vary systematically with agent's perceptions of underlying uncertainty.

While our initial results suggest the promise of the ARCH technique to applications that require the measurement of uncertainty, we feel that the current model is but a first step. The ARCH framework may be applied to more general models of uncertainty and risk. For example, the capital asset pricing model suggests that risk premia are not a function of simple risk, but rather of undiversifiable risk. Risk premia therefore depend on the covariance of asset returns with the returns of the market as a whole. The general ARCH framework may be extended to allow conditional covariances to vary, resulting in time varying risk betas. Such a model is beyond the scope of the current paper and is mentioned to give some indication of possible extensions of our much simpler approach.

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Manuscript received February, 1982; revision received February, 1986.

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PMA-R23

J Regul Econ (2011) 40:261–278
DOI 10.1007/s11149-011-9160-5

ORIGINAL ARTICLE

New approach to estimating the cost of common equity capital for public utilities

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Published online: 26 August 2011

Abstract The regulatory process for setting public utilities' allowed rate of return on common equity has generally used the Gordon DCF, CAPM and Risk Premium specifications to estimate the cost of common equity. Despite the widely known problems with these models, there has been little movement to adopt more recently developed asset pricing models to provide additional evidence for estimating the cost of capital. This paper presents, validates empirically and applies a general yet simple consumption-based asset pricing specification to model the risk-return relationship for stocks and estimate the cost of common equity for public utilities. The model is not necessarily superior to other models in its practical results, yet these results do indicate that it should be used to provide additional estimates of the cost of common equity. Additionally, the model raises doubts as to whether assets such as utility stocks are a consumption (business cycle) hedge.

Keywords Public utilities · Cost of capital · GARCH · Consumption asset pricing model

JEL Classification G12 · L94 · L95

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1 Introduction

Following electricity deregulation with the National Energy Policy Act of 1992, the estimation of the cost of common equity capital remains a critical component of the utility rate-of-return regulatory process. Since the cost of common equity is not observable in capital markets, it must be inferred from asset pricing models. The models that are commonly applied in regulatory proceedings are the Gordon (1974) Discounted Cash Flow (DCF), the Capital Asset Pricing (CAPM) and Risk Premium Models. There are other tools used to estimate the cost of common equity such as comparable earnings or earnings-to-price ratios, but they are not asset pricing models. The empirical literature on the CAPM is vast {Fama and French (2004)} and the CAPM is used by a number of US regulatory jurisdictions. The DCF model has not been empirically tested to the same extent as the CAPM, yet it is considered by many US regulatory jurisdictions.

The purpose of this paper is to present, test empirically and apply a recently developed general consumption-based asset pricing model that estimates the risk-return relationship directly from asset pricing data and, when estimated with recently developed time series methods, produces a prediction of the equity risk premium that is driven by its predicted volatility. The predicted risk premium is then added to a risk-free rate of return to provide an estimate of the cost of common equity. We predict two forms of the equity risk premium with the model, the risk premium net of the risk-free rate and the equity-to-debt risk premium (equity risk premium net of the relevant bond yield for the company's stock). Either can be applied to predict the common equity cost of capital for a public utility. Although the model is tested and applied to public utilities for rate of return regulation, it can be used to estimate the cost of capital for any stock. Section 2 reviews the asset pricing models typically used in public utility rate cases and the generalized consumption asset pricing model we propose to estimate the cost of common equity. Section 3 discusses the data and the empirical testing of the consumption asset pricing model. Section 4 reviews the application of the model and compares it with the DCF and CAPM results. Section 5 is the conclusion.

2 DCF, CAPM and consumption asset pricing model

2.1 DCF and CAPM approaches

The standard DCF model frequently used in estimative the cost rate of common equity in regulatory proceedings is defined by the following equation:

$$k = D_0\,(1+g)\,/P_0 + g,$$

where k is the expected return on common equity; D_0 is the current dividend per share; g is the expected dividend per share growth rate; and P_0 is the current market price.

The DCF was developed by Gordon (1974) specifically for regulatory purposes. Underlying the DCF model is the theory that the present value of an expected future stream of net cash flows during the investment holding period can be determined by discounting those cash flows at the cost of capital, or the investors' capitalization rate. DCF theory indicates that an investor buys a stock for an expected total return rate which is derived from cash flows received in the form of dividends plus appreciation in market price (the expected growth rate) over the investment holding period. Mathematically, the expected dividend yield ($D_0(1+g)/P_0$) on market price plus an expected growth rate equals the capitalization rate, i.e., the expected return on common equity.

The standard DCF contains several restrictive assumptions, the most contentious of which during utility cost of capital proceedings is typically that dividends per share (DPS), book value per share (BVPS), earnings per share (EPS) as well as market price grow at the same rate in perpetuity. There is also considerable contention over the proper proxy for g, prospective or historical growth in DPS, BVPS, EPS and market price and over what time period. In addition, although the standard DCF described above is a single stage annual growth model, there is considerable discussion over the use of multiple stage growth models during regulatory proceedings. Some analysts use the discrete version and others use the continuous version of the DCF model. Solving these models for k, the cost of common equity, results in differing equations to solve for k. The equation above is from the discrete version. The continuous version uses the current dividend yield and is not adjusted by g, which results in a lower estimate for k. Because of these and other restrictive assumptions that require numerous subjective judgments in application, it is often difficult for regulatory commissions to reconcile the frequently large disparities in rates of return on common equity recommended by various parties in a public utility rate case.

The CAPM model is defined by the following equation:

$$k = R_f + \beta\left(R_m - R_f\right),$$

where k is the expected return on common equity; R_f is the expected risk-free rate of return; β is the expected beta; and R_m is the expected market return.

CAPM theory defines risk as the co-variability of a security's returns with the market's returns or β, also known as systematic or market risk, with the market beta being defined as 1.0. Because CAPM theory assumes that all investors hold perfectly diversified portfolios, they are presumed to be exposed only to systematic risk and the market (according to the model) will not reward them a risk premium for unsystematic or non-market risk. In other words, the CAPM presumes that investors require compensation only for systematic or market risks which are due to macroeconomic and other events that affect the returns on all assets. Mathematically, the CAPM is applied by adding a forward-looking risk-free rate of return to an expected market equity risk premium adjusted proportionately by the expected beta to reflect the systematic risk.

As with the DCF, there is considerable contention during regulatory cost of capital proceedings as to the proper proxies for all components of the CAPM: the R_f, the R_m, as well as β. In addition, the CAPM assumption that the market will only reward investors for systematic or market risk is extremely restrictive when estimating the expected return on common equity for a single asset such as a single jurisdictional regulated operating utility. Additionally, this assumption requires that the investor have a perfectly diversified portfolio, that is, one with no unsystematic risk. Since this assumption is not applicable, estimating the cost of common equity capital for a single utility's common equity undoubtedly will not reflect the risk actually faced by the imperfectly diversified investor.

As will be discussed in the next section, our application of the risk premium approach, the consumption asset pricing model and GARCH[1] rest on minimal assumptions and restrictions and therefore requires considerably less judgment in its application.

2.2 Risk premium approach, consumption asset pricing models, and GARCH

A widely used model to estimate the cost of common equity capital for public utilities is the risk premium approach. This approach often estimates the expected rate of return as the long-term historic mean of the realized risk premium above an historic yield plus the current yield of the relevant bond applicable to a specific utility or peer group of utilities. Litigants in public utility rate proceedings debate the choice of inputs to estimate the risk premium as well as how far back to reach into history to collect data for calculating an average that is representative of a forward-looking premium.

It is surprising that, as popular as the risk premium method is in public utility rate cases, the intuitively appealing general consumption-based asset pricing model, with its minimal assumptions and strong theoretical foundation, has not been applied to estimate the cost of common equity capital for public utilities. The model provides projections of the conditional expected risk premium on an asset based on its relation to its predicted conditional volatility. This model generalizes the well known special case asset pricing models such as the Merton (1973) intertemporal capital asset pricing model, Campbell (1993) intertemporal asset pricing model, and the habit-persistence model of Campbell and Cochrane (1999), which are special cases of the general model. The relation of the model to their specialized cases can be found in Cochrane (2006) and Cochrane (2007). The approach of consumption asset pricing models is to make investment decisions that maximize investors' utility from the consumption that they ultimately desire, not returns.

Even if the model is not used to project directly the expected risk premium, it can, at a minimum, be used to verify that the risk premia data chosen for estimating the cost of capital is empirically validated by fitting the model well. The model can be used to predict the equity risk premia net of the risk-free rate (equity risk premium) or to predict the equity-to-debt risk premium for a firm. We perform both of these empirical tests in this paper. The general consumption-based asset pricing model developed in Michelfelder and Pilotte (2011) and based on Cochrane (2004) provides the relationship of the ex ante risk premium to an asset's own volatility in return:

$$E_t[R_{i,t+1}] - R_{f,t} = -\frac{vol_t[M_{t+1}]}{E_t\left[M_{t+1}\right]} vol_t[R_{i,t+1}] corr_t[M_{t+1}, R_{i,t+1}]. \quad (1)$$

[1] GARCH refers to the generalized autoregressive conditional heteroskedasticity regression model which is discussed below.

where vol_t is the conditional volatility, $corr_t$ is the conditional correlation, and M_{t+1} is the stochastic discount factor (SDF).

The SDF is the intertemporal marginal rate of substitution in consumption, or, $M_{t+1} = \beta \frac{U_{c,t+1}}{U_{c,t}}$, where the U_c's are the marginal utilities of consumption in the next period, $t+1$, and the current period, t, and β is the discount factor for period t to $t+1$. Equation 1 shows that the algebraic sign of the relation between the expected risk premium and the conditional volatility of an asset's risk premium is determined by the correlation between the asset's return and the SDF. That is, the direction of the relation between the asset return and the ratio of intertemporal marginal utilities in consumption inversely determines the relation between the expected risk premium and conditional volatility. When the correlation is equal to negative one, the asset's conditional expected risk premium is perfectly positively correlated with its conditional volatility. A positive relation between the conditionally expected risk premium and volatility obtains when $-1 < corr_t < 0$. A negative relation obtains when $0 < corr_t < 1$. For an asset that represents a perfect hedge against shocks to the marginal utility of consumption, with $corr_t = 1$, there will be a perfect negative correlation between the conditionally expected risk premium and its volatility.[2] Therefore, estimates of the relation between the first two conditional moments of a public utility stock's returns provide a direct test of the effectiveness of a public utility stock, or any asset, as a consumption hedging asset. In Eq. 1, $vol_t[M_{t+1}]/E_t[M_{t+1}]$ is the slope of the mean-variance frontier. If this slope changes over time, the estimated relation between the stock's risk and return will vary over time. This model can also be viewed simplistically as the projected expected risk premium as a function of its own projected risk, given information available at time t.

Note that the model allows for the expected risk premium to be negative if the asset hedges shocks to the marginal utility of consumption. Investors are willing to accept an expected rate of return lower than the risk-free rate of return if the pattern of volatility is such that returns are expected to rise with expected reductions in consumption. Simply, investors are willing to *pay* a premium for a higher level of returns volatility that has the desired pattern of returns. These desired returns patterns have a tendency to offset drops in consumption. Therefore, this model shows that investors may not be averse to volatility, but rather to the timing of expected changes in returns.

Summarizing, several conclusions can be drawn from the general model of asset pricing. First, the sign of the relation between a stock's risk premium and conditional volatility depends on the extent to which the stock serves as an intertemporal hedge against shocks to the marginal utility of consumption. Second, the relation between stock risk and return may be time-varying depending on changes in the slope of the mean-variance frontier. Third, hedging assets have desired patterns of volatility that result in expected rates of return that are less than the risk-free rate. We do not expect

[2] A hedging asset is one that has a positive increase in returns that is coincident with a positive shock in the ratio of intertemporal marginal utilities of consumption. Note that if we assume a concave utility function in consumption, as consumption declines, the marginal utility of consumption rises relative to last period marginal utility. If we think of a decline in consumption as a contraction in the business cycle, the hedging asset delivers positive changes in returns when the business cycle is moving into a contraction, and therefore the asset is a business cycle hedge.

that public utility stocks serve as a hedging asset as they are not viewed as defensive stocks (they do not rise in value during downturns in the stock market) due to asymmetric regulation and returns as discussed in detail in Kolbe and Tye (1990). Under asymmetric regulation, utility regulators have a tendency to allow the return on equity to fall below the allowed return during downturns in the business cycle and to reduce the return should it rise above the allowed return during expansions. Therefore we expect that the parameter estimates of the return-risk relationship to be positive as utility stocks are hypothesized to not be hedges.

We use the GARCH model to estimate the general asset pricing model since the GARCH model accommodates ARCH effects that improve the efficiency of the parameter estimates. It also provides a volatility forecasting model for the conditional volatility of the asset's risk premium. The conditional volatility projection is used, in turn to predict the expected risk premium. We also use the GARCH-in-Mean model (GARCH-M) since it specifies that the conditional expected risk premium is a linear function of its conditional volatility. There is a vast body of literature that estimates asset pricing models with the GARCH and GARCH-M methods and therefore we will not attempt to summarize them here.

The GARCH-M model was initially developed and tested by Engle et al. (1987) to estimate the relationship between US Treasury and corporate bond risk premia and their expected volatilities. The GARCH-M model is specified as:

$$R_{t+1} - R_{f,t+1} = \alpha\sigma_{t+1}^2 + \varepsilon_{t+1} \quad (2)$$

$$\sigma_{t+1}^2 = \beta_0 + \beta_1\sigma_t^2 + \beta_2\varepsilon_t^2 + \eta_{t+1} \quad (3)$$

$$\varepsilon_t \,|\psi_{t-1} \sim T(0, \sigma_t^2) \quad (4)$$

where R_{t+1} is the expected total return on the public utility stock index or individual utility stock; $R_{f,t+1}$ is the risk-free rate of return or the yield on an index of public utility bonds of a specified bond rating for the equity-to-debt premium; σ_{t+1}^2 is the conditional or predicted variance of the risk premium that is conditioned on past information (ψ_{t-1}); and ε_t is the error term that is conditional on ψ_{t-1}.

The conditional distribution of the error term is specified as the non-unitary variance T-distribution due to the thick-tailed distribution of the risk premia data. If the error distribution is thick-tailed, using an approximating distribution that accommodates thick tails improves the efficiency of the estimates. The parameter, α, is the return-to-risk coefficient as specified in Eq. 1 as:

$$\alpha = -\frac{vol_t[M_{t+1}]}{E_t\left[M_{t+1}\right]} corr_t[M_{t+1}, R_{i,t+1}] \quad (5)$$

Note that the coefficient will be positive if the conditional correlation between the SDF and the asset return is negative, indicating that the stock is not a hedging asset. Recall that the SDF is the ratio of intertemporal marginal utilities. Assuming a concave utility function, an upward shock in the ratio implies falling consumption, therefore an associated rise (positive correlation) in the return (R_i) would offset the reduction in consumption, thereby causing the sign of α to be negative. The parameter, α, is also the ratio of risk premium to variance, or, the Sharpe ratio.

The intercept in Eq. 2 is restricted to zero as specified by the general asset pricing model specification. The restriction on the intercept equal to zero has been found to be robust in producing consistently positive and significant relationships between equity risk premia and risk in GARCH-M models. This is discussed in Lanne and Saikkonen (2006) and Lanne and Luoto (2007). We have found the same results in our modeling in this paper, although we have excluded these results for brevity (available upon request). Therefore we specify the prior assumption that the intercept or the "excess" return, i.e., the return not associated with risk to be equal to zero and drop the intercept from the model.

The consumption asset pricing model is estimated in the empirical section of the paper and applied in the applications section of the paper. The model is tested to (1) determine if equity-to-debt risk premium indices for utilities of differing risk specified by differing bond ratings are validated by the asset pricing model and therefore have some empirical support for risk premium prediction and application to utility cost of capital estimation, (2) determine whether equity risk premia can be predicted and fit the model and therefore be used to estimate the cost of common equity, (3) empirically test the consumption asset pricing model, and (4) ascertain whether utility stocks are assets that hedge shocks to the marginal utility of consumption.

If utility stocks are hedging assets then the cost of common equity should reflect a downward adjustment to a specified risk-free rate to reflect investors' preferences for a hedge and the compensation that they are willing to pay for it.

3 Data and empirical results

We use portfolios as represented by public utility stock and bond indices to estimate the conditional return-risk relationship for the equity-to-debt premium. The equity-to-debt risk premium data employed for estimating Eq. 1 with the GARCH-M conditional return-risk regressions are monthly total returns on the Standard and Poor's Public Utilities Stock Index (utility portfolio), and the monthly Moody's Public Utility Aa, A, and Baa yields for the debt cost. We also obtained equity risk premia for the utility portfolio using the Fama-French specified risk-free rate of return, which is the holding period return on a 1-month US Treasury Bill. The data range from January 1928 to December 2007 with 960 observations. The return-risk relationships for the equity-to-debt premia are risk-differentiated by their own bond rating.

As a check, we also estimate Eq. 1 with the GARCH-M for large common stock returns using the monthly Ibbotson Large Company Common Stocks Portfolio total returns and the Ibbotson US Long-Term Government income returns as the risk-free rate. Additionally, as another check, we do the same for the University of Chicago's Center for Research in Security Prices value-weighted stock index (CRSP) using the Fama-French risk-free rate. This is the Fama-French specification of the market equity risk premium. The data range from January 1926 to December 2007 with 984 observations for the Large Company Common Stock estimation and the data ranges

Table 1 Descriptive statistics: public utility and large company common stocks equity-to-debt and equity risk premia

Utility bond rating	Mean	Std. Dev.	Skewness	Kurtosis	JB
Aa	0.0037	0.0568	0.0744	10.07	2,001.2***
A	0.0035	0.0568	0.0632	10.06	1,991.8***
Baa	0.0031	0.0568	0.0375	10.02	1,973.6***
Ibbotson					
Large common stocks	0.0054	0.0554	0.4300	12.84	3,954.7***
CRSP value-weighted stock index	0.0062	0.0544	0.2309	10.92	2,519.1***

The public utility equity-to-debt risk premia monthly time series is from January 1928 to December 2007 with 960 observations. The equity risk premium monthly time series for the Large Common Stocks and the CRSP index are January 1926 to December 2007 with 984 observations, and January 1926 to December 2007 with 984 observations, respectively. The public utility stocks equity-to-debt risk premia are calculated as the total return on the S&P Public Utilities Index of stocks minus the Moody's Public Utility Aa, A, and Baa Indices yields to maturity. The Large Company Common Stock equity risk premia are the monthly total returns on the Ibbotson Large Company Common Stocks Portfolio minus the Ibbotson Long-Term US Government Bonds Portfolio income yield. The CRSP equity risk premia, or the Fama-French market risk premia are the CRSP total returns on the value-weighted equity index minus the 1-month holding period return on a 1 month Treasury Bill. The Jarque-Bera (JB) statistic is a goodness-of-fit measure of the departure of the distribution of a data series from normality, based on the levels of skewness and excess kurtosis. The JB statistic is χ^2 distributed with 2° of freedom. *** Significant at 0.01 level, one-tailed test

from January 1928 to January 2007 with 960 observations (same as the utilities) for the CRSP estimation.

Table 1 displays the descriptive statistics for these data. We have estimated the mean, standard deviation, skewness and kurtosis parameters, as well as the Jarque-Bera (JB) statistic to test the distribution of the data. The means of the utility equity-to-debt risk premia fall as the risk (bond rating) declines. This is consistent with the notion that larger yields are subtracted from stock returns the lower the bond rating. Intertemporally, there is an inverse relationship between risk premia and interest rates (See Brigham et al. (1985) and Harris et al. (2003)). The mean for risk premia will have a tendency to be larger during low interest rate periods.

Not surprisingly, large company common stocks have the highest mean risk premia as the majority of these firms are not rate-of-return regulated firms with a ceiling on their ROE's close to their cost of capital. Interestingly, the standard deviations of the utility stock returns are similar and slightly higher than large company common stocks. Skewness coefficients are small and positive except for Ibbotson large company common stock returns and CRSP returns that have large positive skewness. This suggests that large unregulated stocks have a tendency to have more and larger positive shocks in returns than do utilities that are rate of return regulated. The kurtosis values show that all of the risk premia are thick-tail distributed. This is also found in the significant JB statistics that test the null hypothesis that the data are normally distributed. The null hypothesis is rejected for all assets. The high kurtosis, low skewness, and significant JB statistics show that the risk premia data are substantially thick-tailed, except for non-utility stocks that are both skewed and thick-tailed. Therefore, robust estimation methods are required to produce efficient regression estimates with non-normal data. Additionally, although not shown but available upon request, the serial correlation and

ARCH Lagrange Multiplier tests show that residuals from OLS regressions of risk premia on volatilities follow an ARCH process. Therefore, the GARCH-M method will improve the efficiency of the estimates. We specify the regression error distribution as a non-unitary variance T-distribution so that thick-tails could be accommodated in the estimation and therefore produce increasingly efficient parameter estimates.

We used maximum likelihood estimation with the likelihood function specified with the non-unitary-variance T-distribution as the approximating distribution of the residuals to accommodate the thick-tailed nature of the error distribution. The equations are estimated as a system using the Marquardt iterative optimization algorithm. The chosen software for estimating the model was EViews© version 6.0 (2007).

Table 2 shows the GARCH-M estimations for the consumption asset pricing Eq. 1. We have estimated Eq. 1 for the utility equity risk premia using the Fama-French risk-free rate in addition to the equity-to-debt risk premia risk-differentiated by bond ratings and the two measures of the market equity risk premium. The chosen measure of volatility is the variance of risk premium (in contrast to other such measures such as the standard deviation or the log of variance. Although these results are not shown for brevity, they are robust to these other measures of volatility). The slope, which is the predicted return-to-predicted risk coefficient and Sharpe ratio, is positive and significant at the 99% level for all assets except the utility stock returns with Baa bonds, which is significant at the 95% level. Given that all slopes are positive, public utility stocks are not found to hedge shocks to the marginal utility of consumption. Note that the reward-to-risk slope rises as bond rating rises. This suggests that lower risk utility stocks provide a higher incremental risk-premium for an increase in conditional volatility. This is consistent with other studies that find that lower risk assets, such as shorter maturity bonds, have higher Sharpe Ratios than long-term bonds and stocks. See Pilotte and Sterbenz (2006) and Michelfelder and Pilotte (2011).

The variance equation shows that all GARCH coefficients (β's) are significant at the 1% level and the sums of β_1 and β_2 are close to, but less than 1.0, indicating that the residuals of the risk premium equation follow a GARCH process and that the persistence of a volatility shock on returns and stock prices for utility stocks is temporary. The estimates of the non-unitary variance T-distribution degrees of freedom parameter are low and statistically significant, indicating that the residuals are well approximated by the T. Similar values for the log-likelihood functions (Log-L) show that each of the regressions has a similar goodness-of-fit. Chi-squared distributed likelihood ratio tests (not shown but available upon request) that compare the goodness of fit among the T and normal specifications of the likelihood function of the GARCH-M regressions show that the T has a significantly better fit than the normal distribution.

The GARCH-M results for the large company common stocks portfolio are similar to those of the utility stocks. Not surprisingly, large company common stocks do not hedge shocks to the marginal utility of consumption and volatility shocks temporarily affect their valuations. The exception is that the return-risk slope is substantially higher than utility stock slopes. This is partially due to the risk-free nature of the risk-free rates used with the non-utility equity risk premia compared to the

Table 2 Estimation of return-risk relation: public utility and large company common stocks

Utility bond rating	α	β_0	β_1	β_2	Log-L	T dist. D.F.
Aa	1.5183*** (0.5308)	0.0000** (0.0000)	0.8791*** (0.0230)	0.1031*** (0.0219)	1,604.4	9.9254*** (3.0272)
A	1.4536*** (0.5308)	0.0000** (0.0000)	0.8790*** (0.0230)	0.1033*** (0.0220)	1,605.0	9.9381*** (3.0408)
Baa	1.3318** (0.5303)	0.0000** (0.0000)	0.8789*** (0.0229)	0.1040*** (0.0220)	1,605.2	10.0*** (3.0540)
Fama-French R_f	2.1428*** (0.5318)	0.0000** (0.0000)	0.8811*** (0.0232)	0.0979*** (0.0212)	1,601.0	9.8773*** (2.9700)
Ibbotson						
Large company common stocks	2.7753*** (0.5513)	0.0001*** (0.0000)	0.8381*** (0.0269)	0.1186*** (0.0332)	1,620.8	8.8457*** (2.1613)
CRSP value-weighted stock index	3.3873*** (0.5673)	0.0001*** (0.0000)	0.8330*** (0.0270)	0.1149*** (0.0358)	1,598.9	8.8571*** (1.9505)

The results below are the GARCH-in-Mean regressions for the risk premium $(R_{t+1} - R_{f,t+1})$ on the conditional variance of the risk premium (σ^2_{t+1}) in the mean equation. The intercept in the mean equation is restricted to be equal to zero. The public utility equity-to-debt risk premia monthly time series is from January 1928 to December 2007 with 960 observations. The equity risk premium monthly time series for the Large Company Common Stocks and the CRSP index are January 1926 to December 2007 with 984 observations, and January 1926 to December 2007 with 984 observations, respectively. The public utility stocks equity-to-debt risk premia are calculated as the total return on the S&P Public Utilities Index of stocks minus the Moody's Public Utility Aa, A, and Baa Indices yields to maturity. The Large Company Common Stock equity risk premia are the monthly total returns on the Ibbotson Large Company Common Stocks Portfolio minus the Ibbotson Long-Term US Government Bonds Portfolio income yield. The CRSP equity risk premia, or the Fama-French market risk premia are the CRSP total returns on the value-weighted equity index minus the 1-month holding period return on a 1 month Treasury Bill. The estimated model is:

$$R_{t+1} - R_{f,t+1} = \alpha\sigma^2_{t+1} + \varepsilon_{t+1} \quad \text{where } \alpha = -\frac{vol_t[M_{t+1}]}{E_t[M_{t+1}]} corr_t[M_{t+1}, R_{i,t+1}]$$

$$\sigma^2_{t+1} = \beta_0 + \beta_1\sigma^2_t + \beta_2\varepsilon^2_t + \eta_{t+1}$$

The conditional distribution of the error term is the non-unitary variance T-distribution to accommodate the kurtosis of the risk premia and error term. Standard errors are in parentheses. ***, **, * denote significance at the 0.01, 0.05, and 0.10 levels, respectively for two-tail tests

utility bond yields that reflect risk. The utility stocks slope value of 2.1428 using the Fama-French risk-free rate is closer to the higher CRSP value of 3.3873 that is also based on the Fama-French risk-free rate. This is inconsistent with previous results herein and in other papers that find that Sharpe Ratios are lower for higher risk assets unless this finding can be interpreted as utility stocks having more risk than non-regulated stocks. The standard deviations on Table 1 suggest that utility stock return volatilities are as high as the stock returns of non-regulated firms. However, similar model estimates of portfolios of common stocks yield unstable results, such as negative as well as positive return-risk slopes when the intercept is not restricted to zero. See Campbell (1987), Glosten et al. (1993), Harvey (2001), and Whitelaw (1994).

Stock market results are highly sensitive to empirical model specification. Many studies do not consider the impact of a zero-intercept prior restriction on the stability of their results. This simple innovation has led to more consistent results in modeling stock market risk-return relationships, and therefore we have included it in this paper.

The estimation of the consumption asset pricing model for utility stock equity-debt risk premia shows that the use of bond-rating risk-differentiated risk premia are validated as their risk-return relationships are well-fitted by theoretical and empirical models of risk and return. Therefore, these data impound good representations of the risk and reward relationship.

One concern is the intertemporal stability of the alphas. Figure 1 plots the utility stock portfolio alpha (using the Fama-French R_f to calculate the premium) and its standard error for 240 month rolling regressions of the model estimated with GARCH-M in the same manner as described above to review the intertemporal stability of the alpha. A 20-year period was used for each estimation to trade off timeliness with sufficient observation of up and down stock market regimes and business cycles. This resulted in 720 estimated alphas from 1947 to 2007. The results show that the utility alpha is stable to the extent that the algebraic sign is always positive and generally significant, therefore the nature of utility stocks are assets that are not and have never been hedges during the second half of the twentieth century up to the present. The value of the alpha does change substantially. The mean of the alpha is 4.40 with a range from -0.11 (insignificantly different from 0) to 11.66. As a comparison, the alpha for the CRSP value-weighted stock index was also estimated with rolling regressions in the same manner and for the same time period. Figure 2 is a plot of the CRSP alpha and standard error. Note that the general stock market alpha is similar to that of utility stocks. They are all positive and almost all statistically significant and follow a strikingly similar cycle. Figure 3 plots both the utility and stock market alphas and demonstrates the similarity. The correlation coefficient between the utility and stock market alphas is 0.88. Recalling that the alpha is a Sharpe Ratio, we see that return to risk ratio does change substantially. This is consistent with the results in Pilotte and Sterbenz (2006).

One other interesting observation is that the standard errors of the alphas are highly stable over the study period and are very similar in magnitude regardless of the size of the corresponding alpha. Whereas the alpha follows a cyclical pattern, the volatility in alpha is highly stationary around a constant, long-run mean.

The GARCH-M model estimations of the consumption asset pricing model were specified with variance as the measure of volatility. We also performed the same model estimations with alternative specifications of volatility such as the standard deviation and the log of variance and the results were not sensitive to this specification.

4 Application

We apply the model in this section to compare the cost of common equity capital estimates with the DCF and CAPM models. Using EViews© Version 6.0, we estimated the model coefficients (α, $\beta's$) over rolling 24 month periods ending December 2008.

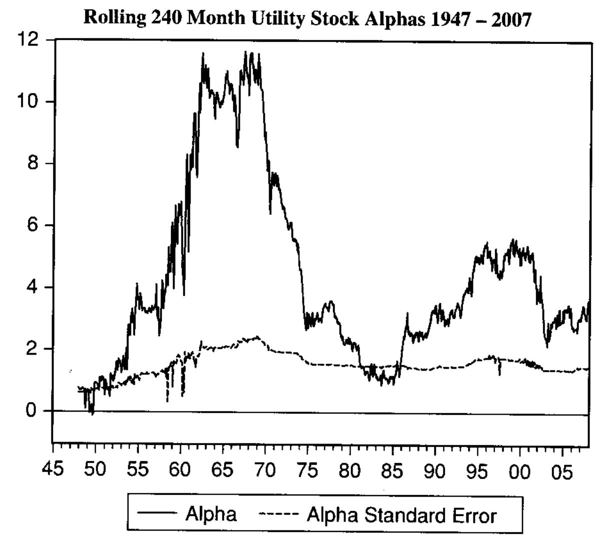


Fig. 1 Rolling 240 month utility stock alphas 1947–2007

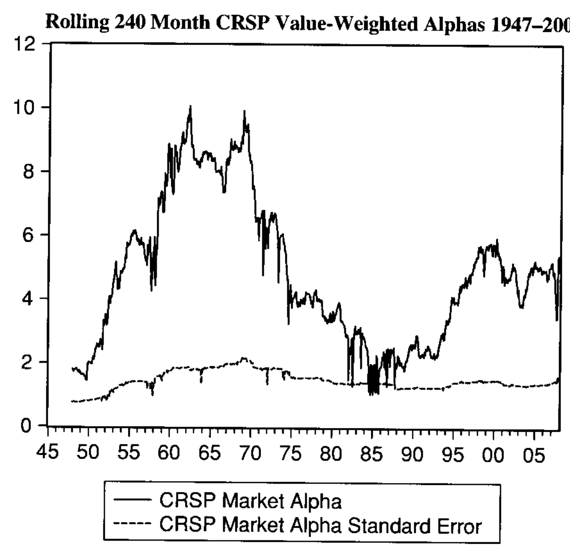


Fig. 2 Rolling 240 month CRSP value-weighted alphas 1947–2007

We repeated the estimation over 5, 10, 15, 20 and 79 year periods.[3] Predicted monthly variances (σ_{t+1}^2) were generated from these estimations to produce predicted risk premiums that were calculated by multiplying the predicted variance by the "α" slope

[3] We did not include the results of the 10 and 15 year estimations to abbreviate the amount of empirical results presented since they added no material insights beyond those already presented.

