BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

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IN THE MATTER OF THE APPLICATION OF ARIZONA-AMERICAN WATER COMPANY, AN ARIZONA CORPORATION, FOR A DETERMINATION OF THE CURRENT FAIR VALUE OF ITS UTILITY PLANT AND PROPERTY AND FOR INCREASES IN ITS RATES AND CHARGES BASED THEREON FOR UTILITY SERVICE BY ITS MOHAVE WATER AND WASTEWATER DISTRICTS	DOCKET NO. WS-01303A-06-_____

DIRECT TESTIMONY
OF
BENTE VILLADSEN
ON BEHALF OF
ARIZONA-AMERICAN WATER COMPANY

JANUARY 13, 2006

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EXECUTIVE SUMMARY

Dr. Bente Villadsen, a senior associate at *The Brattle Group*, files testimony on the cost of capital for Mohave Water district and Mohave Wastewater district (collectively, "Mohave").

Dr. Villadsen selects two benchmark samples, water utilities and gas LDC companies. She estimates the sample companies' cost of equity, associated after-tax weighted-average cost of capital, and the corresponding cost of equity at 40 percent equity. She also reviews recent Arizona water and wastewater decisions.

Based on the evidence from the samples and recent Arizona water and wastewater decisions, Dr. Villadsen estimates a cost of equity for Mohave in the range of 11¼ to 11¾ percent at 40 percent equity; with a midpoint of 11½.. She therefore finds that Mohave's request for 11.5 percent return on equity at 40 percent equity is reasonable.

INTRODUCTION AND SUMMARY

Q1. Please state your name and address.

A1. My name is Bente Villadsen. My business address is *The Brattle Group*, 44 Brattle Street, Cambridge, MA 02138, USA.

Q2. Please describe your job and your educational experience.

A2. I am a Senior Associate of *The Brattle Group*, ("Brattle"), an economic, environmental and management consulting firm with offices in Cambridge, Washington, San Francisco, London and Brussels. My work concentrates on regulatory finance and accounting. I hold a B.S. and M.S. from University of Aarhus, Denmark and a Ph.D. from Yale University's School of Management.

Q3. What is the purpose of your testimony in this proceeding?

A3. I have been asked by Arizona-American Water Company ("Arizona-American" or the "Company") to estimate the cost of equity that the Arizona Corporation Commission ("ACC" or the "Commission") should allow the Mohave Water district and Mohave Wastewater district (collectively "Mohave") an opportunity to earn on the equity financed portion of its rate base.

To determine the cost of equity for Mohave, I first estimate the overall cost of capital for two samples of regulated companies using several versions of the discounted cash flow

("DCF") and risk positioning models. Second, I determine the cost of equity that the estimated overall cost of capital gives rise to at Mohave's requested capital structure consisting of 40% equity. Third, I evaluate the relative risk of Mohave and the sample companies to determine the recommended cost of equity for Mohave.

Q4. Please summarize any parts of your background and experience that are particularly relevant to your testimony on these matters.

A4. Brattle's specialties include financial economics, regulatory economics, and the utility industry. I have worked extensively on cost of capital matters for electric, natural gas distribution, pipeline and water utilities in both state and federal jurisdictions. Additionally, I have significant experience in other areas of rate regulation, credit risk in the utilities industry, energy contracts, and accounting issues. I have filed direct and rebuttal testimony on the equity method of accounting, the classification of debt versus equity, and the distinction between categories of liabilities. Appendix A contains more information on my professional qualifications.

Q5. Please summarize your approach to estimating the cost of capital for Mohave.

A5. To assess the cost of capital for Mohave, I select two benchmark samples, regulated water utilities and natural gas local distribution companies ("LDC"). These samples are selected to have risks characteristics comparable to those of Mohave. I give the results from the

water sample the most weight, but because the water sample suffers from numerous data issues, I use the gas LDC sample as a check on the results from the water sample. For each sample, I estimate the sample companies cost of equity using several versions of the DCF method and of the risk positioning model. Based on data availability and the current state of the water and gas distribution industries I assign the most weight to the risk positioning models.

