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BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE APPLICATION OF CHAPARRAL CITY WATER COMPANY, INC., AN ARIZONA CORPORATION, FOR A DETERMINATION OF THE FAIR VALUE OF ITS UTILITY PLANT AND PROPERTY AND FOR INCREASES IN ITS RATES AND CHARGES FOR UTILITY SERVICE BASED THEREON.	DOCKET NO. W-02113A-07-0551

CHAPARRAL CITY WATER COMPANY'S APPLICATION FOR REHEARING

Arizona Corporation Commission
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Pursuant to A.R.S. § 40-253, Chaparral City Water Company ("Chaparral City" or "the Company") hereby applies to the Arizona Corporation Commission ("the Commission") for rehearing of Decision No. 71308 (October 21, 2009) ("the Decision"). In support of this application, the Company hereby incorporates by reference the following brief filed in the docket in the above-entitled matter: The Company's Closing Brief (Rate Base, Income Statement and Rate Design) (filed Jan. 28, 2009); its Closing Brief on Cost of Capital and Rate of Return (filed Feb. 13, 2009); its Reply Brief (Rate Base, Income Statement and Rate Design) (filed Feb. 13, 2009); and its Reply Brief (Cost of Capital and Rate of Return) (filed Feb. 27, 2009).

In the Decision, the Commission granted the Company a revenue increase of $1,764,371, which is more than $1 million less than the Company's requested revenue increase. As a result, the rates do not provide the Company with either a fair rate of return on the fair value of its utility plant and property or an adequate opportunity to actually earn the authorized rate of return. Moreover, the rates ultimately approved by Commission produce revenue that is nearly $500,000 that than revenue increase authorized in the Decision.

There are five primary flaws that render the Decision (i) arbitrary, capricious and/or contrary to governing law; (ii) not supported by substantial evidence in the record; (iii) in violation of the Company's due process and constitutional rights; or (iv) otherwise unlawful:

- The Commission's treatment of the FHSD settlement proceeds conflicts with Commission precedent and effectively confiscates the Company's property without just compensation.
- The Commission's denial of rate case expense for the Company's successful appeal was punitive and sets a dangerous precedent.
- The Commission again has violated the Arizona Constitution's fair value standard.

- The authorized return on equity is arbitrary and result-driven, and conflicts with the evidence in the record.

- The rates do not produce the Commission's authorized revenue requirement.

For the reasons set forth hereinafter, the Company requests that rehearing be granted on each of these issues.

I. FIRST BASIS FOR REHEARING: THE COMMISSION'S TREATMENT OF THE FHSD SETTLEMENT PROCEEDS CONFLICTS WITH COMMISSION PRECEDENT AND EFFECTIVELY CONFISCATES THE COMPANY'S PROPERTY WITHOUT JUST COMPENSATION

The Fountain Hills Sanitary District ("FHSD") provides wastewater collection and treatment in the Company's certificated area. FHSD constructed an aquifer storage and recovery well in the vicinity of the Company's Well No. 9.[1] Although the Company relies primarily on surface water obtained under its CAP contracts, water from Well No. 9 was blended with CAP water, and water from two other wells.[2] The Company was forced to take Well No. 9 off-line as a result of its proximity to the effluent storage and recovery site, and FHSD attempted to provide Chaparral City with a replacement well.

Efforts to drill a replacement well were unsuccessful, and, ultimately, the Company and FHSD entered into a settlement agreement to avoid litigation.[3] Under this agreement, FHSD paid Chaparral City $1.52 million, and the Company agreed to cap Well No. 9, and another nearby well, Well No. 8.[4] Well No. 8 was historically used as a raw water source for Fountain Hills park and lake, but was never used to provide potable water service.[5] The Company disclosed the settlement payment in this rate case and, while it was not required to do so, proposed that the proceeds be shared equally between ratepayers and

[1] Tr. at 118.
[2] Hanford Dt. at 3; Tr. at 101.
[3] Hanford Dt. at 10.
[4] Exh. R-10.
[5] Tr. at 101.

shareholders by deducting half of the settlement proceeds from rate base.[6] The Utilities Division ("Staff") agreed with Company's proposal. The Residential Utility Consumer Office ("RUCO"), however, argued that customers should be the sole beneficiaries of the settlement and that the entire settlement amount should be deducted from Chaparral City's rate base, effectively confiscating $1.52 million of utility plant.

The Commission agreed with RUCO. Through an amendment proposed by Commissioner Pierce at the October 8, 2009 Open Meeting, the Commission decided that the customers should receive all of the benefits obtained through the settlement, with the exception of $30,000 to reimburse the Company for pursuing the settlement "on behalf of ratepayers."[7] The Commission's justification for allocating all of the settlement proceeds to the ratepayers was that Wells No. 8 and No. 9 "are fully depreciated," indicating that the Commission believes customers acquire an ownership interest in the property of a utility by virtue of paying for utility service. Of course, this is not the law. The United States Supreme Court has explained:

> Customers pay for service, not for the property used to render it. Their payments are not contributions to depreciation or other operating expenses or to the capital of the company. By paying bills for service they do not acquire any interest, legal or equitable, in the property used for their convenience or in the funds of the company. Property purchased out of moneys received for service belongs to the company just as does that purchased out of proceeds of its bonds and stock.[8]

By taking the all of settlement proceeds from the Company (except for $30,000) through a reduction to the Company's rate base under the theory that customers owned the wells, the Commission has effectively confiscated more than $1.5 million of the Company's assets. This was illegal.

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[6] Bourassa Dt. at 10-11; Bourassa Rb. at 13-15; Hanford Rb. at 1-4.
[7] Decision at 9.
[8] *Bd. of Pub. Utility Comm'rs v. New York Tele. Co.*, 271 U.S. 23, 32 (1926).

The reality is that the Company took two aged assets and turned them into cash, which it proposed to share with its customers. The Company felt, and still feels, that its proposed treatment of the FHSD settlement proceeds is fair.[9] The Commission addressed treatment of proceeds from a similar settlement in Decision No. 66849 (March 19, 2004) for Arizona Water Company's Eastern Group. In that case, the utility had sought to retain all of a $1.4 million settlement payment from a group of mining companies, whose activities had contaminated Arizona Water Company's well field. Like RUCO in this case, Staff recommended that all of the proceeds be used to benefit ratepayers through a reduction in rate base. RUCO, in contrast, asserted that "requiring an equal allocation strikes a balance between encouraging the Company to pursue legitimate legal remedies, while at the same time preventing the company from attaining an unjustified windfall."[10]

Agreeing with RUCO's reasoning, the Commission ordered the settlement proceeds to be shared equally between Arizona Water and its ratepayers, explaining that "an equal sharing of the settlement proceeds provides a reasonable balance between the rights of shareholders and ratepayers and will provide the Company with a sufficient incentive to pursue future settlement or litigation of claims that the Company and its customers may be entitled to receive."[11] The Company followed this precedent in proposing the same treatment of the FHSD settlement proceeds. The Company further offered that in the unlikely event that either of the wells or wellsites is sold in the future, such proceeds would also be divided equally.[12]

RUCO's flawed logic is readily apparent from its contrary position on the regulatory treatment in the event of a sale. According to RUCO's witness, the proceeds of a sale would be shared equally.[13] Thus, if the Company had transferred ownership of the

[9] Hanford Rb. at 4-5.
[10] *Arizona Water Company (Eastern Group)*, Decision No. 66849 (March 19, 2004) at 33.
[11] *Id.* at 35.
[12] Hanford Rb. at 3-4.
[13] Tr. at 264-265.

wells to the district as part of the settlement, there would be no issue regarding the disposition of the proceeds. But because the Company retained ownership of the wells, the Commission has ordered that all of the settlement proceeds should be allocated to customers by reducing the Company's rate base. In addition to be confiscatory, it makes no sense.

Boiled down, what the Commission apparently advocates is that the utility take all the risk of pursuing settlement or litigation, but receive none of the reward if successful.[14] Chaparral City would be better off next time walking away from the assets.[15] Obviously, this is an a extremely poor policy for the Commission to adopt, and it provides a strong disincentive to utilities, the opposite of the Commission's message in the Arizona Water Company-Eastern Group decision relied upon by the Company.

In short, ratepayers do not have any right or interest in the Company's property by virtue of paying for service.[16] In this case, ratepayers had no legal right to half of the settlement proceeds in the first place. The record is clear that the assets belong to the Company – a position aptly illustrated by the position of RUCO that if the wells had been sold, things would be different. In other words, it is the ratepayers that have received everything they are entitled to from the Company, and the Commission's decision is nothing more than a taking of the Company's property without just compensation. Further, the Commission's decision violates prior Commission precedent on this issue and, therefore, is arbitrary, capricious and an abuse of discretion.

II. SECOND BASIS FOR REHEARING: THE COMMISSION'S DENIAL OF RATE CASE EXPENSE FOR THE COMPANY'S SUCCESSFUL APPEAL WAS PUNITIVE AND SETS A DANGEROUS PRECEDENT

In Decision No. 70441,[17] the Commission directed the Company to seek rate case

[14] Tr. at 138.

[15] Hanford Rb. at 3.

[16] *Bd. of Pub. Utility Comm'rs v. New York Tele. Co.*, 271 U.S. at 32 (1926).

[17] Chaparral City Water Co., Decision No. 70441 (July 28, 2008).

expense in this docket for its successful appeal of Commission Decision No. 68176 (September 30, 2005).[18] Although the Company had originally requested recovery of $258,511, which amount covered about one-half of the cost of the Company's appeal and the subsequent remand proceeding (which dragged on for over one year), to reduce issues the Company accepted Staff's recommended amount, $100,000.[19] That the Company had prevailed at the Court of Appeals on its challenge to the constitutionality of the Commission's decision was never in dispute. Instead, RUCO objected to authorizing recovery of additional rate case expense because the Company's decision to appeal was a "business decision" intended to produce more operating income, and did not specifically benefit ratepayers.[20]

The recommended opinion and order issued by the Administrative Law Judge authorized the Company to recover $100,000 in expense. However, at the October 8, 2009 Open Meeting, the Commission adopted Commissioner Pierce's amendment and denied the Company recovery of a single dollar of rate case expense for an appeal and remand that took nearly four years and cost more than half a million dollars. The basis for the Commission's denial was that "[t]he Company spent more than $500,000 to recover an additional $12,000 in operating income."[21] In effect, the Commission adopted a "success on the merits" test for expense recovery, i.e., although the Company prevailed on appeal, the ultimate result was a miniscule increase in revenues (which has resulted in a second appeal). This was arbitrary, capricious and contrary to applicable law, and further violated the Company's due process and other constitutional rights.

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[18] Decision 70441 at 39, 43.

[19] Bourassa Supp. Dt. at 2, 6-7.

[20] Rigsby Sb. at 4-5.

[21] Decision No. 71308 at 28. Actually, the Company recovered an additional $12,000 in revenues and an additional $7,400 in operation income, despite the fact that the Company's fair value rate base is $3.3 million larger than its original cost rate base. *See id.* at 41. Consequently, the Company has appealed Decision No. 71308. *See Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 08-0002.

Frankly, the Decision appears intended to discourage utilities from challenging unlawful actions by the Commission. It will chill future challenges to Commission decisions, even when, as in this case, the Commission has violated the Arizona Constitution. However, the ability to access the courts to vindicate rights secured under federal and state law is protected under the Constitution,[22] and the Commission may not deny the right to seek judicial review of Commission decisions.[23] That is what the Commission has done in this case by denying recovery of rate case expense relating to the prior successful appeal against the Commission. In *Ex Parte Young*, 209 U.S. 123, 147 (1908), the United States Supreme Court noted that it would be unconstitutional to make a state commission's rate-setting decision "conclusive" and beyond challenge. Thus, a "law which indirectly accomplishes a like result" by penalizing the regulated party for taking a judicial appeal is also unconstitutional.[24]

The Decision also has significant policy implications, which the Company respectfully suggests the Commission will come to regret. In short, by denying the Company rate case expense, despite the Company's success at the appellate court, simply because it did not obtain a higher increase in rates on remand, the Commission ensures that the Company will be entitled to an award of additional rate case expense if it prevails in its current appeal of Decision No. 70441. Such an award may exceed $500,000 if the court again determines that the Commission has violated the fair value standard and directs the Commission to approval a far more substantial increase, together with interest. This can be corrected by amending the Decision to award the Company $100,000 in rate

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[22] *See, e.g., In Re Primus*, 436 U.S. 412, 422-23 (1978).

[23] *See, e.g., GST Tucson Lightwave, Inc. v. City of Tucson*, 190 Ariz. 478, 949 P.2d 971, 978 (App. 1997) ("Under the well-settled doctrine of unconstitutional conditions, the government may not require a person to give up a constitutional right in exchange for a discretionary benefit conferred by the government.").

[24] *Ex Parte Young*, 209 U.S. at 147. *See also Oklahoma Gen. Co. v. Love*, 252 U.S. 331, 336-337 (1920) (laundry regulation scheme that "beset" judicial review with penalties that deterred any appeal "does not satisfy the constitutional requirements").

case expense for the successful appeal and remand, as the Administrative Law Judge and Staff recommended.

III. THIRD BASIS FOR REHEARING: THE COMMISSION AGAIN HAS VIOLATED THE ARIZONA CONSTITUTION'S FAIR VALUE STANDARD[25]

A. The Commission Failed to Properly Use Fair Value to Set Rates

Under Arizona law, the Commission must find and use the fair value of the utility's plant and property in the setting of rates.[26] On appeal of Decision No. 68176, the Arizona Court of Appeals stated:

> Under the Arizona Constitution, a public utility is entitled to a fair return on the fair value of its property devoted to public use. ... The Commission is required to find the fair value of the utility's property at the time of the inquiry and to use that finding in setting just and reasonable rates. ... Here, the Commission determined Chaparral City's operating income based on its OCRB and then mathematically calculated a corresponding rate of return had the income based on the FVRB [fair value rate base]. Under this method, Chaparral City's operating income, and therefore its revenue requirements and rates, were not based on the fair value of its property, but on its OCRB, which does not comport with the Arizona Constitution.[27]

The court did not direct the Commission to use a specific rate of return methodology on remand, but emphasized that the "Commission cannot determine rates based on the original cost, or OCRB, and then engage in a superfluous mathematical exercise to

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[25] In addition to incorporating its closing and reply briefs in support of this application, the Company also incorporates by this reference its Opening Brief (filed Feb. 25, 2009) and Reply Brief (filed May 12, 2009) in *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 08-0002.

[26] *See US West Communic's, Inc. v. Ariz. Corp. Comm'n*, 201 Ariz. 242, 244-46, ¶¶ 13-19, 34 P.3d 351, 354-55 (2001) (summarizing Arizona court decisions requiring the use of fair value); *Simms v. Round Valley Light & Power Co.*, 80 Ariz. 145, 149-51, 294 P.2d 378, 382 (1956); *Ariz. Corp. Comm'n v. Ariz. Water Co.*, 85 Ariz. 198, 203, 335 P.2d 412, 415 (1959).