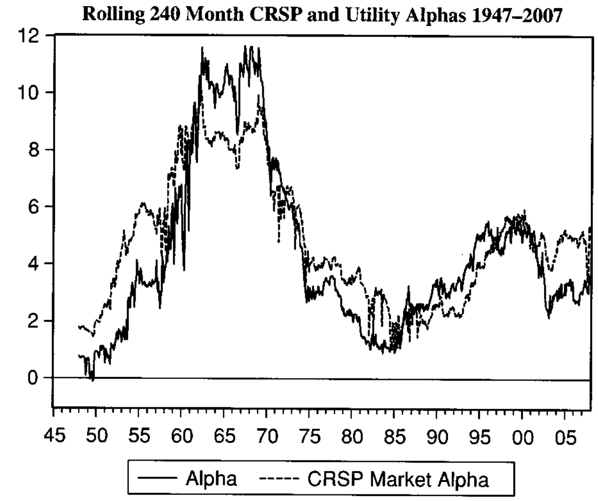


Fig. 3 Rolling 240 month CRSP and utility alphas 1947–2007

Table 3 Estimates of expected risk premia

	Mean (%)		Range (%)		Standard deviation (%)	
	Average	Spot	Average	Spot	Average	Spot
Ibbotson Associates data						
79-years	9.59	5.76	8.74–9.96	2.62–22.60	0.32	5.24
20-years	6.77	6.94	4.99–8.50	2.24–28.95	0.95	6.88
5-years	4.20	10.25	−98.49–11.62	−100.00–39.65	22.00	26.61
S&P Utility Index						
79-years	5.28	2.90	4.30–5.28	1.65–8.15	0.32	1.60
20-years	3.93	3.51	2.78–5.03	2.18–6.88	0.57	1.11
5-years	31.82	326.63	7.77–156.97	6.12–6465.74	31.47	1283.51

coefficient. To test the stability of the predicted risk premia over time, the predicted risk premia were calculated using either the predicted variance over each entire time period or the last monthly (spot) predicted variance. Table 3 presents the mean predicted risk premia, the range of predicted premia and the standard deviations for each time period. It is clear from the results that the risk premia are more stable over the rolling 24 month period when calculated using the average predicted variance compared with using the spot variance. Secondly, the 20 and 79 year means are substantially more stable and reasonable in magnitude than the 5 year means.

Next, given the lessons from the analyses above, we apply the model to mechanically[4] estimate the cost of common equity for 8 utility companies using the model and

[4] The term "mechanically" in this context means that the resulting values have been developed in a consistent manner with the same inputs across all utility stocks but no subjective judgment was used to develop final values for each specific utility stock application.

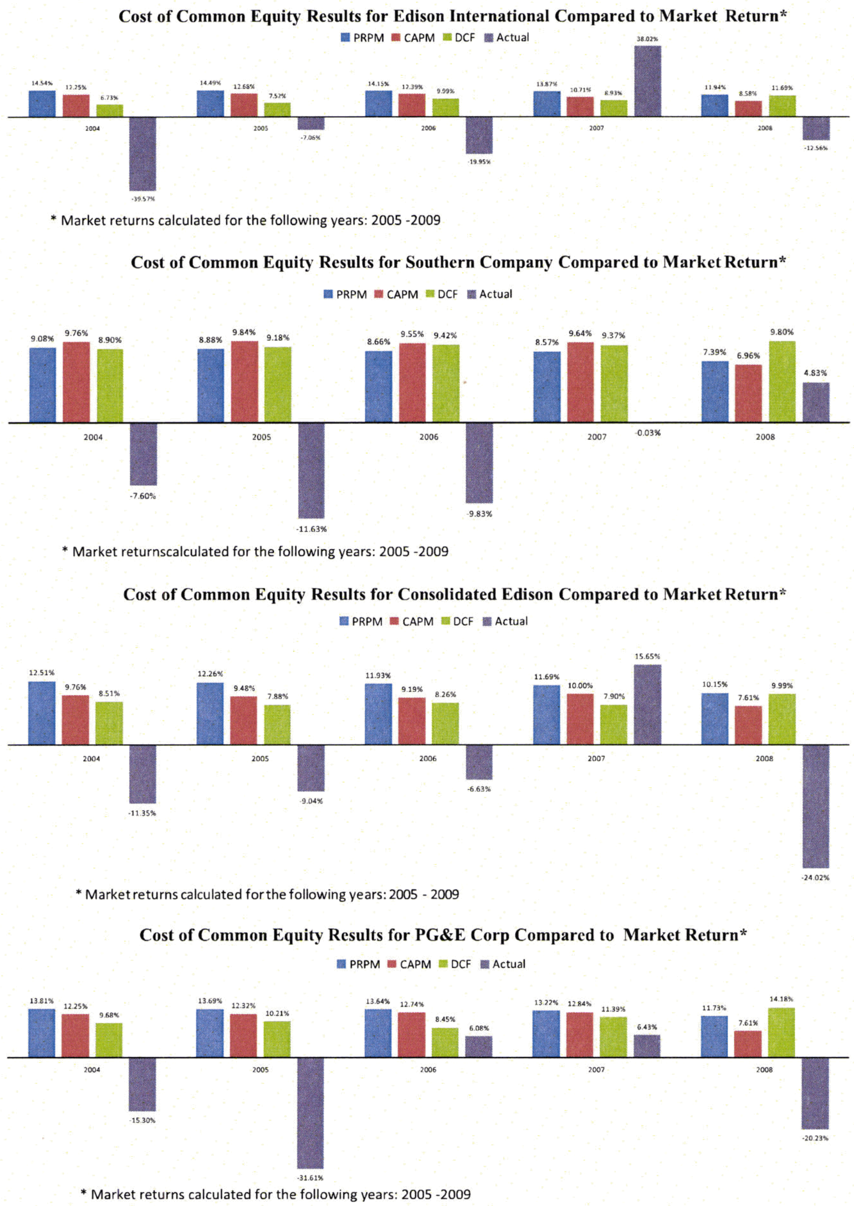
the DCF and CAPM as comparisons. We also calculated the realized market return for comparison. Two publicly-traded electric, electric and gas combination, gas, and water utilities respectively were chosen for the application. The Gordon (1974) DCF and CAPM models are used in many utility regulatory jurisdictions in the US.

The DCF was applied using a dividend yield, D_0/P_0, derived by dividing the year-end indicated dividend per share (D_0) by the year-end spot market price (P_0). The dividend yield is grown by the year-end I/B/E/S five year projected earnings per share growth rate (g) to derive $D_0(1+g)/P_0$. The one-year predicted dividend yield is then added to the I/B/E/S five-year projected EPS growth rate to obtain the DCF estimate of the cost of common equity capital, k. This study was conducted for the 5 years ending 2008.

The CAPM was applied by multiplying the Value Line beta (β) available at year-end for each company by the long-term historic arithmetic mean market risk premium ($R_m - R_f$). $R_m - R_f$ is derived as the spread of the total return of large company common stocks over the income return on long-term government bonds from the Ibbotson SBBI 2009 Valuation Yearbook. The resulting company-specific market equity risk premium is then added to a projected consensus estimate of the yield on 30-year U.S. Treasury rate provided by Blue Chip Financial Forecasts as the risk-free rate (R_f) to obtain the CAPM result. This study was also conducted over the 5 years ending 2008.

Figures 4–11 show the histograms of the cost of common equity capital estimations for each of the eight public utility stocks and the realized market returns in the forthcoming year. The consumption asset pricing model appears to track more consistently with the CAPM than with the DCF which seems to produce generally lower values than the other methods. The consumption asset pricing model results are similar to the CAPM. The model and the CAPM compete as the best predictor of the rate of return on the book value of common equity (not shown but available upon request), but none of the expected returns were good predictors of market returns. That does not infer that they were not good predictors of *expected* market returns. These results are an initial indicator that the consumption asset pricing model provides reasonable and stable results. This paper does not suggest at this early juncture that the consumption asset pricing model is superior to the CAPM or DCF, although it is based on far less restrictive assumptions than these other models. For example, both the DCF and CAPM assume that markets are efficient. Many assume that the DCF requires that the market-to-book ratio to always equal one, whereas the long-term value for the Standard and Poor's 500 is equal to 2.34. The CAPM assumes that investors demand higher returns for higher volatility and that the minimum required return is the risk-free rate, whereas the consumption asset pricing model allows for investors to require returns less than the risk-free rate for stocks that may have relatively higher volatility but are hedging assets that have desirable return fluctuation patterns that offset downturns in the business cycle. Unlike the CAPM, the model prices the risk to which investors are actually exposed, whether it's systematic risk or not. Some investors are diversified and some are not; the model prices whatever risk to which the aggregate of investors of the specific stock is exposed.

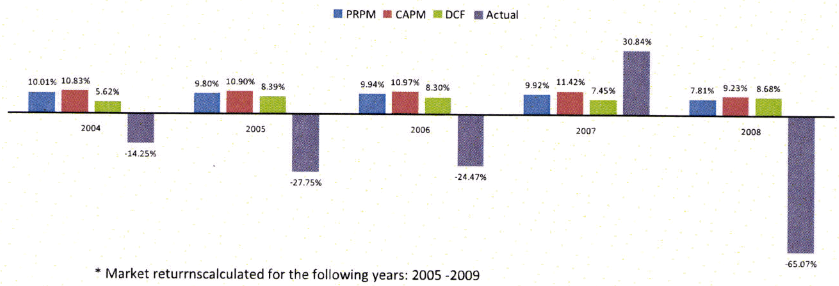
We find that the consumption asset pricing model should be used in combination with other cost of common equity pricing models as additional information in the devel-



Figs. 4–11 Comparison of the cost of common equity estimates and market

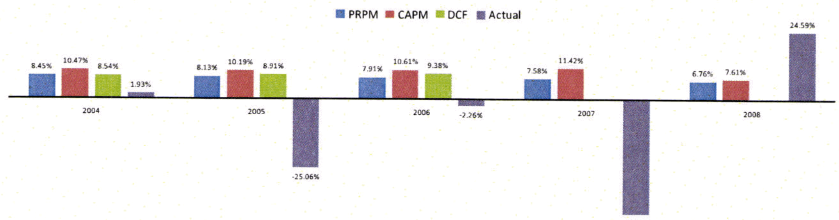
opment of a cost of common equity capital recommendation. Practitioners may find the modeling methods and the use of relatively advanced econometric methods rather cumbersome. The software for performing these estimations is readily available from EViews© and SAS©; two commonly available software packages at utilities, consult-

Cost of Common Equity Results for National Fuel Gas Co. Compared to Market Return*



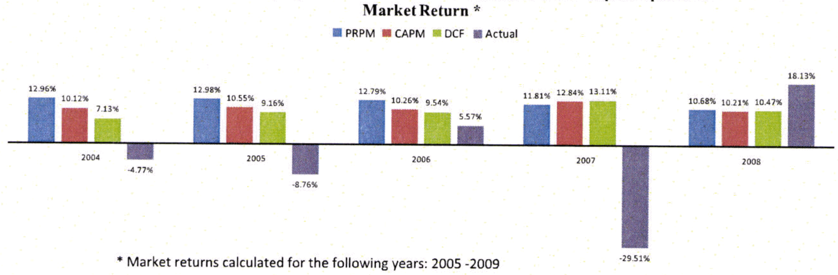
* Market returrnscalculated for the following years: 2005 -2009

Cost of Common Equity Results for Laclede Group Compared to Market Return*



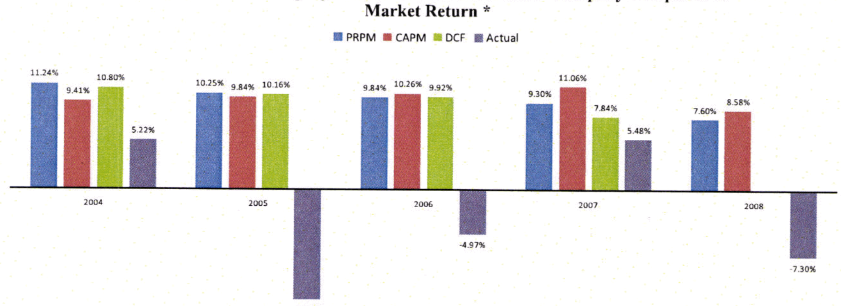
* Market returnscalculated for the following years: 2005-2009
Missing DCF Cost of Capital Estimates Due to Unavailable Growth Rate

Cost of Common Equity Results for California Water Service Group Compared to Market Return *



* Market returns calculated for the following years: 2005 -2009

Cost of Common Equity Results for Middlesex Water Company Compared to Market Return *



* Market returnscalculated for following years: 2005 -2009
Missing DCF Cost of Capital Estimate Due to Unavailable Growth Rate

Figs. 4–11 continued

ing firms and financial firms. Recent Ph.D. and M.S. holding members of research departments of investment and consulting firms have ready access to the model and methods discussed in this paper, although it will require years for these tools, like any "new" technology, to diffuse into standard use. Another problem is that the model requires a substantial time series history on stock returns data to develop stable estimates of risk premia This is problematic especially for the electric and gas utility industries that have consolidated with many mergers in the recent past. This problem can be addressed by developing and predicting the value-weighted risk premium of a portfolio of similar stocks such as electric utilities that have nuclear generating assets. The specific stock in question would be included in the returns index with a weight based on market capitalization that would go to 0 when the stock price history is no longer existent reaching back into the past.

5 Conclusion

The purpose of this paper is to introduce, test empirically and apply a general consumption based asset pricing model that is based on a minimum of assumptions and restrictions that can be used to predict the risk premium to be applied in estimating the cost of common equity for public utilities in regulatory proceedings. The results support the simple consumption-based asset pricing model that predicts the ex ante risk premium with a conditionally predicted volatility in risk premium. The estimates of the cost of common equity from the consumption asset pricing model compare well with rates of return on the book value of common equity and with the CAPM, although both the model and the CAPM results are substantially higher than the DCF. This is quite common in the practice of the cost of common equity in the utility industry. The results of the model are stable and consistent over time. Therefore the model should be considered as it provides additional evidence on the cost of common equity in general and specifically in public utility regulatory proceedings. Secondly, the use of bond-rated yields to predict risk differentiated equity-to-debt risk premia is supported by the empirical evidence and therefore should be applied in estimating the cost of common equity. Finally, the robust empirical evidence on the positive risk-return relationship also shows that utility stocks are not a consumption hedge and are not good hedging securities against contractions in the economy. The model and estimation methodology presented in this paper provide a relatively simple tool to determine whether any asset is a hedge to adverse changes in the business cycle through the level of consumption in the economy.

Acknowledgments We would like to thank Dylan D'Ascendis, Sal Giunta, Selby Jones, III and Alison McVicker for highly capable research assistance, participants at the Center for Research in Regulated Industries Eastern Conferences and the Society of Utility Regulatory and Financial Analysts Annual Financial Forum, two anonymous reviewers and the editor for helpful comments.

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PMA-R24

Journal of Economic Perspectives—Volume 15, Number 4—Fall 2001—Pages 157–168

GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics

Robert Engle

The great workhorse of applied econometrics is the least squares model. This is a natural choice, because applied econometricians are typically called upon to determine how much one variable will change in response to a change in some other variable. Increasingly however, econometricians are being asked to forecast and analyze the size of the errors of the model. In this case, the questions are about volatility, and the standard tools have become the ARCH/GARCH models.

The basic version of the least squares model assumes that the expected value of all error terms, when squared, is the same at any given point. This assumption is called homoskedasticity, and it is this assumption that is the focus of ARCH/GARCH models. Data in which the variances of the error terms are not equal, in which the error terms may reasonably be expected to be larger for some points or ranges of the data than for others, are said to suffer from heteroskedasticity. The standard warning is that in the presence of heteroskedasticity, the regression coefficients for an ordinary least squares regression are still unbiased, but the standard errors and confidence intervals estimated by conventional procedures will be too narrow, giving a false sense of precision. Instead of considering this as a problem to be corrected, ARCH and GARCH models treat heteroskedasticity as a variance to be modeled. As a result, not only are the deficiencies of least squares corrected, but a prediction is computed for the variance of each error term. This prediction turns out often to be of interest, particularly in applications in finance.

The warnings about heteroskedasticity have usually been applied only to cross-section models, not to time series models. For example, if one looked at the

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cross-section relationship between income and consumption in household data, one might expect to find that the consumption of low-income households is more closely tied to income than that of high-income households, because the dollars of savings or deficit by poor households are likely to be much smaller in absolute value than high income households. In a cross-section regression of household consumption on income, the error terms seem likely to be systematically larger in absolute value for high-income than for low-income households, and the assumption of homoskedasticity seems implausible. In contrast, if one looked at an aggregate time series consumption function, comparing national income to consumption, it seems more plausible to assume that the variance of the error terms doesn't change much over time.

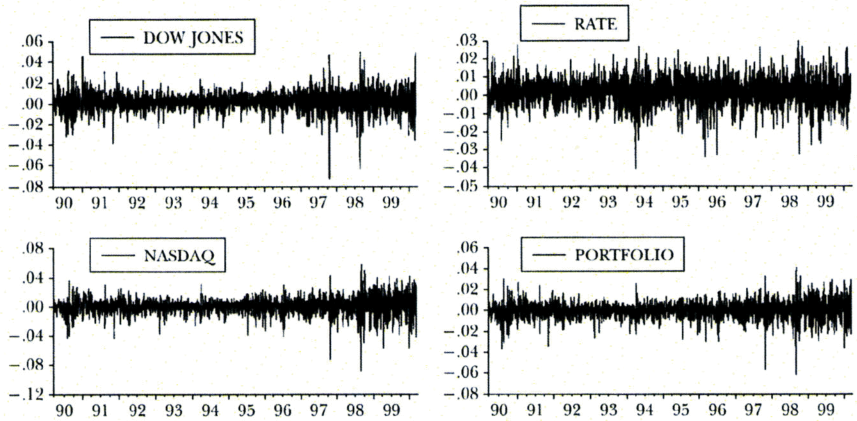
A recent development in estimation of standard errors, known as "robust standard errors," has also reduced the concern over heteroskedasticity. If the sample size is large, then robust standard errors give quite a good estimate of standard errors even with heteroskedasticity. If the sample is small, the need for a heteroskedasticity correction that does not affect the coefficients, and only asymptotically corrects the standard errors, can be debated.

However, sometimes the natural question facing the applied econometrician is the accuracy of the predictions of the model. In this case, the key issue is the variance of the error terms and what makes them large. This question often arises in financial applications where the dependent variable is the return on an asset or portfolio and the variance of the return represents the risk level of those returns. These are time series applications, but it is nonetheless likely that heteroskedasticity is an issue. Even a cursory look at financial data suggests that some time periods are riskier than others; that is, the expected value of the magnitude of error terms at some times is greater than at others. Moreover, these risky times are not scattered randomly across quarterly or annual data. Instead, there is a degree of autocorrelation in the riskiness of financial returns. Financial analysts, looking at plots of daily returns such as in Figure 1, notice that the amplitude of the returns varies over time and describe this as "volatility clustering." The ARCH and GARCH models, which stand for autoregressive conditional heteroskedasticity and *generalized* autoregressive conditional heteroskedasticity, are designed to deal with just this set of issues. They have become widespread tools for dealing with time series heteroskedastic models. The goal of such models is to provide a volatility measure—like a standard deviation—that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing.

ARCH/GARCH Models

Because this paper will focus on financial applications, we will use financial notation. Let the dependent variable be labeled r_t, which could be the return on an asset or portfolio. The mean value m and the variance h will be defined relative to a past information set. Then, the return r in the present will be equal to the mean

Figure 1
Nasdaq, Dow Jones and Bond Returns



value of r (that is, the expected value of r based on past information) plus the standard deviation of r (that is, the square root of the variance) times the error term for the present period.

The econometric challenge is to specify how the information is used to forecast the mean and variance of the return, conditional on the past information. While many specifications have been considered for the mean return and have been used in efforts to forecast future returns, virtually no methods were available for the variance before the introduction of ARCH models. The primary descriptive tool was the rolling standard deviation. This is the standard deviation calculated using a fixed number of the most recent observations. For example, this could be calculated every day using the most recent month (22 business days) of data. It is convenient to think of this formulation as the first ARCH model; it assumes that the variance of tomorrow's return is an equally weighted average of the squared residuals from the last 22 days. The assumption of equal weights seems unattractive, as one would think that the more recent events would be more relevant and therefore should have higher weights. Furthermore the assumption of zero weights for observations more than one month old is also unattractive. The ARCH model proposed by Engle (1982) let these weights be parameters to be estimated. Thus, the model allowed the data to determine the best weights to use in forecasting the variance.

A useful generalization of this model is the GARCH parameterization introduced by Bollerslev (1986). This model is also a weighted average of past squared residuals, but it has declining weights that never go completely to zero. It gives parsimonious models that are easy to estimate and, even in its simplest form, has proven surprisingly successful in predicting conditional variances. The most widely used GARCH specification asserts that the best predictor of the variance in the next period is a weighted average of the long-run average variance, the variance predicted for this period, and the new information in this period that is captured by the most recent squared residual. Such an updating rule is a simple description of adaptive or learning behavior and can be thought of as Bayesian updating.

Consider the trader who knows that the long-run average daily standard deviation of the Standard and Poor's 500 is 1 percent, that the forecast he made yesterday was 2 percent and the unexpected return observed today is 3 percent. Obviously, this is a high volatility period, and today is especially volatile, which suggests that the forecast for tomorrow could be even higher. However, the fact that the long-term average is only 1 percent might lead the forecaster to lower the forecast. The best strategy depends upon the dependence between days. If these three numbers are each squared and weighted equally, then the new forecast would be $2.16 = \sqrt{(1 + 4 + 9)/3}$. However, rather than weighting these equally, it is generally found for daily data that weights such as those in the empirical example of (.02, .9, .08) are much more accurate. Hence the forecast is $2.08 = \sqrt{.02*1 + .9*4 + .08*9}$.

To be precise, we can use h_t to define the variance of the residuals of a regression $r_t = m_t + \sqrt{h_t}\varepsilon_t$. In this definition, the variance of ε is one. The GARCH model for variance looks like this:

$$h_{t+1} = \omega + \alpha(r_t - m_t)^2 + \beta h_t = \omega + \alpha h_t \varepsilon_t^2 + \beta h_t.$$

The econometrician must estimate the constants ω, α, β; updating simply requires knowing the previous forecast h and residual. The weights are $(1 - \alpha - \beta, \beta, \alpha)$, and the long-run average variance is $\sqrt{\omega/(1 - \alpha - \beta)}$. It should be noted that this only works if $\alpha + \beta < 1$, and it only really makes sense if the weights are positive, requiring $\alpha > 0$, $\beta > 0$, $\omega > 0$.

The GARCH model that has been described is typically called the GARCH(1,1) model. The (1,1) in parentheses is a standard notation in which the first number refers to how many autoregressive lags, or ARCH terms, appear in the equation, while the second number refers to how many moving average lags are specified, which here is often called the number of GARCH terms. Sometimes models with more than one lag are needed to find good variance forecasts.

Although this model is directly set up to forecast for just one period, it turns out that based on the one-period forecast, a two-period forecast can be made. Ultimately, by repeating this step, long-horizon forecasts can be constructed. For the GARCH(1,1), the two-step forecast is a little closer to the long-run average variance than is the one-step forecast, and, ultimately, the distant-horizon forecast is the same for all time periods as long as $\alpha + \beta < 1$. This is just the unconditional variance. Thus, the GARCH models are mean reverting and conditionally heteroskedastic, but have a constant unconditional variance.

I turn now to the question of how the econometrician can possibly estimate an equation like the GARCH(1,1) when the only variable on which there are data is r_t. The simple answer is to use maximum likelihood by substituting h_t for σ^2 in the normal likelihood and then maximizing with respect to the parameters. An even simpler answer is to use software such as EViews, SAS, GAUSS, TSP, Matlab, RATS and many others where there exist already packaged programs to do this.

But the process is not really mysterious. For any set of parameters ω, α, β and a starting estimate for the variance of the first observation, which is often taken to be the observed variance of the residuals, it is easy to calculate the variance forecast for the second observation. The GARCH updating formula takes the weighted average of the unconditional variance, the squared residual for the first observation and the starting variance and estimates the variance of the second observation. This is input into the forecast of the third variance, and so forth. Eventually, an entire time series of variance forecasts is constructed. Ideally, this series is large when the residuals are large and small when they are small. The likelihood function provides a systematic way to adjust the parameters ω, α, β to give the best fit.

Of course, it is entirely possible that the true variance process is different from the one specified by the econometrician. In order to detect this, a variety of diagnostic tests are available. The simplest is to construct the series of $\{\varepsilon_t\}$, which are supposed to have constant mean and variance if the model is correctly specified. Various tests such as tests for autocorrelation in the squares are able to detect model failures. Often a "Ljung box test" with 15 lagged autocorrelations is used.

A Value-at-Risk Example

Applications of the ARCH/GARCH approach are widespread in situations where the volatility of returns is a central issue. Many banks and other financial institutions use the concept of "value at risk" as a way to measure the risks faced by their portfolios. The 1 percent value at risk is defined as the number of dollars that one can be 99 percent certain exceeds any losses for the next day. Statisticians call this a 1 percent quantile, because 1 percent of the outcomes are worse and 99 percent are better. Let's use the GARCH(1,1) tools to estimate the 1 percent value at risk of a $1,000,000 portfolio on March 23, 2000. This portfolio consists of 50 percent Nasdaq, 30 percent Dow Jones and 20 percent long bonds. The long bond is a ten-year constant maturity Treasury bond.[1] This date is chosen to be just before the big market slide at the end of March and April. It is a time of high volatility and great anxiety.

First, we construct the hypothetical historical portfolio. (All calculations in this example were done with the EViews software program.) Figure 1 shows the pattern of returns of the Nasdaq, Dow Jones, bonds and the composite portfolio leading up to the terminal date. Each of these series appears to show the signs of ARCH effects in that the amplitude of the returns varies over time. In the case of the equities, it is clear that this has increased substantially in the latter part of the sample period. Visually, Nasdaq is even more extreme. In Table 1, we present some illustrative

[1] The portfolio has constant proportions of wealth in each asset that would entail some rebalancing over time.

Table 1
Portfolio Data

	NASDAQ	*Dow Jones*	*Rate*	*Portfolio*
Mean	0.0009	0.0005	0.0001	0.0007
Std. Dev.	0.0115	0.0090	0.0073	0.0083
Skewness	−0.5310	−0.3593	−0.2031	−0.4738
Kurtosis	7.4936	8.3288	4.9579	7.0026

Sample: March 23, 1990 to March 23, 2000.

statistics for each of these three investments separately and for the portfolio as a whole in the final column. From the daily standard deviation, we see that the Nasdaq is the most volatile and interest rates the least volatile of the assets. The portfolio is less volatile than either of the equity series even though it is 80 percent equity—yet another illustration of the benefits of diversification. All the assets show evidence of fat tails, since the kurtosis exceeds 3, which is the normal value, and evidence of negative skewness, which means that the left tail is particularly extreme.

The portfolio shows substantial evidence of ARCH effects as judged by the autocorrelations of the squared residuals in Table 2. The first order autocorrelation is .210, and they gradually decline to .083 after 15 lags. These autocorrelations are not large, but they are very significant. They are also all positive, which is uncommon in most economic time series and yet is an implication of the GARCH(1,1) model. Standard software allows a test of the hypothesis that there is no autocorrelation (and hence no ARCH). The test *p*-values shown in the last column are all zero to four places, resoundingly rejecting the "no ARCH" hypothesis.

Then we forecast the standard deviation of the portfolio and its 1 percent quantile. We carry out this calculation over several different time frames: the entire ten years of the sample up to March 23, 2000; the year before March 23, 2000; and from January 1, 2000, to March 23, 2000.

Consider first the quantiles of the historical portfolio at these three different time horizons. To do this calculation, one simply sorts the returns and finds the 1 percent worst case. Over the full ten-year sample, the 1 percent quantile times $1,000,000 produces a value at risk of $22,477. Over the last year, the calculation produces a value at risk of $24,653—somewhat higher, but not enormously so. However, if the 1 percent quantile is calculated based on the data from January 1, 2000, to March 23, 2000, the value at risk is $35,159. Thus, the level of risk apparently has increased dramatically over the last quarter of the sample. Each of these numbers is the appropriate value at risk if the next day is equally likely to be the same as the days in the given sample period. This assumption is more likely to be true for the shorter period than for the long one.

The basic GARCH(1,1) results are given in Table 3. Under this table it lists the dependent variable, PORT, and the sample period, indicates that it took the algorithm 16 iterations to maximize the likelihood function and computed stan-

Table 2
Autocorrelations of Squared Portfolio Returns

	AC	*Q-Stat*	*Prob*
1	0.210	115.07	0.000
2	0.183	202.64	0.000
3	0.116	237.59	0.000
4	0.082	255.13	0.000
5	0.122	294.11	0.000
6	0.163	363.85	0.000
7	0.090	384.95	0.000
8	0.099	410.77	0.000
9	0.081	427.88	0.000
10	0.081	445.03	0.000
11	0.069	457.68	0.000
12	0.080	474.29	0.000
13	0.076	489.42	0.000
14	0.074	503.99	0.000
15	0.083	521.98	0.000

Sample: March 23, 1990 to March 23, 2000.

Table 3
GARCH(1,1)

	Variance Equation			
Variable	*Coef*	*St. Err*	*Z-Stat*	*P-Value*
C	1.40E-06	4.48E-07	3.1210	0.0018
ARCH(1)	0.0772	0.0179	4.3046	0.0000
GARCH(1)	0.9046	0.0196	46.1474	0.0000

Notes: Dependent Variable: PORT.
Sample (adjusted): March 23, 1990 to March 23, 2000.
Convergence achieved after 16 iterations.
Bollerslev-Woodridge robust standard errors and covariance.

dard errors using the robust method of Bollerslev-Wooldridge. The three coefficients in the variance equation are listed as C, the intercept; ARCH(1), the first lag of the squared return; and GARCH(1), the first lag of the conditional variance. Notice that the coefficients sum up to a number less than one, which is required to have a mean reverting variance process. Since the sum is very close to one, this process only mean reverts slowly. Standard errors, *Z*-statistics (which are the ratio of coefficients and standard errors) and *p*-values complete the table.