Given the cost of equity estimates for each company and the company market costs of debt and preferred stock, I calculate each firm's overall cost of capital, i.e., its after-tax weighted-average cost of capital ("ATWACC"), using the company market value capital structure. I report the samples' average ATWACC and the cost of equity for a capital structure with 40 percent equity. Thus, I present the cost of equity that is consistent with the samples' market information and Mohave's regulatory capital structure. (By "regulatory capital structure," I mean the capital structure that Mohave proposes in its application.)

Focusing on the overall cost of capital rather than its components avoids potential problems of inconsistency between the estimated cost of equity and the level of financial risk at the regulated company's capital structure.

Q6. Please summarize your conclusions regarding Mohave's cost of equity.

A6. The midpoint of both the water utility and the gas LDC samples' cost of equity is 11½ percent with a range of 11¼ to 11¾ percent at 40 percent equity using the risk positioning

method. The corresponding overall after-tax weighted average cost of capital has a midpoint a bit over 6½ percent for an ATWACC range of 6¼ to 6¾ percent. I specify a plus or minus ¼ percent range for the cost of equity because I do not believe that it is possible to estimate the cost of capital or equity more precisely than that. The estimates from the discounted cash flow method are higher for both samples with a midpoint above 12 percent for the water sample and above 12½ for the gas LDC sample. The company's request for an 11.50 percent return on equity equals the midpoint of my risk positioning estimates and is below my DCF estimates. Therefore, in my opinion, the request for 11.5% return on equity is reasonable.

Q7. Why do you need to consider Mohave's regulatory capital structure?

A7. The more leveraged a company is the higher its risk. Investors in companies with higher risk require a higher rate of return, so *the cost of equity goes up at an ever increasing rate as a company adds debt*, which offsets the lower cost of debt. That is, the associated capital structure affects an estimated cost of equity estimate just as a life insurance applicant's age affects the required life insurance premium. Consequently, I calculate the sample's cost of equity at Mohave's regulatory capital structure.

Q8. How is the rest of your testimony organized?

A8. *Section II* defines the cost of capital and discusses the principles relating the cost of capital and capital structure for a business. *Section III* summarizes the effects of leverage on the cost of equity. *Section IV* presents the methods used to estimate the cost of capital for the benchmark samples and the associated numerical analyses. This section also explains the basis of my conclusions for the benchmark samples' returns on equity and overall costs of capital. *Section V* summarizes the analysis and discusses the recommendation for Mohave. Appendix A lists my qualifications. Appendices B and C support *Section IV* while Appendix D supports *Section III*. Appendices B and C provide details on the risk positioning and DCF approaches, respectively, including the details underlying the numerical analyses. Appendix D discusses the impact of leverage on the cost of capital in more detail. Note that portions of the testimony are repeated in the appendices in order to give the reader the context of the issues before additional technical detail and further discussion are presented.

THE COST OF CAPITAL AND RISK

Q9. Please formally define the "cost of capital."

A9. The *cost of capital* is *the expected rate of return in capital markets on alternative investments of equivalent risk*. In other words, it is the rate of return investors require based on the risk-return alternatives available in competitive capital markets. The cost of capital is a type of opportunity cost: it represents the rate of return that investors could expect to earn elsewhere without bearing more risk. "Expected" is used in the statistical sense: the mean of the distribution of possible outcomes. The terms "expect"and "expected" in this testimony, as in the definition of the cost of capital itself, refer to the probability-weighted average over all possible outcomes.