[27] *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007) at . 11-12, ¶ 14 (citations omitted).

identify the equivalent FVRB rate of return."[28]

On remand, unfortunately, the Commission again violated the fair value standard by adjusting the rate of return downward to produce a result that is equivalent to using original cost. In its pending appeal of Decision No. 70441, the Company has asserted that by reducing the cost of equity to account for the impacts of "inflation," the Commission has again failed to provide the Company with a just and reasonable return on the fair value of its plant devoted to public service, as required by the Arizona Constitution.[29]

In the instant case, the Commission has repeated this error and again undermined the use of fair value to set Chaparral City's rates. The Commission subtracted an "inflation factor" of 1.2 percent from the weighted average cost of capital ("WACC"), reducing the rate of return from 8.72 percent to 7.52 percent.[30] It then applied that that percentage to the Company's fair value rate base of $26,776,414 to derive the Company's operating income.[31] This violated the fair value standard. As the United States Supreme Court held:

> In theory the *Smyth v. Ames* fair value standard mimics the operation of the competitive market. To the extent the utilities' investments in plants are good ones (because their benefits exceed their costs) *they are rewarded with an opportunity to earn an "above-cost" return, that is, a fair return on the current "market value" of the plant.* To the extent utilities' investments turn out to be bad ones (such as plants that are canceled and so never used and useful to the public), the utilities suffer because the investments have no fair value and so justify no return.[32]

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[28] *Id.* at 13-14, ¶ 17.

[29] *See* Chaparral City's Opening Brief (filed Feb. 25, 2009) and Chaparral City's Reply Brief (filed May 12, 2009) in *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 08-0002.

[30] Decision at 49.

[31] *Id.*

[32] *Duquesne Light Co. v. Barasch*, 488 U.S. 299, 308-09 (1989) (emphasis supplied) (citing *Smyth v. Ames*, 169 U.S. 466, 547 (1898)).

Consequently, under the fair value standard, rates must be set "according to the actual present value of the assets employed in the public service," and utility investors are rewarded "with an opportunity to earn an 'above-cost' return" when the value of their assets increases, but must bear the burden when the value declines.[33] The Supreme Court has stated that "[r]ates which are not sufficient to yield a reasonable return ***on the value of the property used at the time it is being used to render the service*** are unjust, unreasonable and confiscatory, and their enforcement deprives the public utility company of its property in violation of the Fourteenth Amendment."[34] That statement is consistent with the Arizona Supreme Court's statement in *Simms* that the "reasonableness and justness of the rates must be related to [the] finding of fair value."[35] And as discussed in the Company's initial closing brief on the cost of capital and rate of return, the WACC methodology can be used to derive this rate of return, using finance models such as the DCF model and the CAPM which rely on market data and do not consider the rate bases of the publicly traded sample utilities.[36]

Despite these legal authorities, the Commission followed Decision No. 70441 and adjusted the rate of return downward to avoid "overstating inflation."[37] In Decision No. 70441, the Commission held that a WACC-derived rate of return must be adjusted

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[33] *Id.* at 308-09. *See also McCardle v. Indianapolis Water Co.*, 272 U.S. 400, 410-11 (1926) ("It is well established that values of utility properties fluctuate, and that owners must bear the decline and are entitled to the increase."); *Bluefield Waterworks & Improvement Co. v. Pub. Serv. Comm'n*, 262 U.S. 679, 690 (1923) ("If the property, which legally enters into the consideration of the question of rates, has increased in value since it was acquired, the company is entitled to the benefit of such increase."); *City of Tucson v. Citizens Utilities Water Co*, 17 Ariz. App. 477, 480, 498 P.2d 551, 554 (1972) ("The [Arizona Supreme] Court reiterated [in *Simms*] that fair value meant 'value of properties at the time of inquiry' ... which figure will necessarily reflect the current cost of construction.").

[34] *Bluefield Waterworks*, 262 U.S. at 690 (emphasis supplied).

[35] *Simms*, 80 Ariz. at 151, 294 P.2d at 382.

[36] Initial Closing Brief on Cost of Capital and Rate of Return at 13-27. *See also State ex rel. Utilities Comm'n v. Duke Power Co.*, 206 S.E.2d 269, 281 (N.C. 1974); *City of Alton v. Commerce Comm'n*, 165 N.E.2d 513, 519 (Ill. 1960).

[37] Decision at 43.

downward to prevent "over-counting the effect of inflation," which undermines the use of fair value.[38] This holding turned on the erroneous belief that the fair value rate base includes "inflation." In reality, the fair value rate base is simply a conservative estimate of current value. The Company's reconstruction cost rate base ("RCRB") is not based on the Consumer Price Index or similar measures of general inflation, but is the current value of its plant based on its reconstruction cost.[39] This method is used to determine value because other methods are not suitable for valuing a utility's property in a rate-setting context.[40] The use of the average of RCRB and the original cost rate base ("OCRB") (which, by definition, contains no inflationary component[41]) as the fair value rate base produces a very conservative estimate of fair value.[42]

In short, only the Company actually used the fair value of the Company's utility plant and property in a meaningful way in setting rates. Chaparral City applied the percentage rate of return, based on the WACC, to the correct rate base. The application of the WACC-derived cost of capital to the fair value rate base correctly recognizes that the difference between OCRB and the fair value rate base is being financed with investor-supplied capital, and that the utility is entitled to a fair return on this rate base increment.[43] The Decision, in contrast, is predicated on the erroneous view that if the fair value of utility's plant is used as its rate base, the rate of return must be reduced to produce rates that are "fair," i.e., are equivalent to using original cost as the rate base.[44] For the same reasons that the downward adjustment to Chaparral City's WACC to account for inflation

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[38] Decision No. 70441 at 33-34.

[39] Ex. A-11.

[40] *Duquesne Light*, 488 U.S. at 309 n.5.

[41] Decision at 43-44. *See also* Fox Dt. at 8 ("The OCRB contains no inflation factor.").

[42] In fact, it is often a stale estimate of current value, as this case illustrates: Chaparral City's fair value rate base is based on plant in service on December 31, 2006, with no consideration of plant that was subsequently placed in service and is currently used to provide service.

[43] *Duquesne Light*, 488 U.S. at 308-09.

[44] Decision at 43, 47-49.

violated the fair value standard in Decision No. 70441, the Commission has again violated the fair value standard in this case, and has rendered the use of fair value meaningless.

B. Errors in the Determination of the "Fair Value" Rate of Return

In addition to improperly adjusting the WACC/rate of return downward to reduce the Company's operating income, the Commission made other errors that impermissibly lowered Chaparral City's authorized operating income. First, the Commission improperly reduced the cost of Chaparral City's outstanding long-term debt by the inflation factor. Second, the Commission ignored the evidence in the record and adopted an inflation factor that is grossly overstated.

In contrast to Decision No. 70441, in which the Commission reduced the Company's 9.3 percent cost of equity by 200 basis points (2 percent) to 7.3 percent to account for "inflation,"[45] in this case the Commission correctly recognized that half of the Company's fair value rate base consists of plant valued at original cost and therefore reduced the "inflation factor" by 50 percent.[46] However, the Commission also reduced the Company's cost of long-term debt by adjusting the WACC rather than just the cost of equity.[47] It did not make such an adjustment in Decision No. 70441, and there is no legitimate basis for adjusting the cost of long-term debt. Long-term debt is an existing contractual obligation that has a fixed cost and is not affected by changes in prices or other inflationary effects.[48] Therefore, it was improper to reduce the cost of debt and thereby impair the Company's ability to recover its authorized return on equity.

Moreover, the inflation factor recommended by Staff and used by the Commission to adjust the WACC, 2.4 percent, was grossly overstated. Staff's cost of capital witness,

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[45] Decision No. 70441 at 37.

[46] Decision at 43-44 (describing Staff's proposed adjustment), 48-49 (adopting Staff's "Method 2").

[47] *Id.* at 44-45, 48-49.

[48] Bourassa Rb. at 20-21.

Mr. Chaves,[49] testified that interest rates cannot be accurately forecasted, and therefore the best information about the future is reflected in current Treasury yields.[50] Obviously the same rationale applies to estimating future inflation through a comparison of Treasury yields, as Mr. Chaves explained in his testimony.[51] Unfortunately, Staff used the wrong Treasury securities. In the Company's prior case, Staff's cost of capital witness testified that most investors consider the intermediate time frame to be the appropriate investment horizon, i.e., they normally consider holding stocks for 5 to 10 years.[52] Notably, this position is consistent with Staff's use of 5, 7, and 10-year Treasury yields in the CAPM and use of 3- to 5-year stock price appreciation in developing the current market risk premium for the CAPM in this case.[53] Likewise, RUCO's witness testified that a 5-year investment horizon should be used in estimating the cost of equity.[54]

If an investor expects to hold a stock for 5 years, he is concerned about inflation during the next 5 years – not inflation a decade later (or, in RUCO's case, eight years earlier). As RUCO's witness explained, the purpose of this adjustment is to remove the "inflation expectation" from the cost of equity.[55] Thus, it does not make sense to use 20-year Treasuries to estimate inflation that is expected in the next 5 years. (And it makes even less sense to consider historic inflation, as RUCO did.) In short, the correct

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[49] Staff switched cost of capital witnesses shortly before the hearing, bringing in an outside consultant, Mr. Parcell, who adopted portions of Mr. Chaves' direct testimony, but presented no independent cost of equity estimate. However, Staff then switched back and presented Mr. Chaves' cost of capital schedules as it final, post-hearing position. *See* Initial Closing Brief on Cost of Capital and Rate of Return at 7-8, 49-51 (describing Staff's pre-hearing witness switch and post-hearing switch back); Staff Final Sch. PMC-1 through PMC-10 (showing Staff's final position on the cost of capital and rate of return). In any case, the Staff witness who computed the inflation factor was Mr. Chaves, using spot yields on long-term Treasuries. *See* Chaves Dt. at 36-37.

[50] Chaves Dt. at 43-44.

[51] *Id.* at 37.

[52] *See* Surrebuttal Testimony of Alejandro Ramirez, Docket No. W-02113A-04-0616, at 11 (May 5, 2005).

[53] Chaves Dt. at 28; Bourassa Rb. at 23-24.

[54] Rigsby Dt. at 32.

[55] *Id.* at 35.

Treasuries are, obviously, 5-year Treasuries. Yet Staff used the yields on long-term Treasuries and the Commission adopted that approach.

In addition, Staff failed to update its inflation estimate to take into account current inflationary expectations, which is the point of using spot yields. The Company's witness, Mr. Bourassa, presented updated estimates of the inflation factor, using Staff's method, using 5-, 7-, and 10-year Treasuries and their corresponding inflation-indexed counterparts as of October 29, 2008, November 21, 2008, and December 18, 2008.[56] His updated estimate of inflation, based on the difference between yields on 5-year Treasuries and TIPS, was negative 0.11 percent as of December 18, 2008.[57] The average estimate of inflation, using all three Treasuries, was 0.03 percent or 30 basis points.[58] No other party provided an updated estimate of inflation or challenged Mr. Bourassa's estimates. This evidence showed that expected inflation was virtually nonexistent and certainly well below the 2.4 percent inflation factor recommended by Mr. Chaves and adopted by the Commission in the Decision. There is simply no credible evidence that inflation will be 2.4 percent over the next several years, when the rates authorized in this case are in effect.

Therefore, the Commission's decision to apply its unlawful inflation adjustment to the Company's cost of capital is unsupported by substantial evidence, as well as arbitrary and capricious. As a consequence, the Decision again violates the Arizona Constitution by failing to find and use fair value.

IV. FOURTH BASIS FOR REHEARING: THE AUTHORIZED RETURN ON EQUITY IS ARBITRARY AND RESULT-DRIVEN, AND CONFLICTS WITH THE EVIDENCE IN THE RECORD

A. Overview: The Parties Recommendations and the Commission's Arbitrary Decision

The Commission authorized a return on equity of 9.9 percent for Chaparral City,

[56] Bourassa Rb. at 23; Bourassa Rj. at 17; Bourassa Supp. Rj. at 4-5.

[57] Bourassa Supp. Rj. at 4-5.

[58] *Id.*

concluding that "the methodologies Staff and RUCO used [are] less biased than those used by the Company, and more reflective of current market conditions."[59] In support of this determination, the Commission misstated the evidence presented and ignored basic finance concepts. Despite the lengthy discussion of the cost of equity in the Decision,[60] it is ultimately not clear how the agency ultimately arrived at its authorized return of 9.9 percent, given the parties' recommendations.

In estimating the cost of equity, all of the parties used the same market-based finance models – the DCF model and the CAPM – the Commission has approved in numerous water and wastewater utility rate cases, including Chaparral City's prior rate case.[61] These models are implemented through the use of financial information for a sample group of water utilities with common stock that is traded on a national exchange.[62] The cost of equity estimates produced by the parties' models, however, varied considerably:

Chaparral City	12.70%
Staff	11.90%
RUCO	8.83%[63]

The methods and inputs used by Staff and the Company were similar in most respects. Staff and the Company relied on the same sample group of six publicly traded water utilities, which are the utilities that have been used by the Commission in setting rates for water and wastewater utilities for a number of years, including Chaparral City's

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[59] Decision at 37.

[60] Decision at 30-37.

[61] Decision No. 68176 (Sept. 30, 2005) at 17-26. Notably, the Arizona Court of Appeals reviewed and approved the methodologies and inputs used by Staff and adopted by the Commission in the Company's prior appeal. *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007).

[62] Bourassa Rb. at 11-12.

[63] Company Final Sch. D-4.0; Staff Final Sch. PMC-3; Rigsby Dt., Sch. WAR-1, p. 4

last rate case.[64] In addition, Staff and the Company both considered current market risk, and did not rely solely on historic market risk in implementing the CAPM. As a result, the cost of equity estimates of Staff and the Company were similar, with Staff's models producing an estimated cost that is somewhat lower than Mr. Bourassa's final estimate, but nevertheless higher than the Company's recommended 11.5 percent equity cost. RUCO, however, used much different inputs and, as a result, derived an equity cost of only 8.83 percent. Those methods and inputs conflict with prior Commission decisions involving water and wastewater rate cases, however. And it is unclear from the Decision how the Commission reconciled the parties' conflicting recommendations to arrive at a return on equity of 9.9 percent for Chaparral City.

B. The Commission Ignored Staff's Downward Adjustment of 180 Basis Points to Staff's 11.9 Percent Cost of Equity Estimate

In the Decision, the Commission failed to acknowledge Staff's 11.9 percent cost of equity estimate, and simply stated that Staff's estimate for Chaparral City was 10.1 percent.[65] However, Staff's final schedules plainly show that the average of Staff's DCF and CAPM estimates, using the same six proxy water utilities that the Company used, was 11.9 percent.[66] But Staff also made an improper downward adjustment to the cost of equity of 180 basis points to account for the Company's financial risk.[67] The Company explained in its initial closing brief on the cost of capital why that adjustment conflicts with Commission precedent and established finance theory and, if adopted, would be grossly excessive.[68]

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[64] Bourassa Rj. at 12-13.

[65] Decision at 30 (citing Staff Final Sch. PMC-1). In fact, the Commission erroneously claimed the Company "ignored Staff's recommended cost of equity of 10.1 percent." *Id.* at 36. Obviously, that is untrue and highlights the result-driven nature of the Commission's decision.

[66] Staff Final Sch. PMC-3.