The standardized residuals are examined for autocorrelation in Table 4. Clearly, the autocorrelation is dramatically reduced from that observed in the portfolio returns themselves. Applying the same test for autocorrelation, we now

Table 4
Autocorrelations of Squared Standardized Residuals

	AC	*Q-Stat*	*Prob*
1	0.005	0.0589	0.808
2	0.039	4.0240	0.134
3	−0.011	4.3367	0.227
4	−0.017	5.0981	0.277
5	0.002	5.1046	0.403
6	0.009	5.3228	0.503
7	−0.015	5.8836	0.553
8	−0.013	6.3272	0.611
9	−0.024	7.8169	0.553
10	−0.006	7.9043	0.638
11	−0.023	9.3163	0.593
12	−0.013	9.7897	0.634
13	−0.003	9.8110	0.709
14	0.009	10.038	0.759
15	−0.012	10.444	0.791

find the *p*-values are about 0.5 or more, indicating that we can accept the hypothesis of "no residual ARCH."

The forecast standard deviation for the next day is 0.0146, which is almost double the average standard deviation of 0.0083 presented in the last column of Table 1. If the residuals were normally distributed, then this would be multiplied by 2.327, because 1 percent of a normal random variable lies 2.327 standard deviations below the mean. The estimated normal value at risk = $33,977. As it turns out, the standardized residuals, which are the estimated values of $\{\varepsilon_t\}$, are not very close to a normal distribution. They have a 1 percent quantile of 2.844, which reflects the fat tails of the asset price distribution. Based on the actual distribution, the estimated 1 percent value at risk is $39,996. Notice how much this value at risk has risen to reflect the increased risk in 2000.

Finally, the value at risk can be computed based solely on estimation of the quantile of the forecast distribution. This has recently been proposed by Engle and Manganelli (2001), adapting the quantile regression methods of Koenker and Basset (1978) and Koenker and Hallock in this symposium. Application of their method to this data set delivers a value at risk = $38,228.

What actually did happen on March 24, 2000, and subsequently? The portfolio lost more than $1000 on March 24 and more than $3000 on March 27. The biggest hit was $67,000 on April 14. We all know that Nasdaq declined substantially over the next year. The Dow Jones average was much less affected, and bond prices increased as the Federal Reserve lowered interest rates. Figure 2 plots the value at risk estimated each day using this methodology within the sample period and the losses that occurred the next day. There are about 1 percent of times the value at risk is exceeded, as is expected, since this is in-sample. Figure 3 plots the same graph for the next year and a quarter, during

Figure 2
Value at Risk and Portfolio Losses In-Sample

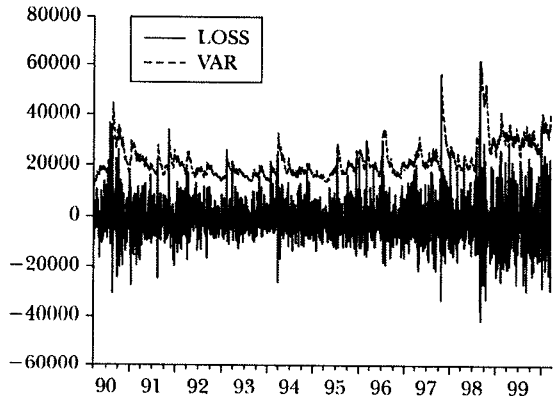
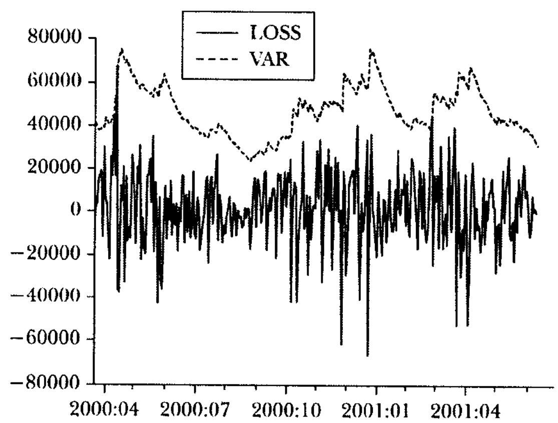


Figure 3
Value at Risk and Portfolio Losses Out of Sample



which the equity market tanks and the bond yields fall. The parameters are not reestimated, but the formula is simply updated each day. The computed value at risk rises substantially from the $40,000 initial figure as the volatility rises in April 2000. Then the losses decline, so that the value at risk is well above the realized losses. Toward the end of the period, the losses approach the value at risk again, but at a lower level. In this year and a quarter, the value at risk is exceeded only once; thus, this is actually a slightly conservative estimate of the risk. It is not easy to determine whether a particular value-at-risk number is correct, although statistical tests can be formulated for this in the same way they are formulated for volatilities. For example, Engle and Manganelli (2001) present a "dynamic quantile test."

Extensions and Modifications of GARCH

The GARCH(1,1) is the simplest and most robust of the family of volatility models. However, the model can be extended and modified in many ways. I will briefly mention three modifications, although the number of volatility models that can be found in the literature is now quite extraordinary.

The GARCH(1,1) model can be generalized to a GARCH(p,q) model—that is, a model with additional lag terms. Such higher-order models are often useful when a long span of data is used, like several decades of daily data or a year of hourly data. With additional lags, such models allow both fast and slow decay of information. A particular specification of the GARCH(2,2) by Engle and Lee (1999), sometimes called the "component model," is a useful starting point to this approach.

ARCH/GARCH models thus far have ignored information on the direction of returns; only the magnitude matters. However, there is very convincing evidence that the direction does affect volatility. Particularly for broad-based equity indices and bond market indices, it appears that market declines forecast higher volatility than comparable market increases do. There is now a variety of asymmetric GARCH models, including the EGARCH model of Nelson (1991), the TARCH model—threshold ARCH—attributed to Rabemananjara and Zakoian (1993) and Glosten, Jaganathan and Runkle (1993), and a collection and comparison by Engle and Ng (1993).

The goal of volatility analysis must ultimately be to explain the causes of volatility. While time series structure is valuable for forecasting, it does not satisfy our need to explain volatility. The estimation strategy introduced for ARCH/GARCH models can be directly applied if there are predetermined or exogenous variables. Thus, we can think of the estimation problem for the variance just as we do for the mean. We can carry out specification searches and hypothesis tests to find the best formulation. Thus far, attempts to find the ultimate cause of volatility are not very satisfactory. Obviously, volatility is a response to news, which must be a surprise. However, the timing of the news may not be a surprise and gives rise to predictable components of volatility, such as economic announcements. It is also possible to see how the amplitude of news events is influenced by other news events. For example, the amplitude of return movements on the United States stock market may respond to the volatility observed earlier in the day in Asian markets as well as to the volatility observed in the United States on the previous day. Engle, Ito and Lin (1990) call these "heat wave" and "meteor shower" effects.

A similar issue arises when examining several assets in the same market. Does the volatility of one influence the volatility of another? In particular, the volatility of an individual stock is clearly influenced by the volatility of the market as a whole. This is a natural implication of the capital asset pricing model. It also appears that there is time variation in idiosyncratic volatility (for example, Engle, Ng and Rothschild, 1992).

This discussion opens the door to multivariate modeling where not only the volatilities but also the correlations are to be investigated. There are now a large number of multivariate ARCH models to choose from. These turn out often to be difficult to estimate and to have large numbers of parameters. Research is continuing to examine new classes of multivariate models that are more convenient for fitting large covariance matrices. This is relevant for systems of equations such as vector autoregressions and for portfolio problems where possibly thousands of assets are to be analyzed.

Conclusion

ARCH and GARCH models have been applied to a wide range of time series analyses, but applications in finance have been particularly successful and have been the focus of this introduction. Financial decisions are generally based upon the tradeoff between risk and return; the econometric analysis of risk is therefore an integral part of asset pricing, portfolio optimization, option pricing and risk management. This paper has presented an example of risk measurement that could be the input to a variety of economic decisions. The analysis of ARCH and GARCH models and their many extensions provides a statistical stage on which many theories of asset pricing and portfolio analysis can be exhibited and tested.

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CHAPTER 19

BEHAVIORAL FINANCE AND THE PSYCHOLOGY OF INVESTING

The rational man—like the Loch Ness monster—is sighted often, but photographed rarely.

DAVID DREMAN, 1998[1]

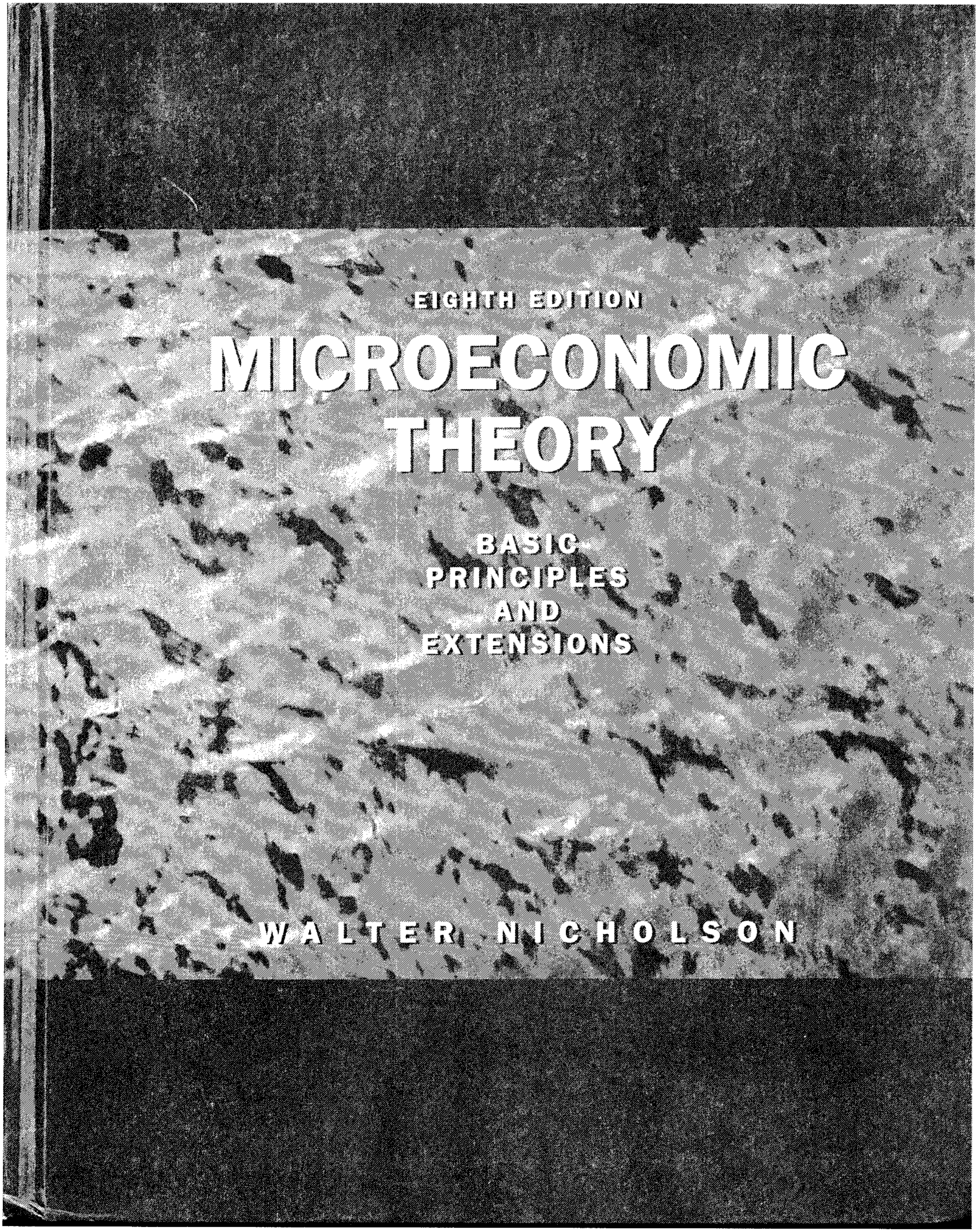
The market is most dangerous when it looks best; it is most inviting when it looks worst.

FRANK J. WILLIAMS, 1930[2]

This book is filled with data, figures, and charts that support a diversified, long-term outlook for stock investors. Yet advice is much easier to take in theory than to put in practice. The finance profession is increasingly aware that psychological factors can thwart rational analysis and prevent investors from achieving the best results for their portfolio. The study of these psychological factors has burgeoned into the field of *behavioral finance.*

[1]David Dreman, *Contrarian Investment Strategies: The Next Generation* (New York: Simon & Schuster, 1998).
[2]Frank J. Williams, *If You Must Speculate, Learn the Rules* (Burlington, VT: Freiser Press, 1930).

PMA-R26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Printed in the United States of America

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Library of Congress Control Number: 2001092127

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CHAPTER 3

PREFERENCES AND UTILITY

In this chapter we look at the way in which economists characterize individuals' preferences. We begin with a fairly abstract discussion of the "preference relation," but quickly turn to the economists' primary tool for studying individual choices—the utility function. We look at some general characteristics of such a function and at a few simple examples of specific utility functions we will encounter throughout this book.

Axioms of Rational Choice

One way to begin an analysis of individuals' choices is to state a basic set of postulates, or axioms, that characterize "rational" behavior. Although a number of sets of such axioms have been proposed, all have similarities in that they begin with the concept of "preference": When an individual reports that "A is preferred to B," it is taken to mean that all things considered, he or she feels better off under situation A than under situation B. This preference relation is assumed to have three basic properties:

I. *Completeness:* If A and B are *any* two situations, the individual can always specify exactly one of the following three possibilities:
   1. "A is preferred to B,"
   2. "B is preferred to A," or
   3. "A and B are equally attractive."

   Individuals are consequently assumed not to be paralyzed by indecision: They completely understand and can always make up their minds about the desirability of any two alternatives. The assumption also rules out the possibility that the individual can report both that A is preferred to B and that B is preferred to A.

II. *Transitivity:* If an individual reports that "A is preferred to B" and that "B is preferred to C," then he or she must also report that "A is preferred to C."

   This assumption states that the individual's choices are internally consistent. Such an assumption can be subjected to empirical study. Generally, such studies conclude that a person's choices are indeed transitive, but that conclusion must be modified in cases where the individual may not fully understand the consequences of the choices he or she is making. Because, for the most part, we will assume choices are fully informed (but see the discussion of uncertainty in Part III and elsewhere), the transitivity property seems an appropriate assumption to make about preferences.

III. *Continuity:* If an individual reports "A is preferred to B," then situations suitably "close to" A must also be preferred to B.

   This rather technical assumption is required if we wish to analyze individuals' responses to relatively small changes in income and prices. The purpose of the assumption is to rule out certain kinds of discontinuous, knife-edge preferences that pose problems for a mathematical development of the theory of choice. Assuming continuity does not seem to run the risk of missing types of economic behavior that are especially important in the real world.

Utility

Given the assumptions of completeness, transitivity, and continuity, it is possible to show formally that people are able to rank in order all possible situations from the least desirable to the most.[1] Following the terminology introduced by the

[1] These properties and their connection to representation of preferences by a utility function are discussed in detail in Andreu Mas-Colell, Michael D. Whinston, and Jerry R. Green, *Microeconomic Theory* (New York: Oxford University Press, 1995).

nineteenth-century political theorist Jeremy Bentham, economists call this ranking *utility*.[2] We also will follow Bentham by saying that more desirable situations offer more utility than do less desirable ones. That is, if a person prefers situation A to situation B, we would say that the utility assigned to option A, denoted by $U(A)$, exceeds the utility assigned to B, $U(B)$.

Nonuniqueness of Utility Measures

We might even attach numbers to these utility rankings. But these numbers will not be unique. Any set of numbers we arbitrarily assign that accurately reflects the original preference ordering will imply the same set of choices. It makes no difference whether we say that $U(A) = 5$ and $U(B) = 4$ or that $U(A) = 1{,}000{,}000$ and $U(B) = 0.5$. In either case the numbers imply that A is preferred to B. In technical terms, our notion of utility is defined only up to an order-preserving ("monotonic") transformation.[3] Any set of numbers that accurately reflects a person's preference ordering will do. Consequently, it makes no sense to ask "how much more is A preferred than B?" since that question has no unique answer. Surveys that ask people to rank their "happiness" on a scale of 1 to 10 could just as well use a scale of 7 to 1,000,000. About all that can be hoped for is that a person who reports he or she is a "6" on the scale one day and a "7" on the next day is indeed happier on the second day. Utility rankings are therefore like the ordinal rankings of restaurants or movies using one, two, three, or four stars. They simply record the relative desirability of commodity bundles.

This lack of uniqueness in the assignment of utility numbers also shows why it is not possible to compare utilities between people. If one person reports that a steak dinner provides a utility of "5" and another reports that the same dinner offers a utility of "100," we cannot say which individual values the dinner more because they could be using very different scales. Similarly, we have no way of measuring whether a move from situation A to situation B provides more utility to one person or to another. Nonetheless, as we will see, economists can say quite a bit about utility rankings by examining what people voluntarily choose to do.

The *Ceteris Paribus* Assumption

Because *utility* refers to overall satisfaction, such a measure clearly is affected by a variety of factors. A person's utility is affected not only by his or her consumption of physical commodities, but also by psychological attitudes, peer group pressures, personal experiences, and the general cultural environment. Although economists do have a general interest in examining such influences, usually a narrowing of focus is necessary. Consequently, a common practice is to devote attention exclusively to choices among quantifiable options (for example, the relative quantities of food and shelter bought, the number of hours worked per week, or votes among specific

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[2] J. Bentham, *Introduction to the Principles of Morals and Legislation* (London: Hafner, 1848).

[3] We can denote this idea mathematically by saying that any numerical utility ranking (U) can be transformed into another set of numbers by the function F providing that $F(U)$ is order preserving. This can be assured if $F'(U) > 0$. For example, the transformation $F(U) = U^2$ is order preserving as is the transformation $F(U) = \ln U$. At some places in the text and problems, we may find it convenient to make such transformations in order to make a particular utility ranking easier to analyze.

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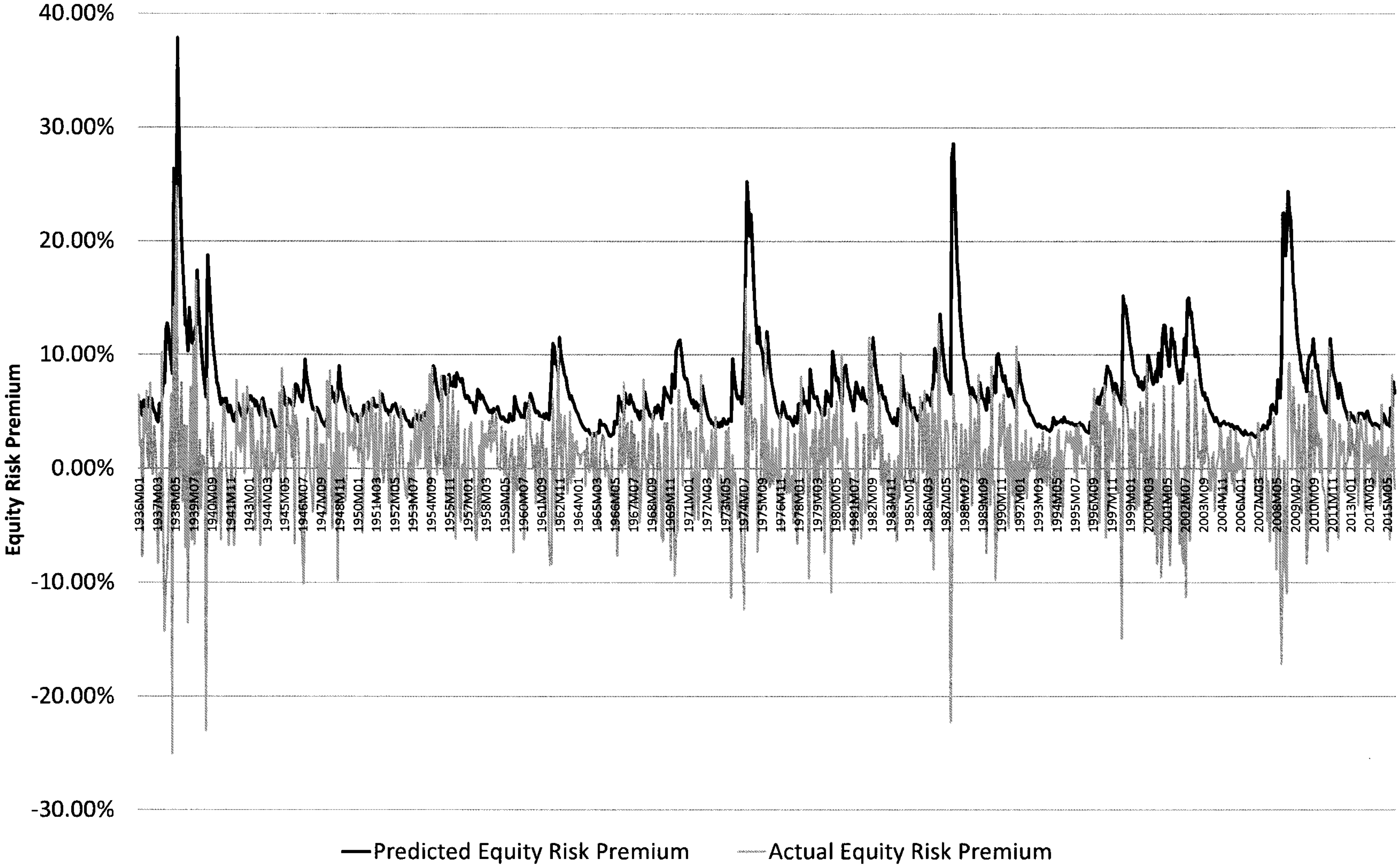
Predicted and Actual Market Equity Risk Premiums (Returns of Market over Income Return on LT Treas. Bonds) 1936-2015



PMA-R28

Financial Management Theory and Practice

Fourth Edition

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Tokyo Mexico City Rio de Janeiro Madrid

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Compositor: The Clarinda Company
Text Type: 10/12 Palatino

Library of Congress Cataloging in Publication Data

Brigham, Eugene F., 1930–
Financial management.

Includes bibliographies and index.
1. Corporations—Finance. I. Title.
HG4026.B669 1985 658.1'5 84-21060
ISBN 0-03-071693-4

Printed in the United States of America
567-032-987654321

Address orders:
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New York, NY 10017

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Hinsdale, IL 60521

CBS COLLEGE PUBLISHING
The Dryden Press
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Portfolio Beta Coefficients

A portfolio consisting of low-beta securities will itself have a low beta, since the beta of any set of securities is a weighted average of the individual securities' betas:

$$b_p = \sum_{i=1}^{n} w_i b_i. \quad (6\text{-}5)$$

Here b_p is the beta of the portfolio, which reflects how volatile the portfolio is in relation to the market index; w_i is the fraction of the portfolio invested in the *i*th stock; and b_i is the beta coefficient of the *i*th stock.

If an investor holds a $100,000 portfolio consisting of $10,000 invested in each of 10 stocks, and if each stock has a beta of 0.8, then the portfolio will have $b_p = 0.8$. Thus, the portfolio is less risky than the market, and it should experience relatively narrow price swings and have small rate of return fluctuations.

Now suppose one of the existing stocks is sold and replaced by a stock with $b_i = 2.0$. This action will increase the riskiness of the portfolio from $b_{p1} = 0.8$ to $b_{p2} = 0.92$:

$$b_{p2} = \sum_{i=1}^{n} w_i b_i = 0.9(0.8) + 0.1(2.0) = 0.92.$$

Had a stock with $b_i = 0.2$ been added, the portfolio beta would have declined from 0.8 to 0.74. Adding this stock would, therefore, reduce the riskiness of the portfolio.

The Relationship between Risk and Rates of Return

In the preceding section, we saw that under the CAPM framework, beta is the appropriate measure of a stock's relevant risk. Now we must specify the relationship between risk and return—if beta rises by some specific amount, by how much must the stock's expected return increase to compensate for the increase in risk? To begin, let us define the following terms:

$\hat{k}_i$ = expected rate of return on the *i*th stock.

k_i = required rate of return on the *i*th stock. If $\hat{k}_i$ is less than k_i, then you would not purchase this stock, or you would sell it if you owned it.

R_F = riskless rate of return, generally measured by the rate of return on U.S. Treasury securities.

b_i = beta coefficient of the *i*th stock.

k_M = required rate of return on an average ($b = 1.0$) stock. k_M is also the required rate of return on a portfolio consisting of all stocks, or the market portfolio.

$RP_M = (k_M - R_F)$ = market risk premium. It is the additional return over the riskless rate required to compensate investors for assuming an "average" amount of risk.

$RP_i = b_i(k_M - R_F)$ = risk premium on the ith stock. The stock's risk premium is less than, equal to, or greater than the premium on an average stock, depending on whether its beta is less than, equal to, or greater than 1.0. If $b_i = 1.0$, then $RP_i = RP_M$.

The market risk premium, RP_M, depends on the degree of aversion that investors, in the aggregate, have to risk.[11] Let us assume that at the current time Treasury bonds yield $R_F = 8\%$, and an average share of stock has a required return of $k_M = 12\%$. Therefore, the market risk premium is 4 percent:

$$RP_M = k_M - R_F = 12\% - 8\% = 4\%.$$

It follows that, if one stock were twice as risky as some other, its risk premium would be twice as high, and, conversely, if its risk were only half as high, its risk premium would be half as high. Further, we can measure a stock's relative riskiness by its beta coefficient. Therefore, if we know the market risk premium, RP_M, and the stock's beta coefficient, b_i, we can find its risk premium as the product $b_i(RP_M)$. For example, if $b_i = 0.5$ and $RP_M = 4\%$, then RP_i is 2 percent:

$$\text{Risk premium for Stock i} = RP_i = b_i(RP_M) = 0.5(4\%) = 2.0\%. \tag{6-6}$$

To summarize, given estimates of R_F, k_M, and b_i, we can find the required rate of return on Stock i:

$$\begin{aligned} k_i &= R_F + b_i(k_M - R_F) = R_F + b_i(RP_M) \\ &= 8\% + 0.5(12\% - 8\%) = 8\% + 0.5(4\%) = 10\%. \end{aligned} \tag{6-7}$$

If some other stock, j, were more risky than Stock i and had $b_j = 2.0$, then its required rate of return would be 16 percent:

$$k_j = 8\% + 2.0(4\%) = 16\%.$$

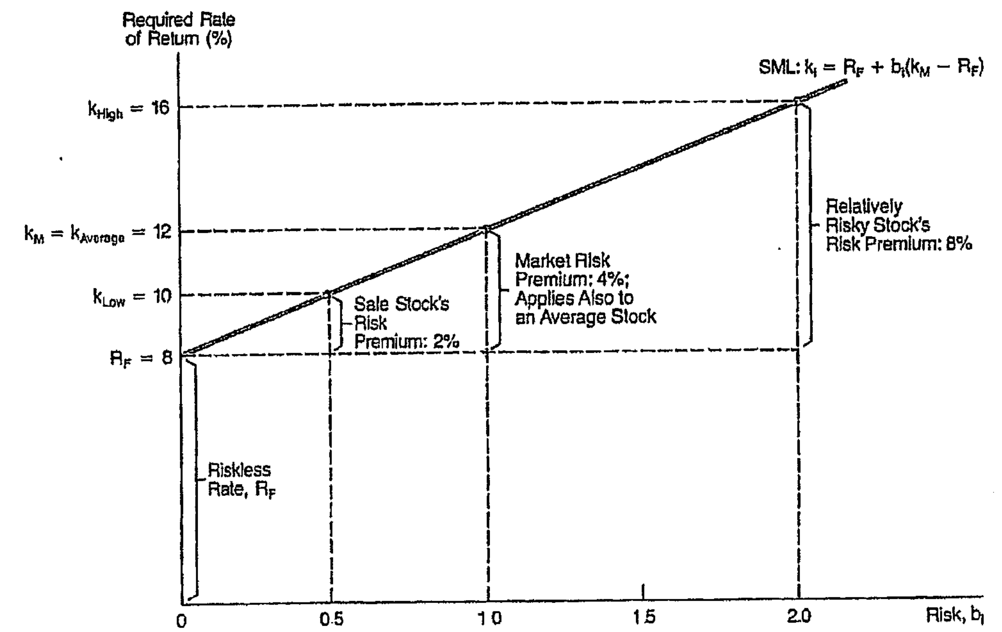
An average stock, with $b = 1.0$, would have a required return of 12 percent, the same as the market return:

$$k_{Average} = 8\% + 1.0(4\%) = 12\% = k_M.$$

Equation 6-7 is often expressed as a graph called the *Security Market Line (SML);* Figure 6-9 shows the SML when $R_F = 8\%$ and $k_M = 12\%$. Note the following points:

[11] This concept is discussed in some detail in Appendix 6B. It should be noted that the risk premium of an average stock, $k_M - R_F$, cannot be measured with great precision because it is impossible to obtain precise values for k_M. However, empirical studies suggest that, where long-term U.S. Treasury bonds are used to measure R_F and where k_M is the expected return on the S&P 400 Industrial Stocks, the market risk premium varies somewhat from year to year, and it has generally ranged from 3 to 6 percent during the last 20 years.

Figure 6-9
The Security Market Line (SML)



1. Required rates of return are shown on the vertical axis, while risk as measured by beta is shown on the horizontal axis.

2. Riskless securities have $b_i = 0$; therefore, R_F appears as the vertical axis intercept.

3. The slope of the SML reflects the degree of risk aversion in the economy—the greater the average investor's aversion to risk, then (1) the steeper is the slope of the line, (2) the greater is the risk premium for any risky asset, and (3) the higher is the required rate of return on risky assets.[12] These points are discussed further in a later section.

[12]Students sometimes confuse beta with the slope of the SML. This is a mistake. As we saw earlier in connection with Figure 6-8, and as is developed further in Appendix 6A, beta does represent the slope of a line, but *not* the Security Market Line. This confusion arises partly because the SML equation is generally written, in this book and throughout the finance literature, as $k_i = R_F + b_i(k_M - R_F)$, and in this form b_i looks like the slope coefficient and $(k_M - R_F)$ the variable. It would perhaps be less confusing if the second term were written $(k_M - R_F)b_i$, but this is not generally done.

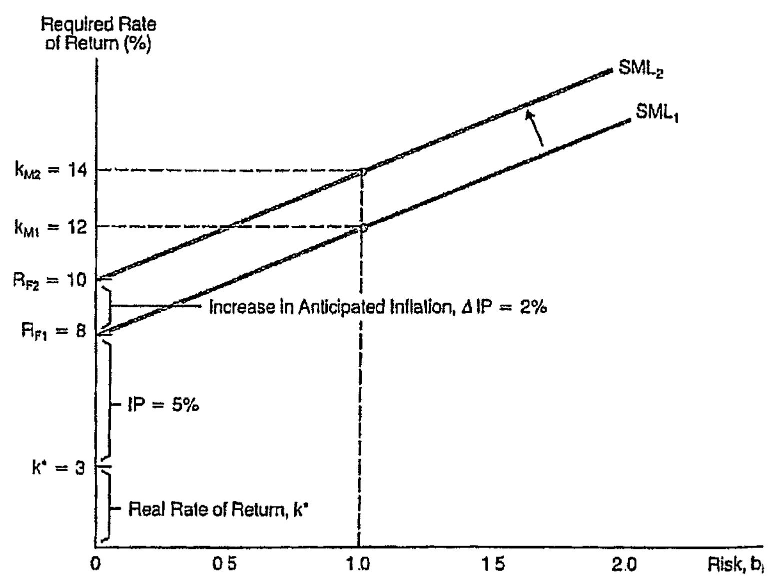
4. The values we worked out for stocks with $b_i = 0.5$, $b_i = 1.0$, and $b_i = 2.0$ agree with the values shown on the graph for k_{Low}, $k_{Average}$, and k_{High}.