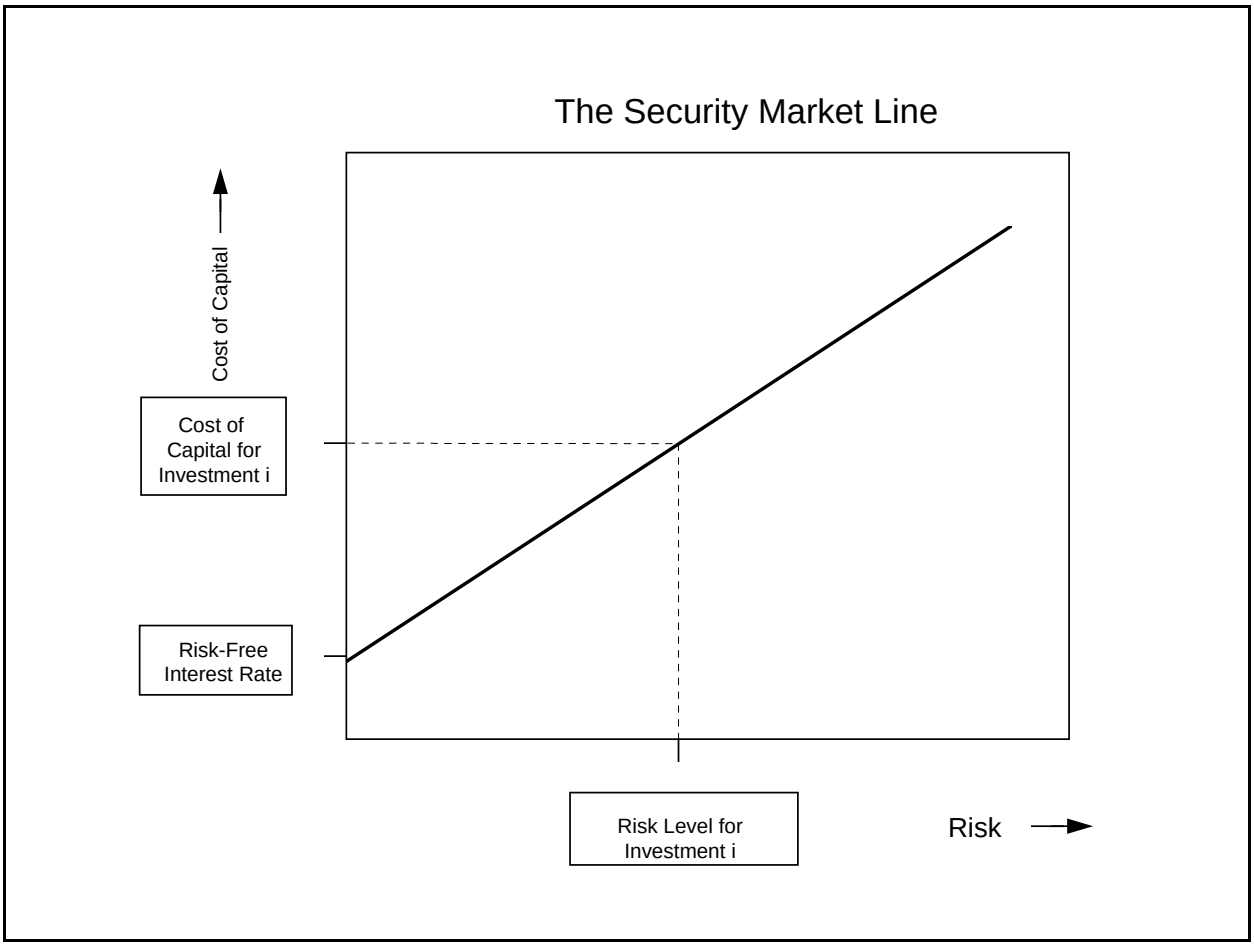

Figure 1

The definition of the cost of capital recognizes a tradeoff between risk and return that is known as the "security market risk-return line," or "security market line" for short. This line is depicted in Figure 1. The higher the risk, the higher the cost of capital. A version of Figure 1 applies for all investments. However, for different types of securities, the location of the line may depend on corporate and personal tax rates.

Q10. Why is the cost of capital relevant in rate regulation?