[67] This adjustment is shown on Staff Final Sch. PMC-3.

[68] Initial Closing Brief on Cost of Capital and Rate of Return at 2-3 (describing issue), 51-56.

The Commission failed to consider the Company's evidence and arguments, which were not contested by any party. Instead, the Commission stated that Staff filed surrebuttal testimony "withdrawing its recommendation for a Hamada adjustment prior to the hearing," and as a result, the Company's testimony and argument concerning Staff's 180 basis point adjustment to the cost of equity "is misplaced and irrelevant." However, Staff's final position, as clearly shown in Staff's post-hearing schedules, was predicated on the Hamada adjustment.[69] It was certainly not based on Mr. Parcell's testimony, which cannot be squared with Staff's final schedules or with the methods and inputs that Staff has consistently used in water and wastewater utility rate cases.

The record shows that the Company accepted Staff's 11.9 percent cost of equity, but disagreed with Staff's erroneous downward adjustment of 180 basis points for financial risk. The Company's evidence and argument on Staff's adjustment was not addressed by any witness and went unchallenged. But the Commission simply ignored it, erroneously claiming that Staff withdrew it. At the same time, the Commission stated that Staff's final recommendation was 10.1 percent, based on Staff's final post-hearing schedules. The Commission cannot have it both ways.

In sum, Staff's final position was that the application of the DCF and CAPM models to Staff's sample group of six publicly traded water utilities results in a cost of equity of 11.9 percent. Its 10.1 percent recommendation for Chaparral City resulted from its misuse of the Hamada Equation. The Commission's failure to acknowledge what the record clearly shows and its failure to address the uncontested evidence and authorities demonstrating that Staff misapplied the Hamada Equation was arbitrary and unsupportable.

[69] Staff Final Sch. PMC-3.

C. The Commission May Not Switch Back and Forth Between Methodologies Without Providing a Reasoned Explanation for Doing So

It is unlawful for a regulatory commission to arbitrarily switch back and forth between methodologies in setting utilities' rates, as the Supreme Court has stated:

> [A] State's decision to arbitrarily switch back and forth between methodologies in a way which required investors to bear the risk of bad investments at some times while denying them the benefit of good investments at others would raise serious constitutional questions.[70]

The Commission violated this fundamental principle. In prior water and wastewater rate cases (including the Company's prior rate case), the Commission has consistently affirmed Staff's choice of inputs for the DCF and the CAPM, as well as the use of those models.[71] After consistently using the same methods and inputs to estimate the cost of equity, the Commission deviated from those methods in this case to lower the Company's cost of equity. This was unlawful.

Staff's cost of capital witness, Mr. Chaves, used the same methods as were used by Mr. Ramirez, who was Staff's cost of capital witness in Chaparral City's previous rate case. This is readily apparent from comparing Staff's final, post-hearing schedules in this case labeled PMC-1 through PMC-10 with Mr. Ramirez's schedules attached to his direct and surrebuttal testimony in the Company's prior case.[72] The only difference between the methods used by the Staff witness in each case was that, as explained above, in this case Mr. Chaves proposed an erroneous downward reduction to Chaparral City's cost of equity to account for financial risk, while such an adjustment was not proposed by Mr. Ramirez.

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[70] *Duquesne Light*, 488 U.S. at 315.

[71] *See, e.g.,* Closing Brief of Commission Staff, *Black Mountain Sewer Corp.*, Docket No. SW-02361A-05-0657(filed Aug. 21, 2006) at 24 and n. 163 (citing numerous decisions) (excerpt attached at tab A).

[72] Direct Testimony of Alejandro Ramirez, *Chaparral City Water Co.*, Docket No. W-02113A-04-0616 (filed March 22, 2005); Surrebuttal Testimony of Alejandro Ramirez, *Chaparral City Water Co.*, Docket No. W-02113A-04-0616 (filed May 5, 2005).

Moreover, as noted above, the Company challenged Mr. Ramirez's methods and inputs, which produced a cost of equity of 9.3 percent, and they were affirmed by the Arizona Court of Appeals.[73]

The bottom line is that the methods and inputs Staff has consistently used and the Commission has consistently approved in numerous water and wastewater utility rate cases produced a cost of equity of 11.9 percent. There was no legitimate basis for rejecting Staff's choice of methods and inputs in this case, and none has been given by the Commission. This was arbitrary and unlawful.

D. If the Gas Utilities Are Considered, the Resulting Cost of Equity Is Significantly Greater than 9.9 Percent

The Commission approved RUCO's use of a sample group of publicly traded gas utilities and further held that no "special adjustment" is needed to make the gas utility industry sample comparable to the water utility industry sample.[74] In so holding, the Commission relied on Decision No. 66849, issued by the Commission in Arizona Water Company's Eastern Group rate case.[75] But the Commission misstated the evidence and holding of that decision in order to support its low equity return for Chaparral City in this case. As explained below, the use of a gas utility sample did not "have the effect of increasing the cost of equity over Staff's recommendation" in the Eastern Group case.

At the time of Arizona Water's Eastern Group rate case, the average betas of the water and gas sample groups were lower than they are today, with the average beta of the gas utility sample being 0.69 and the average of the water utility sample being only 0.59.[76]

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[73] *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007) at 14-28, ¶¶ 18-49 (discussing and affirming the Commission's methodologies used to determine the cost of equity).

[74] Decision at 32-33.

[75] *Id.* at 32.

[76] *See* Direct Testimony of Joel M. Reiker, Docket No. W-01445A-02-0619 (filed July 8, 2003) at 26, Sch. JMR-5, Sch. JMR-16. "Beta," which is a key input in the CAPM, is an estimate of a stock's market risk (i.e., the risk that cannot be eliminated by diversification). Thus, an increase in a stock's beta indicates that the stock has become more risky relative to the market as a whole, and investors would require a

Using its established methods and inputs, Staff estimated that the equity costs for the sample gas utilities and sample water utilities were 10.3 percent and 9.2 percent respectively.[77] Thus, the average cost of equity for the two industry groups was 9.8%. Consequently, if the Commission had considered the unadjusted cost of equity for the gas utility sample, Arizona Water's authorized return on equity would have been 9.8 percent.

Instead, Staff performed a CAPM analysis, and determined that the cost of equity for the gas utilities was approximately 100 basis points higher than the sample water utility group based on the difference in risk (i.e., the average betas for each industry).[78] Therefore, Staff argued that the gas utilities' cost of equity "would require a *significant downward adjustment*" to make the two groups comparable.[79] The Commission adopted Staff's recommendation, but elected not to reduce Arizona Water's return on equity from 9.2 percent to 9.0 percent for financial risk, even though Arizona Water's capital structure contained approximately 70 percent debt.[80] Thus, Arizona Water's authorized return on equity, 9.2 percent, was equal to the water utility sample's cost of equity.

In this case, the gas utility sample had an average beta of 0.82, while RUCO's water utility sample had an average beta of 1.05.[81] Therefore, the water utility sample has significantly more risk than the gas utility sample, and cannot be used to estimate Chaparral City's cost of equity unless a significant *upward* adjustment to the cost of equity is made to account for the difference in risk.[82] However, the Commission ignored

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greater return as a result. *See* Chaves Dt. at 26-27, 29; *Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007) at 19-20, ¶¶ 33-34 (discussing Staff's implementation of the CAPM in Chaparral City's prior rate case).

[77] Decision No. 66849 at 21.

[78] Staff estimated that the cost of equity for the gas utilities was 10.4% using the CAPM, while the cost of equity for the water utilities was 9.4% – a difference of 100 basis points. *See* Direct Testimony of Joel M. Reiker, Docket No. W-01445A-02-0619 (filed July 8, 2003), at 26.

[79] *Id.* (italics original). *See also* Decision No. 66849 at 21.

[80] Decision No. 66849 at 23-24.

[81] Rigsby Dt., Sch. WAR-7, p. 1.

[82] The CAPM "quantifies the additional return required [by investors] for bearing incremental risk, and

the fact that the water and gas utility industry proxy groups have different levels of market risk and thereby implicitly rejected the CAPM, even though the Commission purported to rely on the CAPM to set the Company's return on equity. Nor did the Commission follow the Arizona Water Company decision, which did not average the cost of equity for the gas utility sample with the water utility sample.

To justify its arbitrary use of the gas industry sample in this case, the Commission asserted that two of the six water utilities had individual betas that fell within the range of the gas utilities in RUCO's sample. The same was true in the Arizona Water case. There, Philadelphia Suburban's individual beta was higher than half of the gas utilities' individual betas. Moreover, three other water utilities, American States Water, California Water Service and Connecticut Water – half of the sample group – had betas equal to three of the gas utilities.[83] The Commission's result-driven reasoning also missed the point: Neither Arizona Water nor Chaparral City have publicly traded stock and therefore have no beta. Consequently, in implementing the CAPM, the Commission assumed that if their stock were publicly traded, the stock's beta would be equal to the average of the industry sample group. It is the industry average that matters, not firm-specific betas.

The Commission recently authorized a 10.0 percent return on equity for Southwest Gas Corporation.[84] The water utility sample group has significantly more market risk than the gas utility sample group, and therefore has a significantly higher cost of equity than 10.0 percent. Yet the Commission authorized Chaparral City a return on equity of only 9.9 percent. This flies in the face of the principles that are the foundation of the CAPM, and demonstrates the arbitrary nature of the Commission's cost of equity determination in

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provides a formal risk-return relationship anchored on the basic idea that only market risk matters, as measured by beta." *Morin* at 146.

[83] Direct Testimony of Joel M. Reiker, Docket No. W-01445A-02-0619 (filed July 8, 2003), Sch. JMR-5 (water utilities) and JMR-16 (gas utilities).

[84] *Southwest Gas Co.*, Decision No. 70665 (Dec. 24, 2008) at 25-26.

this case. In Chaparral City's prior rate case, the Company specifically challenged the Commission's reliance on the CAPM and its rejection of the Risk Premium Method proposed by the Company's witness, and the Commission argued that the CAPM was theoretically sound and produced reasonable results. In this case, the Commission has apparently abandoned the CAPM or, at least, has rejected its theoretical underpinnings to support its result. This was arbitrary and capricious.

E. Other Errors and Issues

The Decision, unfortunately, raises a number of additional issues concerning the cost of equity, which were discussed at length in the Company's initial closing brief and reply closing brief on the cost of capital. Several of these errors will be briefly discussed below. Others are identified in the Company's closing briefs. The most remarkable aspect of these errors is that the position adopted by the Commission in this case conflicts with the position that was taken by Staff and approved by the Commission in previous water and wastewater utility rate cases, including Chaparral City's prior rate case. Thus, the Commission has repudiated its prior methodologies without explaining why those methods are erroneous in order to lower Chaparral City's return on equity. Yet at the same time, Staff's final position in this case – which the Commission ignored – is consistent with those previous decisions. Clearly, this was arbitrary and capricious.

1. The Use of a Geometric Average to Compute the Historic Market Risk Premium in the CAPM Was Improper

In contrast to Chaparral City and Staff, RUCO relied on geometric annual averages in his CAPM estimates instead of conceptually correct arithmetic annual averages to compute the historic market risk premium in the CAPM.[85] As explained in the Company's initial closing brief on the cost of capital, it is well established that the arithmetic mean most accurately approximates the expected future rate of return and is the

[85] Decision at 34-35.

theoretically correct method for estimating the cost of capital.[86] Attached to Mr. Bourassa's rejoinder testimony at tab 3 was an excerpt from Dr. Roger Morin's textbook on regulatory finance, which provides a detailed discussion of this issue.[87] Dr. Morin explains (citing numerous texts and authorities) that although "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."[88] While geometric averages provide a useful way to compare past performance of assets (which is why they are widely reported), they fail to capture future volatility (i.e., risk) and, as a result, understate the future return required by an investor on an investment in a risky asset.[89]

The Commission, however, ignored this evidence and the numerous authorities cited by the Company, as well as the fact that Staff has consistently relied solely on an arithmetic average in computing the historic market risk premium,[90] and instead approved the use of a geometric average. The Commission looked at the result produced – a lower historic market risk premium, and then cited testimony by Mr. Parcell that since geometric averages are reported, investors rely on them.[91] This result-driven logic, i.e., that conceptually infirm methods are acceptable simply because an investor might misuse them, conflicts with past decisions in which the Commission has rejected cost of equity estimates because Staff's methods are conceptually superior. In Chaparral City's prior rate case, for example, the Company's witness used the Risk Premium Method to estimate the cost of equity. Although the Risk Premium Method is well established and, therefore,

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[86] *E.g.*, Morin at 133-43; Richard A. Brealey, Stewart C. Myers and Franklin Allen, *Principles of Corporate Finance* 175-76 (McGraw Hill/Irwin 8th ed. 2006); *Ibbotson SBBI Valuation Edition Yearbook* 59-60 (Morningstar 2009). Copies of these authorities are attached at tab B. *See also* Bourassa Rj. at 25-26; Bourassa Rb. at 40-41.

[87] *Morin* at 133-43.

[88] *Id.* at 133.

[89] Initial Closing Brief on Cost of Capital and Rate of Return at 41-42.

[90] *See* Staff Final Sch. PMC-3; Chaves Dt. at 30.

[91] Decision at 34-35.

investors certainly use that method,[92] the Commission adopted Staff's position that the Risk Premium Method is conceptually flawed and rejected the Company's testimony and recommendation, choosing to rely instead on the CAPM.[93] Apparently, conceptually infirm methods are acceptable as long as they lower the utility's equity return.

2. The Commission Arbitrarily Ignored Current Market Risk to Lower Chaparral City's Cost of Equity Under Current Market Conditions

Staff has consistently recommended, and the Commission has consistently approved, the use of a current market risk premium in implementing the CAPM in water and wastewater utility rate cases. In Chaparral City's prior case, for example, Staff used an historic market risk premium and a current market risk premium in its CAPM estimates.[94] In this case, Staff again calculated a current market risk premium, which it used, along with an historic market risk premium calculated on the basis of an arithmetic average, to derive its 11.9 percent cost of equity estimate.[95]

RUCO, however, ignored current market risk in its CAPM estimates and relied instead on incorrectly calculated historic market risk premiums. In the Decision, the Commission agreed with RUCO, rejecting the Company's CAPM estimate using a current market risk premium,[96] while ignoring the CAPM estimate using a current market risk premium in Staff's final schedules. As shown in Staff's final schedules, Staff's current market risk premium was 12.6 percent, resulting in a CAPM estimate of 17.4 percent. Staff then averaged that equity cost estimate with its CAPM estimate using an historic

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[92] *See, e.g., Morin* at 107-131 (discussing the Risk Premium method and concluding that this method "is conceptually sound and firmly rooted in the conceptual framework of the Capital Market Theory.").

[93] Decision No. 68176 at 23, 26.

[94] *See Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007) at 19-20, ¶ 33 (discussing Staff's use of a current market risk premium in Chaparral City's prior rate case); Direct Testimony of Alejandro Ramirez, Docket No. W-02113A-04-0616 (March 22, 2005); Surrebuttal Testimony of Alejandro Ramirez, Docket No. W-02113A-04-0616 (May 5, 2005).

[95] Final Staff Sch. PMC-3.