The Security Market Line, and a company's position on the line, change over time as interest rates, investors' risk aversion, and individual companies' betas change. Such changes are discussed in the following sections.

The Impact of Inflation

As we saw in Chapter 3, interest amounts to "rent" on borrowed money, or the "price" of money. Thus, R_F is the price of money to a riskless borrower. The existing market risk-free rate is called the *nominal rate*, and it consists of two elements: (1) a *real*, or *inflation-free, rate of return*, k*, and (2) an *inflation premium*, IP, equal to the anticipated rate of inflation. Thus, $R_F = k^* + IP$. The real rate on risk-free government securities has, historically, ranged from 2 to 4 percent, with a mean of about 3 percent. Thus, if no inflation were expected, risk-free government securities would tend to yield about 3 percent. However, as the expected rate of inflation increases, a premium must be added to the real rate of return to compensate investors for the loss of purchasing

Figure 6-10
Shift in the SML Caused by an Increase in Inflation



PMA-R29

NORTH-HOLLAND

The Quarterly Review of Economics and Finance
43 (2003) 578–582

The QUARTERLY REVIEW of ECONOMICS And FINANCE

Short communication

Utility stocks and the size effect—revisited

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Received 7 January 2002; received in revised form 27 August 2002; accepted 29 August 2002

Abstract

Wong concluded there is weak empirical support that firm size is a missing factor from the capital asset pricing model for industrial stocks but not for utility stocks. Her weak results, however, do not rule out the possibility of a small firm effect for utilities. The issue she addressed has important financial implications in regulated proceedings that set rates of return for utilities. New studies based on different size water utilities are presented that do support a small firm effect in the utility industry.

Keywords: Utility stocks; Beta risk; Firm size

Annie Wong concludes there is some weak evidence that firm size is a missing factor from the capital asset pricing model ("CAPM") for industrial stocks but not for utility stocks (Wong, 1993, p. 98). This "firm size effect" is an observation that small firms tend to earn higher returns than larger firms after controlling for differences in estimates of beta risk in the CAPM. Wong notes that if the size effect exists, it has important implications and should be considered by regulators when they determine fair rates of return for public utilities. This paper re-examines the basis for her conclusions and presents new information that indicates there is a small firm effect in the utility sector.

1. Reconsideration of the evidence provided by Wong

Wong relies on Barry and Brown (1984) and Brauer (1986) to suggest the small firm effect may be explained by differences in information available to investors of small and large firms.

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1062-9769/02/$ – see front matter
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She states that requirements to file reports and information generated during regulatory proceedings indicate the same amount of information is available for large and small utilities and thus, if the differential information hypothesis explains the small firm effect, then the uniformity of information available among utility firms would suggest the size effect should not be observed in the utility industry. But contrary to the facts she assumes, there are differences in information available for large and small utilities. More parties participate in proceedings for large utilities and thus generate more information. Also, in some jurisdictions smaller utilities are not required to file all of the information that is required of larger firms. Thus, if the small firm effect is explained by differential information, contrary to Wong's hypothesis, differences in available information suggests there is a small firm effect in the utility industry. Wong did not discuss other potential explanations of the small firm effect for utilities.[3]

Wong's empirical results are not strong enough to conclude that beta risks of utilities are unrelated to size. In the period 1963–1967, when monthly data were used to estimate betas, her estimates of utility betas as well as industrial betas increased as the size of the firms decreased, but she did not find the same inverse relationship between size and beta risk for utilities in other periods. Being unable to demonstrate a relationship between size and beta in other periods may be the result of Wong using monthly, weekly and daily data to make those beta estimates. Roll (1980) concluded trading infrequency seems to be a powerful cause of bias in beta risk estimates when time intervals of a month or less are used to estimate betas for small stocks. When a small stock is thinly traded, its stock price does not reflect the movement of the market, which drives down the apparent covariance with the market and creates an artificially low beta estimate.

Ibbotson Associates (2002) found that when annual data are used to estimate betas, beta estimates for the smaller firms increase more than beta estimates for larger firms. Table 1 compares Value Line (2000) beta estimates for three relatively small water utilities that are made with weekly data and an adjusted beta estimated with pooled annual data for the utilities for the 5-year period ending in December 2000. In making the latter estimate, it is assumed that the underlying beta for each of water utilities is the same. The t-statistics for the unadjusted beta

Table 1
Beta estimates reported by Value Line and estimated with pooled annual returns for relatively small water utilities

	Value Line	Estimated with annual data
Connecticut Water Service	0.45	
Middlesex Water	0.45	
SJW Corporation	0.50	
Average	0.47	0.78
t-statistic		2.72[c,d]

[a] As reported in Value Line (2000). Betas estimated with 5 years of weekly data.

[b] Estimated with pooled annual return premiums for the 5-year period ending December 2000. Proxy market returns are total returns for the S&P 500 index. Dummy variable in 1999 to reflect the proposed acquisition of SJW Corporation included in analysis.

[c] Significant at the 95% level.

[d] The t-statistic for the null hypothesis that the true beta is 0.18 (the derived unadjusted Value Line beta) when the estimated betas is 0.65 (the unadjusted estimated beta) is 1.97. It is significant at the 95% level.

estimate is reported in parentheses. As was found by Ibbotson Associates (2002) for stocks in general, when annual data are used to estimate betas for small utility stocks, the beta estimate increases.

Wong used the Fama and MacBeth (1973) approach to estimate how well firm size and beta explain future returns in four periods. She reports weak empirical results for both the industrial and utility sectors. In every one of the statistical results reported for utilities, the coefficient for the size effect has a negative sign as would be expected if there is a size effect in the utility industry but only one of the results was found to be statistically significant at the 5% level. With the industrial sector, though she found two cases to have a significant size effect, a negative sign for the size coefficient occurred only 75% of the time. What is puzzling is that with these weak results, Wong concludes the analysis provides support for the small firm effect for the industrial industry but no support for a small firm effect for the utility industry.

2. New evidence on risk premiums required by small utilities

Two other studies support a conclusion that small utilities are more risky than larger ones. A study made by Staff of the Water Utilities Branch of the California Public Utilities Commission Advisory and Compliance Division (CPUC Staff, 1991) used proxies for beta risk and determined small water utilities were more risky than larger water utilities. Part of the difficulty with examining the question of relative risk of utilities is that the very small utilities are not publicly-traded. This CPUC Staff study addressed that concern by computing proxies for beta risk estimated with accounting data for the period 1981–1991 for 58 water utilities. Based on that analysis, CPUC Staff concluded that smaller water utilities were more risky and required higher equity returns than larger water utilities. Following 8 days of hearings and testimony by 21 witnesses regarding this study, it was adopted by the California Public Utilities Commission in CPUC Decision 92-03-093, dated March 31, 1992.

Table 2 provides the results of another study of differences in required returns estimated from discounted cash flow ("DCF") model estimates of the costs of equity for water utilities of different sizes. The study compares average estimates of equity costs for two smaller water utilities, Dominguez Water Company and SJW Corporation, with equity cost estimates for two larger companies, California Water Service and American States Water, for the period 1987–1997. All four utilities operated primarily in the same regulatory jurisdiction during that period. Estimates of future growth are required to make DCF estimates. Gordon, Gordon, and Gould (1989) found that a consensus of analysts' forecasts of earnings per share for the next 5 years provides a more accurate estimate of growth required in the DCF model than three different historical measures of growth. Unfortunately, such analysts' forecasts are not generally available for small utilities and thus this study assumes, as was assumed by staff at the regulatory commission, that investors relied upon past measures of growth to forecast the future. The results in Table 2 show that the smaller water utilities had a cost of equity that, on average, was 99 basis points higher than the average cost of equity for the larger water utilities. This result is statistically significant at the 90% level. In terms of the issues being addressed by Wong, the 99 basis points could be the result of differences in beta risk, the small firm effect or some combination of the two.

Table 2
Small firm equity cost differential: case study based on a comparison of DCF equity cost estimates for larger and smaller California water utilities (1987–1997)

	Larger water utilities[a]			Smaller water utilities[b]			Smaller utilities minus larger utilities
	D_0/P_0 (%)	Estimated growth (%)[c]	Equity cost estimate (%)[d]	D_0/P_0 (%)	Estimated growth (%)[c]	Equity cost estimate (%)[d]	
1987	6.60	7.17	14.24	5.38	10.06	15.98	1.74
1988	6.75	6.30	13.48	5.81	9.08	15.42	1.94
1989	7.10	6.30	13.84	6.47	7.00	13.93	0.09
1990	7.24	6.19	13.87	6.96	7.51	14.99	1.11
1991	6.94	6.29	13.67	6.64	6.24	13.30	−0.36
1992	6.18	5.96	12.50	6.50	6.71	13.65	1.14
1993	5.32	5.68	11.30	5.49	6.31	12.15	0.85
1994	6.03	4.40	10.70	5.80	4.86	10.94	0.25
1995	6.44	3.86	10.55	6.44	4.88	11.64	1.09
1996	5.60	4.06	9.88	5.77	5.58	11.67	1.79
1997	4.93	3.31	8.40	4.52	4.89	9.64	1.23
Averarage difference							0.99
t-statistic							1.405[e]

Limited to period for which Dominguez Water Company data were available. 1998 excluded due to pending buyout.

[a] American States Water and California Water Service.

[b] Dominguez Water Company and SJW Corporation.

[c] Average of 5- and 10-year dividends per share growth, 10-year earnings per share growth and estimates of sustainable growth from internal and external sources for the most recent 10-year period when data are available (1991–1997), otherwise most recent 5-year period (1987–1990).

[d] DCF equity cost as computed by California PUC staff: $k = (D_0/P_0) \times (1 + g) + g$.

[e] Significant at the 90% level.

3. Concluding remarks

Wong's concluding remarks should be re-examined and placed in perspective. She noted that industrial betas tend to decrease with increases in firm size but the same relationship is not found in every period for utilities. Had longer time intervals been used to estimated betas, as was done in Table 1, she may have found the same inverse relationship between size and beta risk for utilities in other periods. She also concludes "there is some weak evidence that firm size is a missing factor from the CAPM for the industrial but not the utility stocks" (Wong, 1993, p. 98), but the weak evidence provides little support for a small firm effect existing or not existing in either the industrial or utility sector. Two other studies discussed here support a conclusion that smaller water utility stocks are more risky than larger ones. To the extent that water utilities are representative of all utilities, there is support for smaller utilities being more risky than larger ones.

Notes

1. Vice President.
2. The small firm effect could also be a proxy for numerous other omitted risk differences between large and small utilities. An obvious candidate is differentials in access to financial markets created by size. Some very small utilities are unable to borrow money without backing of the owner. Other small utilities are limited to private placements of debt and have no access to the more liquid financial markets available to larger utilities.

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PMA-R30

CCH® BUSINESS VALUATION ALERT

VOL. 1, ISSUE NO. 2
DECEMBER 1999

Do Smaller Companies Warrant a Higher Discount Rate for Risk?

The "Size Effect" Debate

by Michael A. Paschall, ASA, CFA, and George B. Hawkins, ASA, CFA, both Managing Directors at Banister Financial, Inc., in Charlotte, North Carolina.

One of the critical issues facing business appraisers today is the so-called "small stock" issue. That is, should the discount or capitalization rate used to value the smaller private held company be higher based on its smaller size? Should a smaller company's earnings or cash flow be discounted or capitalized at a higher rate (which results in a lower value) just because the company is small (as measured by earnings, assets, market value, or whatever)? Should larger public company multiples be adjusted downward for comparison with smaller private companies based on size differences alone? This article will outline the current debate in the industry and will explore some possible resolutions to this issue.

The size debate has very real implications to the valuation of companies for purchase or sale, estate planning, divorce, minority shareholder litigation, ESOPs, and other purposes. In some locales (as well as in some pending Tax Court cases) the IRS is beginning to challenge business valuations where a size impact is taken into account. While it is almost universally accepted in the valuation field that small companies are generally riskier, recent attacks are forcing the profession to respond.

Illustration of the Risk Premium

Most business appraisers use some form of the Capital Asset Pricing Model (CAPM) to develop a discount or capitalization rate. Appraisers may use a CAPM formula that incorporates a measure called "beta,"[1] or alternatively, a build-up method whereby a discount or capitalization rate is developed by use of various components. Under the use of the build-up method, an appraiser first determines a risk-free rate (usually utilizing rates of risk-free government securities) that represents the return from a total riskless investment. Since a company's stock is more risky than a riskless investment, this then necessitates the addition of various equity risk premiums depending on the perceived risk of an investment in the common stock of the subject company, over and above a risk-free rate. A simplified example is shown in Table 1.

Table 1
Example of the Build-Up Method

Risk-Free Rate	6.0%
Equity Risk Premium	7.0%
Specific Company Risk Premium	2.0%
Discount Rate	15.0%
Less: Growth Rate	(5.0)%
Capitalization Rate	10.0%

Assuming the Company's annual income or cash flow stream to be capitalized is $1,000,000, the estimated value of the Company (before minority or marketability considerations) is calculated as $1,000,000 ÷ 10% = $10,000,000. The equity risk premium represents the amount necessary to add to the risk-free rate to recognize the fact that returns on common equity are not risk-free and buyers should be compensated for bearing that additional risk by earning a higher return.

Ibbotson and PricewaterhouseCoopers each author studies that have stratified the equity risk premium by firm size, finding a direct relationship between firm size and return (discussed in more detail below). In general, these studies show that smaller companies are more risky and investors therefore require a greater return, on average, over longer periods of time for bearing this risk. Mathematically speaking, this equates to a higher equity risk premium and lower value for the smaller company. This is the crux of the size premium argument.

Traditional Thinking

It has long been observed in the finance field that there exists a so-called "small stock" effect. This refers to the observation that over long periods of time, small public company stocks have been shown to have significantly higher average annual rates of total returns than have larger public companies. The size issue has been one of the most disputed findings of corporate finance since being identified by Banz in 1981.[2] Also, Fama and French published a study that calls into doubt the ability of CAPM to forecast expected rates of return due to inaccuracies in the consideration of company size.[3] Finally, there are at least two published studies that demonstrate a clear risk premium based on company size.

Grabowski and King Studies. A study[4] by Roger Grabowski, ASA, and David King, CFA, finds a clear and strong statistical relationship between company size and rates of return. In short, the study finds that the smaller the public company (note that public companies are used since rates of return are not observable in private company shares), the higher the average rate of return required annually by investors. In their first published study, encompassing the period from 1963 to 1996, they separated stocks into 25 distinct groupings by size and found this relationship regardless of whether size is defined by annual sales revenues, number of employees, book value of shareholders' equity, or other measures.

According to the study, the smallest public companies (with average revenues of $47 million (much larger than many of the typical privately held companies)) had an average annual return (between dividends and capital appreciation) of 13.6% above the returns on U.S. Treasury bonds (i.e., 13.6% higher than a risk-free U.S. Treasury bond investment). This is in contrast to the largest public companies (with average revenues of $4.86 billion) that had an average annual return of 5.9% above the returns on U.S. Treasury bonds. In other words, on average, investors required an additional return of 7.7% (13.6% equity risk premium for small companies, less 5.9% for large companies) annually to invest in the stocks of small companies. This is referred to as the small stock premium and illustrates the "small stock effect."

Ibbotson Associates Data. Another highly respected resource, the *SBBI Yearbook,* prepared annually by Ibbotson Associates, finds similar clear indications that smaller companies require much higher average annual rates of return. Ibbotson data differs in various respects, most notably in how it defines size (in terms of a public company's market value of its shares outstanding) and in the measurement period used.

The Case Made Against the Size Effect

Despite this evidence of a size premium, there have been challenges made to this traditional thinking since its discovery. These challenges are along the following lines:

- **Excess Returns Occur in Only a Few Trading Days.** Early 1980s research shows that all of the excess return for small publicly traded stocks occurs in the first few trading days in January, and is not a generalized phenomena over the entire year.

- **Research Alleged to Be Flawed.** The excess returns of small stocks may really be related to high transaction costs and poor liquidity, factors that were not appropriately considered in prior research demonstrating the small stock effect. Additionally, allegations have been made that there are problems in the public company stock data used by Ibbotson, including a "delisting" bias, that when corrected for, causes the small stock effect to disappear.

- **No Demonstrated Ability to Earn Excess Returns in Reality.** Investment professionals have not shown any evidence that investing in small common stocks over long periods of time has actually yielded an excess return.

- **Recent Years Fail to Exhibit a Small Stock Effect.** From the 1980s through the 1990s, small stocks have actually returned less, on average, than large stocks. If the small stock effect existed the reverse would be true.

Other Arguments. Others have suggested that the small or specific company risk is irrelevant in the context of CAPM. This is because CAPM assumes all investors are well diversified and that specific company risk (called "non-systematic" risk in the language of CAPM) is eliminated by holding a diversified portfolio. The investor is only left with "systematic," or general market risk.

Complicating the small stock issue further is a study recently published in *Business Valuation Review* that claims to contradict the small stock effect noted in the Ibbotson data, PricewaterhouseCoopers research and other studies.[5] Many business appraisers define rates of return by looking at long-term averages from those studies, although another option would be to use the so-called compound (or geometric) rate of return. This recent study maintains that if compound annual rates of return of public companies are used, the small stock effect goes away completely and there is no discernable difference in returns based on company size. This study was only recently published, so whether or not there are flaws in its methodology or logic that would render its findings invalid will need to be followed closely, particularly since it is almost sure to be cited in future valuation challenges by the government. The general question of whether or not to use average or compound rates of return to develop a company's discount rate has been long-debated and still has its advocates in both camps periodically publishing new articles favoring one or the other.

Legal Precedent Challenging the Size Premium

In *Estate of Jung v. Commissioner,*[6] the Tax Court addressed the issue of whether an incremental risk premium is applicable due solely to a company's size. The *Jung* Court ultimately held that a company's discount rate does not warrant an incremental risk premium due solely to its size. The *Jung* Court reached its decision despite a statement to the contrary by the IRS in its own internal training manuals. The Court sided with the IRS experts' position that companies are risky because they are in risky industries, not because of their size. The Court noted that the taxpayer's expert presented no evidence on why the size of the corporation affects the appropriateness of a minority discount (or an incremental risk premium).

The careful business appraiser should come away from the *Jung* case with the lesson that courts want to see a specific analysis of the risks of a company, not just a showing that the company is smaller and therefore demands a size premium as a result. Although, as a general proposition, smaller companies are riskier than larger companies, it is safer to agree with the *Jung* court that a specific analysis of the particular risk of a company must be examined in each valuation situation. A size premium does not automatically apply in every case. Each privately held company should be analyzed to determine if a size premium is appropriate in its particular case. There can be unusual circumstances where a small company has risk characteristics that make it far less risky than the average company, warranting the use of a very low equity risk premium. One possible example of this is a private water utility (monopoly situation, very low risk, near-guarantee of payments). The use of a size premium without consideration of the risk of the specific company may subject the appraisal to challenge and rejection on down the road.

Data Now Allows for Analysis Other Than Based on Size

Grabowski and King, via the PricewaterhouseCoopers study, have recently broadened the way they measure public company rates of return that go beyond mere size. In the 1999 version of their study, rates of return are also calculated based on the five-year average operating profit margins of the public companies, as well as the covariance (a measure of its variability) of the operating profit margin, and a measure of return on equity.

Interestingly, the study shows a clear relationship between these measures and rate of return. In particular, the higher the five-year average operating profit margin of the average public company, the lower the rate of return on its stock, and vice versa. In other words, companies with higher average operating profit margins (separate and apart from their size) may be seen as less risky by investors than companies with thin operating profit margins. Of great interest is the statistical underpinning for this finding, which showed the five-year average operating profit margin to explain a substantial 76% of the variation observed in the rate of return of a public company's stock. Thus, a valuator can now see how measures other than size might affect a company's rate of return.

Two Main Reasons for a Size Premium

As a general proposition, a size premium is usually appropriate. The support for the size premium falls into two main categories: first, a time horizon viewpoint, and second, a common sense viewpoint. Following is a discussion of why each explanation suggests that valuators should not abandon the additional risk premium associated with size.

Time Horizon Analysis. It is general knowledge that publicly traded common stock returns exhibit wide degrees of volatility from one year to the next. Therefore, in the context of shorter time horizons, it is quite possible that returns for small or large stocks might differ, and in some years, even show negative returns. For example, a valuator is preparing a discounted cash flow valuation forecast for five years, then capitalizing the final year cash flow into perpetuity based on a capitalization rate (a cap rate is simply a discount rate minus the long term annual growth rate).

To compute the present values of each year's cash flows, a discount rate must be developed that takes into account risk. The valuator decides to use a shorter-term measure of the discount rate, basing it on the small stock rate of return for a five-year period. It is entirely possible that a five-year period could be cherry-picked from rate of return data that shows an average rate of return even below the risk-free rate, or in some cases, a negative return. From a rational point of view, it certainly does not make sense that prudent investors would require a return less than the risk-free rate on a longer-term series of inherently more risky cash flows. Rational investors would always sell the stock and buy risk-free treasuries where they could earn a higher return with no risk.

Therein lies the problem of using a short-term time horizon (such as recent years, where no small stock effect is alleged to exist) to discount a longer-term income stream. In any particular short-term period, any variety of return patterns might be observed due to the inherent volatility of stock market returns in general, whether for small or large stocks. A significant portion of the value in the discounted cash flow model comes from the terminal year value. That terminal year value is based on a perpetuity assumption, i.e., that earnings or cash flows continue indefinitely into the future, growing at the annual growth rate. If the terminal value drives a significant portion of the total value, should the valuator use short-term oscillations in returns as the basis for discounting longer-term earnings or cash flows? Of course not. Even if the investor only intends to hold the security for three or five years, rational investors pricing the security in the market are certainly taking this longer term cash flow into account since it drives so much of a stock's total return. Thus, even the investor with a shorter-term time horizon is forced by market forces to consider the long term.

Michael Annin, CFA, and Dominic Falaschetti, CFA, of Ibbotson Associates, have also examined the attack against assigning an additional small company equity risk premium.[7] They found there is a short-term phenomena of small company stocks under-performing large company stocks in 10 of the 20 years during the 1977 to 1996 time frame. However, they found that this is not true in any longer-term time frame that might be selected. Regardless of any rolling 20-year time frame from 1926 to 1996, in no single period have average 20-year small company stocks had average returns equal to or less than those of large companies. In all but a few periods, the stocks of small public companies have actually realized returns that are substantially in excess of those of large companies. These findings support the earlier comments that a longer-term time horizon is appropriate.

While the foregoing analysis might seem convincing, this study data is based on average annual public company rates of return. As noted previously, a recent study suggests that using a compound rate of return eliminates the small stock premium even if the measurement period is long-term in nature.

Common Sense Analysis. To this point, this article has only dealt with the "numbers" of academic studies. It is also important to consider the common sense aspect of the issue and forget momentarily the academic theory and studies. Is it reasonable to expect small companies to be more risky than large ones? There can certainly be cases where a particular small company has a unique aspect that reduces its risk beyond what is normally seen. It is the job of the valuator to spot these situations and take them into account in making adjustments to the discount rate. However, most smaller companies have very real aspects of risk that are not present (or at least not to the same degree) in larger companies. Regardless of whether CAPM, the build-up method or some other mathematical proxy for risk does or does not capture this risk, it is very real indeed for the buyer. This includes key person risks, customer and supplier concentrations, a tenuous dependence on less certain bank financing, a nondiversified product line, poor financial information and information systems to track the business, and a whole host of other risks. Does the small three-store retail chain in one locality have the same risk as Wal-Mart? Unless there is something extremely unusual about the chain, the answer is a resounding "no." Yet the view of the opponents of a small company equity risk premium, if taken to its logical extension, would make no such distinction.

Conclusion

The current challenge to traditional thinking about a small stock premium is a very real and potentially troublesome issue. The challenge comes from bright and articulate people and has already been incorporated into some court cases, providing further ammunition for the IRS. Failing to consider the additional risk associated with most smaller companies, however, is to fail to acknowledge reality. Measured properly, small company stocks have proven to be more risky over a long period of time than have larger company stocks. This makes sense due to the various advantages that larger companies have over smaller companies. Investors looking to purchase a riskier company will require a greater return on investment to compensate for that risk. There are numerous other risks affecting a particular company, yet the use of a size premium is one way to quantify the risk associated with smaller companies. However, business appraisers must focus on what drives the risk in each specific company valuation and articulate it, rather than falling into the complacency of relying on the small stock issue alone.

END NOTES

1 Beta is a measure of risk based on a stock's variance with the overall market, and is incorporated in the Capital Asset Pricing Model. This measure will not be explored in this article, but is discussed at length in Chapter 17 of the *CCH Business Valuation Guide.*

2 R.F. Banz, "The Relation Between Return and Market Value of Common Stocks," *Journal of Financial Economics* (1981, vol. 9) 3-18.

3 Kenneth French and Eugene Fama, "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics* (January 1993).

4 The study was later published and sold in subsequent updates by their employer, PricewaterhouseCoopers.

5 Brian Becker, Ph.D., and Ian Gray, "Does a Small Firm Effect Exist When Using the CAPM? Not Since 1980 and Not When Using Geometric Means of Historical Returns," *Business Valuation Review (September 1999)* 104-111. *Business Valuation Review* is a publication of the Business Valuation Committee of the American Society of Appraisers.

6 *Estate of Jung*, 101 TC 412, Dec. 49,387 (1993).

7 Michael Annin and Dominic Falaschetti, "Is There Still a Size Premium?" *CPA Expert* (Winter 1998).

PMA-R31

Exhibit PMA-R31
Page 1 of 2

Companies Ranked by Market Value of Equity

Historical Equity Risk Premium: Average Since 1963

Data for Year Ending December 31, 2014

Premia over CAPM (Size Premia, RP_s)

Exhibit B-1

Portfolio Rank by Size	Average Mkt. Value (in $millions)	Log of Average Mkt. Value	Beta (Sum Beta) Since '63	Arithmetic Average Return	Arithmetic Average Risk Premium	Indicated CAPM Premium	Premium over CAPM	*Smoothed Premium over CAPM*
1	178,744	5.25	0.83	12.13%	5.52%	4.21%	1.31%	*-1.07%*
2	53,009	4.72	0.96	11.15%	4.54%	4.84%	-0.30%	*0.29%*
3	32,537	4.51	0.92	11.66%	5.04%	4.67%	0.38%	*0.84%*
4	24,601	4.39	0.94	12.86%	6.25%	4.77%	1.48%	*1.16%*
5	17,777	4.25	0.99	12.37%	5.76%	5.00%	0.76%	*1.52%*
6	13,745	4.14	1.02	12.89%	6.27%	5.17%	1.10%	*1.81%*
7	11,640	4.07	1.01	13.55%	6.94%	5.12%	1.81%	*2.00%*
8	9,409	3.97	1.06	14.64%	8.03%	5.36%	2.67%	*2.23%*
9	7,894	3.90	1.10	15.55%	8.94%	5.56%	3.37%	*2.43%*
10	6,698	3.83	1.11	15.29%	8.68%	5.59%	3.08%	*2.62%*
11	5,692	3.76	1.10	14.75%	8.14%	5.56%	2.58%	*2.80%*
12	4,950	3.69	1.11	14.02%	7.40%	5.62%	1.78%	*2.96%*
13	4,383	3.64	1.12	14.93%	8.32%	5.64%	2.68%	*3.09%*
14	3,880	3.59	1.15	15.26%	8.65%	5.82%	2.82%	*3.23%*
15	3,358	3.53	1.14	17.38%	10.77%	5.74%	5.02%	*3.39%*
16	2,785	3.44	1.16	16.64%	10.02%	5.87%	4.16%	*3.60%*
17	2,323	3.37	1.19	15.89%	9.28%	6.04%	3.24%	*3.80%*
18	1,954	3.29	1.22	15.11%	8.49%	6.16%	2.33%	*4.00%*
19	1,651	3.22	1.21	16.76%	10.15%	6.13%	4.02%	*4.19%*
20	1,324	3.12	1.21	16.15%	9.53%	6.11%	3.43%	*4.44%*
21	1,084	3.03	1.25	16.96%	10.35%	6.33%	4.02%	*4.66%*
22	868	2.94	1.23	17.48%	10.87%	6.21%	4.67%	*4.91%*
23	639	2.81	1.26	17.05%	10.43%	6.36%	4.08%	*5.25%*
24	412	2.62	1.24	19.45%	12.84%	6.27%	6.57%	*5.74%*
25	132	2.12	1.28	22.92%	16.31%	6.47%	9.84%	*7.03%*
Large Stocks (Ibbotson SBBI data)				11.66%	5.05%			
Small Stocks (Ibbotson SBBI data)				16.47%	9.86%			
Long-Term Treasury Income (Ibbotson SBBI data)				6.61%				

Equity Risk Premium Study: Data through December 31, 2014

Data Smoothing with Regression Analysis

Dependent Variable: Premium over CAPM

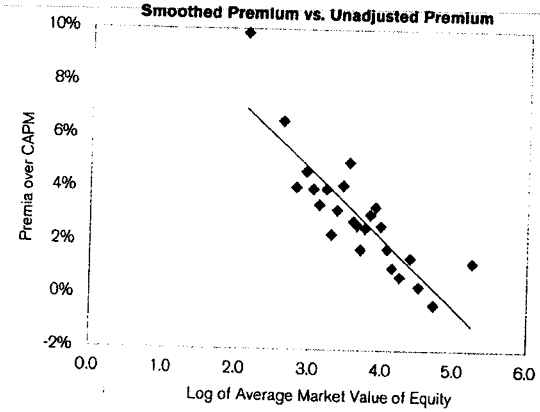
Independent Variable: Log of Average Market Value of Equity

Regression Output:

Constant	12.505%
Standard Error of Y Estimate	1.105%
R Squared	74%
No. of Observations	25
Degrees of Freedom	23
X Coefficient(s)	-2.585%
Standard Error of Coefficient	0.322%
t-Statistic	-8.02

*Smoothed Premium = 12.505% - 2.585% * Log(Market Value)*

Smoothed Premium vs. Unadjusted Premium



Sources of underlying data: 1.) © 201502 CRSP®, Center for Research in Security Prices. University of Chicago Booth School of Business used with permission. All rights reserved. 2.) Morningstar *Direct* database. Used with permission. All rights reserved. Calculations performed by Duff & Phelps LLC.

Arizona Water Company
Duff & Phelps Size Premiums for Various Capitalizations

Market Value of Equity

Capitalization Size	Midpoint of Capitalization Size Range (1) ($ M)		2014 Duff & Phelps Interpolated Premium (2)
Under $2B	$	1,000	4.75%
$2 - $5 B	$	2,000	3.97%
$5 - $10 B	$	7,500	2.49%
$10 - $20 B	$	15,000	1.71%
$20 B Plus	$	20,000	1.39%

Notes: (1) Except for the $20B plus range, since there is no top of the range.