A10. It has become routine in U.S. rate regulation to accept the "cost of capital" as the right expected rate of return on utility investment.[1] From an economic perspective, rate levels that give investors a fair opportunity to earn the cost of capital are the lowest levels that compensate investors for the risks they bear. Over the long run, an expected return above the cost of capital makes customers overpay for service. Regulatory commissions normally try to prevent such outcomes, unless there are offsetting benefits (e.g., from incentive regulation that reduces future costs). At the same time, an expected return below the cost of capital shortchanges investors. In the long run, such a return denies the company the ability to attract capital, to maintain its financial integrity, and to expect a return commensurate with that of other enterprises attended by corresponding risks and uncertainties. The failure to give investors a fair opportunity to earn the cost of capital can have significant adverse consequences for the utility as well as for customers.

Of course, the cost of capital cannot be estimated with perfect certainty, and other aspects of the way the revenue requirement is set may mean investors expect to earn more or less than the cost of capital even if the allowed rate of return equals the cost of capital exactly. However, a commission that on average sets rates so investors expect to earn the

[1] To the best of my knowledge, the first paper formally to link the cost of capital as defined by financial economics with the right expected rate of return for utilities is Stewart C. Myers, *Application of Finance Theory to Public Utility Rate Cases, The Bell Journal of Economics and Management Science,* 3:58-97 (Spring 1972).

cost of capital treats both customers and investors fairly, and acts in the long-run interests of both groups.

THE RELATIONSHIP BETWEEN CAPITAL STRUCTURE AND THE COST OF EQUITY

Q11. Please explain why it is necessary to report the cost of equity adjusted for capital structure.

A11. In most jurisdictions in North America, rate regulation focuses on the components of the rates. In other words, the focus of cost of capital estimation is usually to determine the "right" cost of equity and to a lesser degree setting the allowed capital structure. While the overall cost of capital depends primarily on the company's line of business, the distribution of the cost of capital among debt and equity depends on their share in total revenues. Debt holders' share is usually a fixed amount (except in situations of default) while equity holders are residual claimants. Because a company's financial risk depends on its capital structure, the risk shareholders carry increases with the leverage of the company. Because shareholders expect to be compensated for increased risk, the required rate of return increases with the company's leverage. The increased risk is caused by the fact that debt has a senior claim on a specified portion of earnings and in bankruptcy on assets. As common equity is the most junior security, it gets what's left after everyone else has been paid. Therefore, common equity holders carry all residual risk. However, as explained in more detail in Appendix D, the overall cost of capital is constant within a broad middle range of

capital structures although the distribution of costs and risks among debt and equity holders is not.

Q12. Please provide an example on how debt adds risk to equity.

A12. As a simple example, think of an investor who takes money out of his savings and invests $100,000 in real estate. The future value of the real estate is uncertain. If the real estate market booms, he wins. If the real estate market goes down, he loses. Figure 2 below illustrates this.