[96] Decision at 33.

market risk premium, which was 11.2 percent, resulting in an overall CAPM estimate of 14.3 percent.[97] As explained, however, the Commission ignored Staff's final CAPM estimate in authorizing a return on equity of 9.9 percent.

The reality is that Staff's 12.6 percent current market risk premium was not particularly high. In Arizona Water Company's Eastern Group rate case, for example, Staff computed a current market risk premium of 13.1 percent in its CAPM estimate, and relied on that market risk premium in estimating a cost of equity of 9.2 percent, using the same six sample water utilities used in this case.[98] At the time of the Arizona Water Company case, the country was in the midst of a recession, and, according to Staff, interest rates had fallen to the lowest levels since the 1950s.[99] Moreover, the average beta of Staff's water utility sample group was only 0.59 at that time, indicating that investment risk for the water utility industry was very low relative to the market.[100]

As explained in the Company's initial closing brief, not only has the Commission consistently considered current market risk in estimating the cost of equity, but changes in the current market risk have had a major impact on the cost of equity, offsetting changes in interest rates and water utility betas in recent cases.[101] Further, RUCO's witness acknowledged the importance of considering current market conditions in determining the cost of equity:

> Consideration of the economic environment is necessary because trends in interest rates, present and projected levels of inflation, and the overall state of the U.S. economy determine the rate of return that investors earn on their invested funds. Each of these factors represent potential risks that must be weighed when estimating the cost of equity capital for a

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[97] Final Staff Sch. PMC-3.

[98] Direct Testimony of Joel M. Reiker, Docket No. W-01445A-02-0619 at 24, 25 (July 8, 2003).

[99] *Id.* at 5. *See also* Ex. A-22 (S&P 500 Index for Jan. 1998 to Jan. 2009).

[100] Direct Testimony of Joel M. Reiker, Docket No. W-01445A-02-0619 at 23 (July 8, 2003).

[101] Initial Closing Brief on Cost of Capital and Rate of Return at 46-47.

> regulated utility and are, most often, the same factors considered by individuals who are also investing in non-regulated entities.[102]

In light of the current volatility in the financial markets (which is comparable to the volatility that occurred during the 2002-2003 time period[103]), the failure to consider current market risk grossly distorted the CAPM result.[104]

Finally, given the Commission's consistent reliance on current market risk in estimating the cost of equity (including the use of current market risk to justify a lower cost of equity in prior cases[105]), it would be arbitrary and capricious to now ignore current market risk. As the U.S. Supreme Court has explained, "a State's decision to arbitrarily switch back and forth between methodologies in a way which required investors to bear the risk of bad investments at some times while denying them the benefit of good investments at others would raise serious constitutional questions."[106] Consequently, the Commission's use of two historic market risk premiums (one of which is conceptually wrong for the reasons given previously) without considering the impact of current market risk on investor expectations, and ignoring Staff's CAPM estimate that utilized a current market risk premium in Staff's final, post-hearing schedules, was clearly arbitrary and result-driven.

3. RUCO Improperly Use Total Returns Rather Than Income Returns in the CAPM, Lowering the Equity Cost

In contrast to Staff and Chaparral City, RUCO erroneously used the average total return on a Treasury security rather than the average income return. As shown on

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[102] Rigsby Dt. at 39.

[103] *See* Ex. A-22

[104] *See* Bourassa Supp. Rj. at 13-14.

[105] Closing Brief of Commission Staff, *Black Mountain Sewer Corp.*, Docket No. SW-02361A-05-0657(filed Aug. 21, 2006) at 24-26 (discussing Staff's use of a current market risk premium) (excerpt attached at tab A).

[106] *Duquesne Light*, 488 U.S. at 315.

Schedule WAR-7, at page 2, attached to Mr. Rigsby's direct testimony, the risk-free rate used to calculate the market risk premium was 5.8 percent. *Ibbotson* reports that the total average return on a long-term Treasury security was 5.8 percent.[107] By contrast, the average income return on a long-term Treasury security was 5.2 percent, while the average income return on an intermediate-term Treasury security (the correct input) was 4.7 percent.[108]

The reason that an average income return must be used, rather than the average total return, is quite straightforward. The CAPM is a risk premium methodology that is based on the premise that an investor expects to earn a return equal to the return on a risk-free investment plus a premium for assuming additional risk that is proportional to the security's market risk (i.e., its beta).[109] U.S. Treasuries are commonly used as a proxy for the risk-free rate because they are backed by the United States government, effectively eliminating default risk.[110] The income return is the portion of the total return that results from the bond's periodic cash flow, i.e., the interest payments. The income return provides an unbiased estimate of the riskless rate of return because an investor can hold the Treasury security to maturity and receive fixed interest payments with no capital loss or capital gain.[111] If the total return on a Treasury security is used instead, additional risk is injected into the CAPM estimate, which is inconsistent with treating the security as a riskless asset. As explained by *Ibbotson*:

> 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

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[107] *See* Bourassa Supp. Rj. at tab 4.

[108] *Id.*

[109] *See Chaparral City Water Co. v. Ariz. Corp. Comm'n*, No. 1 CA-CC 05-002 (Feb. 13, 2007) at 19-20, ¶¶ 33-34 (discussing Staff's implementation of the CAPM in Chaparral City's prior rate case); Chaves Dt. at 26-27; Bourassa Dt. at 33-34; Rigsby Dt. at 29-30.

[110] *Morin* at 152-53. *See also* Rigsby Dt. at 31; Chaves Dt. at 28.

[111] Bourassa Supp. Rj. at 19.

> 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.[112]

As a consequence of this error, together with RUCO's use of a geometric average to calculate the historic market risk premium and its failure to consider current market risk, RUCO's CAPM estimate dramatically understated the cost of equity for the water utility sample. The Commission, however, accepted RUCO's CAPM estimates or, more precisely, rejected every argument made by the Company in its closing briefs in order to reach its desired equity return. In the process the Commision ignored the evidence in the record, the authorities cited by the Company, and the fact that its Staff's own estimate of the cost of equity – 11.9 percent – was higher than the Company's requested return of 11.5 percent. This result-driven decision-making was unreasonable and unlawful.

V. FIFTH BASIS FOR REHEARING: THE RATES DO NOT PRODUCE THE COMMISSION'S AUTHORIZED REVENUE REQUIREMENT

On September 23, 2009, the Administrative Law Judge submitted a recommended opinion and order ("ROO") for the Commission's consideration. The ROO recommended that the Company be granted an increase in annual revenue of $1,896,281. At the Open Meeting, the Commission adopted two amendments sponsored by Commissioner Pierce that collectively reduced the Company's annual revenue increase to $1,764,371. The

[112] *Ibbotson* at 58 (copy attached at tab B).

Commission then approved the ROO as amended. Because of the amendments to the ROO, new rates had to be calculated based on the revised revenue increase. As a result, the Decision was not signed and filed in the docket until October 21, 2009.

After the Decision was filed, the Company discovered that the new rates and charges do not produce the authorized revenue increase and required rate of return. Instead, the rates produced revenues that are $490,041 (28 percent) less than the increase authorized in the Decision, $1,764,371, which the Commission determined to be just and reasonable. This revenue deficiency is calculated as follows:

Test year adjusted revenue	$7,505,010
Authorized increase in revenue per Decision	1,764,371
Total revenue requirement	$9,269,381
Revenue produced by rates in Decision	8,779,340
Revenue deficiency	**$490,041**

Notably, there is no dispute concerning this error, which was identified by a Staff employee following his discussions with Mr. Bourassa.[113]

It is axiomatic that the rates authorized by the Commission must be sufficient to produce the authorized rate of return on the utility's fair value rate base. For example, in *Consolidated Water Utilities, Ltd. v. Ariz. Corp. Comm'n*, 178 Ariz. 478, 484-85, 875 P.2d 137, 143-44 (App. 1994), the Commission authorized rates that produced annual revenue that was 28 percent less than the revenue necessary to produce the required operating income and authorized rate of return on the utility's fair value rate base. The court explained that "[a] shortfall in revenue mean a corresponding shortfall in income," which "goes directly to the Company's bottom line" and results in rates that are

[113] *See* materials attached at tab C. The Company previously advised Staff that its rates do not produce the revenue requirement set forth in Staff's direct filing, and attempted to work with Staff to correct this problem. *See* Bourassa Rj. at 2. Apparently, the problems with Staff's rates were never addressed.

"unreasonable and unlawful." *Id.* at 485, 875 P.2d at 144 (quotation marks omitted). The rates authorized by the Commission in the Decision likewise produce a 28 percent shortfall in revenue – nearly $500,000 – and for the same reason, are unreasonable and unlawful.

Although the Company has moved for an order correcting this error, at the time of this filing corrected rates have not been approved. A procedural order was docketed on November 5, 2009, and was received by the Company's counsel on November 9, 2009, indicating that the Commission intends to investigate how the computational error occurred. Consequently, it uncertain whether or when corrected rates may be authorized. In the meantime, until this error is corrected, the Decision is unlawful.

VI. CONCLUSION AND RELIEF REQUESTED

For the foregoing reasons, Chaparral City requests that rehearing be granted on all of the errors discussed above, and that the Commission issue an order authorizing adjusted rates to be implemented that correct such errors, together with a surcharge designed to allow the Company to recover the revenue deficiency that it has experienced since October 15, 2009, when the rates authorized by the Decision were made effective, together with interest thereon at the rate of 10 percent per annum.

Respectfully submitted this 10th day of November, 2009.

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BEFORE THE ARIZONA CORPORATION C

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COMMISSIONERS

JEFF HATCH-MILLER - Chairman
WILLIAM A. MUNDELL
MIKE GLEASON
KRISTIN K. MAYES
BARRY WONG

IN THE MATTER OF THE APPLICATION OF BLACK MOUNTAIN SEWER CORPORATION, AN ARIZONA CORPORATION, FOR A DETERMINATION OF THE FAIR VALUE OF ITS UTILITY PLANT AND PROPERTY AND FOR INCREASES IN ITS RATES AND CHARGES FOR UTILITY SERVICE BASED THEREON.	DOCKET NO. SW-02361A-05-0657 **CLOSING BRIEF OF COMMISSION STAFF**

Black Mountain Sewer Corporation ("Black Mountain Sewer" or the "Company") filed an application for a rate increase in the above captioned docket on September 16, 2005. The Company's current rates were authorized in Decision No. 59944, dated December 26, 1996.[1] In the test year ending December 31, 2004, the Company provided wastewater service to 1,923 customers in the Town of Carefree, in unincorporated portions of Maricopa County and in portions of the City of Scottsdale. Most of the Company's customers reside in the Town of Carefree.[2] On October 23, 2001, the Company changed its name from Boulders Carefree Sewer Corporation to Black Mountain Sewer Corporation.

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[1] Exhibit S-9 at 3.
[2] *Id.* at 2.

and shareholders. As a result, Staff recommends an increase of $4,800 over the Company's initial request. Accordingly, Staff recommends $124,800 in total for rate case expenses.

IV. COST OF CAPITAL

Staff recommends a capital structure of 100% equity and 0% debt.[145] The Company and Staff agree on capital structure. Staff's final recommended ROE is 9.6%. The Company's recommended ROE is 11%.[146]

Staff's recommendations use market-based financial models that have been accepted by this Commission for many years. Staff uses both historical and forecasted inputs. All of Staff's inputs are factors which investors can reasonably be expected to consider in determining their expected rate of return. The models are also widely accepted in the financial industry and by most state commissions in setting just and reasonable rates of return.

The Company's recommendations are based on two different constant growth DCF models and one multi-stage DCF model.[147] The Company then selects its recommended ROE with the range of results by comparing them to two different "approaches."

These "approaches" rely heavily on non-market based data and forecasts. The approaches are the "risk premium approach" and the "comparable earnings approach." The Company requests an increase in ROE to compensate for the Company's small firm size and individual business risk. The Commission has repeatedly rejected these approaches, and risk premiums for small firm size and individual business risk.

A. The Commission Should Adopt Staff's Recommended ROE Of 9.6% Because It Is Based On Proven Financial Models And On Balanced And Reasonable Inputs.

To determine the required rate of return, Staff used the following financial models: (1) the constant growth discounted cash flow ("DCF") model (9.4%); (2) the multi-stage DCF model (9.8%);

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[145] But see Staff Brief Schedule PMC-2. Staff calculated a downward adjustment of 50 basis points for financial risk. Staff used the Hamada equation to quantify financial risk due to the Company's capital structure. Staff did not recommend the downward adjustment because the Company's capital structure is reasonable. Exhibit S-5 at 2, ll. 11-17. The Company has two inter-company loans that are not included in the capital structure pursuant to Decision Nos. 59944 and 60240. Staff recognizes that investors would view the loans as debt in determining capital structure. Exhibit S-4 at 6, l. 21 - 7, l. 7. See also Staff Brief Schedule PMC-3 comparing the Company's actual capital structure with the average for Staff's proxy water companies.

[146] Staff Brief Schedule PMC-1. Note that the overall rate of return ("ROR") is the same as the ROE for Staff and the Company because of the capital structure.

[147] Exhibit A-1 at 40, l. 8-18.

and (3) the capital asset pricing model ("CAPM"). Staff used two CAPM estimates, one using an historical market risk premium (10.1%), and one using a current market risk premium (8.9%). Staff first calculated an average for the DCF results (9.6%); then calculated an average for the CAPM results (9.5%); and finally calculated the average for both models (9.6%).[148] Staff's recommended ROE is the average for both models.

For the constant growth DCF, Staff calculated the growth factor by averaging the results of six different methods for calculating it.[149] The growth factor is the most frequently disputed input in the model. Staff chose a balanced methodology that "gives equal weight to historical and projected earnings per share ("EPS"), dividends per share ("DPS"), and sustainable growth."[150] Staff witness Mr. Pedro Chaves testified that his choice of inputs "avoids the skewing that can occur by a less balanced analysis such as that prepared by the Company's witness."[151]

Mr. Bourassa criticized Staff's choice of inputs because "individual DCF results using these growth rates...produce indicated equity costs below the cost of debt."[152] Apparently, Mr. Bourassa expects Staff to calculate six different costs of equity using each method for calculating growth.[153] Then, if any result is below the cost of debt, Mr. Bourassa expects Staff to not use that particular input.[154] Mr. Chaves testified that if the Commission adopted Mr. Bourassa's approach, it should also exclude "the highest growth components to maintain a balanced outcome."[155] More importantly, Mr. Chaves testified that it is unreasonable to assume investors ignore low outcomes and accept high outcomes.[156]

Mr. Bourassa also criticizes Staff's growth factor in its multi-stage DCF model. Although Mr. Bourassa uses the same long term growth rate (6.8%), he criticized Staff's short term growth rate because it was lower than its constant growth DCF growth factor.[157] Staff calculated its short term growth rate using projections of dividends for each of its sample companies.[158] Mr. Bourassa's

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[148] See Staff Brief Schedule PMC-2.
[149] Exhibit S-4 at 16, ll. 10-15.
[150] Exhibit S-5 at 4, ll. 14-17.
[151] *Id.*
[152] Exhibit A-2 at 57, ll. 1-2.
[153] Exhibit S-5 at 5, ll. 4-12.
[154] Exhibit A-2 at 57, ll. 3-4.
[155] Exhibit S-5 at 5, ll. 12-17.
[156] *Id.*, ll. 10-12.
[157] Exhibit A-2 at 67, ll. 7-13.
[158] Exhibit S-4 at 25, ll. 13-17.

criticism is obviously result driven. Mr. Bourassa explains that "while financial models are useful, they cannot be used [mechanically or] blindly."[159]

However, it is Mr. Bourassa, and not Mr. Chaves, that uses professional judgment inappropriately. Mr. Bourassa uses a shot gun approach. He analyzes inputs by looking at the results they produce when used in financial models. He then selectively rejects and accepts inputs based on his initial iteration.