(2) Smoothed Premium = 12.505% - 2.585* Log(Market Value). From page 2 of this Exhibit

Arizona Water Company
Brief Summary of Common Equity Cost Rate

Line No.	Principal Methods	The Proxy Group of Eight Water Companies
1.	Discounted Cash Flow Model (DCF) (1)	8.16 %
2.	Risk Premium Model (RPM) (2)	10.70
3.	Capital Asset Pricing Model (CAPM) (3)	10.26
4.	Indicated Common Equity Cost Rate before Adjustment for Business Risks	10.00 %
5.	Credit Risk Adjustment (4)	0.93
6.	Size Adjustment (5)	0.50
7.	Indicated Common Equity Cost Rate	11.43 %
8.	Recommended Common Equity Cost Rate	11.45 %

Notes:
(1) From page 2 of this Exhibit.
(2) From page 11 of this Exhibit.
(3) From page 22 of this Exhibit.
(4) Credit risk adjustment to reflect Arizona Water Company's likely Moody's bond rating of Baa2 relative to the proxy group's average Moody's Bond rating of A2/A3.

(5) Business risk adjustment to reflect Arizona Water Company's greater business risk due to its small size relative to the proxy group.

Arizona Water Company
Indicated Common Equity Cost Rate Using the Discounted Cash Flow Model for
The Proxy Group of Eight Water Companies

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
The Proxy Group of Eight Water Companies	Average Dividend Yield (1)	Value Line Projected Five Year Growth in EPS (2)	Reuters Mean Consensus Projected Five Year Growth Rate in EPS	Zack's Five Year Projected Growth Rate in EPS	Yahoo! Finance Projected Five Year Growth in EPS	Average Projected Five Year Growth in EPS (3)	Adjusted Dividend Yield (4)	Indicated Common Equity Cost Rate (5)
American States Water Co.	2.12 %	6.00 %	3.85 %	3.80 %	3.85 %	4.38 %	2.17 %	6.55 %
American Water Works Company Inc	2.09	7.00	7.60	7.40	7.60	7.40	2.17	9.57
Aqua America Inc	2.29	7.50	5.85	6.20	5.85	6.35	2.36	8.71
California Water Service Group	2.77	6.50	5.00	5.00	5.00	5.38	2.84	8.22
Connecticut Water Service Inc	2.57	4.50	5.00	5.00	5.00	4.88	2.63	7.51
Middlesex Water Co.	2.82	5.00	N/A	N/A	2.70	3.85	2.87	6.72
SJW Corp	2.40	1.50	N/A	N/A	14.00	7.75	2.49	10.24
York Water Co.	2.26	6.50	N/A	N/A	4.90	5.70	2.32	8.02
							Average	8.19 %
							Median	8.12 %
							Average of Mean and Median	8.16 %

N/A= Not Available

Notes:

(1) Indicated dividend at 03/31/2016 divided by the average closing price of the last 60 trading days ending 03/31/2016 for each company.

(2) From pages 3 through 10 of this Schedule.

(3) Average of columns 2 through 5 excluding negative growth rates.

(4) This reflects a growth rate component equal to one-half the conclusion of growth rate (from column 6) x column 1 to reflect the periodic payment of dividends (Gordon Model) as opposed to the continuous payment. Thus, for American States Water Co., 2.12% x (1+(1/2 x 4.38%)) = 2.17%.

(5) Column 6 + column 7.

Source of Information:

Value Line Investment Survey
www.reuters.com Downloaded on 03/31/2016
www.zacks.com Downloaded on 03/31/2016
www.yahoo.com Downloaded on 03/31/2016

AMER. STATES WATER NYSE-AWR

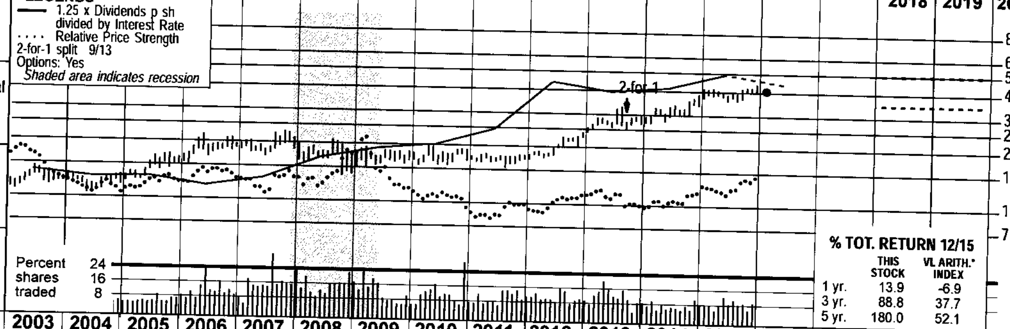
RECENT PRICE 40.79 | P/E RATIO 24.9 (Trailing: 24.7; Median: 20.0) | RELATIVE P/E RATIO 1.44 | DIV'D YLD 2.3% | VALUE LINE

TIMELINESS 2 Raised 6/5/15
SAFETY 2 Raised 7/20/12
TECHNICAL 3 Lowered 11/27/15
BETA .70 (1.00 = Market)

High:	13.4	17.3	21.9	23.1	21.0	19.4	19.8	18.2	24.1	33.1	38.7	44.1
Low:	10.4	12.2	15.1	16.8	13.5	14.9	15.6	15.3	17.0	24.0	27.0	35.8

Target Price Range 2018 | 2019 | 2020

LEGENDS
— 1.25 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
2-for-1 split 9/13
Options: Yes
Shaded area indicates recession



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	50	(+25%)	7%
Low	35	(-15%)	-1%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	0	0	0
Options	0	1	0	1	0	1	0	2	3
to Sell	0	1	0	0	3	1	1	5	3

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	86	80	91
to Sell	93	82	89
Hld's(000)	23637	23707	23779

Percent shares traded 24 16 8

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	13.9	-6.9
3 yr.	88.8	37.7
5 yr.	180.0	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
6.45	6.08	6.53	6.89	6.99	6.81	7.03	7.88	8.75	9.21	9.74	10.71	11.12	12.12	12.19	12.17	*12.45*	*12.35*	Revenues per sh	*15.00*
1.13	1.10	1.26	1.27	1.04	1.11	1.32	1.45	1.65	1.69	1.70	2.11	2.13	2.48	2.65	2.67	*2.75*	*2.90*	"Cash Flow" per sh	*3.45*
.60	.64	.67	.67	.39	.53	.66	.67	.81	.78	.81	1.11	1.12	1.41	1.61	1.57	*1.60*	*1.70*	Earnings per sh A	*2.15*
.43	.43	.43	.44	.44	.44	.45	.46	.48	.50	.51	.52	.55	.64	.76	.83	.87	*.92*	Div'd Decl'd per sh B■	*1.15*
2.15	1.51	1.59	1.34	1.88	2.51	2.12	1.95	1.45	2.23	2.09	2.12	2.13	1.77	2.52	1.89	*2.20*	*2.15*	Cap'l Spending per sh	*2.20*
5.91	6.37	6.61	7.02	6.98	7.51	7.86	8.32	8.77	8.97	9.70	10.13	10.84	11.80	12.72	13.24	*13.00*	*13.85*	Book Value per sh	*14.85*
26.87	30.24	30.24	30.36	30.42	33.50	33.60	34.10	34.46	34.60	37.06	37.26	37.70	38.53	38.72	38.29	*36.50*	*36.50*	Common Shs Outst'g C	*37.00*
17.1	15.9	16.7	18.3	31.9	23.2	21.9	27.7	24.0	22.6	21.2	15.7	15.4	14.3	17.2	20.1	*24.7*		Avg Ann'l P/E Ratio	*20.5*
.97	1.03	.86	1.00	1.82	1.23	1.17	1.50	1.27	1.36	1.41	1.00	.97	.91	.97	1.06	*1.25*		Relative P/E Ratio	*1.30*
4.2%	4.2%	3.9%	3.6%	3.5%	3.6%	3.1%	2.5%	2.5%	2.9%	2.9%	3.0%	3.2%	3.1%	2.7%	2.6%	2.2%		Avg Ann'l Div'd Yield	*2.7%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $325.9 mill. **Due in 5 Yrs** $41.6 mill.
LT Debt $325.6 mill. **LT Interest** $21.5 mill.
(41% of Cap'l)

Leases, Uncapitalized: Annual rentals $0.4 mill.
Pension Assets-12/14 $140.6 mill.
Oblig. $185.2 mill.
Pfd Stock None.

Common Stock 36,728,248 shs.
as of 11/2/15

MARKET CAP: $1.5 billion (Mid Cap)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		18-20
236.2	268.6	301.4	318.7	361.0	398.9	419.3	466.9	472.1	465.8	*455*	*450*	Revenues ($mill)	*555*
22.5	23.1	28.0	26.8	29.5	41.4	42.0	54.1	62.7	61.1	*60.0*	*62.0*	Net Profit ($mill)	*80.0*
47.0%	40.5%	42.6%	37.8%	38.9%	43.2%	41.7%	39.9%	36.3%	38.4%	*39.0%*	*38.0%*	Income Tax Rate	*37.5%*
--	12.2%	8.5%	6.9%	3.2%	5.8%	2.0%	2.5%	2.5%	.5%	*.5%*	*1.0%*	AFUDC % to Net Profit	*1.0%*
50.4%	48.6%	46.9%	46.2%	45.9%	44.3%	45.4%	42.2%	39.8%	39.1%	*40.5%*	*40.0%*	Long-Term Debt Ratio	*42.0%*
49.6%	51.4%	53.1%	53.8%	54.1%	55.7%	54.6%	57.8%	60.2%	60.9%	*59.5%*	*60.0%*	Common Equity Ratio	*58.0%*
532.5	551.6	569.4	577.0	665.0	677.4	749.1	787.0	818.4	832.6	*800*	*830*	Total Capital ($mill)	*950*
713.2	750.6	776.4	825.3	866.4	855.0	896.5	917.8	981.5	1003.5	*1040*	*1090*	Net Plant ($mill)	*1250*
5.4%	6.0%	6.7%	6.4%	5.9%	7.6%	7.1%	8.3%	8.9%	8.6%	*9.0%*	*9.0%*	Return on Total Cap'l	*9.5%*
8.5%	8.1%	9.3%	8.6%	8.2%	11.0%	10.3%	11.9%	12.7%	12.0%	*12.5%*	*12.5%*	Return on Shr. Equity	*14.5%*
8.5%	8.1%	9.3%	8.6%	8.2%	11.0%	10.3%	11.9%	12.7%	12.0%	*12.5%*	*12.5%*	Return on Com Equity	*14.5%*
2.8%	2.7%	3.9%	3.1%	3.2%	5.8%	5.3%	6.6%	6.8%	5.7%	*5.5%*	*5.5%*	Retained to Com Eq	*6.5%*
67%	67%	58%	64%	61%	47%	49%	45%	47%	53%	*54%*	*54%*	All Div'ds to Net Prof	*53%*

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	38.2	76.0	27.3
Accts Receivable	23.8	18.8	22.1
Other	129.6	114.7	86.1
Current Assets	191.6	209.5	135.5
Accts Payable	49.8	41.9	46.5
Debt Due	6.3	.3	.3
Other	44.8	57.1	77.2
Current Liab.	100.9	99.3	124.0

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	6.0%	5.5%	*3.5%*
"Cash Flow"	8.5%	9.0%	*5.0%*
Earnings	11.0%	14.0%	*6.0%*
Dividends	5.5%	8.5%	*7.5%*
Book Value	6.0%	6.5%	*3.0%*

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	107.6	114.3	133.5	111.5	466.9
2013	110.6	120.7	130.9	109.9	472.1
2014	102.0	115.6	138.3	109.9	465.8
2015	100.9	114.6	133.0	*106.5*	*455*
2016	*95.0*	*110*	*135*	*110*	*450*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.27	.40	.49	.26	1.41
2013	.35	.43	.53	.30	1.61
2014	.28	.39	.54	.36	1.57
2015	.32	.41	.56	*.31*	*1.60*
2016	*.31*	*.46*	*.60*	*.33*	*1.70*

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.14	.14	.1775	.1775	.64
2013	.1775	.1775	.2025	.2025	.76
2014	.2025	.2025	.213	.213	.83
2015	.213	.213	.224	.224	.87
2016					

BUSINESS: American States Water Co. operates as a holding company. Through its principal subsidiary, Golden States Water Company, it supplies water to 258,191 customers in 75 communities and 10 counties. Service areas include the greater metropolitan areas of Los Angeles and Orange Counties. The company also provides electric utility services to 23,716 customers in the city of Big Bear Lake and in areas of San Bernardino County. Sold Chaparral City Water of Arizona (6/11). Has 707 employees. Blackrock, Inc., owns 9.8% of out. shares; Vanguard, 8.5%; off. & dir. 1.5%. (4/15 Proxy). Chairman: Lloyd Ross. President & CEO: Robert J. Sprowls. Inc: CA. Addr: 630 East Foothill Boulevard, San Dimas, CA 91773. Tel: 909-394-3600. Internet: www.aswater.com.

Shares of American States Water have not performed well lately. Since our October report, the equity of the company has declined 1.3% compared to an average gain of 4.9% for the typical water utility, and a 1.9% rise in the S&P 500. Indeed, only two out of the nine members in the group posted losses, and each one has significant operations in California.

Despite the ongoing drought, we expect earnings growth to be healthy in 2016. In California, petitions for higher rates are made triennially. So, this year is important as we expect the California Public Utility Commission to be reasonable regarding the Golden State Water subsidiary's request for higher tariffs. Based on this assumption, and a greater contribution from ASUS (see below), we think the company's bottom line should rise a solid 6%, to $1.70 a share.

Nonregulated businesses may play a more important role in the future. Through its ASUS subsidiary, the company has been operating the water systems at several U.S. Army bases. Responsible for an estimated 15% of income, this percentage could rise as the government privatizes more of these facilities. We think ASUS should win more contracts, which are for a 50-year period. This could provide a boost to earnings because returns on equity in this sector are not regulated.

All in all, American States is in good shape. Like all water utilities, Golden State has to invest heavily in upgrading its antiquated water infrastructure. With a strong balance sheet, however, we think the financial integrity of the firm will be maintained through the late decade. Another benefit is operating in California, as the regulatory environment has improved significantly in years past.

Shares of American States are ranked to outperform the broader market averages in the year ahead. This equity might only be suitable for momentum accounts, however. That's because many water utility investors traditionally take a long-term view of their holdings. From this perspective, the stock looks more than fully valued. Indeed, even with the recent weakness in the stock price, AWR's total return potential is still substantially lower than the *Value Line* median.

James A. Flood *January 15, 2016*

(A) Primary earnings. Excludes nonrecurring gains/(losses): '04, 7¢; '05, 13¢; '06, 3¢; '08, (14¢); '10, (23¢) '11, 10¢. Next earnings report due late February. Quarterly earnings may not add due to rounding.
(B) Dividends historically paid in early March, June, September, and December. ■ Div'd reinvestment plan available.
(C) In millions, adjusted for splits.

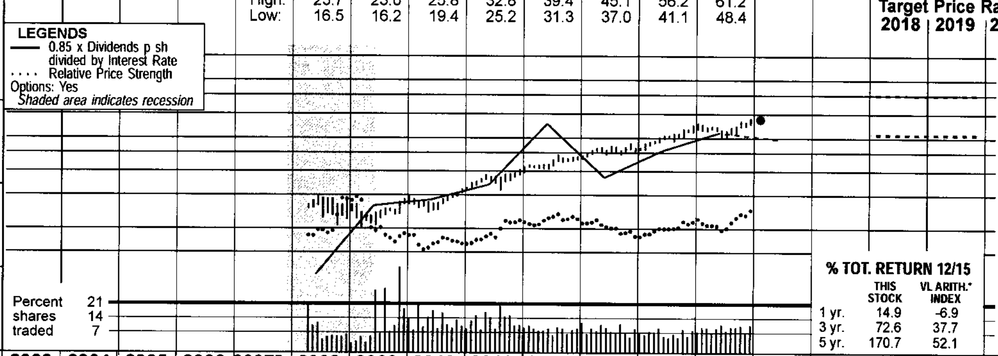
Company's Financial Strength	A
Stock's Price Stability	90
Price Growth Persistence	70
Earnings Predictability	90

AMERICAN WATER NYSE-AWK

RECENT PRICE **60.15** | P/E RATIO **22.4** (Trailing: 23.1 / Median: NMF) | RELATIVE P/E RATIO **1.29** | DIV'D YLD **2.4%** | VALUE LINE

TIMELINESS 2 Lowered 7/10/15
SAFETY 3 New 7/25/08
TECHNICAL 3 Lowered 11/27/15
BETA .70 (1.00 = Market)

	High:	Low:
2008	23.7	16.5
2009	23.0	16.2
2010	25.8	19.4
2011	32.8	25.2
2012	39.4	31.3
2013	45.1	37.0
2014	56.2	41.1
2015	61.2	48.4



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	80	(+35%)	10%
Low	50	(-15%)	-1%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	1	0	0
Options	2	5	0	2	0	0	1	0	0
to Sell	2	5	0	4	0	0	1	0	0

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	213	247	211
to Sell	222	206	220
Hld's(000)	147193	145636	148013

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	14.9	-6.9
3 yr.	72.6	37.7
5 yr.	170.7	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007E	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
--	--	--	--	--	--	--	13.08	13.84	14.61	13.98	15.49	15.18	16.25	16.28	16.78	17.55	18.45	Revenues per sh	21.60
--	--	--	--	--	--	--	.65	d.47	2.87	2.89	3.56	3.73	4.27	4.36	4.75	5.05	5.30	"Cash Flow" per sh	6.50
--	--	--	--	--	--	--	d.97	d2.14	1.10	1.25	1.53	1.72	2.11	2.06	2.39	2.60	2.80	Earnings per sh A	3.25
--	--	--	--	--	--	--	--	--	.40	.82	.86	.90	1.21	.84	1.21	1.33	1.45	Div'd Decl'd per sh B■	1.75
--	--	--	--	--	--	--	4.31	4.74	6.31	4.50	4.38	5.27	5.25	5.50	5.33	7.20	6.50	Cap'l Spending per sh	6.50
--	--	--	--	--	--	--	23.86	28.39	25.64	22.91	23.59	24.11	25.11	26.52	27.39	29.05	30.40	Book Value per sh D	36.75
--	--	--	--	--	--	--	160.00	160.00	160.00	174.63	175.00	175.66	176.99	178.25	179.46	179.00	179.00	Common Shs Outst'g C	185.00
--	--	--	--	--	--	--	--	--	18.9	15.6	14.6	16.8	16.7	19.9	20.0	20.8		Avg Ann'l P/E Ratio	20.0
--	--	--	--	--	--	--	--	--	1.14	1.04	.93	1.05	1.06	1.12	1.05	1.06		Relative P/E Ratio	1.25
--	--	--	--	--	--	--	--	--	1.9%	4.2%	3.8%	3.1%	3.4%	2.0%	2.5%	2.5%		Avg Ann'l Div'd Yield	2.7%

2005	2006	2007E	2008	2009	2010	2011	2012	2013	2014	2015	2016		18-20
--	2093.1	2214.2	2336.9	2440.7	2710.7	2666.2	2876.9	2901.9	3011.3	3140	3300	Revenues ($mill)	4000
--	d155.8	d342.3	187.2	209.9	267.8	304.9	374.3	369.3	429.8	468	500	Net Profit ($mill)	600
--	--	--	37.4%	37.9%	40.4%	39.5%	40.7%	39.1%	39.4%	40.0%	38.5%	Income Tax Rate	37.5%
--	--	--	--	--	--	--	6.2%	5.1%	1.4%	2.5%	2.4%	AFUDC % to Net Profit	3.0%
--	56.1%	50.9%	53.1%	56.9%	56.8%	55.7%	53.9%	52.4%	52.4%	53.5%	53.5%	Long-Term Debt Ratio	53.0%
--	43.9%	49.1%	46.9%	43.1%	43.2%	44.2%	46.1%	47.6%	47.4%	46.5%	46.5%	Common Equity Ratio	47.0%
--	8692.8	9245.7	8750.2	9289.0	9561.3	9580.3	9635.5	9940.7	10364	11200	11655	Total Capital ($mill)	14500
--	8720.6	9318.0	9991.8	10524	11059	11021	11739	12391	12900	13800	14500	Net Plant ($mill)	16000
--	NMF	NMF	3.7%	3.8%	4.4%	4.8%	5.4%	5.1%	5.5%	5.5%	5.5%	Return on Total Cap'l	5.5%
--	NMF	NMF	4.6%	5.2%	6.5%	7.2%	8.4%	7.8%	8.7%	9.0%	9.0%	Return on Shr. Equity	9.0%
--	NMF	NMF	4.6%	5.2%	6.5%	7.2%	8.4%	7.8%	8.7%	9.0%	9.0%	Return on Com Equity	9.0%
--	NMF	NMF	3.0%	1.8%	2.8%	3.5%	3.6%	4.7%	4.3%	4.5%	4.5%	Retained to Com Eq	4.0%
--	--	--	34%	65%	56%	52%	57%	40%	50%	51%	52%	All Div'ds to Net Prof	54%

CAPITAL STRUCTURE as of 9/30/15
Total Debt $6342.6 mil. **Due in 5 Yrs** $1294.5 mil.
LT Debt $5940.6 mil. **LT Interest** $295.0 mil.
(53% of Cap'l)

Leases, Uncapitalized: Annual rentals $14.0 mill.
Pension Assets 12/14 $1428.2 mill
Oblig. $1746.5 mill.
Pfd Stock $14.3 mill. **Pfd Div'd** $.5 mill

Common Stock 179,469,453 shs.
as of 10/30/2015

MARKET CAP: $10.8 billion (Large Cap)

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	27.0	23.1	75.2
Accts Receivable	244.6	267.1	341.7
Other	278.8	638.3	462.1
Current Assets	550.4	661.4	879.0
Accts Payable	264.1	285.8	281.3
Debt Due	644.5	511.1	402.0
Other	326.9	444.1	482.1
Current Liab.	1235.5	1241.0	1165.4

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	--	3.0%	4.5%
"Cash Flow"	--	20.5%	6.5%
Earnings	--	NMF	7.0%
Dividends	--	21.5%	8.5%
Book Value	--	.5%	5.5%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	618.5	745.6	831.8	681.0	2876.9
2013	636.1	724.3	829.2	712.3	2901.9
2014	679.0	754.8	846.1	731.4	3011.3
2015	698.1	782.1	896.2	763.6	3140
2016	735	830	920	815	3300

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.28	.66	.87	.30	2.11
2013	.32	.57	.84	.33	2.06
2014	.39	.62	.86	.52	2.39
2015	.44	.68	.96	.52	2.60
2016	.48	.72	1.03	.57	2.80

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.23	.23	.25	.50	1.21
2013	--	.28	.28	.28	.84
2014	.28	.31	.31	.31	1.21
2015	.31	.34	.34	.34	1.33
2016					

BUSINESS: American Water Works Company, Inc. is the largest investor-owned water and wastewater utility in the U.S., providing services to over 15 million people in over 47 states and Canada. (Regulated presence in 16 states.) Nonregulated business assists municipalities and military bases with the maintenance and upkeep as well. Regulated operations made up 88.8% of 2014 revenues. New Jersey is its largest market accounting for 22.7% of regulated revenues. Has roughly 6,400 employees. BlackRock, Inc., owns 10.0% of outstanding shares; Vanguard, 6.3%; officers & directors, less than 1.0%. (3/15 Proxy). Pres. & CEO: Susan Story. Chairman: George Mackenzie. Addr.: 1025 Laurel Oak Road, Voorhees, NJ 08043. Tel.: 856-346-8200. Internet: www.amwater.com.

Shares of American Water Works continue to rise. Once again, the stock had a strong three-month showing. Since our mid-October report, AWK increased 8.1% in value compared to the water utility average of 4.9% and the 1.9% for the S&P 500 Index. Indeed, the equity reached a new all time high before trading lower during a general market sell off.

Acquisitions are an integral part of management's long-term strategy. In the U.S., there are literally thousands of small municipally-run water districts. (Even after excluding the very minor operations, there are still over 50,000.) As these systems age and large amounts of capital are required to modernize the infrastructure, some of the more financially-pressed districts look to be purchased. This often works out very well for the acquirer because of the large amount of redundancies in the industry that can be eliminated, resulting in higher returns. As the biggest investor-owned water utility in the country, American Water Works has been using its size to benefit from this situation for years, making hundreds of acquisitions.

Earnings prospects for 2016 are bright. We expect the company's share net to rise a healthy 8% over our 2015 estimate. Much of the earnings improvement will continue to be derived from synergies from the acquisitions, as well as successful cost controls on existing operations.

The balance sheet is just average. The capital expenditure budget has been, and should continue to be burdensome through late decade. Internally generated funds will not be sufficient to finance the investment, so additional debt may be required. The firm has not had a major equity offering in years and the timing might be good considering the lofty stock price.

Our Ranking System continues to favor shares of American Water Works. Long-term income-oriented investors, who usually are attracted to water utility stocks for current income and dividend growth prospects, may want to look elsewhere, however. That's because the stock's yield is now just equal to the *Value Line* median, and its total-return prospects through 2018-2020 are substantially below average.

James A. Flood *January 15, 2016*

(A) Diluted earnings. Excludes nonrecurring losses: '08, $4.62; '09, $2.63; '11, $0.07. Discontinued operations: '06, ($0.04); '11, $0.03; '12, ($0.10); '13,($0.01). GAAP used as of 2014. Next earnings report due late February. Quarterly earnings may not sum due to rounding. (B) Dividends paid in March, June, September, and December. ■ Div. reinvestment available. Two payments made in 4th quarter of 2012. (C) In millions. (D) Includes intangibles. In 2014: $1.21 billion, $6.73/share. (E) Pro forma numbers for '06 & '07.

Company's Financial Strength	B+
Stock's Price Stability	100
Price Growth Persistence	85
Earnings Predictability	35

AQUA AMERICA NYSE-WTR

RECENT PRICE **29.65** | P/E RATIO **23.2** (Trailing: 23.7; Median: 23.0) | RELATIVE P/E RATIO **1.34** | DIV'D YLD **2.5%** | VALUE LINE

TIMELINESS 3 Lowered 5/24/13
SAFETY 2 Raised 4/20/12
TECHNICAL 3 Raised 10/23/15
BETA .75 (1.00 = Market)

2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	45	(+50%)	13%
Low	30	(Nil)	3%

Insider Decisions

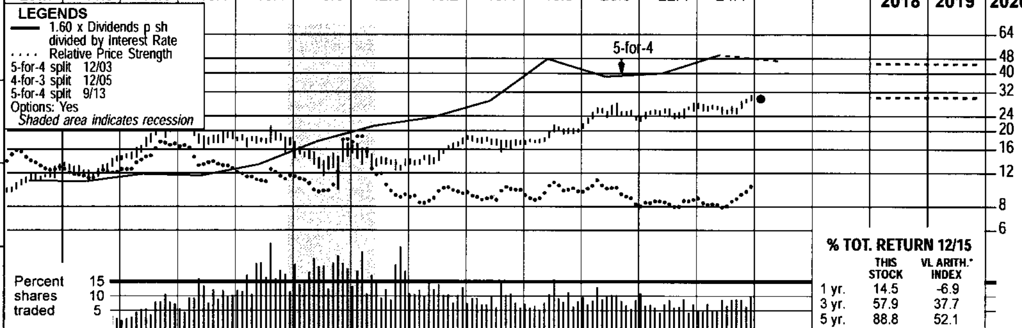
	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	0	0	0
Options	0	0	0	1	0	0	1	0	1
to Sell	1	1	1	2	1	0	2	2	1

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	153	156	166
to Sell	133	145	138
Hld's(000)	81133	82530	84833

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High:	14.8	23.4	23.8	21.3	17.6	17.2	18.4	19.0	21.5	28.1	28.2	31.1
Low:	11.3	14.0	16.1	15.1	9.8	12.3	13.2	15.4	16.8	20.6	22.4	24.4

Target Price Range
2018 | 2019 | 2020



% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	14.5	-6.9
3 yr.	57.9	37.7
5 yr.	88.8	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
1.93	1.97	2.16	2.28	2.38	2.78	3.08	3.23	3.61	3.71	3.93	4.21	4.10	4.32	4.32	4.37	*4.65*	*4.75*	Revenues per sh	*5.90*
.58	.61	.69	.76	.77	.87	.97	1.01	1.10	1.14	1.29	1.42	1.45	1.51	1.82	1.89	*2.00*	*2.10*	"Cash Flow" per sh	*2.60*
.33	.37	.41	.43	.46	.51	.57	.56	.57	.58	.62	.72	.83	.87	1.16	1.20	*1.25*	*1.35*	Earnings per sh A	*1.65*
.22	.23	.24	.26	.28	.29	.32	.35	.38	.41	.44	.47	.50	.54	.58	.63	.69	*.76*	Div'd Decl'd per sh B■	*1.00*
.72	.93	.87	.96	1.06	1.23	1.47	1.64	1.43	1.58	1.66	1.89	1.90	1.98	1.73	1.84	*1.95*	*2.00*	Cap'l Spending per sh	*2.00*
2.74	3.08	3.32	3.49	4.27	4.71	5.04	5.57	5.85	6.26	6.50	6.81	7.21	7.90	8.63	9.27	*9.80*	*10.10*	Book Value per sh	*11.75*
133.50	139.78	142.47	141.49	154.31	158.97	161.21	165.41	166.75	169.21	170.61	172.46	173.60	175.43	177.93	178.59	*175.50*	*174.00*	Common Shs Outst'g C	*170.00*
21.2	18.2	23.6	23.6	24.5	25.1	31.8	34.7	32.0	24.9	23.1	21.1	21.3	21.9	21.2	20.8	*21.4*		Avg Ann'l P/E Ratio	*22.5*
1.21	1.18	1.21	1.29	1.40	1.33	1.69	1.87	1.70	1.50	1.54	1.34	1.34	1.39	1.19	1.10	*1.10*		Relative P/E Ratio	*1.40*
3.0%	3.3%	2.5%	2.5%	2.5%	2.3%	1.8%	1.8%	2.1%	2.8%	3.1%	3.1%	2.8%	2.8%	2.4%	2.5%	2.6%		Avg Ann'l Div'd Yield	*2.7%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $1756.7 mill. **Due in 5 Yrs** $437.0 mill.
LT Debt $1681.1 mill. **LT Interest** $74.0 mill.
(49% of Cap'l)

Pension Assets-12/14 232.4 mill. **Oblig.** $281.2 mill.