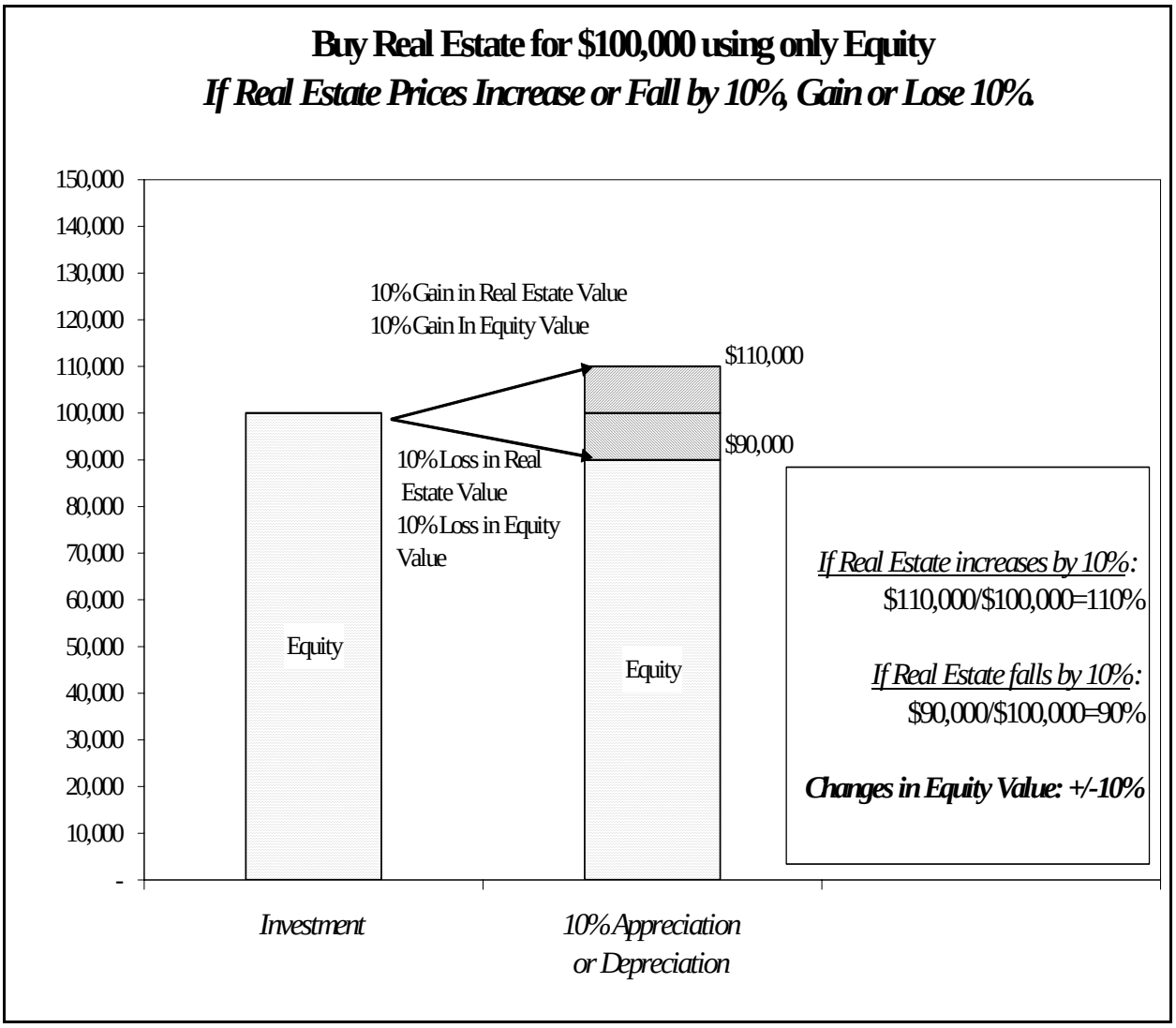

Figure 2

In the scenario above, the investor financed his real estate purchase through 100 percent equity. Suppose instead that the investor had financed 50 percent of his real estate investment with a mortgage of $50,000. The mortgage lender does not expect to share in any

benefits from increases in real estate values. Neither does the mortgage lender expect to share in any losses from falling real estate values. I.e., the investor carries the entire risk of fluctuating real estate prices. Figure 3 illustrates this effect.