Staff chooses its inputs by first identifying available market data. It then analyzes whether investors can be expected to rely on the available data. Staff inputs are pre-selected as specified from a balanced methodology. Staff does not use results to determine inputs. If inputs are selected appropriately, the results speak for themselves.

Finally, Mr. Bourassa criticizes Staff's CAPM results because (1) its risk-free rate uses spot prices for five-, seven- and ten-year intermediate U.S. Treasury securities;[160] (2) its results don't increase in lock step with increases in interest rates;[161] and (3) its current market risk premium ("MRP") is unstable.[162] The Commission has repeatedly affirmed Staff's choice of inputs for both its DCF and CAPM models.[163]

Staff also believes that the record in this case does not support a conclusion that its current MRP is unstable. The MRP moves with the market which can be volatile. Market volatility does not make the CAPM model unstable or subject to manipulation. The evidence in this case also shows that Staff's overall results for its current MRP CAPM model did not change from its direct testimony to its surrebuttal testimony.

In Staff's direct testimony, its risk premium was 5.7%,[164] and in its surrebuttal testimony, it was 5.4%.[165] However, its overall results were 8.9% in both its direct and surrebuttal testimony

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[159] *Id.* at 54, ll. 20-21.

[160] Exhibit A-2 at 73, l. 12 - 74, l. 2.

[161] Exhibit A-3 at 26, ll. 14-22.

[162] Exhibit A-2 at 75, ll. 11-15.

[163] See e.g. *In the Matter of the Application of Southwest Gas*, Docket No. G-01551A-04-0876, Decision No. 68487 (Feb. 23, 2006); *In the Matter of the Application of Chaparral City Water Company*, Docket W-02113A-04-0616, Decision No. 68176 (Sep. 30, 2005); *In the Matter of the Application of Arizona Water* Company, Docket No. W-01445A-02-0619, Decision No. 66849 (Mar. 19, 2004); In *the Matter of the Application of Rio Rico Utilities, Inc.*, Docket No. WS-02676A-03-0434, Decision No. 67279 (Oct. 5, 2004); *In the Matter of the Application of Bella Vista Water Co., Inc.*, Docket No. W-02465A-01-0776, Decision No. 65350 (Nov. 1, 2002).

[164] See Exhibit S-6 (Revised Direct Testimony Schedule PMC-2).

[165] See Staff Brief Schedule PMC-2.

because the risk-free rate changed during the time interval.[166] Mr. Chaves also testified that the MRP varies with the market which varies over time.[167] He explained that variability is expected because the CAPM model is a market-based model.[168] Mr. Chaves testified that Staff uses both an historical MRP and a current MRP to mitigate the market's volatility.[169]

The Company introduced evidence which it implies demonstrates that the CAPM model is subject to manipulation.[170] In Company Exhibit A-20, the Company selected a handful of dates looking backward in time.[171] The Company then calculated the current MRP that would have resulted on those days.[172]

Mr. Chaves testified that it is possible to select dates looking backward in time to support a variety of positions.[173] Mr. Chaves further testified that Staff selects the dates for its inputs before the date occurs. Staff's process is to select the most recent date it can before *finalizing* its testimony.[174] Therefore, Staff's process does not manipulate the CAPM model to achieve a specific result.

Next, Mr. Bourassa claims that rising interest rates do not affect Staff's cost of capital analysis.[175] Mr. Bourassa ignores the fact that the CAPM model has three inputs which do not necessarily move in the same direction at the same time. Mr. Chaves specifically testified that "there is a relationship between interest rates and the cost of equity capital."[176] He also explained that the cost of equity capital will move in the same direction as interest rates if all other variables remain the same.[177]

He explained that, even though interest rates increased between the time of his Direct Testimony and his Surrebuttal Testimony, Staff's current MRP declined. The decline in current MRP offset the increase in interest rates.[178] Mr. Chaves made the same comparison between his testimony

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166 See footnotes 166 and 167 above.
167 Tr. 716, ll. 7-23.
168 *Id.*
169 *Id.* 703, l. 23 - 704, l. 1; see also *Id.* 707, ll. 9-15.
170 *Id.* 705, l. 12 - 707, l. 20.
171 *Id.* 717, ll. 14-19.
172 Exhibit A-20.
173 Tr. 717, ll. 16-19.
174 *Id.* 717, ll. 3-10; and at 717, l. 22 - 719, l. 1.
175 Exhibit A-3 at 26, ll. 21-22.
176 Tr. 684, ll. 10-16.
177 *Id.* at ll. 17-19.
178 *Id.* at 719, ll. 5 to 722, ll. 18.

in this case and Staff's testimony in Company Exhibit A-21.[179] Although interest rates increased from 3.3% to 4.7%, the current MRP declined from 13.1% to 5.7%.[180]

B. The Commission Should Reject The Company's Recommended ROE Of 11% Because It Is Based On "Approaches" And Choices Of Inputs That Artificially Inflate Required Return, And Include Premiums For Which Investors May Eliminate Through Diversification.

Mr. Bourassa testified that his recommended ROE "is based on cost of equity estimates using constant growth and multi-stage growth discounted cash flow ("DCF") and *is confirmed by a risk premium analysis, [a comparable earnings analysis], and my review of the economic conditions expected to prevail during the period in which new rates will be in effect.*"[181] Mr. Bourassa testifies that his DCF results must be confirmed to comply with the *Bluefield Water Works*[182] and *Hope Natural Gas*[183] decisions.[184] The Company also argues that Black Mountain Sewer's small size and individual business risk should increase its ROE.[185]

The Company's DCF results are identical to Staff's DCF results. Mr. Bourassa corrected the results in his Rebuttal Testimony at the hearing. With the corrections, the average midpoint of his three DCF models is 9.6%.[186] The Company's results could be even lower. Mr. Bourassa's DCF model using EPS excluded one of his sample companies.

He excluded Middlesex because the "indicated cost of equity [is] only 40 basis points *above* [the] projected cost of Baa investment grade bonds."[187] Mr. Chaves testified that Mr. Bourassa's reason to exclude Middlesex was insufficient.[188] He calculated the average indicated cost of equity ("COE") including Middlesex.[189] Without Middlesex the average was 9.7%, but with Middlesex, it is 9.3%. With Middlesex, the Company's overall DCF results drop from 9.6% to 9.5%.

In addition to the exclusion of Middlesex, the Company's results could have been lower if it chose more balanced inputs. The Company only used forecasted EPS growth estimates. It excluded

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[179] *Id.* at 722, ll. 2-11.
[180] Compare Exhibit A-21, Schedule JMR-7 to Exhibit No. S-6.
[181] Exhibit A-1 at 13, ll. 18-23.
[182] *Bluefield Water Works and Improvement Co. v. Public Service Commission of West Virginia*, 262 U.S. 679 (1923).
[183] *Federal Power Commission v. Hope Natural Gas*, 320 U.S. 591 (1944).
[184] Exhibit No. A-1 at 31, ll. 1-20 (emphasis added).
[185] *Id.* at 28, ll. 3-22.
[186] See Tr, 230, ll. 22-25; Tr. 231, ll. 106; Tr. 157, ll. 7-21; Tr. 144, ll. 16 - 145, l. 2; and Tr. 144, ll. 1-15.
[187] Exhibit A-3, Schedule D-4.9, footnote (b) (emphasis added).
[188] Tr. 712, ll. 19 to 713, ll. 17.
[189] Exhibit S-8.

historical DPS, historical EPS, and forecasted DPS. The Commission has specifically rejected the Company's choice of inputs and accepted Staff's choices.[190]

Mr. Bourassa uses his risk premium approach, comparable earnings approach, and the Company's small size to select his final recommended ROE. His DCF results ranged from 8.5% to 11.0%.[191] He selected the highest ROE in that range. The Commission has consistently rejected all three approaches to inflate ROE.[192] In rejecting the risk premium and comparable earnings approaches, the Commission recently held that Staff's methodology of determining ROE does not violate the *Bluefield Water Works* or the *Hope Natural Gas* decisions.[193]

RESPECTFULLY Submitted this 21st day of August 2006,

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[190] See footnote 165, *supra.*
[191] Exhibit No. A-3 at 22, ll. 11 to 23, ll. 2.
[192] See footnote 165, *supra.*
[193] *In the Matter of the Application of Southwest Gas*, Docket No. G-01551A-04-0876, Decision No. 68487 (Feb. 23, 2006).

B

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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.

TABLE 4A-1
GEOMETRIC VS. ARITHMETIC RETURNS

	Stock A	Stock B
1996	50.0%	11.61%
1997	−54.7%	11.61%
1998	98.5%	11.61%
1999	42.2%	11.61%
2000	−32.3%	11.61%
2001	−39.2%	11.61%
2002	153.2%	11.61%
2003	−10.0%	11.61%
2004	38.9%	11.61%
2005	20.0%	11.61%
Standard Deviation	64.9%	0.0%
Arithmetic Mean	26.7%	11.6%
Geometric Mean	11.6%	11.6%

Theory

The geometric mean measures the magnitude of the returns, as the investor starts with one portfolio and ends with another. It does not measure the variability of the journey, as does the arithmetic mean. The geometric mean is backward looking. There is no difference in the geometric mean of two stocks or portfolios, one of which is highly volatile and the other of which is absolutely stable. The arithmetic mean, on the other hand, is forward-looking in that it does impound the volatility of the stocks.

To illustrate, Table 4A-1 shows the historical returns of two stocks, the first one is highly volatile with a standard deviation of returns of 65% while the second one has a zero standard deviation. It makes no sense intuitively that the geometric mean is the correct measure of return, one that implies that both stocks are equally risky since they have the same geometric mean. No rational investor would consider the first stock equally as risky as the second stock. Every financial model to calculate the cost of capital recognizes that investors are risk-averse and avoid risk unless they are adequately compensated for undertaking it. It is more consistent to use the mean that fully impounds risk (arithmetic mean) than the one from which risk has been removed (geometric mean). In short, the arithmetic mean recognizes the uncertainty in the stock market while the geometric mean removes the uncertainty by smoothing over annual differences.

Empirical Evidence

If both the geometric and arithmetic mean returns over the 1926–2004 data are regressed against the standard deviation of returns for the firms in the

deciles, the arithmetic mean outperforms the geometric mean in this statistical regression. Moreover, the constant of arithmetic mean regression matches the average Treasury bond rate and therefore makes economic sense while the constant for the geometric mean matches nothing in particular. This is simply because the geometric mean is stripped of volatility information and, as a result, does a poor job of forecasting returns based on volatility.

The following illustration is frequently invoked in defense of the geometric mean. Suppose that a stock's performance over a two-year period is representative of the probability distribution, doubling in one year ($r_1 = 100\%$) and halving in the next ($r_2 = -50\%$). The stock's price ends up exactly where it started, and the geometric average annual return over the two-year period, r_g, is zero:

$$\begin{aligned} 1 + r_g &= [(1 + r_1)(1 + r_2)]^{1/2} \\ &= [(1 + 1)(1 - .50)]^{1/2} = 1 \\ r_g &= 0 \end{aligned}$$

confirming that a zero year-by-year return would have replicated the total return earned on the stock. The expected annual future rate of return on the stock is not zero, however. It is the arithmetic average of 100% and −50%, (100 − 50)/2 = 25%. There are two equally likely outcomes per dollar invested: either a gain of $1 when r = 100% or a loss of $0.50 when r = −50%. The expected profit is ($1 − $.50)/2 = $.25 for a 25% expected rate of return. The profit in the good year more than offsets the loss in the bad year, despite the fact that the geometric return is zero. The arithmetic average return thus provides the best guide to expected future returns.

What Academics Have to Say

Bodie, Kane, and Marcus (2005) cite:

> Which is the superior measure of investment performance, the arithmetic average or the geometric average? The geometric average has considerable appeal because it represents the constant rate of return we would have needed to earn in each year to match actual performance over some past investment period. It is an excellent measure of *past* performance. However, if our focus is on future performance, then the arithmetic average is the statistic of interest because it is an unbiased estimate of the portfolio's expected future return (assuming, of course, that the expected return does not change over time). In contrast, because the geometric return over a sample period is always less than the arithmetic mean,

> it constitutes a downward-biased estimator of the stock's expected return in any future year.
>
> Again, the arithmetic average is the better guide to future performance.

Another way of stating the Bodie, Kane, Marcus argument in favor of the arithmetic mean is that it is the best estimate of the future value of the return distribution because it represents the expected value of the distribution. It is most useful for determining the central tendency of a distribution at a particular time, that is, for cross-sectional analysis. The geometric mean, on the other hand, is best suited for measuring an investment's compound rate of return over time, that is, for time-series analysis. This is the same argument made by Ibbotson Associates (2005) where it is shown, using probability theory, that future terminal wealth is given by compounding the arithmetic mean, and not the geometric mean. In other words, if we accept the past as prologue, the best estimate of a future year's return based on a random distribution of the prior years' returns is the arithmetic average. Statistically, it is our best guess for the holding-period return in a given year.

Brigham and Ehrhardt (2005) in their widely used corporate finance text point out that the arithmetic average is more consistent with CAPM theory, as one of its key underpinning assumptions is that investors are supposed to focus, in their portfolio decisions, upon returns in the next period and the standard deviation of this return. To the extent that this next period is one year, the preference for the arithmetic mean, which derives from a set of single one year period returns, follows. It is also noteworthy that one of the crucial assumptions inherent in the CAPM is that investors are single-period expected utility of terminal wealth maximizers who choose among alternative portfolios on the basis of each portfolio's expected return and standard deviation.

Brealey, Myers, and Allen (2006) in their leading graduate textbook in corporate finance opt strongly for the arithmetic mean. The authors illustrate the distinction between arithmetic and geometric averages and conclude that arithmetic averages are appropriate when estimating the cost of capital:

> 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.
>
> 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 $1/3(-10+10+30) = +10$ 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:

$$PV = \frac{110}{1.10} = \$100$$

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 average compound annual return on Big Oil stock would be

$$(.9 \times 1.1 \times 1.3)^{1/3} - 1 = .088, \text{ or } 8.8\%$$

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 (geometric averages).

(Richard A. Brealey, Stewart C. Myers, and Paul Allen, *Principles of Corporate Finance*, 8th Edition, Irwin McGraw-Hill, 2006, page 156–7.)

The widely cited Ibbotson Associates publication also contains a detailed and rigorous discussion of the impropriety of using geometric averages in estimating the cost of capital.[12]

[12] Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2005 Yearbook, Valuation Edition*, page 75.