Pfd Stock None

Common Stock 176,428,025 shares as of 10/23/15

MARKET CAP: $5.2 billion (Mid Cap)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		18-20
496.8	533.5	602.5	627.0	670.5	726.1	712.0	757.8	768.6	779.9	*815*	*825*	Revenues ($mill)	*1000*
91.2	92.0	95.0	97.9	104.4	124.0	144.8	153.1	205.0	213.9	*220*	*235*	Net Profit ($mill)	*280*
38.4%	39.6%	38.9%	39.7%	39.4%	39.2%	32.9%	39.0%	10.0%	10.5%	*10.0%*	*11.0%*	Income Tax Rate	*23.0%*
--	--	--	--	--	--	--	--	1.1%	2.4%	*2.0%*	*2.5%*	AFUDC % to Net Profit	*3.0%*
52.0%	51.6%	55.4%	54.1%	55.6%	56.6%	52.7%	52.7%	48.9%	48.5%	*49.5%*	*49.5%*	Long-Term Debt Ratio	*50.0%*
48.0%	48.4%	44.6%	45.9%	44.4%	43.4%	47.3%	47.3%	51.1%	51.5%	*50.5%*	*50.5%*	Common Equity Ratio	*50.0%*
1690.4	1904.4	2191.4	2306.6	2495.5	2706.2	2646.8	2929.7	3003.6	3216.0	*3425*	*3550*	Total Capital ($mill)	*4000*
2280.0	2506.0	2792.8	2997.4	3227.3	3469.3	3612.9	3936.2	4167.3	4402.0	*4675*	*4900*	Net Plant ($mill)	*5000*
6.9%	6.4%	5.9%	5.7%	5.6%	5.9%	6.9%	6.6%	8.0%	7.8%	*7.5%*	*7.5%*	Return on Total Cap'l	*8.5%*
11.2%	10.0%	9.7%	9.3%	9.4%	10.6%	11.6%	11.0%	13.4%	12.9%	*13.0%*	*13.5%*	Return on Shr. Equity	*14.0%*
11.2%	10.0%	9.7%	9.3%	9.4%	10.6%	11.6%	11.0%	13.4%	12.9%	*13.0%*	*13.5%*	Return on Com Equity	*14.0%*
4.9%	3.7%	3.2%	2.8%	2.7%	3.7%	4.6%	4.3%	6.7%	6.1%	*5.5%*	*6.0%*	Retained to Com Eq	*5.5%*
56%	63%	67%	70%	72%	65%	60%	61%	50%	52%	*55%*	*56%*	All Div'ds to Net Prof	*61%*

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	5.1	4.1	4.1
Receivables	95.4	97.0	111.1
Inventory (AvgCst)	11.4	12.8	12.9
Other	59.8	38.6	40.2
Current Assets	171.7	152.5	168.3
Accts Payable	65.8	60.0	45.1
Debt Due	123.0	70.0	75.6
Other	78.1	95.3	95.3
Current Liab.	266.9	225.3	216.0

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	5.5%	3.0%	5.5%
"Cash Flow"	8.0%	8.0%	7.0%
Earnings	8.5%	13.0%	7.5%
Dividends	7.5%	7.0%	9.5%
Book Value	7.5%	6.5%	5.5%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	164.0	191.7	214.6	187.5	757.8
2013	180.0	195.7	204.3	188.6	768.6
2014	182.7	195.3	210.5	191.4	779.9
2015	190.3	205.8	221.1	*197.8*	*815*
2016	*192*	*208*	*225*	*200*	*825*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.15	.24	.29	.19	.87
2013	.26	.30	.36	.24	1.16
2014	.24	.31	.38	.27	1.20
2015	.27	.32	.38	*.28*	*1.25*
2016	*.28*	*.34*	*.42*	*.31*	*1.35*

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.132	.132	.132	.14	.54
2013	.14	.14	.152	.152	.58
2014	.152	.152	.165	.165	.63
2015	.165	.165	.178	.178	.69
2016					

BUSINESS: Aqua America, Inc. is the holding company for water and wastewater utilities that serve approximately three million residents in Pennsylvania, Ohio, North Carolina, Illinois, Texas, New Jersey, Florida, Indiana, and five other states. Has 1,617 employees. Acquired AquaSource, 7/03; Consumers Water, 4/99; and others. Water supply revenues '14: residential, 68%; commercial, 17%; industrial & other, 15%. Officers and directors own .8% of the common stock; Vangurad Group, 7.1%; Blackrock, Inc, 6.7%; State Street Capital Corp., 5.7% (3/15 Proxy). Chairman: Nicholas DeBenedictis. CEO: Christopher Franklin. Incorporated: Pennsylvania. Address: 762 West Lancaster Avenue, Bryn Mawr, Pennsylvania 19010. Tel.: 610-525-1400. Internet: www.aquaamerica.com.

Shares of Aqua America have been on a roll. Like several other water utility stocks, this equity has turned in an excellent performance since our mid-October report, increasing roughly 11% in value. In contrast, the typical stock in the group rose about 5%, while the S&P 500 gained only 2%, over the same period.

Our earnings estimates are unchanged. Last year's fourth-quarter profits should probably be similar to 2014's. For the full year, we expect Aqua's share net to rise a decent 4%. (Comparisons on a year-over-year basis would look better if not for an unusual gain posted in 2014.) In 2016, results should be more impressive as Aqua should benefit from a combination of factors, including synergies derived from many of its acquisitions, rate relief, and relative constructive regulatory treatment. All told, we think a solid 7% rise in earnings per share is possible.

Aqua is one of the nation's best-run water utilities. There may be only nine members in this industry, but the company has some compelling attributes. For starters, it is one of only a handful of firms that has a meaningful market capitalization ($5.2 billion). Furthermore, despite a large capital budget, the company's finances are solid. In addition, there are thousands of small municipally-owned water districts that can be purchased by larger water companies like Aqua and made more profitable due to the large amount of redundancies prevalent in the industry. Acquisitions are usually small, so the process is ongoing. For example, the company made 16 purchases last year alone. We are not sure how many will eventually be made, but we expect the customer base to be increased by 1.5%-2% annually, via this method.

We think this stock has lost some of its appeal. A water utility is attractive in part for its yield and dividend growth prospects. Due to the recent run-up in WTR's price, its yield is now only 10 basis points higher than the *Value Line* median. So, while Aqua remains a very sound company, we think that the market may be placing too high a premium on its shares. Also, with so many positives factored into the current price, we think the equity may be vulnerable to any bad news.

James A. Flood *January 15, 2016*

(A) Diluted egs. Excl. nonrec. gains (losses): '99, (9¢); '00, 2¢; '01, 2¢; '02, 4¢; '03, 3¢; '12, 18¢. Excl. gain from disc. operations: '12, 7¢; '13, 9¢; '14, 11¢. May not sum due to rounding.

Next earnings report due late February.
(B) Dividends historically paid in early March, June, Sept. & Dec. ■ Div'd. reinvestment plan available (5% discount).

(C) In millions, adjusted for stock splits.

Company's Financial Strength	A
Stock's Price Stability	95
Price Growth Persistence	60
Earnings Predictability	100

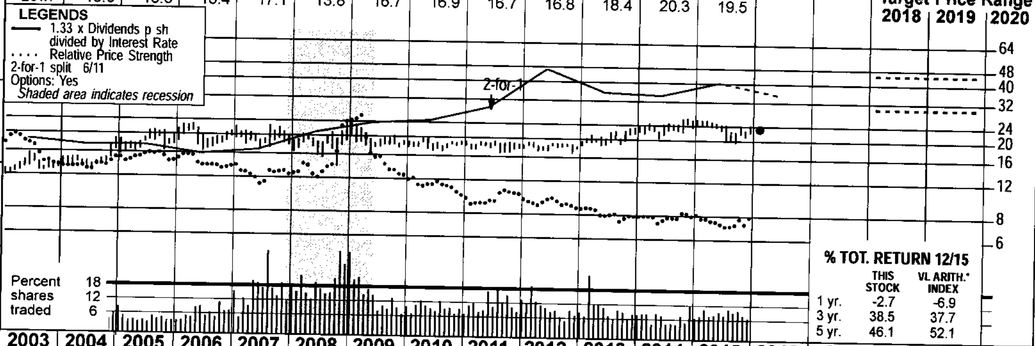
CALIFORNIA WATER NYSE-CWT

RECENT PRICE 23.24 | P/E RATIO 20.0 (Trailing: 23.2 / Median: 20.0) | RELATIVE P/E RATIO 1.16 | DIV'D YLD 3.0% | VALUE LINE

TIMELINESS 3 Raised 1/8/16
SAFETY 3 Lowered 7/27/07
TECHNICAL 5 Lowered 12/18/15
BETA .75 (1.00 = Market)

High:	19.0	21.1	22.9	22.7	23.3	24.1	19.8	19.4	19.3	23.4	26.4	26.0		
Low:	13.0	15.6	16.4	17.1	13.8	16.7	16.9	16.7	16.8	18.4	20.3	19.5		

Target Price Range
2018 | 2019 | 2020



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	45	(+95%)	20%
Low	30	(+30%)	7%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	1	0	0
Options	0	3	0	0	0	0	0	0	0
to Sell	0	2	0	1	0	0	1	0	0

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	79	82	69
to Sell	67	66	74
Hld's(000)	29379	29659	28655

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	-2.7	-6.9
3 yr.	38.5	37.7
5 yr.	46.1	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
7.98	8.08	8.13	8.67	8.18	8.59	8.72	8.10	8.88	9.90	10.82	11.05	12.00	13.34	12.23	12.50	12.20	12.50	Revenues per sh	14.40
1.37	1.26	1.10	1.32	1.26	1.42	1.52	1.36	1.56	1.86	1.93	1.93	2.07	2.32	2.21	2.47	2.30	2.60	"Cash Flow" per sh	3.25
.77	.66	.47	.63	.61	.73	.74	.67	.75	.95	.98	.91	.86	1.02	1.02	1.19	1.00	1.25	Earnings per sh A	1.55
.54	.55	.56	.56	.56	.57	.57	.58	.58	.59	.59	.60	.62	.63	.64	.65	.67	.69	Div'd Decl'd per sh B ■	.97
1.72	1.23	2.04	2.91	2.19	1.87	2.01	2.14	1.84	2.41	2.66	2.97	2.83	3.04	2.58	2.76	3.30	3.00	Cap'l Spending per sh	3.15
6.71	6.45	6.48	6.56	7.22	7.83	7.90	9.07	9.25	9.72	10.13	10.45	10.76	11.28	12.54	13.11	13.45	13.90	Book Value per sh C	16.00
25.87	30.29	30.36	30.36	33.86	36.73	36.78	41.31	41.33	41.45	41.53	41.67	41.82	41.98	47.74	47.81	48.00	48.00	Common Shs Outst'g D	50.00
17.8	19.6	27.1	19.8	22.1	20.1	24.9	29.2	26.1	19.8	19.7	20.3	21.3	17.9	20.1	19.7	23.3		Avg Ann'l P/E Ratio	23.0
1.01	1.27	1.39	1.08	1.26	1.06	1.33	1.58	1.39	1.19	1.31	1.29	1.34	1.14	1.13	1.04	1.18		Relative P/E Ratio	1.45
4.0%	4.3%	4.4%	4.5%	4.2%	3.9%	3.1%	2.9%	3.0%	3.1%	3.1%	3.2%	3.4%	3.5%	3.1%	2.8%	2.9%		Avg Ann'l Div'd Yield	3.0%
						320.7	334.7	367.1	410.3	449.4	460.4	501.8	560.0	584.1	597.5	585	600	Revenues ($mill) E	720
						27.2	25.6	31.2	39.8	40.6	37.7	36.1	42.6	47.3	56.7	48.0	60.0	Net Profit ($mill)	77.5
						42.4%	37.4%	39.9%	37.7%	40.3%	39.5%	40.5%	37.5%	30.3%	33.0%	28.0%	29.0%	Income Tax Rate	35.5%
						3.3%	10.6%	8.3%	8.6%	7.6%	4.2%	7.6%	8.0%	4.3%	2.7%	7.0%	5.0%	AFUDC % to Net Profit	5.0%
						48.3%	43.5%	42.9%	41.6%	47.1%	52.4%	51.7%	47.8%	41.6%	40.1%	40.0%	41.5%	Long-Term Debt Ratio	41.5%
						51.1%	55.9%	56.6%	58.4%	52.9%	47.6%	48.3%	52.2%	58.4%	59.9%	60.0%	58.5%	Common Equity Ratio	58.5%
						568.1	670.1	674.9	690.4	794.9	914.7	931.5	908.2	1024.9	1045.9	1070	1145	Total Capital ($mill)	1370
						862.7	941.5	1010.2	1112.4	1198.1	1294.3	1381.1	1457.1	1515.8	1590.4	1685	1755	Net Plant ($mill)	1820
						6.3%	5.2%	5.9%	7.1%	6.5%	5.5%	5.5%	6.3%	6.0%	6.3%	5.5%	6.5%	Return on Total Cap'l	7.0%
						9.3%	6.8%	8.1%	9.9%	9.6%	8.6%	8.0%	9.0%	7.9%	9.1%	7.5%	9.0%	Return on Shr. Equity	9.5%
						9.3%	6.8%	8.1%	9.9%	9.6%	8.6%	8.0%	9.0%	7.9%	9.1%	7.5%	9.0%	Return on Com Equity	9.5%
						2.1%	1.0%	1.8%	3.8%	3.8%	3.0%	2.3%	3.4%	3.4%	4.1%	2.5%	4.0%	Retained to Com Eq	3.5%
						78%	86%	77%	61%	60%	66%	71%	62%	56%	55%	67%	55%	All Div'ds to Net Prof	63%

CAPITAL STRUCTURE as of 9/30/15
Total Debt $559.6 mill. **Due in 5 Yrs** $165.8 mill.
LT Debt $416.4 mill. **LT Interest** $24.0 mill.
(39% of Cap'l)

Pension Assets-12/14 $306.3 mill.
Oblig. $390.6 mill.

Pfd Stock None

Common Stock 47,876,087 shs.
as of 10/27/15

MARKET CAP: $1.1 billion (Mid Cap)

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	27.5	19.6	50.8
Other	112.0	134.5	140.3
Current Assets	139.5	154.1	191.1
Accts Payable	55.1	59.4	77.3
Debt Due	54.7	85.7	143.2
Other	56.8	72.6	80.3
Current Liab.	166.6	217.7	300.8

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	4.0%	5.0%	2.0%
"Cash Flow"	6.0%	5.5%	5.5%
Earnings	5.0%	4.0%	6.5%
Dividends	1.5%	2.0%	7.0%
Book Value	5.5%	5.0%	4.5%

Cal-endar	QUARTERLY REVENUES ($ mill.)E Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	116.8	143.6	178.1	121.5	560.0
2013	111.4	154.6	184.4	133.7	584.1
2014	110.5	158.4	191.2	137.4	597.5
2015	122.0	144.4	183.5	135.1	585
2016	120	150	190	140	600

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.03	.31	.56	.12	1.02
2013	.01	.28	.61	.12	1.02
2014	d.11	.36	.70	.24	1.19
2015	.03	.21	.52	.24	1.00
2016	.05	.35	.60	.25	1.25

Cal-endar	QUARTERLY DIVIDENDS PAID B ■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.1575	.1575	.1575	.1575	.63
2013	.16	.16	.16	.16	.64
2014	.1625	.1625	.1625	.1625	.65
2015	.1675	.1675	.1675	.1675	.67
2016					

BUSINESS: California Water Service Group provides regulated and nonregulated water service to 477,900 customers in 85 communities in the state of California. Accounts for over 94% of total customers. Also operates in Washington, New Mexico, and Hawaii. Main service areas: San Francisco Bay area, Sacramento Valley, Salinas Valley, San Joaquin Valley & parts of Los Angeles. Acquired Rio Grande Corp; West Hawaii Utilities (9/08). Revenue breakdown, '14: residential, 68%; business, 19%; industrial, 5%; public authorities, 3%; other 5%. '14 reported depreciation rate: 4.0%. Has 1,105 employees. President, Chairman, and CEO: Peter C. Nelson. Inc.: DE. Address: 1720 North First St., San Jose, CA 95112-4598. Tel.: 408-367-8200. Internet: www.calwatergroup.com.

The California Water Service Group posted its second-straight poor quarter. The water utility's share earnings came in at $0.52, versus the prior year's $0.70, and our $0.69 estimate. Even though the same quarter in 2014 had been aided by a tax adjustment and revenue recognition from outlays the company had made earlier in the year, the bottom-line showing was still a disappointment. Increased costs related to the state's ongoing drought, higher maintenance expenses, and meaningful "uninsured loss costs," were also provided by management as reasons for the earnings miss.

The utility's profitability is not supposed to be meaningfully impacted by the drought. In an attempt to preserve water, the California Public Utility Commission (CPUC) has mandated strict restrictions on usage. Previously, the CPUC instituted a change in how water utilities' income is calculated. Based on the new methodology, income and revenues were switched from being a "quantity based" to a "fixed-rate charge" system. The main goal of this maneuver was to incentivize utilities to sway customers to use less water. Thus, revenues are now more fee-based and don't correlate as much to the volume of water sold.

We are cutting our estimates once again. We now expect the company's share net to reach $1.00 for 2015, $0.15 less than our previous forecast. A $0.10 a-share-reduction has also been made to our 2016 figure. In any case, we think any drought-related costs will eventually be recovered by California Water. Indeed, at the end of the third quarter, the company had a large increase in unbilled revenues, which are incurred expenses that the utility has not been reimbursed for yet.

These shares may appeal to long-term accounts willing to assume slightly more risk than the typical water utility investor. The premium that was usually priced into the value of this equity has dissipated, as some investors appear wary of owning water utilities domiciled in California. Based on our assumption that the CPUC will maintain its current constructive approach, we think CWT could provide better long-term returns through late decade than the average water utility.

James A. Flood *January 15, 2016*

(A) Basic EPS. Excl. nonrecurring gain (loss): '00, (4¢); '01, 2¢; '02, 4¢; '11, 4¢. Next earnings report due late February.
(B) Dividends historically paid in late Feb., May, Aug., and Nov. ■ Div'd reinvestment plan available.
(C) Incl. intangible assets. In '14 : $7.3 mill., $0.15/sh.
(D) In millions, adjusted for splits.
(E) Excludes non-reg. rev.

Company's Financial Strength	B++
Stock's Price Stability	95
Price Growth Persistence	35
Earnings Predictability	85

CONNECTICUT WATER NDQ-CTWS

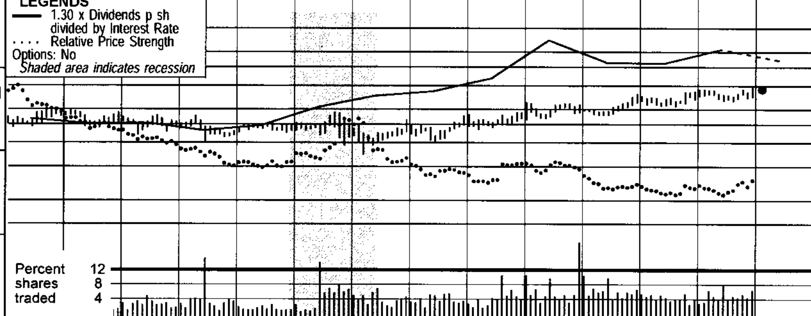
RECENT PRICE 38.47 | P/E RATIO 19.2 (Trailing: 18.7; Median: 21.0) | RELATIVE P/E RATIO 1.11 | DIV'D YLD 2.8% | VALUE LINE

TIMELINESS 3 Lowered 11/21/14
SAFETY 3 New 1/18/13
TECHNICAL 4 Lowered 1/1/16
BETA .65 (1.00 = Market)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
High:	29.8	28.2	27.7	25.6	29.0	26.4	27.9	29.1	32.8	36.4	37.5	39.9
Low:	23.8	21.9	20.3	22.4	19.3	17.3	20.0	23.3	26.2	27.8	31.0	33.2

Target Price Range 2018 | 2019 | 2020

LEGENDS
— 1.30 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: No
Shaded area indicates recession



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	50	(+30%)	10%
Low	35	(-10%)	1%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	0	0	0
Options	0	0	0	0	0	0	0	0	0
to Sell	0	0	0	0	0	0	0	0	0

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	37	54	50
to Sell	40	37	34
Hld's(000)	4289	4391	4527

Percent shares traded 12 / 8 / 4

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	7.8	-6.9
3 yr.	39.8	37.7
5 yr.	59.9	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
5.87	5.70	5.93	5.77	5.91	6.04	5.81	5.68	7.05	7.24	6.93	7.65	7.93	9.47	8.29	8.45	*8.60*	*9.00*	Revenues per sh	*12.90*
1.65	1.73	1.78	1.78	1.89	1.91	1.62	1.52	1.90	1.95	1.93	2.04	2.11	2.64	2.63	2.97	*3.25*	*3.40*	"Cash Flow" per sh	*3.75*
1.03	1.09	1.13	1.12	1.15	1.16	.88	.81	1.05	1.11	1.19	1.13	1.13	1.53	1.66	1.92	*2.05*	*2.10*	Earnings per sh A	*2.25*
.79	.79	.80	.81	.83	.84	.85	.86	.87	.88	.90	.92	.94	.96	.98	1.01	1.05	*1.09*	Div'd Decl'd per sh B■	*1.30*
1.42	1.43	1.86	1.98	1.49	1.58	1.96	1.96	2.24	2.44	3.28	3.06	2.61	2.79	3.02	4.11	*3.60*	*5.80*	Cap'l Spending per sh	*3.00*
8.61	8.92	9.25	10.06	10.46	10.94	11.52	11.60	11.95	12.23	12.67	13.05	13.50	20.95	17.92	18.83	*19.95*	*21.15*	Book Value per sh D	*23.35*
7.26	7.28	7.65	7.94	7.97	8.04	8.17	8.27	8.38	8.46	8.57	8.68	8.76	8.85	11.04	11.12	*11.20*	*11.35*	Common Shs Outst'g C	*12.00*
18.2	18.2	21.5	24.3	23.5	22.9	28.6	29.0	23.0	22.2	18.4	20.7	23.0	19.4	18.4	17.5	*17.5*		Avg Ann'l P/E Ratio	*19.0*
1.04	1.18	1.10	1.33	1.34	1.21	1.52	1.57	1.22	1.34	1.23	1.32	1.44	1.23	1.03	.92	*.89*		Relative P/E Ratio	*1.20*
4.2%	4.0%	3.3%	3.0%	3.0%	3.1%	3.4%	3.6%	3.6%	3.6%	4.1%	3.9%	3.6%	3.2%	3.2%	3.0%	2.9%		Avg Ann'l Div'd Yield	*3.1%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $190.7 mill. Due in 5 Yrs $19.3 mill.
LT Debt $176.7 mill. LT Interest $7.0 mill.
(44% of Cap'l)

Leases, Uncapitalized: Annual rentals $.1 mill.
Pension Assets-12/14 $61.6 mill.
Oblig. $79.8 mill.

Pfd Stock $0.8 mill. Pfd Divd NMF

Common Stock 11,181,070 shs.
as of 10/31/15
MARKET CAP: $425 million (Small Cap)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		18-20
47.5	46.9	59.0	61.3	59.4	66.4	69.4	83.8	91.5	94.0	*96.5*	*102*	Revenues ($mill)	*155*
7.2	6.7	8.8	9.4	10.2	9.8	9.9	13.6	18.3	21.3	*23.0*	*23.5*	Net Profit ($mill)	*27.0*
--	23.5%	32.4%	27.2%	19.5%	35.2%	41.3%	32.0%	28.0%	14.4%	*5.0%*	*19.0%*	Income Tax Rate	*27.0%*
--	--	--	1.7%	--	--	--	1.7%	2.0%	2.4%	*2.0%*	*2.5%*	AFUDC % to Net Profit	*2.0%*
44.9%	44.4%	47.8%	46.9%	50.6%	49.5%	53.2%	49.0%	46.9%	45.7%	*44.0%*	*44.5%*	Long-Term Debt Ratio	*47.0%*
54.6%	55.1%	51.8%	52.7%	49.1%	50.2%	46.5%	50.8%	52.9%	54.1%	*56.0%*	*55.5%*	Common Equity Ratio	*53.0%*
172.3	174.1	193.2	196.5	221.3	225.6	254.2	364.6	373.6	386.8	*400*	*425*	Total Capital ($mill)	*510*
247.7	268.1	284.3	302.3	325.2	344.2	362.4	447.9	471.9	506.9	*535*	*565*	Net Plant ($mill)	*650*
5.0%	4.9%	5.5%	5.9%	5.5%	5.4%	4.9%	4.8%	5.9%	6.4%	*6.5%*	*6.5%*	Return on Total Cap'l	*6.5%*
7.5%	6.9%	8.7%	9.0%	9.3%	8.6%	8.3%	7.3%	9.2%	10.1%	*10.5%*	*10.0%*	Return on Shr. Equity	*9.5%*
7.6%	7.0%	8.7%	9.1%	9.4%	8.7%	8.3%	7.3%	9.2%	10.2%	*10.5%*	*10.0%*	Return on Com Equity	*9.5%*
.3%	NMF	1.6%	1.9%	2.3%	1.6%	1.4%	2.8%	3.8%	4.8%	*5.0%*	*5.0%*	Retained to Com Eq	*4.0%*
95%	105%	82%	79%	76%	81%	83%	62%	59%	53%	*52%*	*52%*	All Div'ds to Net Prof	*58%*

CURRENT POSITION ($MILL.)

	2013	2014	9/30/15
Cash Assets	18.4	2.5	2.2
Accounts Receivable	12.3	12.0	13.0
Other	16.2	21.7	24.1
Current Assets	46.9	36.2	39.3
Accts Payable	10.8	10.0	9.7
Debt Due	4.1	4.4	14.0
Other	7.8	9.2	8.5
Current Liab.	22.7	23.6	32.2

ANNUAL RATES

of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	4.0%	4.5%	*6.5%*
"Cash Flow"	4.0%	7.5%	*5.5%*
Earnings	4.0%	9.0%	*4.5%*
Dividends	2.0%	2.0%	*5.0%*
Book Value	6.5%	9.5%	*3.5%*

QUARTERLY REVENUES ($ mill.)

Cal-endar	Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	18.5	21.3	24.5	19.5	83.8
2013	19.7	22.6	27.6	21.6	91.5
2014	20.3	25.4	27.6	20.7	94.0
2015	20.0	26.6	28.4	*21.5*	*96.5*
2016	*22.5*	*27.5*	*30.0*	*22.0*	*102*

EARNINGS PER SHARE A

Cal-endar	Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.22	.47	.67	.17	1.53
2013	.24	.39	.86	.17	1.66
2014	.27	.67	.76	.22	1.92
2015	.28	.77	.79	*.21*	*2.05*
2016	*.32*	*.68*	*.85*	*.25*	*2.10*

QUARTERLY DIVIDENDS PAID B ■

Cal-endar	Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.238	.238	.2425	.2425	.962
2013	.2425	.2425	.2475	.2475	.98
2014	.2475	.2475	.2575	.2575	1.01
2015	.2575	.2575	.2675	.2675	1.05
2016					

BUSINESS: Connecticut Water Service, Inc. is a non-operating holding company, whose income is derived from earnings of its wholly-owned subsidiary companies (regulated water utilities). In 2014, 93% of net income was derived from these activities. Provides water services to 400,000 people in 77 municipalities throughout Connecticut and Maine. Acquired The Maine Water Company, January, 2012; Biddeford and Saco Water, December, 2012. Incorporated: Connecticut. Has 265 employees. Chairman/President/Chief Executive Officer: Eric W. Thornburg. Officers and directors own 2.3% of the common stock; BlackRock, Inc. 7.0%; (4/15 proxy). Address: 93 West Main Street, Clinton, CT 06413. Telephone: (860) 669-8636. Internet: www.ctwater.com.

Connecticut Water Service probably turned in another solid earnings performance last year. Even though we are expecting the company to report a negative profit comparison in the fourth quarter, we think the utility still posted a healthy 7% increase in full-year share earnings versus 2014. This would mark the fourth-straight year of healthy gains.

We are being more conservative in our expectations for 2016. For now, we are sticking with our $2.10-a-share forecast, which would be only a 2.5% increase over 2015. Connecticut Water could surprise to the upside, however, due to the continued benefits of an earlier rate increase in Maine.

A substantial hike in capital expenditures has been approved for this year. In late November, the company announced it will spend $66 million on major projects during 2016. This represents a hefty 47% rise over what we estimate Connecticut spent in 2015. Roughly one-third of the total will be used to upgrade a wastewater facility, with the rest expected to be spent replacing the company's aging infrastructure.

The balance sheet is in decent shape. The company carries an average Financial Strength rating of B+, but that would be higher if Connecticut's market capitalization was larger. The current long-term debt-to-total capital ratio is 44%, which is near the lower end of the industry spectrum. What's more, even with the company's higher projected budgets over the next year or two, we think the balance sheet should remain quite sound through the late decade.

Dividend growth is clearly on the upswing. For years, the company would only raise its annual payout by 2%. Starting in 2014, the rate rose to 3%, and increased 4% in 2015. Over the next 3- to 5-year period, we expect growth to average 5%.

These shares are ranked to perform in line with the broader market averages in the year ahead. Moreover, it appears that all of the company's strong points are currently factored into the recent price. Indeed, the stock's capital appreciation potential to 2018-2020 is only 10%, versus the median of 50% for all companies in the *Value Line* universe.

James A. Flood *January 15, 2016*

(A) Diluted earnings. Next earnings report due late February. Quarterly earnings do not add in 2012 due to rounding.
(B) Dividends historically paid in mid-March, June, September, and December. ■ Div'd reinvestment plan available.
(C) In millions, adjusted for split.
(D) Includes intangibles. In 2014: $31.7 million/$2.85 a share.

Company's Financial Strength	B+
Stock's Price Stability	90
Price Growth Persistence	50
Earnings Predictability	85

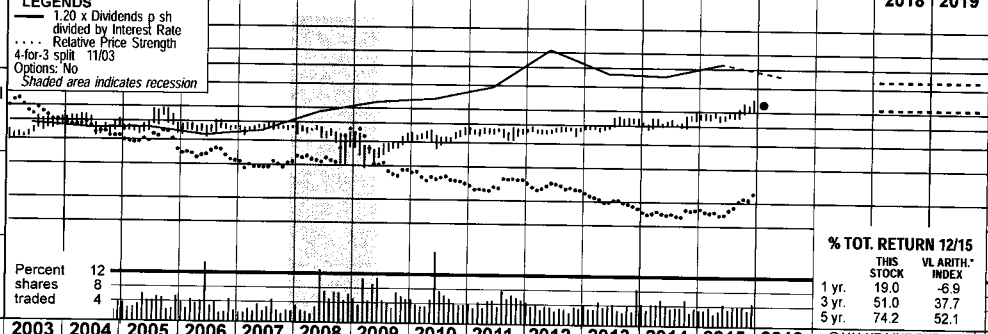
MIDDLESEX WATER NDQ-MSEX

RECENT PRICE **26.23** | P/E RATIO **21.3** (Trailing: 22.6 / Median: 21.0) | RELATIVE P/E RATIO **1.23** | DIV'D YLD **3.0%** | VALUE LINE

TIMELINESS **3** Lowered 4/11/14
SAFETY **2** New 10/21/11
TECHNICAL **3** Lowered 12/18/15
BETA .70 (1.00 = Market)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High:	21.8	23.5	20.5	20.2	19.8	17.9	19.3	19.4	19.6	22.5	23.7	28.0
Low:	16.7	17.1	16.5	16.9	12.0	11.6	14.7	16.5	17.5	18.6	19.1	21.2

Target Price Range 2018 | 2019 | 2020



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	35	(+35%)	10%
Low	25	(-5%)	2%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	0	0	0	0	0	0	0	0
Options	0	0	0	0	0	0	0	0	0
to Sell	0	0	0	0	0	0	0	0	0

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	40	43	47
to Sell	38	36	42
Hld's(000)	6413	6487	6614

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	19.0	-6.9
3 yr.	51.0	37.7
5 yr.	74.2	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
5.35	5.39	5.87	5.98	6.12	6.25	6.44	6.16	6.50	6.79	6.75	6.60	6.50	6.98	7.19	7.26	*7.70*	*8.00*	Revenues per sh	*9.10*
1.19	.99	1.18	1.20	1.15	1.28	1.33	1.33	1.49	1.53	1.40	1.55	1.46	1.56	1.72	1.84	*2.10*	*2.15*	"Cash Flow" per sh	*2.25*
.76	.51	.66	.73	.61	.73	.71	.82	.87	.89	.72	.96	.84	.90	1.03	1.13	*1.20*	*1.30*	Earnings per sh A	*1.35*
.60	.61	.62	.63	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.78	*.81*	Div'd Decl'd per sh B■	*.89*
2.33	1.32	1.25	1.59	1.87	2.54	2.18	2.31	1.66	2.12	1.49	1.90	1.50	1.36	1.26	1.40	*1.60*	*1.75*	Cap'l Spending per sh	*2.00*
6.95	6.98	7.11	7.39	7.60	8.02	8.26	9.52	10.05	10.03	10.33	11.13	11.27	11.48	11.82	12.24	*12.45*	*12.95*	Book Value per sh	*14.30*
10.00	10.11	10.17	10.36	10.48	11.36	11.58	13.17	13.25	13.40	13.52	15.57	15.70	15.82	15.96	16.12	*16.25*	*16.25*	Common Shs Outst'g C	*17.00*
17.6	28.7	24.6	23.5	30.0	26.4	27.4	22.7	21.6	19.8	21.0	17.8	21.7	20.8	19.7	18.5	*19.4*		Avg Ann'l P/E Ratio	*21.0*
1.00	1.87	1.26	1.28	1.71	1.39	1.46	1.23	1.15	1.19	1.40	1.13	1.36	1.32	1.11	.98	*.98*		Relative P/E Ratio	*1.30*
4.4%	4.2%	3.8%	3.7%	3.5%	3.4%	3.5%	3.7%	3.7%	4.0%	4.7%	4.2%	4.0%	4.0%	3.7%	3.7%	3.3%		Avg Ann'l Div'd Yield	*3.1%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $158.9 mill. **Due in 5 Yrs** $49.8 mill.
LT Debt $135.2 mill. **LT Interest** $4.6 mill.