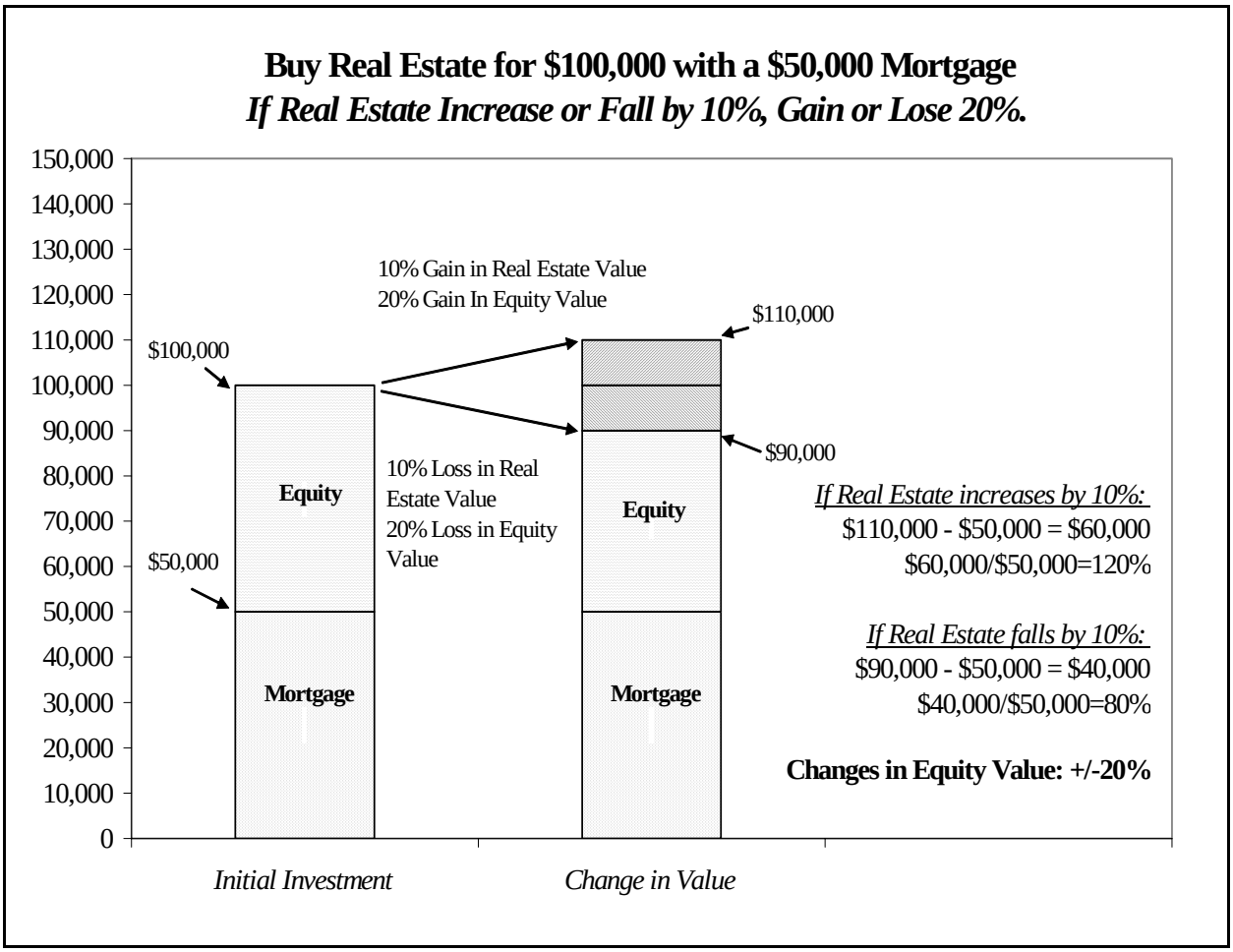

Figure 3

In Figure 3 where the investor financed his purchase through 50 percent equity and 50 percent debt, the variability in the investor's equity return is two times greater than that of Figure 2. The entire fluctuation of 10 percent from rising or falling real estate prices falls

on the investor's $50,000 equity investment. The lesson from the example is obvious, debt adds risk to equity.

Q13. Please explain the implications of the relationship between capital structure and the cost of equity for rate regulation.

A13. The risk equity holders carry, and therefore the cost of equity, depends on the capital structure. As illustrated in the example above, as leverage increases, the market risk increases and hence the required return on equity increases.

Q14. To assess the magnitude of financial risk for a rate regulated company, should you use the market-value or the book-value capital structure?