> 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, since it represents the compound average return.
>
> The argument for using the arithmetic average is quite straightforward. In looking at projected cash flows, the equity risk premium that should be employed is the equity risk premium that is expected to actually be incurred over the future time periods.
>
> The best estimate of the expected value of a variable that has behaved randomly in the past is the average (or arithmetic mean) of its past values.

In their widely publicized research on the market risk premium, Dimson, Marsh and Staunton (2002) state

> The arithmetic mean of a sequence of different returns is always larger than the geometric mean. To see this, consider equally likely returns of +25 and −20 percent. Their arithmetic mean is 2½ percent, since (25 − 20)/2 = 2½. Their geometric mean is zero, since (1 + 25/100) × (1 − 20/100) − 1 = 0. But which mean is the right one for discounting risky expected future cash flows? For forward-looking decisions, the arithmetic mean is the appropriate measure.
>
> To verify that the arithmetic mean is the correct choice, we can use the 2½ percent required return to value the investment we just described. A $1 stake would offer equal probabilities of receiving back $1.25 or $0.80. To value this, we discount the cash flows at the arithmetic mean rate of 2½ percent. The present values are respectively $1.25/1.015 = $1.22 and $0.80/1.025 = $0.78, each with equal probability, so the value is $1.22 × ½ + $0.80 × ½ = $1.00. If there were a sequence of equally likely returns of +25 and −20 percent, the geometric mean return will eventually converge on zero. The 2½ percent forward-looking arithmetic mean is required to compensate for the year-to-year volatility of returns.

Lastly, on the practical side, Bruner, Eades, Harris, and Higgins (1998) found that 71% of the texts and tradebooks in their extensive survey of practice supported use of an arithmetic mean for estimation of the cost of equity.

Mean Reversion Argument

Some academics have argued that if stock returns were expected to revert to a trend, this would suggest the use of a geometric mean since the geometric mean is, by definition, an estimate of a smoothed long-run trend increment. These same academics have argued that the historical estimate of the market risk premium (''MRP'') is upward-biased by the buoyant performance of the stock market prior to 2002, and because of the extraordinary and unusually high realized MRPs in those years, investors expect a return to lower MRPs in the future, bringing the average MPR to a more ''normal'' level.

The presence or absence of mean reversion is an empirical issue. The empirical findings are weak and highly contradictory; the empirical evidence is inconclusive and unconvincing, certainly not enough to support the ''mean reversion'' hypothesis. The weight of the empirical evidence on this issue is that the more sophisticated tests of mean reversion in the MRP demonstrate that the realized MRP over the last 75 years or so was almost perfectly free of mean reversion, and had no statistically identifiable time trend. It is also noteworthy that most of these studies were performed prior to the stock market's debacle in 2000–2002, years of extraordinary and unusually low realized MRPs. The stock market's dismal performance of 2000–2002 has certainly taken the wind out of the mean reversion school's sails.

An examination of historical MRPs reveals that the MRP is random with no observable pattern. To the extent that the estimated historical equity risk premium follows what is known in statistics as a random walk, one should expect the equity risk premium to remain at its historical mean. Therefore, the best estimate of the future risk premium is the historical mean.

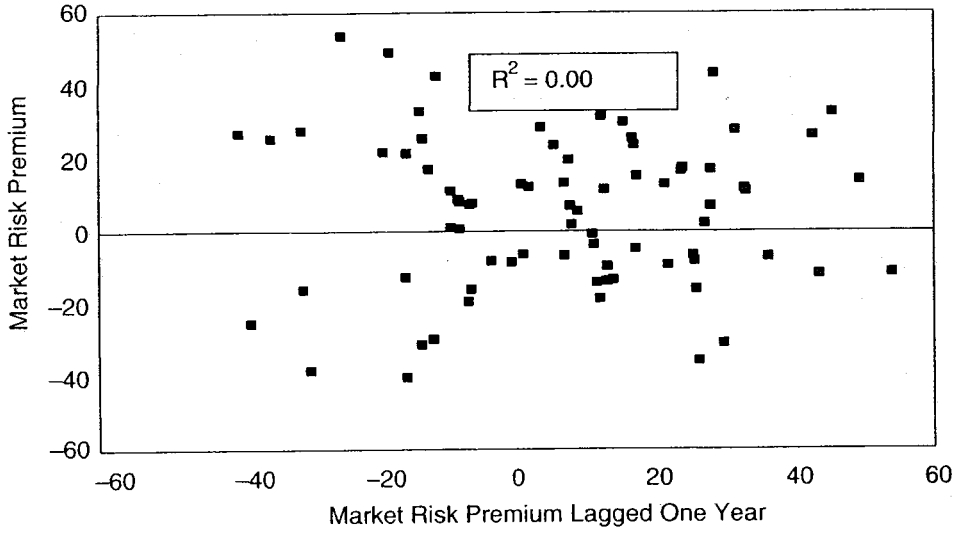
Ibbotson Associates (2005) find no evidence that the market price of risk or the amount of risk in common stocks has changed over time:

> Our own empirical evidence suggests that the yearly difference between the stock market total return and the U.S. Treasury bond income return in any particular year is random . . . there is no discernable pattern in the realized equity risk premium. (Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2005 Yearbook, Valuation Edition,* pages 74–75)

In statistical parlance, there is no significant serial correlation in successive annual market risk premiums, that is, no trend. Ibbotson Associates go on to state that it is reasonable to assume that these quantities will remain stable in the future (*Id.*):

> The best estimate of the expected value of a variable that has behaved randomly in the past is the average (or arithmetic mean)

FIGURE 4A-1
MARKET RISK PREMIUM 1926–2004
Year-to-Year Correlation



of its past values. (Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2004 Yearbook, Valuation Edition*, page 75)

Nowhere is it suggested by Ibbotson Associates that the market risk premium has declined over time.

Because there is little evidence that the MRP has changed over time, it is reasonable to assume that these quantities will remain stable in the future. Figure 4A-1 shows the relationship, or the lack of relationship, between year-to-year MRPs reported in the Ibbotson Associates Valuation Yearbook, 2005 edition, for the 1926–2004 period. The relationship is virtually absent, as indicated by the low R^2 of zero between successive MRPs. In other words, there is no history in successive MRPs as indicated by the zero serial correlation coefficient.

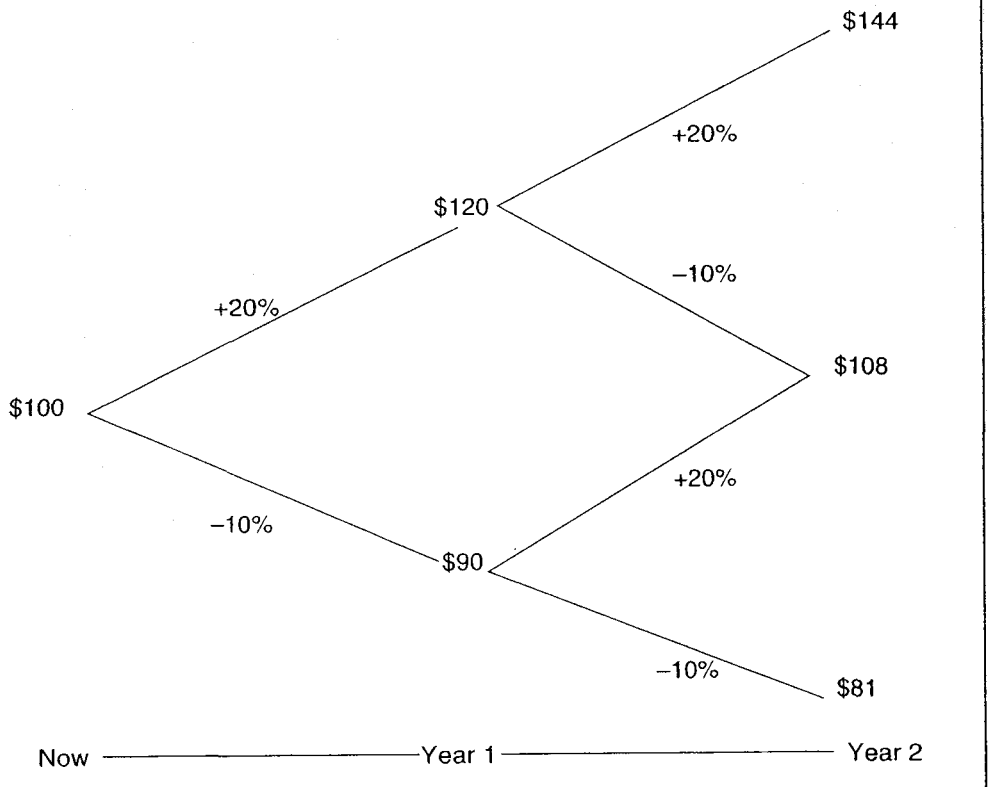
In short, the determination of the cost of capital with the CAPM requires an unbiased estimate of the expected annual return. The expected arithmetic return provides the appropriate measure for this purpose.

Formal Demonstration

This section shows why arithmetic rather than geometric means should be used for forecasting, discounting, and estimating the cost of capital.[13] By

[13] This section is adapted from a similar treatments and demonstration in Brealey, Myers, and Allen (2006) and Ibbotson Associates (2005).

FIGURE 4A-2
POSSIBLE STOCK PRICES



definition, the cost of equity capital is the annual discount rate that equates the discounted value of expected future cash flows (from dividends and the sale of the stock at the end of the investor's investment horizon) to the current market price of a share in the firm. The discount rate that equates the discounted value of future expected dividends and the end of period expected stock price to the current stock price is a prospective arithmetic, rather than a prospective geometric, mean rate of return. Since future dividends and stock prices cannot be predicted with certainty, the "expected" annual rate of return that investors require is an average "target" percentage rate around which the actual, year-by-year returns will vary. This target rate is, in effect, an arithmetic average.

A numerical illustration will clarify this important point. Consider a non-dividend paying stock trading for $100 which has, in every year, an equal chance of appreciating by 20% or declining by 10%. Thus, after one year, there is an equal chance that the stock's price will be $120 and an equal chance the price will be $90. Figure 4A-2 presents all possible eventualities after two periods have elapsed (the rates of return are presented at the end of the lines in the diagram).

The possible stock prices are shown in the following table.

TABLE 4A-2
STOCK PRICES AFTER TWO PERIODS

Price	Chance
$144	1 chance in 4
$108	2 chances in 4
$ 81	1 chance in 4

The expected future stock price after two periods is then:

$$1/4\ (\$144) + 2/4\ (\$108) + 1/4\ (\$81) = \$110.25$$

The cost of equity capital is calculated as the discount rate that equates the present value of the future expected cash flows to the current stock price. In the present simple example, the only cash flow is the gain from selling the stock after two periods have elapsed. Thus, using the expected stock price of $110.25 calculated above, the expected rate of return is that r, which solves the following equation:

$$\text{Current Stock Price} = \frac{\text{Expected Stock Price}}{(1 + r)^2}$$

The factor $(1 + r)^2$ discounts the expected stock price to the present. Substituting the numerical values, we have:

$$\$100 = \frac{\$110.25}{(1+r)^2}$$

$$r = 5\%$$

Thus, the cost of equity capital is 5%. This 5% cost of equity capital is equal to the prospective arithmetic mean rate of return, which is the probability-weighted average single period rate of return on equity. Since in every period there is an equal chance that the stock's return will be 20% or -10%, the probability-weighted average is:

$$1/2\ (20\%) + 1/2\ (-10\%) = 5\%$$

However, the 5% cost of equity capital is not equal to the prospective geometric mean rate of return, which is a probability-weighted average of the possible compounded rates of return over the two periods. Now consider the prospective geometric mean rate of return. Table 4A-3 shows the possible compounded rates of return over two periods, and the probability of each.

Thus, the prospective geometric mean rate of return is:

$$1/4\ (20\%) + 2/4\ (3.92\%) + 1/4\ (-10\%) = 4.46\%$$

TABLE 4A-3
STOCK PRICES AND RETURNS AFTER TWO PERIODS

Price	Chance	Compounded Return
$144	1 chance in 4	20.00%
$108	2 chances in 4	3.92%
$ 81	1 chance in 4	−10.00%

This return is not equal to the 5% cost of equity capital.

The example can easily be extended to include the case of a dividend-paying company and will reach the same conclusion: the implied discount rate calculated in the DCF model is an expected arithmetic rather than an expected geometric mean rate of return.

The foregoing analysis shows that it is erroneous to use a prospective multi-year geometric mean rate of return as a "target" rate of return for each year of the period. If, for example, investors currently require an expected future rate of return on an investment of 13% each year, then 13% is the appropriate annual rate of return on equity for ratemaking purposes. Consequently, in using a risk premium approach for the purposes of rate of return regulation, the single-year annual required rate of return should be estimated using arithmetic mean risk premiums.

It should be pointed out that the use of the arithmetic mean does not imply an investment holding period of one year. Rather, it is premised on the uncertainty with respect to each year's return during the holding period, however many years that may be. When computing the arithmetic average of historic annual returns in order to calculate the average return (expected value of the return), every achieved return outcome is one possible future outcome for each year the security will be held. Each historic return has an equal probability of occurring during each year of the holding period. The resulting expected value of the risk premium is the arithmetic average of all of the past premiums considered, regardless of the length of the expected holding period.

PRINCIPLES of CORPORATE FINANCE

NINTH EDITION

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CHAPTER EIGHT

INTRODUCTION TO RISK, RETURN, AND THE OPPORTUNITY COST OF CAPITAL

WE HAVE MANAGED to go through seven chapters without directly addressing the problem of risk, but now the jig is up. We can no longer be satisfied with vague statements like "The opportunity cost of capital depends on the risk of the project." We need to know how risk is defined, what the links are between risk and the opportunity cost of capital, and how the financial manager can cope with risk in practical situations.

In this chapter we concentrate on the first of these issues and leave the other two to Chapters 9 and 10. We start by summarizing more than 100 years of evidence on rates of return in capital markets. Then we take a first look at investment risks and show how they can be reduced by portfolio diversification. We introduce you to beta, the standard risk measure for individual securities.

The themes of this chapter, then, are portfolio risk, security risk, and diversification. For the most part, we take the view of the individual investor. But at the end of the chapter we turn the problem around and ask whether diversification makes sense as a corporate objective.