(39% of Cap'l)

Pension Assets-12/14 $51.6 mill.
Oblig. $75.0 mill.
Pfd Stock $2.4 mill. **Pfd Div'd:** $.1 mill.

Common Stock 16,211,304 shs.
as of 10/31/15

MARKET CAP: $425 million (Small Cap)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		18-20
74.6	81.1	86.1	91.0	91.2	102.7	102.1	110.4	114.8	117.1	*125*	*130*	Revenues ($mill)	*155*
8.5	10.0	11.8	12.2	10.0	14.3	13.4	14.4	16.6	18.4	*20.5*	*21.0*	Net Profit ($mill)	*23.0*
27.6%	33.4%	32.6%	33.2%	34.1%	32.1%	32.7%	33.9%	34.1%	35.0%	*35.0%*	*31.0%*	Income Tax Rate	*34.0%*
--	--	--	--	--	6.8%	6.1%	3.4%	1.9%	1.7%	*1.0%*	*1.5%*	AFUDC % to Net Profit	*2.5%*
55.3%	49.5%	49.0%	45.6%	46.6%	43.1%	42.3%	41.5%	40.4%	40.5%	*40.0%*	*40.0%*	Long-Term Debt Ratio	*43.5%*
41.3%	47.5%	49.6%	51.8%	52.1%	55.8%	56.6%	57.4%	58.7%	58.8%	*59.5%*	*59.5%*	Common Equity Ratio	*56.5%*
231.7	264.0	268.8	259.4	267.9	310.5	312.5	316.5	321.4	335.8	*340*	*355*	Total Capital ($mill)	*430*
288.0	317.1	333.9	366.3	376.5	405.9	422.2	435.2	446.5	465.4	*480*	*495*	Net Plant ($mill)	*555*
5.0%	5.1%	5.6%	5.8%	5.0%	5.7%	5.2%	5.4%	5.9%	6.3%	*6.5%*	*7.0%*	Return on Total Cap'l	*6.5%*
8.2%	7.5%	8.6%	8.6%	7.0%	8.1%	7.5%	7.8%	8.7%	9.2%	*10.0%*	*10.0%*	Return on Shr. Equity	*9.5%*
8.6%	7.8%	8.7%	8.9%	7.0%	8.2%	7.5%	7.8%	8.7%	9.3%	*10.0%*	*10.0%*	Return on Com Equity	*9.5%*
.6%	1.3%	1.8%	2.0%	NMF	2.1%	1.0%	1.4%	2.4%	3.1%	*4.0%*	*4.0%*	Retained to Com Eq	*3.5%*
94%	84%	79%	78%	98%	75%	87%	83%	73%	67%	*62%*	*62%*	All Div'ds to Net Prof	*66%*

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	4.8	2.7	4.7
Other	21.0	20.2	26.2
Current Assets	25.8	22.9	30.9
Accts Payable	6.3	6.4	8.6
Debt Due	33.8	24.9	23.7
Other	12.6	12.6	14.6
Current Liab.	52.7	43.9	46.9

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	1.5%	1.5%	*4.0%*
"Cash Flow"	3.5%	3.0%	*4.5%*
Earnings	4.0%	4.5%	*5.0%*
Dividends	1.5%	1.5%	*3.0%*
Book Value	4.5%	3.0%	*3.0%*

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	23.5	27.4	32.4	27.1	110.4
2013	27.0	29.1	31.3	27.4	114.8
2014	27.1	29.2	32.7	28.1	117.1
2015	28.8	31.7	34.7	*29.8*	*125*
2016	*29.5*	*32.5*	*35.5*	*32.5*	*130*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.11	.24	.38	.17	.90
2013	.20	.28	.36	.19	1.03
2014	.20	.29	.42	.22	1.13
2015	.22	.31	.41	*.26*	*1.20*
2016	*.23*	*.33*	*.45*	*.29*	*1.30*

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.185	.185	.185	.1875	.74
2013	.1875	.1875	.1875	.19	.75
2014	.19	.19	.19	.1925	.76
2015	.1925	.1925	.1925	.19875	.78
2016					

BUSINESS: Middlesex Water Company engages in the ownership and operation of regulated water utility systems in New Jersey, Delaware, and Pennsylvania. It also operates water and wastewater systems under contract on behalf of municipal and private clients in NJ and DE. Its Middlesex System provides water services to 60,000 retail customers, primarily in Middlesex County, New Jersey. In 2014, the Middlesex System accounted for 60% of operating revenues. At 12/31/14, the company had 282 employees. Incorporated: NJ. President, CEO, and Chairman: Dennis W. Doll. Officers & directors own 3.5% of the common stock; BlackRock Institutional Trust Co., 6.6% (4/15 proxy). Add.: 1500 Ronson Road, Iselin, NJ 08830. Tel.: 732-634-1500. Internet: www.middlesexwater.com.

Shares of Middlesex continue to perform well. Since our mid-October report, the value of the equity has risen 8.2%, compared to 4.9% for the industry, and 1.9% for the S&P 500 Index.

We think the utility finished 2015 on a positive note. Third-quarter results were disappointing due to a sharp spike in expenses related to the company's employee benefit plan. With costs at more normal levels in the final quarter, Middlesex probably posted an earnings-per-share gain of over 15%. Rate relief implemented in New Jersey was almost certainly the reason for the expected strong showing.

Earnings should be even better this year. Even though New Jersey regulators were restrictive in last year's major rate case by allowing only $5 million of the $9 million in higher tariffs sought by Middlesex, the rate hike will be in effect for the entire year. Moreover, despite the aforementioned employee compensation charge, the utility has been doing a fairly good job of containing costs.

A major change has been made in Middlesex's dividend policy. The company has increased the annual dividend since 1997 by exactly $0.01 a share annually (one-quarter of one cent every quarter). In the final period of 2015, however, instead of raising the quarterly payout the usual amount to $.1925, or +1.3%, management hiked the payout five-eights of one cent, or 3.2%. To reflect this, we've raised our long-term growth forecast.

Finances are very solid. Though not a large company, Middlesex has an equity-to-total capital ratio close to 60%, which is extremely high for a water utility. Due to projected greater capital spending commitments to modernize the existing water infrastructure, we expect the financial metrics to slide marginally, but still remain well above industry levels.

Most of the bloom is off the rose of these shares. As evidenced by the recent strength in the stock price, investors have become well aware of company's positive attributes. The equity is current ranked to only be a market performer this year. Over the pull to 2018-2020, though, projected capital appreciation is only 15%, substantially below the 50% median of all stocks in the *Value Line* universe.

James A. Flood *January 15, 2016*

(A) Diluted earnings. May not sum due to rounding. Next earnings report due late February.
(B) Dividends historically paid in mid-Feb., May, Aug., and November.■ Div'd reinvestment plan available.
(C) In millions, adjusted for splits.

Company's Financial Strength	B++
Stock's Price Stability	95
Price Growth Persistence	35
Earnings Predictability	80

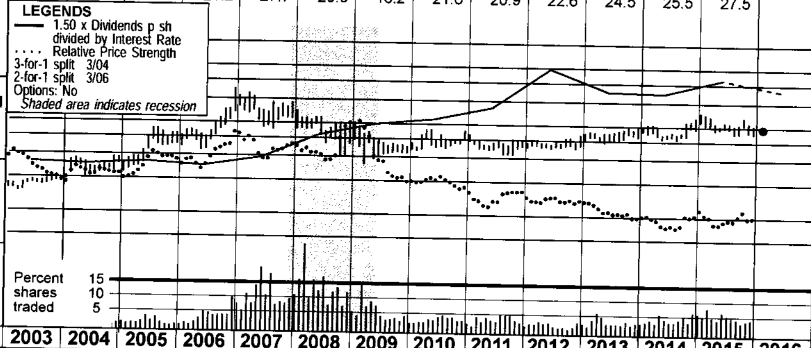
SJW CORP. NYSE-SJW

RECENT PRICE 29.52 | P/E RATIO 21.7 (Trailing: 22.2; Median: 24.0) | RELATIVE P/E RATIO 1.25 | DIV'D YLD 2.7% | VALUE LINE

TIMELINESS 4 Lowered 11/27/15
SAFETY 3 New 4/22/11
TECHNICAL 4 Lowered 1/15/16
BETA .75 (1.00 = Market)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High:	19.6	27.8	45.3	43.0	35.1	30.4	28.2	26.8	26.9	30.1	33.7	35.7
Low:	14.6	16.1	21.2	27.7	20.0	18.2	21.6	20.9	22.6	24.5	25.5	27.5

Target Price Range 2018 | 2019 | 2020



2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	45	(+50%)	13%
Low	30	(Nil)	3%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	1	3	0	0	1	0	1	0	0
Options	0	0	0	0	0	0	0	0	0
to Sell	1	0	0	0	1	0	0	0	0

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	61	63	61
to Sell	47	49	44
Hld's(000)	10898	10749	9038

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	-5.3	-6.9
3 yr.	20.7	37.7
5 yr.	28.7	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
6.40	6.74	7.45	7.97	8.20	9.14	9.86	10.35	11.25	12.12	11.68	11.62	12.85	14.01	13.73	15.76	*14.15*	*14.30*	Revenues per sh	*17.60*
1.43	1.23	1.49	1.55	1.75	1.89	2.21	2.38	2.30	2.44	2.21	2.38	2.80	2.97	2.90	4.42	*3.40*	*3.65*	"Cash Flow" per sh	*3.95*
.87	.58	.77	.78	.91	.87	1.12	1.19	1.04	1.08	.81	.84	1.11	1.18	1.12	2.54	*1.35*	*1.55*	Earnings per sh A	*1.75*
.40	.41	.43	.46	.49	.51	.53	.57	.61	.65	.66	.68	.69	.71	.73	.75	*.78*	*.81*	Div'd Decl'd per sh B■	*1.05*
1.77	1.89	2.63	2.06	3.41	2.31	2.83	3.87	6.62	3.79	3.17	5.65	3.75	5.67	4.68	5.02	*4.65*	*5.20*	Cap'l Spending per sh	*4.95*
7.88	7.90	8.17	8.40	9.11	10.11	10.72	12.48	12.90	13.99	13.66	13.75	14.20	14.71	15.92	17.75	*18.30*	*19.30*	Book Value per sh	*22.60*
18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.28	18.36	18.18	18.50	18.55	18.59	18.67	20.17	20.29	*20.50*	*21.00*	Common Shs Outst'g C	*23.00*
15.5	33.1	18.5	17.3	15.4	19.6	19.7	23.5	33.4	26.2	28.7	29.1	21.2	20.4	24.3	11.2	*22.8*		Avg Ann'l P/E Ratio	*22.0*
.88	2.15	.95	.94	.88	1.04	1.05	1.27	1.77	1.58	1.91	1.85	1.33	1.30	1.37	.59	*1.16*		Relative P/E Ratio	*1.40*
3.0%	2.1%	3.0%	3.4%	3.5%	3.0%	2.4%	2.0%	1.7%	2.3%	2.8%	2.8%	2.9%	3.0%	2.7%	2.6%	2.5%		Avg Ann'l Div'd Yield	*2.7%*
						180.1	189.2	206.6	220.3	216.1	215.6	239.0	261.5	276.9	319.7	*290*	*300*	Revenues ($mill)	*405*
						20.7	22.2	19.3	20.2	15.2	15.8	20.9	22.3	23.5	51.8	*27.5*	*32.0*	Net Profit ($mill)	*40.0*
						41.6%	40.8%	39.4%	39.5%	40.4%	38.8%	41.1%	41.1%	38.7%	32.5%	*37.0%*	*36.5%*	Income Tax Rate	*37.0%*
						1.6%	2.1%	2.7%	2.3%	2.0%	--	--	--	2.0%	1.0%	*1.5%*	*1.5%*	AFUDC % to Net Profit	*1.5%*
						42.6%	41.8%	47.7%	46.0%	49.4%	53.7%	56.6%	55.0%	51.1%	51.6%	*51.0%*	*51.5%*	Long-Term Debt Ratio	*52.5%*
						57.4%	58.2%	52.3%	54.0%	50.6%	46.3%	43.4%	45.0%	48.9%	48.4%	*49.0%*	*48.5%*	Common Equity Ratio	*47.5%*
						341.2	391.8	453.2	470.9	499.6	550.7	607.9	610.2	656.2	744.5	*765*	*835*	Total Capital ($mill)	*1100*
						484.8	541.7	645.5	684.2	718.5	785.5	756.2	831.6	898.7	963.0	*1030*	*1100*	Net Plant ($mill)	*1300*
						7.6%	7.0%	5.7%	5.8%	4.4%	4.3%	4.9%	5.0%	5.0%	8.3%	*5.0%*	*5.5%*	Return on Total Cap'l	*5.5%*
						10.6%	9.7%	8.2%	8.0%	6.0%	6.2%	7.9%	8.1%	7.3%	14.4%	*7.0%*	*8.0%*	Return on Shr. Equity	*7.5%*
						10.6%	9.7%	8.2%	8.0%	6.0%	6.2%	7.9%	8.1%	7.3%	14.4%	*7.0%*	*8.0%*	Return on Com Equity	*7.5%*
						5.6%	5.2%	3.5%	3.3%	1.2%	1.2%	3.1%	3.3%	2.8%	10.2%	*3.0%*	*4.0%*	Retained to Com Eq	*3.0%*
						47%	46%	57%	59%	80%	80%	61%	59%	62%	29%	*58%*	*52%*	All Div'ds to Net Prof	*60%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $405.8 mill. **Due in 5 Yrs** $21.2 mill.
LT Debt $381.0 mill. **LT Interest** $21.0 mill.
(51% of Cap'l)

Leases, Uncapitalized: Annual rentals $5.5 mill.

Pension Assets-12/14 $91.4 mill.
Oblig. $128.7 mill.

Pfd Stock None.

Common Stock 20,381,949 shs.
as of 10/21/15
MARKET CAP: $600 million (Small Cap)

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	2.3	2.4	6.3
Accts Receivable	14.5	15.0	20.3
Other	22.9	50.7	50.3
Current Assets	39.7	68.1	76.9
Accts Payable	12.6	7.0	17.5
Debt Due	23.0	13.8	24.8
Other	23.6	23.9	30.7
Current Liab.	59.2	44.7	73.0

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	5.5%	4.5%	3.5%
"Cash Flow"	7.0%	8.0%	2.5%
Earnings	6.5%	10.5%	1.5%
Dividends	4.0%	3.0%	6.0%
Book Value	6.0%	3.5%	6.0%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	51.1	65.6	82.4	62.4	261.5
2013	50.1	74.2	85.2	67.4	276.9
2014	54.6	70.4	125.4	69.3	319.7
2015	62.1	72.4	83.0	*72.5*	*290*
2016	*60.0*	*75.0*	*90.0*	*75.0*	*300*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.06	.28	.53	.31	1.18
2013	.07	.37	.44	.24	1.12
2014	.04	.34	1.88	.28	2.54
2015	.23	.36	.46	*.30*	*1.35*
2016	*.18*	*.42*	*.60*	*.35*	*1.55*

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.1775	.1775	.1775	.1775	.71
2013	.1825	.1825	.1825	.1825	.73
2014	.1875	.1875	.1875	.1875	.75
2015	.1950	.1950	.1950	.1950	.78
2016					

BUSINESS: SJW Corporation engages in the production, purchase, storage, purification, distribution, and retail sale of water. It provides water service to approximately 229,000 connections with a total population of roughly one million people in the San Jose area and 12,000 connections that reaches about 36,000 residents in the region between San Antonio and Austin, Texas. The company also offers nonregulated water-related services and owns and operates commercial real estate investments. Has about 395 employees. Officers and directors (including Nancy O. Moss) own 27.9% of outstanding shares. Chairman: Charles J. Toeniskoetter. Incorporated: California. Address: 110 West Taylor Street, San Jose, CA 95110. Telephone: (408) 279-7800. Internet: www.sjwater.com.

Shares of SJW Corp. have badly underperformed both the company's peer group and the broader market averages since our mid-October report. During this span, the value of SJW has declined 5.0%, versus the 4.9% increase posted by the average water utility, and the gain of about 1.9% recorded by the S&P 500 Index.

We have reduced our full-year 2015 earnings estimate for the company. Share earnings for the third quarter came in at $0.46, $0.07 below our forecast. The disappointing results were mainly attributed to higher administrative costs, pension-related expenses, and a spike in the income tax rate. We should note that comparing figures from 2014 and 2015 is difficult, as 2014's income was bolstered by a one-time $45 million reimbursement for expenses incurred in past years. In any case, we have sliced $0.10 a share off of our prior estimate and now think SJW's earnings per share will only reach $1.35.

The profit picture looks much brighter next year. For starters, the utility operates in a thriving service area, which includes Silicon Valley. Moreover, the regulatory climate in California is actually constructive as authorities have been working with utilities to enable them to earn a reasonable rate of return on equity despite spending freely to replace old pipes and modernize other parts of the water distribution system. SJW has been investing heavily (and should continue to do so through late decade) on modernizing its entire water infrastructure. All told, we think share net can rise 15%, to $1.55. One caveat is that our assumption does not factor in a lengthy delay in recovering costs related to the drought.

Dividend growth prospects are decent. Even though we only project earnings to increase 1%-2% annually through to 2018-2020, we think the current dividend-to-net profit ratio is relatively low, which should enable dividends to increase a healthy 6% a year, over that time.

SJW stock is the lone equity in the water utility group expected to underperform the market averages in the year ahead. Furthermore, despite the recent price weakness, long-term total return prospects are also not appealing.

James A. Flood — *January 15, 2016*

(A) Diluted earnings. Excludes nonrecurring losses : '03, $1.97; '04, $3.78; '05, $1.09; '06, $16.36; '08, $1.22; '10, $0.46. GAAP accounting as of 2013. Next earnings report due late February. Quarterly earnings may not add due to rounding.
(B) Dividends historically paid in early March, June, September, and December. ■ Div'd reinvestment plan available.
(C) In millions, adjusted for stock splits.

Company's Financial Strength	B+
Stock's Price Stability	85
Price Growth Persistence	20
Earnings Predictability	50

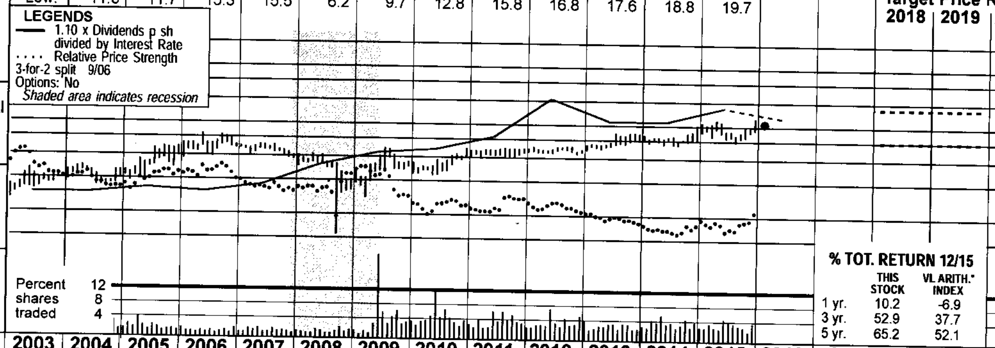
YORK WATER NDQ-YORW

RECENT PRICE 24.84 | P/E RATIO 25.6 (Trailing: 25.3; Median: 25.0) | RELATIVE P/E RATIO 1.48 | DIV'D YLD 2.5% | VALUE LINE

TIMELINESS 2 Raised 12/18/15
SAFETY 3 Lowered 7/17/15
TECHNICAL 3 Raised 1/15/16
BETA .75 (1.00 = Market)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High:	14.0	17.9	21.0	18.5	16.5	18.0	18.0	18.1	18.5	22.0	24.3	26.7
Low:	11.0	11.7	15.3	15.5	6.2	9.7	12.8	15.8	16.8	17.6	18.8	19.7

LEGENDS
— 1.10 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
3-for-2 split 9/06
Options: No
Shaded area indicates recession



Target Price Range 2018 | 2019 | 2020

2018-20 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	30	(+20%)	7%
Low	20	(-20%)	-2%

Insider Decisions

	F	M	A	M	J	J	A	S	O
to Buy	0	2	4	1	0	4	1	0	4
Options	0	0	0	0	0	0	0	0	0
to Sell	0	0	0	0	0	0	0	0	1

Institutional Decisions

	1Q2015	2Q2015	3Q2015
to Buy	33	34	30
to Sell	29	31	27
Hld's(000)	3841	3769	3840

% TOT. RETURN 12/15

	THIS STOCK	VL ARITH.* INDEX
1 yr.	10.2	-6.9
3 yr.	52.9	37.7
5 yr.	65.2	52.1

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	© VALUE LINE PUB. LLC	18-20
--	--	2.05	2.05	2.17	2.18	2.58	2.56	2.79	2.89	2.95	3.07	3.18	3.21	3.27	3.58	*3.75*	*4.00*	Revenues per sh	*5.00*
--	--	.59	.57	.65	.65	.79	.77	.86	.88	.95	1.07	1.09	1.12	1.19	1.36	*1.45*	*1.55*	"Cash Flow" per sh	*1.75*
--	--	.43	.40	.47	.49	.56	.58	.57	.57	.64	.71	.71	.72	.75	.89	*.93*	*1.00*	Earnings per sh A	*1.15*
--	--	.34	.35	.37	.39	.42	.45	.48	.49	.51	.52	.53	.54	.55	.57	.60	*.63*	Div'd Decl'd per sh B	*.80*
--	--	.75	.66	1.07	2.50	1.69	1.85	1.69	2.17	1.18	.83	.74	.94	.76	1.10	*.95*	*1.25*	Cap'l Spending per sh	*1.10*
--	--	3.79	3.90	4.06	4.65	4.85	5.84	5.97	6.14	6.92	7.19	7.45	7.73	7.98	8.15	*8.40*	*8.40*	Book Value per sh	*9.50*
--	--	9.46	9.55	9.63	10.33	10.40	11.20	11.27	11.37	12.56	12.69	12.79	12.92	12.98	12.83	*12.75*	*12.50*	Common Shs Outst'g C	*12.00*
--	--	17.8	26.9	24.5	25.7	26.3	31.2	30.3	24.6	21.9	20.7	23.9	24.4	26.3	23.1	*24.5*		Avg Ann'l P/E Ratio	*22.5*
--	--	.91	1.47	1.40	1.36	1.40	1.68	1.61	1.48	1.46	1.32	1.50	1.55	1.48	1.22	*1.24*		Relative P/E Ratio	*1.40*
--	--	4.4%	3.3%	3.2%	3.1%	2.9%	2.5%	2.8%	3.5%	3.6%	3.5%	3.1%	3.1%	2.8%	2.8%	2.6%		Avg Ann'l Div'd Yield	*3.2%*
						26.8	28.7	31.4	32.8	37.0	39.0	40.6	41.4	42.4	45.9	*48.0*	*50.0*	Revenues ($mill)	*60.0*
						5.8	6.1	6.4	6.4	7.5	8.9	9.1	9.3	9.7	11.5	*12.0*	*12.5*	Net Profit ($mill)	*14.0*
						36.7%	34.4%	36.5%	36.1%	37.9%	38.5%	35.3%	37.6%	37.6%	29.8%	*30.5%*	*24.5%*	Income Tax Rate	*32.5%*
						--	7.2%	3.6%	10.1%	--	1.2%	1.1%	1.1%	.8%	1.8%	*1.0%*	*1.0%*	AFUDC % to Net Profit	*1.0%*
						44.1%	48.3%	46.5%	54.5%	45.7%	48.3%	47.1%	46.0%	45.1%	44.8%	*45.0%*	*49.5%*	Long-Term Debt Ratio	*48.0%*
						55.9%	51.7%	53.5%	45.5%	54.3%	51.7%	52.9%	54.0%	54.9%	55.2%	*55.0%*	*52.5%*	Common Equity Ratio	*52.0%*
						90.3	126.5	125.7	153.4	160.1	176.4	180.2	184.8	188.4	189.4	*195*	*200*	Total Capital ($mill)	*220*
						155.3	174.4	191.6	211.4	222.0	228.4	233.0	240.3	244.2	253.2	*263*	*270*	Net Plant ($mill)	*280*
						8.4%	6.2%	6.7%	5.7%	6.2%	6.5%	6.4%	6.4%	6.5%	7.4%	*7.5%*	*8.0%*	Return on Total Cap'l	*8.0%*
						11.6%	9.3%	9.5%	9.2%	8.6%	9.8%	9.5%	9.3%	9.3%	11.0%	*11.0%*	*12.0%*	Return on Shr. Equity	*12.0%*
						11.6%	9.3%	9.5%	9.2%	8.6%	9.8%	9.5%	9.3%	9.3%	11.0%	*11.0%*	*12.0%*	Return on Com Equity	*12.0%*
						3.0%	2.2%	1.7%	1.4%	1.9%	2.7%	2.5%	2.4%	2.4%	3.9%	*4.0%*	*4.5%*	Retained to Com Eq	*3.5%*
						74%	77%	82%	85%	78%	72%	73%	74%	74%	64%	*65%*	*63%*	All Div'ds to Net Prof	*69%*

CAPITAL STRUCTURE as of 9/30/15
Total Debt $87.3 mill. **Due in 5 Yrs** $30.5 mill.
LT Debt $87.3 mill. **LT Interest** $5.1 mill.
(45% of Cap'l)
Pension Assets 12/14 $30.6 mill.
Oblig. $40.9 mill.

Pfd Stock None

Common Stock 12,791,600 shs.
as of 11/5/15
MARKET CAP: $325 million (Small Cap)

CURRENT POSITION ($MILL.)	2013	2014	9/30/15
Cash Assets	7.6	1.5	1.1
Accounts Receivable	3.8	4.0	4.3
Inventory (Avg. Cost)	.7	.8	.8
Other	3.1	4.9	4.0
Current Assets	15.2	11.2	10.2
Accts Payable	1.8	1.6	2.0
Debt Due	--	--	--
Other	6.0	4.3	4.3
Current Liab.	7.8	5.9	6.3

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '12-'14 to '18-'20
Revenues	4.5%	3.0%	*7.0%*
"Cash Flow"	7.0%	6.5%	*6.0%*
Earnings	5.5%	6.0%	*6.5%*
Dividends	4.0%	2.5%	*6.5%*
Book Value	6.5%	4.5%	*3.0%*

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	9.6	10.4	11.0	10.4	41.4
2013	10.1	10.7	10.9	10.7	42.4
2014	10.6	11.8	12.0	11.5	45.9
2015	11.2	11.9	12.4	*12.5*	*48.0*
2016	*11.5*	*12.5*	*13.0*	*13.0*	*50.0*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun. 30	Sep. 30	Dec. 31	Full Year
2012	.15	.17	.22	.18	.72
2013	.17	.18	.19	.21	.75
2014	.16	.22	.23	.28	.89
2015	.20	.22	.28	*.23*	*.93*
2016	*.20*	*.26*	*.28*	*.26*	*1.00*

Cal-endar	QUARTERLY DIVIDENDS PAID B Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2012	.134	.134	.134	.134	.535
2013	.138	.138	.138	.138	.552
2014	.1431	.1431	.1431	.1431	.572
2015	.1495	.1495	.1495	.1555	.604
2016					

BUSINESS: The York Water Company is the oldest investor-owned regulated water utility in the United States. It has operated continuously since 1816. As of December 31, 2014, the company's average daily availability was 35.2 million gallons and its service territory had an estimated population of 190,000. Has more than 65,100 customers. Residential customers accounted for 63% of 2014 revenues; commercial and industrial (29%); other (8%). It also provides sewer billing services. Incorporated: PA. York had 106 full-time employees at 12/31/14. President/CEO: Jeffrey R. Hines. Officers/directors own 1.1% of the common stock (4/15 proxy). Address: 130 East Market Street, York, Pennsylvania 17401. Telephone: (717) 845-3601. Internet: www.yorkwater.com.

Shares of York Water have been stellar performers of late. Over the past three months, the price of this stock has surged roughly 13% in value versus the returns of only about 2% posted by the S&P 500 Index.

Fourth-quarter comparisons are likely to be negative. In the December, 2014 period, York's profits were boosted significantly by a large tax adjustment. Absent this factor, we expect the company's share net to reach only $0.23, well short of the $0.28 posted in the similar 2014 time frame. On the plus side, for the full year, York should be able to increase earnings per share by 4% against a difficult comparison.

The earnings outlook is relatively bright for this year. We think the company should continue to benefit to some degree from how the IRS values tangible property. The resulting low tax rate, along with about 2% less shares outstanding (due to a stock-repurchase program), and the utility's ability to earn a return on newly spent capital expenditures, should enable York's share net to rise to $1.00 a share, almost 8% higher than 2015's estimated level.

Over the long pull, we think York's dividends and earnings growth rates will be moderate, but be well-defined. The company doesn't operate in a service area that is experiencing rapid growth. Thus, with population increases projected to be marginal at best, revenue and profit expansion should come from mostly upgrading and replacing its aging water infrastructure. Since the need to replace the existing pipeline is obvious, we don't foresee any major disputes with state regulators. Therefore, any harsh regulatory rulings would make our earnings estimates through 2018-2020 too optimistic.

Our ranking system believes the stock of York still has some gas left in the tank. Despite the equity's recent run, we think York will outperform the broader market averages in the year ahead.