8.1 OVER A CENTURY OF CAPITAL MARKET HISTORY IN ONE EASY LESSON

Financial analysts are blessed with an enormous quantity of data. There are comprehensive databases of the prices of U.S. stocks, bonds, options, commodities, as well as huge amounts of data for securities in other countries. We will focus on a

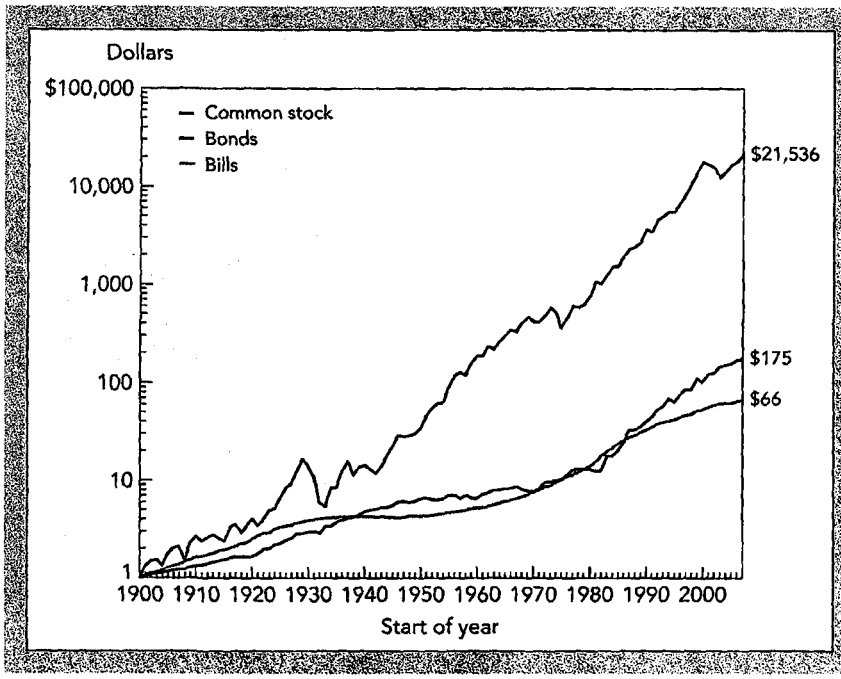

FIGURE 8.1
How an investment of $1 at the start of 1900 would have grown, assuming reinvestment of all dividend and interest payments.
Source: E. Dimson, P. R. Marsh, and M. Staunton, *Triumph of the Optimists: 101 Years of Investment Returns* (Princeton, NJ: Princeton University Press, 2002). © 2002 Reprinted by permission of Princeton University Press with updates provided by the authors.

study by Dimson, Marsh, and Staunton that measures the historical performance of three portfolios of U.S. securities:[1]

1. A portfolio of Treasury bills, that is, U.S. government debt securities maturing in less than one year.[2]
2. A portfolio of U.S. government bonds.
3. A portfolio of U.S. common stocks.

These investments offer different degrees of risk. Treasury bills are about as safe an investment as you can make. There is no risk of default, and their short maturity means that the prices of Treasury bills are relatively stable. In fact, an investor who wishes to lend money for, say, three months can achieve a perfectly certain payoff by purchasing a Treasury bill maturing in three months. However, the investor cannot lock in a *real rate of return*: There is still some uncertainty about inflation.

By switching to long-term government bonds, the investor acquires an asset whose price fluctuates as interest rates vary. (Bond prices fall when interest rates rise and rise when interest rates fall.) An investor who shifts from bonds to common stocks shares in all the ups and downs of the issuing companies.

Figure 8.1 shows how your money would have grown if you had invested $1 at the start of 1900 and reinvested all dividend or interest income in each of the three portfolios.[3] Figure 8.2 is identical except that it depicts the growth in the *real* value of the portfolio. We will focus here on nominal values.

[1] See E. Dimson, P. R. Marsh, and M. Staunton, *Triumph of the Optimists: 101 Years of Investment Returns* (Princeton, NJ: Princeton University Press, 2002).

[2] Treasury bills were not issued before 1919. Before that date the interest rate used is the commercial paper rate.

[3] Portfolio values are plotted on a log scale. If they were not, the ending values for the common stock portfolio would run off the top of the page.

FIGURE 8.2

How an investment of $1 at the start of 1900 would have grown in real terms, assuming reinvestment of all dividend and interest payments. Compare this plot with Figure 8.1, and note how inflation has eroded the purchasing power of returns to investors.

Source: E. Dimson, P. R. Marsh, and M. Staunton, *Triumph of the Optimists: 101 Years of Investment Returns* (Princeton, NJ: Princeton University Press, 2002). © 2002 Reprinted by permission of Princeton University Press, with updates provided by the authors.

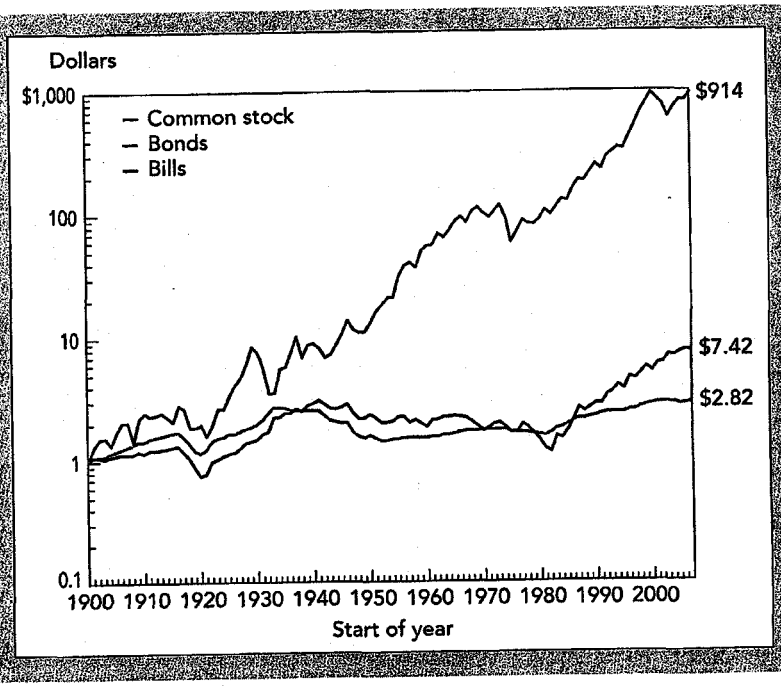

TABLE 8.1

Average rates of return on U.S. Treasury bills, government bonds, and common stocks, 1900–2006 (figures in % per year).

Source: E. Dimson, P. R. Marsh, and M. Staunton, *Triumph of the Optimists: 101 Years of Investment Returns* (Princeton, NJ: Princeton University Press, 2002). © 2002 Reprinted by permission of Princeton University Press, with updates provided by the authors.

	Average Annual Rate of Return		Average Risk Premium (Extra Return versus Treasury Bills)
	Nominal	Real	
Treasury bills	4.0	1.1	0
Government bonds	5.2	2.4	1.2
Common stocks	11.7	8.5	7.6

Investment performance coincides with our intuitive risk ranking. A dollar invested in the safest investment, Treasury bills, would have grown to $66 by the end of 2006, barely enough to keep up with inflation. An investment in long-term Treasury bonds would have produced $175. Common stocks were in a class by themselves. An investor who placed a dollar in the stocks of large U.S. firms would have received $21,536.

We can also calculate the rate of return from these portfolios for each year from 1900 to 2006. This rate of return reflects both cash receipts—dividends or interest—and the capital gains or losses realized during the year. Averages of the 107 annual rates of return for each portfolio are shown in Table 8.1.

Since 1900 Treasury bills have provided the lowest average return—4.0% per year in *nominal* terms and 1.1% in *real* terms. In other words, the average rate of

inflation over this period was about 3% per year. Common stocks were again the winners. Stocks of major corporations provided an average nominal return of 11.7%. By taking on the risk of common stocks, investors earned a risk premium of $11.7 - 4.0 = 7.6\%$ over the return on Treasury bills.[4]

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.[5]

Arithmetic Averages and Compound Annual Returns

Notice that the average returns shown in Table 8.1 are arithmetic averages. In other words, we simply added the 107 annual returns and divided by 107. The arithmetic average is higher than the compound annual return over the period. The 107-year compound annual return for the S&P index was 9.8%.[6]

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.

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%, +10%, or +30% (we assume that Big Oil does not pay a dividend). The *expected* return is $\frac{1}{3}(-10 + 10 + 30) = +10\%$.

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:

$$PV = \frac{110}{1.10} = \$100$$

The expected return of 10% 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 that 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% in a third of the years, +10% in a further third, and +30% in the remaining years. The arithmetic average of these yearly returns is

$$\frac{-10 + 10 + 30}{3} = +10\%$$

---

[4] Figures don't add due to rounding.

[5] 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 1.9%. There is a 95% chance that the *true* average is within plus or minus 2 standard errors of the 7.6% estimate. In other words, if you said that the true average was between 3.8 and 11.4%, you would have a 95% chance of being right. *Technical note:* The standard error of the average is equal to the standard deviation divided by the square root of the number of observations. In our case the standard deviation is 19.8%, and therefore the standard error is $19.8/\sqrt{107} = 1.9$.

[6] This was calculated from $(1 + r)^{107} = 21{,}536$, which implies $r = .098$. *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%. Variance was therefore $.20^2$, or .04. The compound annual return is $.04/2 = .02$, or 2 percentage points less than the arithmetic average.

Thus the arithmetic average of the returns correctly measures the opportunity cost of capital for investments of similar risk to Big Oil stock.[7]

The average compound annual return[8] on Big Oil stock would be

$$(.9 \times 1.1 \times 1.3)^{1/3} - 1 = .088, \text{ or } 8.8\%,$$

which is *less* than the opportunity cost of capital. Investors would not be willing to invest in a project that offered an 8.8% expected return if they could get an expected return of 10% in the capital markets. The net present value of such a project would be

$$\text{NPV} = -100 + \frac{108.8}{1.1} = -1.1$$

Moral: If the cost of capital is estimated from historical returns or risk premiums, use arithmetic averages, not compound annual rates of return.[9]

Using Historical Evidence to Evaluate Today's Cost of Capital

Suppose there is an investment project that 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 8.1. In this case, you would set r_m at 11.7%, 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, in 1981 the interest rate on Treasury bills was about 15%. It is difficult to believe that investors in that year were content to hold common stocks offering an expected return of only 11.7%.

If you need to estimate the return that investors expect to receive, a more sensible procedure is to take the interest rate on Treasury bills and add 7.6%, the average *risk premium* shown in Table 8.1. For example, in mid-2006 the interest rate on Treasury bills was about 5%. Adding on the average risk premium, therefore, gives

$$\begin{aligned} r_m(2006) &= r_f(2006) + \text{normal risk premium} \\ &= .05 + .076 = .126, \text{ or } 12.6\% \end{aligned}$$

---

[7] You sometimes hear that the arithmetic average correctly measures the opportunity cost of capital for one-year cash flows, but not for more distant ones. Let us check. Suppose that you expect to receive a cash flow of $121 in year 2. We know that one-year hence investors will value that cash flow by discounting at 10% (the arithmetic average of possible returns). In other words, at the end of the year they will be willing to pay $PV_1 = 121/1.10 = \$110$ for the expected cash flow. But we already know how to value an asset that pays off $110 in year 1—just discount at the 10% opportunity cost of capital. Thus $PV_0 = PV_1/1.10 = 110/1.1 = \$100$. Our example demonstrates that the arithmetic average (10% in our example) provides a correct measure of the opportunity cost of capital regardless of the timing of the cash flow.

[8] The compound annual return is often referred to as the *geometric average* return.

[9] Our discussion above assumed that we *knew* that the returns of −10, +10, and +30% were equally likely. For an analysis of the effect of uncertainty about the expected return see I. A. Cooper, "Arithmetic Versus Geometric Mean Estimators: Setting Discount Rates for Capital Budgeting," *European Financial Management* 2 (July 1996), pp. 157–167.

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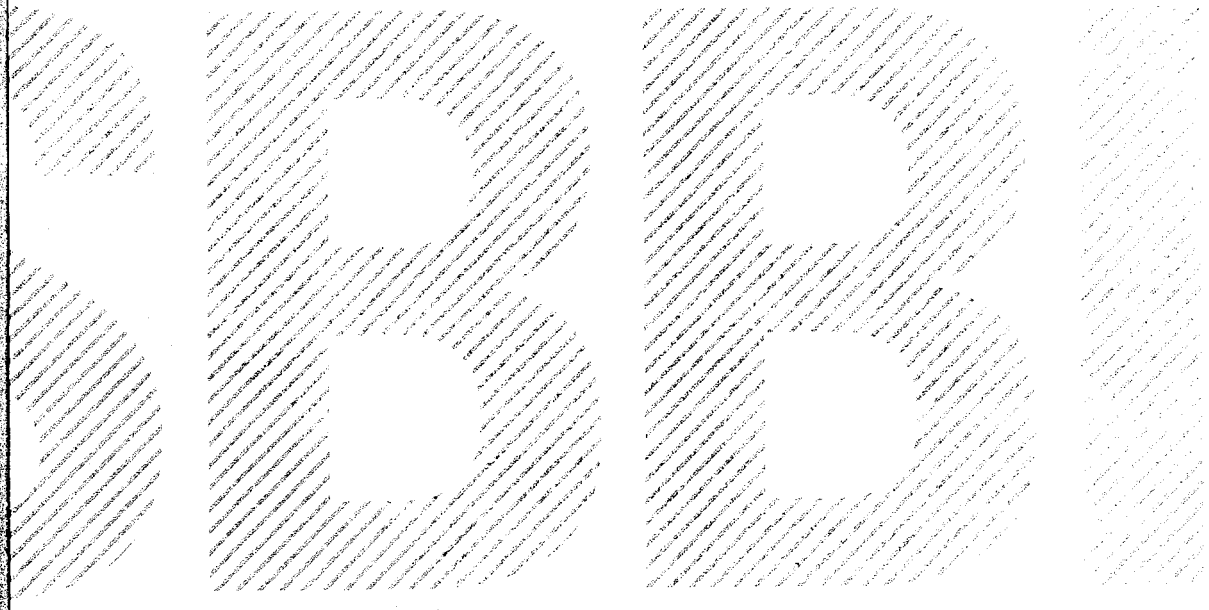
Market Results for
Stocks, Bonds, Bills, and Inflation
1926–2008



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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 due 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.

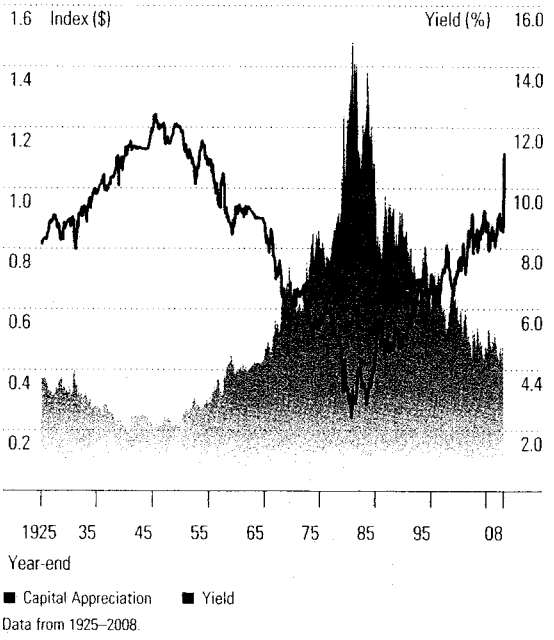
The same reason exists for why we do not use the 10-year Treasury bond—a long history of market data is not available for 10-year bonds. We have persisted in using a 20-year bond to keep the basis of the time series consistent.

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 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.[2]

Yields have generally risen on the long-term bond over the 1926–2008 period, so it has experienced negative capital appreciation over much of this time. This trend has turned around since the 1980s, however. Graph 5-2 illustrates the yields on the long-term government bond series compared to an index of the long-term government bond capital appreciation. In general, as yields rose, the capital appreciation index fell, and vice versa. Had an investor held the long-term bond to maturity, he would have realized the yield on the bond as the total return. However, in a constant maturity portfolio, such as those used to measure bond returns in this publication, bonds are sold before maturity (at a capital loss if the market yield has risen since the time of purchase). This negative return is associated with the risk of unanticipated yield changes.

Graph 5-2: Long-term Government Bond Yields versus Capital Appreciation Index



Data from 1925–2008.

For example, if bond yields rise unexpectedly, investors can receive a higher coupon payment from a newly issued bond than from the purchase of an outstanding bond with the former lower-coupon payment. The outstanding lower-coupon bond will thus fail to attract buyers, and its price will decrease, causing its yield to increase correspondingly, as its coupon payment remains the same. The newly priced outstanding bond will subsequently attract purchasers who will benefit from the shift in price and yield; however, those investors who already held the bond will suffer a capital loss due to the fall in price.

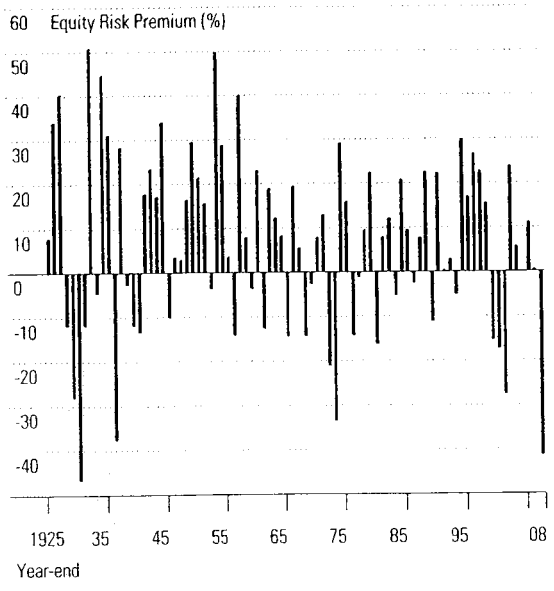
Anticipated changes in yields are assessed by the market and figured into the price of a bond. Future changes in yields that are not anticipated will cause the price of the bond to adjust accordingly. Price changes in bonds due to unanticipated changes in yields introduce price risk into the total return. Therefore, the total return on the bond series does not represent the riskless rate of return.The income return better represents the unbiased estimate of the purely riskless rate of return, since an investor can hold a bond to maturity and be entitled to the income return with no capital loss.

Arithmetic versus Geometric Means

The equity risk premium data presented in this book are arithmetic average risk premia as opposed to geometric average risk premia. 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, since it represents the compound average return.

The argument for using the arithmetic average is quite straightforward. In looking at projected cash flows, the equity risk premium that should be employed is the equity risk premium that is expected to actually be incurred over the future time periods. Graph 5-3 shows the realized equity risk premium for each year based on the returns of the S&P 500 and the income return on long-term government bonds. (The actual, observed difference between the return on the stock market and the riskless rate is known as the realized equity risk premium.) There is considerable volatility in the year-by-year statistics. At times the realized equity risk premium is even negative.

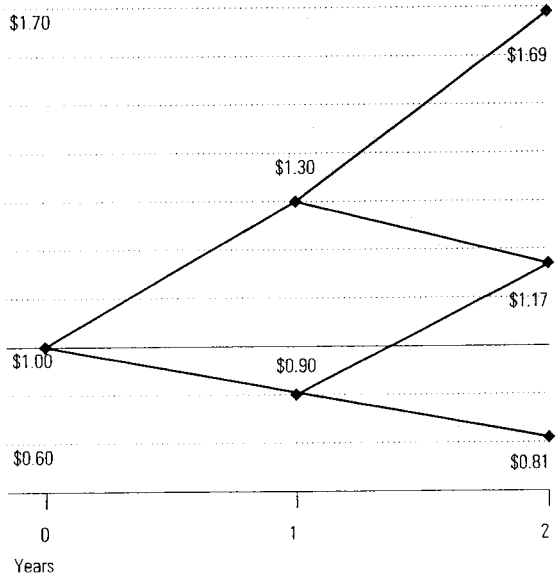
Graph 5-3: Realized Equity Risk Premium Per Year



Data from 1926–2008.

To illustrate how the arithmetic mean is more appropriate than the geometric mean in discounting cash flows, suppose the expected return on a stock is 10 percent per year with a standard deviation of 20 percent. Also assume that only two outcomes are possible each year: +30 percent and –10 percent (i.e., the mean plus or minus one standard deviation). The probability of occurrence for each outcome is equal. The growth of wealth over a two-year period is illustrated in Graph 5-4.

Graph 5-4: Growth of Wealth Example



The most common outcome of $1.17 is given by the geometric mean of 8.2 percent. Compounding the possible outcomes as follows derives the geometric mean:

$$\left[(1+0.30)\times(1-0.10)\right]^{1/2}-1=0.082$$

However, the expected value is predicted by compounding the arithmetic, not the geometric, mean. To illustrate this, we need to look at the probability-weighted average of all possible outcomes:

(0.25 × $1.69)	= $0.4225
+ (0.50 × $1.17)	= $0.5850
+ (0.25 × $0.81)	= $0.2025
Total	$1.2100

Therefore, $1.21 is the probability-weighted expected value. The rate that must be compounded to achieve the terminal value of $1.21 after 2 years is 10 percent, the *arithmetic mean*:

$$\$1\times(1+0.10)^2=\$1.21$$

The geometric mean, when compounded, results in the median of the distribution:

$$\$1\times(1+0.082)^2=\$1.17$$

The arithmetic mean equates the expected future value with the present value; it is therefore the appropriate discount rate.

Appropriate Historical Time Period

The equity risk premium can be estimated using any historical time period. For the U.S., market data exists 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 100 years.

Our equity risk premium covers the time period from 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 their analysis of market returns with 1926 for two main reasons. CRSP determined that the time period around 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 twenties and early thirties; 1926 was chosen because it includes one full business cycle of data before the market crash of 1929. These are the most basic reasons why our equity risk premium calculation window starts in 1926.

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.

Does the Equity Risk Premium Revert to Its Mean Over Time?

Some have argued that the estimate of the equity risk premium is upwardly biased since the stock market is currently priced high. In other words, since there have been several years with extraordinarily high market returns and realized equity risk premia, the expectation is that returns and realized equity risk premia will be lower in the future, bringing the average back to a normalized level. This argument relies on several studies that have tried to determine whether reversion to the mean exists in stock market prices and the equity risk premium.[3] Several academics contradict each other on this topic; moreover, the evidence supporting this argument is neither conclusive nor compelling enough to make such a strong assumption.

Our own empirical evidence suggests that the yearly difference between the stock market total return and the U.S. Treasury bond income return in any particular year is random. Graph 5-3, presented earlier, illustrates the randomness of the realized equity risk premium.

A statistical measure of the randomness of a return series is its serial correlation. Serial correlation (or autocorrelation) is defined as the degree to which the return of a given series is related from period to period. A serial correlation near positive one indicates that returns are predictable from one period to the next period and are positively related. That is, the returns of one period are a good predictor of the returns in the next period. Conversely, a serial correlation near negative one indicates that the returns in one period are inversely related to those of the next period. A serial correlation near zero indicates that the returns are random or unpredictable from one period to the next. Table 5-3 contains the serial correlation of the market total returns, the realized long-horizon equity risk premium, and inflation.

Table 5-3: Interpretation of Annual Serial Correlations

Series	Serial Correlation	Interpretation
Large Company Stock Total Returns	0.04	Random
Equity Risk Premium	0.04	Random
Inflation Rates	0.64	Trend

Data from 1926–2008

C

JAMES, NORM

From: Thomas J. Bourassa [tjb114@cox.net]
Sent: Friday, October 30, 2009 3:10 PM
To: JAMES, NORM
Subject: [Fwd: Chaparral Rate Design]

Attachments: Final ROO - Rate Design.pdf

Final ROO - Rate Design.pdf (1...

-------- Original Message --------
Subject: Chaparral Rate Design
Date: Thu, 29 Oct 2009 09:57:09 -0700
From: Alexander Igwe <AIgwe@azcc.gov>
To: Teena Wolfe <TWolfe@azcc.gov>
CC: Deborah Person <DPerson@azcc.gov>, Thomas J. Bourassa <tjb114@cox.net>

Teena: <<Final ROO - Rate Design.pdf>>

Please find attached herewith schedules showing the authorized Revenue Requirement and the related Rate Designs. Per your instruction, I only modified the Commodity rate for each tier, and Mr. Bourassa has confirmed that it yields the approved Revenue Requirement.

1st Tier Commodity Rate - $2.25
2nd Tier Commodity Rate - $2.90
3rd Tier Commodity Rate - $3.55

Just for your information, my hunch was correct in that Staff's billing determinant did not incorporate the appropriate data for the irrigation customers. Mr. Bourassa confirms that the billing determinant was modified subsequent to the original filing.

Thanks.

Alexander Ibhade Igwe, CPA
Executive Consultant III
Utilities Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007
aigwe@azcc.gov
Phone: (602) 542-0857
Fax: (602) 542-2129

Chaparral City Water Company Revenue Proof Final Decision
Test Year Ended December 31, 2006
Revenue Summary
With Annualized Revenues to Year End Number of Customers

Exhibit
Rejoinder Schedule H-1
Page 3
Witness: Bourassa

Line No.		Present Revenues	Proposed Revenues	Dollar Change	Percent Change	Percent of Present Water Revenues	Percent of Proposed Water Revenues
1							
2							
3	Subtotal Metered Revenues	$ 7,665,568	$ 9,708,204	$ 2,042,636	26.65%	100.00%	100.00%
4	Subtotal Revenue Annualization	(250,897)	(518,229)	(267,332)	106.55%	-3.27%	-5.34%
5	Total Metered Revenues	$ 7,414,671	$ 9,189,975	$ 1,775,304	23.94%		
6							
7	Misc. Revenues	$ 82,289	$ 82,289	-	0.00%	1.07%	0.85%
8	Reconciling Amount to GL	-	-	-	0.00%	0.00%	0.00%
9	Total Water Revenues	$ 7,496,960	$ 9,272,264	$ 1,775,304	23.68%	0.00%	0.00%
10			9,269,381				
11			2,883				
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Chaparral City Water Company Revenue Proof Final Decision
Test Year Ended December 31, 2006
Present and Proposed Rates

Exhibit
Schedule H-3
Page 1

Line No.	Monthly Usage Charge for:	Present Rates	Proposed Rates	Percent Change
1	All Zones and Classes			
1	3/4 Inch	$ 13.60	$ 16.50	21.32%
2	1 Inch	22.70	27.50	21.15%
3	1 1/2 Inch	45.40	55.00	21.15%
4	2 Inch	73.00	88.00	20.55%
5	3 Inch	146.00	176.00	20.55%
6	4 Inch	227.00	275.00	21.15%
7	6 Inch	454.00	550.00	21.15%
8	8 Inch	730.00	880.00	20.55%
9	10 Inch	1,043.00	1,265.00	21.28%
10	12 Inch	1,980.00	2,365.00	19.44%
11				
12	Fire Hydrants Basic Service	$ -	$ -	
13				
14	Fire Hydrants Used for Irrigation	By Meter Size	By Meter Size	
15				
16	Irrigation and Construction	By Meter Size	By Meter Size	
17				
18	Monthly Service Charge for Fire Sprinkler			
19	4 Inch or smaller	$ 10.00	$ 10.00	0.00%
20	6 Inch	10.00	10.00	0.00%
21	8 Inch	10.00	10.00	0.00%
22	10 Inch	10.00	10.00	0.00%
23	Larger than 10 Inch	10.00	10.00	0.00%
24				
25	Gallons In Minimum (All Zonesand Classes)	-	-	
26				

		Present Rates	Proposed Rates	Percent Change
27				
28				
29	**Commodity Rates**			
30	**Residential, Commercial, Industrial**			
31	**Gallons Per Tiers**			
32	**Tier 1**: (Gallon upper limit.)			
33	3/4 Inch (Residential)	3,000	3,000	0.00%
34	3/4 Inch (Commercial and Industrial)	9,000	9,000	0.00%
35	1 Inch (Residential, Commerical, Industrial)	24,000	24,000	0.00%
36	1 1/2 Inch (Residential, Commerical, Industrial)	60,000	60,000	0.00%
37	2 Inch (Residential, Commerical, Industrial)	100,000	100,000	0.00%
38	3 Inch (Residential, Commerical, Industrial)	225,000	225,000	0.00%
39	4 Inch (Residential, Commerical, Industrial)	350,000	350,000	0.00%
40	6 Inch (Residential, Commerical, Industrial)	725,000	725,000	0.00%
41	8 Inch (Residential, Commerical, Industrial)	1,125,000	1,125,000	0.00%
42	10 Inch (Residential, Commerical, Industrial)	1,500,000	1,500,000	0.00%
43	12 Inch (Residential, Commerical, Industrial)	2,250,000	2,250,000	0.00%
44				
45				
46	**Tier 2:** (Gallons upper limit)			
47	3/4 Inch (Residential)	9,000	9,000	0.00%
48	3/4 Inch (Commercial and Industrial)	99,999,999	99,999,999	0.00%
49	1 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
50	1 1/2 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
51	2 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
52	3 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
53	4 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
54	6 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
55	8 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
56	10 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
57	12 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%

Chaparral City Water Company Revenue Proof Final Decision
Test Year Ended December 31, 2006
Present and Proposed Rates

Exhibit
Schedule H-3
Page 2

Line No.				
1	**Tier 3:** (Gallons upper limit)			
2	3/4 Inch (Residential)	99,999,999	99,999,999	0.00%
3	3/4 Inch (Commercial and Industrial)	99,999,999	99,999,999	0.00%
4	1 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
5	1 1/2 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
6	2 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
7	3 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
8	4 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
9	6 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
10	8 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
11	10 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
12	12 Inch (Residential, Commerical, Industrial)	99,999,999	99,999,999	0.00%
13				
14	**Residential, Commercial, Industrial**			
15	**Commodity Rates**	**Present Rates**	**Proposed Rates**	**Percent Change**
16	**First Tier**			
17	3/4 Inch (Residential)	$ 1.68	$ 2.250	33.93%
18	3/4 Inch (Commercial and Industrial)	2.52	$ 2.900	15.08%
19	1 Inch and Larger Meters	2.52	$ 2.900	15.08%
20				
21	**Second Tier**			
22	3/4 Inch (Residential)	$ 2.52	$ 2.900	15.08%
23	3/4 Inch (Commercial and Industrial)	3.03	$ 3.550	17.16%
24	1 Inch and Larger Meters	3.03	$ 3.550	17.16%
25				
26	**Third Tier**			
27	3/4 Inch (Residential)	$ 3.03	$ 3.550	17.16%
28				
29				
30	**Irrigation/Construction/Bulk**			
31	All Gallons	$ 1.56	$ 2.900	85.90%
32				
33	**Fire Hydrant Irrigation**			
34	All Gallons	$ 1.56	$ 2.900	85.90%
35				
36	**Standpipe (Fire Hydrants)**			
37	All Gallons	$ 2.52	$ 2.900	15.08%
38				
39	**Fire Sprinklers**			
40	All Gallons	$ 2.52	$ 2.900	15.08%
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