Long-term prospects are unattractive, however. We think the price of these shares now reflects almost all of the utility's positive attributes. Indeed, the stock is already trading well within our projected late-decade Target Price Range.

James A. Flood *January 15, 2016*

(A) Diluted earnings. Next earnings report due late February.
(B) Dividends historically paid in mid-January, April, July, and October.
(C) In millions, adjusted for splits.

Company's Financial Strength	B+
Stock's Price Stability	90
Price Growth Persistence	50
Earnings Predictability	95

Arizona Water Company
Summary of Risk Premium Models for
The Proxy Group of Eight Water Companies

		The Proxy Group of Eight Water Companies
Predictive Risk Premium Model ™ (PRPM™) (1)		11.55 %
Risk Premium Using an Adjusted Total Market Approach (2)		9.85 %
	Average	10.70 %

Notes:
(1) From page 12 of this Schedule.
(2) From page 13 of this Schedule.

The Proxy Group of Eight Water Companies
Indicated ROE
Derived by the Predictive Risk Premium Model (1)

The Proxy Group of Eight Water Companies	[1] LT Average Predicted Variance	[2] Spot Predicted Variance	[3] Average Predicted Variance	[4] GARCH Coefficient	[5] Predicted Risk Premium (2)	[6] Risk-Free Rate (3)	[7] Indicated ROE (4)
American States Water Co.	0.39%	0.36%	0.37%	1.68659	7.75%	3.58%	11.33%
American Water Works Company Inc	NM	NM	NM	NM	NM	NM	NM
Aqua America Inc	0.46%	0.28%	0.37%	2.32213	10.81%	3.58%	14.39%
California Water Service Group	0.31%	0.25%	0.28%	1.92421	6.66%	3.58%	10.24%
Connecticut Water Service Inc	0.28%	0.32%	0.30%	1.93139	7.18%	3.58%	10.76%
Middlesex Water Co.	0.27%	0.25%	0.26%	2.20167	7.09%	3.58%	10.67%
SJW Corp	0.42%	0.43%	0.42%	1.44864	7.55%	3.58%	11.13%
York Water Co.	0.44%	0.33%	0.39%	2.35793	11.61%	3.58%	15.19%
						Average	11.96%
						Median	11.13%
						Average of Mean and Median	11.55%

Notes:

(1) The Predictive Risk Premium Model uses historical data to generate a predicted variance and a GARCH coefficient. The historical data used are the equity risk premiums for the first available trading month on a major index (e.g. NYSE) through March 2016.

(2) (1+(Column [3] * Column [4])^12) - 1.

(3) From note 2 on page 23 of this Exhibit.

(4) Column [5] + Column [6].

Arizona Water Company
Indicated Common Equity Cost Rate
Through Use of a Risk Premium Model
Using an Adjusted Total Market Approach

Line No.		The Proxy Group of Eight Water Companies
1.	Prospective Yield on Aaa Rated Corporate Bonds (1)	4.70 %
2.	Adjustment to Reflect Yield Spread Between Aaa Rated Corporate Bonds and A Rated Public Utility Bonds	0.25 (2)
3.	Adjusted Prospective Yield on A Rated Public Utility Bonds	4.95 %
4.	Adjustment to Reflect Bond Rating Difference of Proxy Group	0.19 (3)
5.	Adjusted Prospective Bond Yield	5.14 %
6.	Equity Risk Premium (4)	4.71
7.	Risk Premium Derived Common Equity Cost Rate	9.85 %

Notes: (1) Consensus forecast of Moody's Aaa Rated Corporate bonds from Blue Chip Financial Forecasts (see pages 19-20 of this Schedule).

(2) The average yield spread of A rated public utility bonds over Aaa rated corporate bonds of 0.25% from page 14 of this Schedule.

(3) Adjustment to reflect the A2 / A3 Moody's LT issuer rating of the proxy group of eight water companies as shown on page 15 of this Schedule. The 0.19% upward adjustment is derived by taking 1/6 of the spread between A2 and A3 Public Utility Bonds (1/6 * 1.12% = 0.19%) as derived from page 14 of this Schedule.

(4) From page 17 of this Schedule.

Arizona Water Company
Interest Rates and Bond Spreads for
Moody's Corporate and Public Utility Bonds

Selected Bond Yields

	[1]	[2]	[3]
	Aaa Rated Corporate Bond	A Rated Public Utility Bond	Baa Rated Public Utility Bond
Mar-2016	3.82 %	4.16 %	5.12 %
Feb-2016	3.96	4.11	5.28
Jan-2016	4.00	4.27	5.49
Average	3.93 %	4.18 %	5.30 %

Selected Bond Spreads

A Rated Public Utility Bonds Over Aaa Rated Corporate Bonds:

0.25 % (1)

Baa Rated Public Utility Bonds Over A Rated Public Utility Bonds:

1.12 % (2)

Notes:
(1) Column [2] - Column [1].
(2) Column [3] - Column [2].

Source of Information:
Bloomberg Professional Service

Arizona Water Company
Comparison of Long-Term Issuer Ratings for
The Proxy Group of Eight Water Companies

	Moody's Long-Term Issuer Rating March 2016		Standard & Poor's Long-Term Issuer Rating March 2016	
The Proxy Group of Eight Water Companies	Long-Term Issuer Rating	Numerical Weighting(1)	Long-Term Issuer Rating	Numerical Weighting(1)
American States Water Co. (2)	A2	6.0	A+	5.0
American Water Works Company Inc. (3)	A3	7.0	A	6.0
Aqua America Inc (4)	NR	- -	A+	5.0
California Water Service Group (4)	NR	- -	A+	5.0
Connecticut Water Service Inc (5)	NR	- -	A	6.0
Middlesex Water Co.	NR	- -	A	6.0
SJW Corp (6)	NR	- -	A	6.0
York Water Co.	NR	- -	A-	7.0
Average	A2/A3	6.5	A	5.8

Notes:

(1) From page 16 of this Schedule.
(2) Ratings that of Golden State Water Company.
(3) Ratings that of New Jersey and Pennsylvania American Water Companies.
(4) Ratings that of California Water Service Company.
(5) Ratings that of Connecticut Water Company.
(6) Ratings that of San Jose Water Company.

Source Information: www.moodys.com
www.standardandpoors.com

Numerical Assignment for Moody's and Standard & Poor's Bond Ratings

Moody's Bond Rating	Numerical Bond Weighting	Standard & Poor's Bond Rating
Aaa	1	AAA
Aa1	2	AA+
Aa2	3	AA
Aa3	4	AA-
A1	5	A+
A2	6	A
A3	7	A-
Baa1	8	BBB+
Baa2	9	BBB
Baa3	10	BBB-
Ba1	11	BB+
Ba2	12	BB
Ba3	13	BB-
B1	14	B+
B2	15	B
B3	16	B-

Arizona Water Company
Judgment of Equity Risk Premium for
The Proxy Group of Eight Water Companies

Line No.		The Proxy Group of Eight Water Companies
1.	Calculated equity risk premium based on the total market using the beta approach (1)	5.56 %
2.	Mean equity risk premium based on a study using the holding period returns of public utilities with A rated bonds (2)	3.85
3.	Average equity risk premium	4.71 %

Notes: (1) From page 18 of this Schedule.
(2) From page 21 of this Schedule.

Arizona Water Company
Derivation of Equity Risk Premium Based on the Total Market Approach
Using the Beta for
The Proxy Group of Eight Water Companies

Line No.	Equity Risk Premium Measure	The Proxy Group of Eight Water Companies
1.	Ibbotson Equity Risk Premium (1)	5.52 %
2.	Ibbotson Equity Risk Premium based on PRPM™ (2)	7.33
3.	Equity Risk Premium Based on Value Line Summary and Index (3)	9.70
4.	Equity Risk Premium Based on S&P 500 Companies(4)	8.78
5.	Conclusion of Equity Risk Premium (5)	7.83 %
6.	Adjusted Beta (6)	0.71
7.	Forecasted Equity Risk Premium	5.56 %

Notes:

(1) Based on the arithmetic mean historical monthly returns on large company common stocks from Morningstar SBBI 2016 Appendix A Tables minus the arithmetic mean monthly yield of Moody's Aaa and Aa corporate bonds from 2015). (11.68% - 6.16% = 5.52%).

(2) The Predictive Risk Premium Model (PRPM) is discussed in Ms. Ahern's accompanying direct testimony. The Ibbotson equity risk premium based on the PRPM is derived by applying the PRPM to the monthly risk premiums between Ibbotson large company common stock monthly returns minus the average Aaa

and Aa corporate monthly bond yields, from January 1928 through March 2016.

(3) The equity risk premium based on the Value Line Summary and Index is derived from taking the projected 3-5 year total annual market return of 14.40% (described fully in note 1 of page 23 of this Exhibit) and subtracting the average consensus forecast of Aaa corporate bonds of 4.70% (Shown on page 13 of this Schedule). (14.40% - 4.70% = 9.70%).

(4) Using data from the Bloomberg Professional Service for the S&P 500, an expected total return of 13.48% was derived based upon expected dividend yields and long-term growth estimates as a proxy for capital appreciation.

Subtracting the average consensus forecast of Aaa corporate bonds of 4.7% results in an expected equity risk premium of 8.78%. (13.48% - 4.7% = 8.78%).

(5) Average of Lines 1 through 4.

(6) Average of mean and median beta from page 22 of this Exhibit.

Sources of Information:

Morningstar SBBI Appendix A tables, Morningstar Stocks, Bonds, Bills, and Inflation 1926-2015

Industrial Manual and Mergent Bond Record Monthly Update.

Value Line Summary and Index

Blue Chip Financial Forecasts, April 1, 2016 and December 1, 2015

Bloomberg Professional Services

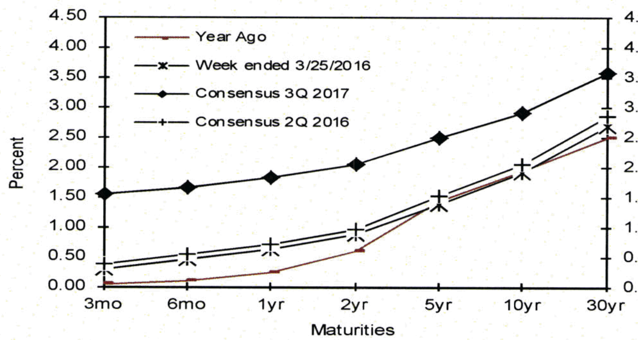
Consensus Forecasts Of U.S. Interest Rates And Key Assumptions[1]

	History								Consensus Forecasts-Quarterly Avg.					
	Average For Week Ending				Average For Month			*Latest Qtr*	2Q	3Q	4Q	1Q	2Q	3Q
Interest Rates	Mar. 25	Mar. 18	Mar. 11	Mar. 4	Feb.	Jan.	Dec.	*1Q2016**	2016	2016	2016	2017	2017	2017
Federal Funds Rate	0.37	0.36	0.36	0.36	0.38	0.34	0.16	*0.36*	**0.5**	**0.6**	**0.8**	**1.0**	**1.3**	**1.5**
Prime Rate	3.25	3.50	3.50	3.50	3.50	3.50	3.29	*3.47*	**3.6**	**3.7**	**3.9**	**4.1**	**4.4**	**4.6**
LIBOR, 3-mo.	0.62	0.63	0.63	0.63	0.62	0.61	0.41	*0.62*	**0.7**	**0.9**	**1.0**	**1.3**	**1.6**	**1.8**
Commercial Paper, 1-mo.	0.34	0.33	0.34	0.35	0.35	0.34	0.17	*0.34*	**0.5**	**0.7**	**0.9**	**1.1**	**1.4**	**1.7**
Treasury bill, 3-mo.	0.30	0.32	0.31	0.32	0.31	0.26	0.13	*0.29*	**0.4**	**0.6**	**0.8**	**1.0**	**1.3**	**1.6**
Treasury bill, 6-mo.	0.46	0.48	0.49	0.48	0.45	0.43	0.31	*0.45*	**0.5**	**0.7**	**0.9**	**1.2**	**1.4**	**1.7**
Treasury bill, 1 yr.	0.63	0.67	0.68	0.66	0.53	0.54	0.25	*0.58*	**0.7**	**0.9**	**1.1**	**1.3**	**1.6**	**1.8**
Treasury note, 2 yr.	0.87	0.91	0.92	0.84	0.73	0.90	0.83	*0.84*	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**
Treasury note, 5 yr.	1.38	1.43	1.42	1.32	1.22	1.52	1.59	*1.38*	**1.5**	**1.7**	**1.9**	**2.1**	**2.3**	**2.5**
Treasury note, 10 yr.	1.91	1.93	1.91	1.82	1.78	2.09	2.19	*1.93*	**2.0**	**2.2**	**2.4**	**2.6**	**2.8**	**2.9**
Treasury note, 30 yr.	2.69	2.71	2.69	2.67	2.62	2.86	2.96	*2.73*	**2.8**	**3.0**	**3.1**	**3.3**	**3.5**	**3.6**
Corporate Aaa bond	3.78	3.80	3.88	3.89	3.96	4.00	3.99	*3.93*	**3.9**	**4.1**	**4.3**	**4.5**	**4.6**	**4.8**
Corporate Baa bond	5.04	5.13	5.25	5.32	5.32	5.45	5.42	*5.30*	**5.3**	**5.4**	**5.5**	**5.7**	**5.8**	**5.9**
State & Local bonds	3.38	3.40	3.42	3.34	3.30	3.41	3.64	*3.37*	**3.5**	**3.7**	**3.8**	**3.9**	**4.1**	**4.2**
Home mortgage rate	3.71	3.73	3.68	3.64	3.66	3.87	3.90	*3.75*	**3.9**	**4.0**	**4.2**	**4.4**	**4.6**	**4.8**

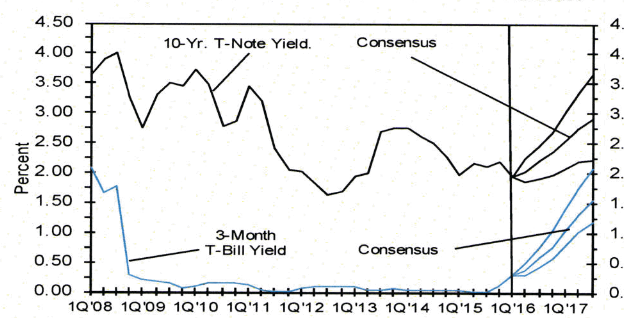
	History								Consensus Forecasts-Quarterly					
	2Q	3Q	4Q	1Q	2Q	3Q	4Q	*1Q*	2Q	3Q	4Q	1Q	2Q	3Q
Key Assumptions	2014	2014	2014	2015	2015	2015	2015	*2016**	2016	2016	2016	2017	2017	2017
Major Currency Index	76.6	77.8	82.6	89.4	89.9	91.8	93.1	*92.0*	**92.9**	**93.3**	**93.7**	**93.7**	**92.9**	**93.2**
Real GDP	4.6	4.3	2.1	0.6	3.9	2.0	1.4	*1.9*	**2.3**	**2.5**	**2.4**	**2.4**	**2.4**	**2.3**
GDP Price Index	2.2	1.6	0.1	0.1	2.1	1.3	0.9	*1.1*	**1.7**	**1.8**	**1.9**	**2.0**	**2.1**	**2.1**
Consumer Price Index	1.9	0.9	-0.3	-2.9	2.4	1.4	0.8	*0.1*	**1.9**	**2.1**	**2.3**	**2.3**	**2.4**	**2.3**

Forecasts for interest rates and the Federal Reserve's Major Currency Index represent averages for the quarter. Forecasts for Real GDP, GDP Price Index and Consumer Price Index are seasonally-adjusted annual rates of change (saar). Individual panel members' forecasts are on pages 4 through 9. Historical data for interest rates except LIBOR is from Federal Reserve Release (FRSR) H.15. LIBOR quotes available from *The Wall Street Journal*. Interest rate definitions are same as those in FRSR H.15. Treasury yields are reported on a constant maturity basis. Historical data for Fed's Major Currency Index is from FRSR H.10 and G.5. Historical data for Real GDP and GDP Chained Price Index are from the Bureau of Economic Analysis (BEA). Consumer Price Index (CPI) history is from the Department of Labor's Bureau of Labor Statistics (BLS). **Interest rate data for 1Q 2016 based on historical data through the week ended March 25th. *Data for 1Q 2016 Major Currency Index is based on data through week ended March 18th. Figures for 1Q 2016 Real GDP, GDP Chained Price Index and Consumer Price Index are consensus forecasts based on a special question asked of the panelists' this month*

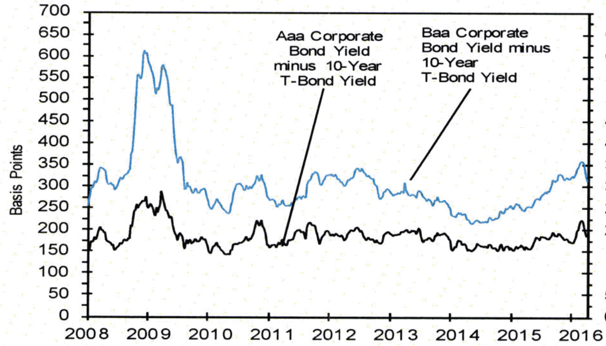
U.S. Treasury Yield Curve
Week ended March 25, 2016 and Year Ago vs. 2Q 2016 and 3Q 2017 Consensus Forecasts



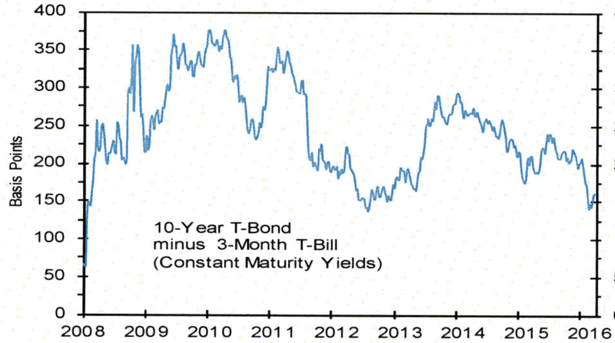
U.S. 3-Mo. T-Bills & 10-Yr. T-Note Yield
(Quarterly Average)



Corporate Bond Spreads
As of week ended March 25, 2016



U.S. Treasury Yield Curve
As of week March 25, 2016



Long-Range Estimates:

The table below contains the results of our twice-annual long-range CONSENSUS survey. There are also Top 10 and Bottom 10 averages for each variable. Shown are consensus estimates for the years 2017 through 2021 and averages for the five-year periods 2017-2021 and 2022-2026. Apply these projections cautiously. Few if any economic, demographic and political forces can be evaluated accurately over such long time spans.

		Average For The Year					Five-Year Averages	
Interest Rates		**2017**	**2018**	**2019**	**2020**	**2021**	**2017-2021**	**2022-2026**
1. Federal Funds Rate	**CONSENSUS**	**2.0**	**2.8**	**3.2**	**3.3**	**3.4**	**2.9**	**3.3**
	Top 10 Average	2.7	3.6	4.0	4.0	4.0	3.7	3.8
	Bottom 10 Average	1.4	2.1	2.3	2.4	2.7	2.2	2.7
2. Prime Rate	**CONSENSUS**	**5.0**	**5.8**	**6.2**	**6.4**	**6.4**	**6.0**	**6.3**
	Top 10 Average	5.7	6.5	7.0	7.1	7.0	6.7	6.8
	Bottom 10 Average	4.4	5.2	5.5	5.7	5.8	5.3	5.7
3. LIBOR, 3-Mo.	**CONSENSUS**	**2.3**	**3.1**	**3.3**	**3.4**	**3.6**	**3.1**	**3.5**
	Top 10 Average	2.8	3.7	4.0	4.2	4.1	3.8	4.0
	Bottom 10 Average	1.8	2.4	2.6	2.7	3.0	2.5	3.0
4. Commercial Paper, 1-Mo.	**CONSENSUS**	**2.2**	**3.0**	**3.4**	**3.5**	**3.4**	**3.1**	**3.4**
	Top 10 Average	2.6	3.5	3.9	4.1	4.0	3.6	3.8
	Bottom 10 Average	1.7	2.4	2.9	2.9	2.9	2.6	2.9
5. Treasury Bill Yield, 3-Mo.	**CONSENSUS**	**2.0**	**2.8**	**3.2**	**3.3**	**3.3**	**2.9**	**3.2**
	Top 10 Average	2.8	3.5	3.9	4.0	3.9	3.6	3.7
	Bottom 10 Average	1.4	2.1	2.5	2.7	2.7	2.3	2.6
6. Treasury Bill Yield, 6-Mo.	**CONSENSUS**	**2.1**	**2.9**	**3.3**	**3.4**	**3.4**	**3.0**	**3.3**
	Top 10 Average	3.0	3.6	4.0	4.1	4.0	3.7	3.8
	Bottom 10 Average	1.5	2.2	2.6	2.8	2.8	2.4	2.7
7. Treasury Bill Yield, 1-Yr.	**CONSENSUS**	**2.3**	**3.1**	**3.4**	**3.5**	**3.5**	**3.2**	**3.4**
	Top 10 Average	3.2	3.8	4.1	4.2	4.2	3.9	4.0
	Bottom 10 Average	1.6	2.3	2.7	2.9	2.9	2.5	2.8
8. Treasury Note Yield, 2-Yr.	**CONSENSUS**	**2.5**	**3.2**	**3.5**	**3.6**	**3.7**	**3.3**	**3.7**
	Top 10 Average	3.4	4.0	4.4	4.4	4.4	4.1	4.3
	Bottom 10 Average	1.8	2.4	2.6	2.7	3.0	2.5	3.0
10. Treasury Note Yield, 5-Yr.	**CONSENSUS**	**3.0**	**3.6**	**3.8**	**3.9**	**4.0**	**3.6**	**4.0**
	Top 10 Average	3.8	4.4	4.7	4.8	4.8	4.5	4.7
	Bottom 10 Average	2.3	2.7	2.8	2.9	3.2	2.8	3.3
11. Treasury Note Yield, 10-Yr.	**CONSENSUS**	**3.4**	**3.8**	**4.1**	**4.2**	**4.3**	**4.0**	**4.3**
	Top 10 Average	4.2	4.7	5.0	5.2	5.2	4.9	5.1
	Bottom 10 Average	2.8	2.9	3.0	3.2	3.5	3.1	3.5
12. Treasury Bond Yield, 30-Yr.	**CONSENSUS**	**4.0**	**4.4**	**4.6**	**4.8**	**4.9**	**4.5**	**4.8**
	Top 10 Average	4.9	5.3	5.7	5.9	5.9	5.5	5.7
	Bottom 10 Average	3.3	3.6	3.5	3.7	3.9	3.6	3.9
13. Corporate Aaa Bond Yield	**CONSENSUS**	**5.1**	**5.5**	**5.7**	**5.8**	**5.8**	**5.6**	**5.8**
	Top 10 Average	5.7	6.2	6.5	6.6	6.6	6.3	6.5
	Bottom 10 Average	4.5	4.9	5.0	5.0	4.9	4.9	5.2
13. Corporate Baa Bond Yield	**CONSENSUS**	**6.0**	**6.5**	**6.7**	**6.8**	**6.7**	**6.5**	**6.8**
	Top 10 Average	6.8	7.2	7.6	7.7	7.6	7.4	7.5
	Bottom 10 Average	5.2	5.7	5.9	6.0	5.8	5.7	6.0
14. State & Local Bonds Yield	**CONSENSUS**	**4.5**	**4.9**	**5.0**	**5.1**	**5.1**	**4.9**	**5.1**
	Top 10 Average	5.0	5.5	5.7	5.8	5.8	5.6	5.8
	Bottom 10 Average	4.0	4.3	4.3	4.4	4.4	4.3	4.4
15. Home Mortgage Rate	**CONSENSUS**	**5.1**	**5.6**	**5.8**	**5.9**	**6.0**	**5.7**	**6.0**
	Top 10 Average	5.8	6.3	6.7	6.8	6.8	6.5	6.7
	Bottom 10 Average	4.4	4.8	4.9	5.0	5.1	4.9	5.2
A. FRB - Major Currency Index	**CONSENSUS**	**92.8**	**91.7**	**91.2**	**90.8**	**91.1**	**91.5**	**90.1**
	Top 10 Average	96.9	96.6	96.4	96.4	96.4	96.5	96.0
	Bottom 10 Average	88.4	86.6	85.7	85.1	85.7	86.3	84.2

		Year-Over-Year, % Change					Five-Year Averages	
		2017	**2018**	**2019**	**2020**	**2021**	**2017-2021**	**2022-2026**
B. Real GDP	**CONSENSUS**	**2.5**	**2.4**	**2.2**	**2.2**	**2.3**	**2.3**	**2.2**
	Top 10 Average	2.9	2.8	2.6	2.6	2.6	2.7	2.5
	Bottom 10 Average	2.2	1.8	1.8	1.9	1.9	1.9	2.0
C. GDP Chained Price Index	**CONSENSUS**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.1**	**2.0**
	Top 10 Average	2.3	2.5	2.4	2.3	2.2	2.3	2.2
	Bottom 10 Average	1.8	1.8	1.9	1.9	1.9	1.9	1.9
D. Consumer Price Index	**CONSENSUS**	**2.3**	**2.4**	**2.3**	**2.3**	**2.3**	**2.3**	**2.2**
	Top 10 Average	2.8	2.8	2.7	2.6	2.5	2.7	2.5
	Bottom 10 Average	2.0	2.0	2.0	2.0	2.1	2.0	2.0

Arizona Water Company
Derivation of Mean Equity Risk Premium Based on a Study
Using Holding Period Returns of Public Utilities

Line No.		Over A Rated Moody's Public Utility Bonds (1)
1.	Arithmetic Mean Holding Period Returns on the Standard & Poor's Utility Index 1928-2015 (2):	10.49 %
2.	Arithmetic Mean Yield on Moody's A Rated Public Utility Yields 1928-2015	(6.64)
3.	Historical Equity Risk Premium	3.84 %
4.	Forecasted Equity Risk Premium Based on PRPM™ (3)	3.94
5.	Forecasted Equity Risk Premium based on Projected Total Return on the S&P Utilities Index (4)	3.76
6.	Average of Historical and PRPM™ Equity Risk Premium	3.85 %

Notes: (1) Based on S&P Public Utility Index monthly total returns and Moody's Public Utility Bond average monthly yields from 1928-2015.

(2) Holding period returns are calculated based upon income received (dividends and interest) plus the relative change in the market value of a security over a one-year holding period.

(3) The Predictive Risk Premium Model (PRPM) is applied to the risk premium of the monthly total returns of the S&P Utility Index and the monthly yields on Moody's A rated public utility bonds from January 1928 - March 2016.

(4) Using data from Bloomberg Professional Service for the S&P Utilities Index, an expected return of 8.71% was derived based on expected dividend yields and long-term growth estimates as a proxy for market appreciation.

Subtracting the expected A rated public utility bond yield of 4.95%, calculated on line 3 of page 13 of this Exhibit results in an equity risk premium of 3.76%. (8.71% - 4.95% = 3.76%)

Arizona Water Company
Indicated Common Equity Cost Rate Through Use
of the Traditional Capital Asset Pricing Model (CAPM) and Empirical Capital Asset Pricing Model (ECAPM)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
The Proxy Group of Eight Water Companies	Value Line Adjusted Beta	Bloomberg Adjusted Beta	Average Beta	Market Risk Premium (1)	Risk-Free Rate (2)	Traditional CAPM Cost Rate	ECAPM Cost Rate	Indicated Common Equity Cost Rate (3)
American States Water Co.	0.70	0.66	0.68	8.93 %	3.58 %	9.65 %	10.37 %	10.01 %
American Water Works Company Inc	0.70	0.54	0.62	8.93	3.58	9.12	9.96	9.54
Aqua America Inc	0.75	0.63	0.69	8.93	3.58	9.74	10.43	10.09
California Water Service Group	0.75	0.73	0.74	8.93	3.58	10.19	10.77	10.48
Connecticut Water Service Inc	0.65	0.66	0.66	8.93	3.58	9.47	10.23	9.85
Middlesex Water Co.	0.70	0.75	0.73	8.93	3.58	10.10	10.70	10.40
SJW Corp	0.75	0.84	0.80	8.93	3.58	10.72	11.17	10.95
York Water Co.	0.75	0.80	0.78	8.93	3.58	10.55	11.04	10.79
Average			0.71			9.94 %	10.58 %	10.26 %
Median			0.71			9.92 %	10.57 %	10.25 %
Average of Mean and Median			0.71			9.93	10.58	10.26 %

Please see page 23 for notes.

Arizona Water Company
Notes to Accompany the Application of the CAPM and ECAPM

(1) The market risk premium (MRP) is an average of four different measures. The first measure of the MRP derives the total return on the market by adding the thirteen-week average forecasted 3-5 year capital appreciation to the thirteen-week average expected dividend yield from Value Line Summary and Index. The projected risk-free rate (developed in Note 2) is then subtracted from the total return to arrive at the projected MRP. The second measure of MRP is based on the arithmetic mean of historical monthly return data of large company stocks less the income return on long-term government bonds from 1926-2014 as published by Morningstar, Inc. The third measure applies the PRPM to the Ibbotson historical data to derive a projected MRP. The fourth measure uses data from Bloomberg Professional Services to derive a total projected return on the S&P 500 by using expected dividend yields and long-term growth estimates as a proxy for capital appreciation. The projected risk-free rate is then subtracted from the projected total return to arrive at the projected MRP. The four measures of MRP are illustrated below:

Measure 1: Value Line Projected MRP Thirteen weeks ending April 1, 2016		
Total projected return on the market 3 -5 years hence:		14.40 %
Projected Risk-Free Rate (described in Note 2):		3.58
MRP based on Value Line Summary & Index:		10.82 %
Measure 2: Ibbotson Arithmetic Mean MRP (1926-2015)		
Arithmetic Mean Monthly Returns for Large Stocks 1926-2015:		11.95 %
Arithmetic Mean Income Returns on Long-Term Government Bonds:		5.20
MRP based on Ibbotson Historical Data:		6.75 %
Measure 3: Application of the PRPM to Ibbotson Historical Data:		
(January 1926 - March 2016)		8.26 %
Measure 4: Bloomberg Projected MRP		
Total return on the Market based on the S&P 500:		13.48 %
Projected Risk-Free Rate (described in Note 2):		3.58
MRP based on Bloomberg data		9.90 %
	Average MRP:	8.93 %

(2) For reasons explained in the direct testimony, the appropriate risk-free rate for cost of capital purposes is the average forecast of 30 year Treasury Bonds per the consensus of nearly 50 economists reported in Blue Chip Financial Forecasts. (See pages 19 and 20 of this Exhibit). The projection of the risk-free rate is illustrated below:

Second Quarter 2016	2.80 %
Third Quarter 2016	3.00
Fourth Quarter 2016	3.10
First Quarter 2017	3.30
Second Quarter 2017	3.50
Third Quarter 2017	3.60
2017-2021	4.50
2022-2026	4.80
	3.58 %

(3) Average of Column 6 and Column 7.

Sources of Information:

Value Line Summary and Index
Blue Chip Financial Forecasts, April 1, 2016 and December 1, 2015
Morningstar SBBI Appendix A tables, Morningstar Stocks, Bonds, Bills, and Inflation 1926-2015
Bloomberg Professional Services