A14. The market-value capital structure is the relevant quantity for analyzing the cost of equity evidence, which is based on market information.[2]

[2] The need to use market-value capital structures to analyze the effect of debt on the cost of equity has been recognized in the financial literature for a long time. For example, the initial reconciliation of the Modigliani-Miller theories of capital structure with the Capital Asset Pricing Model, in Robert S. Hamada, "Portfolio Analysis, Market Equilibrium and Corporate Finance," The Journal of Finance 24: 13-31 (March 1969) works with market-value capital structures. For a more recent presentation of the concept, see, for example, Richard A. Brealey, Stewart C. Myers, and Franklin Allen, *Principles of Corporate Finance*, New York: McGraw-Hill/Irwin 8th ed. (2005) pp. 504-05. Book values may be relevant for some issues, e.g., for covenants on individual bond issues, but as explained in the text, market values are the determinants of the impact of debt on the cost of equity.

Q15. Please provide an example that illustrates why market values are relevant.

A15. Suppose in the example from above that the investor has invested in real estate 10 years ago. Further assume that depreciation has reduced the book value of the real estate from $100,000 to $75,000 and assume the investor has paid off 40 percent of his $50,000 mortgage. Thus, the investor has a remaining mortgage of $30,000 (= 60% × $50,000). The book value of the investor's equity investment is therefore $45,000 (= $75,000 - $30,000).

What happens now if real estate prices rise or fall 20 percent? To answer that question, we need to know how real estate prices have developed over the past 10 years. If the market value of the real estate now is $200,000 then a 20 percent decrease in the price of real estate ($40,000) is almost equal to the investor's book value equity. However, his market value equity (or net worth) is equal to the value of the real estate minus what he owes on the mortgage. If we assume that the market value of the mortgage equals the unpaid balance ($30,000), then the investor's net worth is calculated as follows:

Net Worth	=	Market Value Of Real Estate	-	Remaining Mortgage	
	=	$200,000	-	$30,000	= $170,000

Therefore, the rate of return on equity due to a 20 percent decline in real estate prices is calculated as follows:

Table 1: Calculating the Rate of Return on Equity	
Decline in Real Estate Value	$40,000
Market-Value Equity	$170,000
Rate of Return on Equity	- $40,000/$170,000 = -23.5%

Q16. Does the example provided above hold more generally?

A16. Yes. The need to use market-value capital structures to analyze the effect of debt on the cost of equity has been recognized from the beginning of the financial literature on the topic. For example, the initial reconciliation of the Modigliani-Miller theories of capital structure with the Capital Asset Pricing Model, in Robert S. Hamada (1969), "Portfolio Analysis, Market Equilibrium and Corporation Finance,[3] works with market-value capital structures. A more recent presentation can be found in, for example, Richard A. Brealey and Stewart C. Myers (2005), *Principles of Corporate Finance*.[4]

[3] *The Journal of Finance* 24, pp. 13-31.

[4] Pp. 504-505.

Q17. Please explain the implications for rate regulation and your testimony.

A17. Because the market risk, and therefore the cost of equity, depends on the market-value capital structures, one must base the estimation of the sample companies cost of capital on market value capital structures. An approach that estimates the cost of equity for each of the sample firms without explicit consideration of the market value capital structure underlying those costs risks material errors. The costs of equity of the sample companies at their actual market-value capital structures do not necessarily correspond to the financial risk faced by equity holders in the regulated company. Therefore, it could lead to an unfair rate of return. I avoid this problem by calculating each sample company's ATWACC using its market value capital structure. I then use the sample companies' average overall cost of capital to determine the corresponding return on equity at Mohave's regulatory capital structure. This procedure ensures that the capital structure and the estimated cost of equity are consistent.

In my analyses, I estimate the cost of equity for each of the sample firms using traditional estimation methods (such as the DCF and Capital Asset Pricing Model ("CAPM"). I use each company's estimated cost of equity along with Arizona-American's marginal tax rate and each company's cost of debt and market-value capital structure to estimate the sample companies' overall cost of capital. I then calculate the sample average overall cost of capital for each equity estimation method for both of the samples. Using the procedure discussed above, I then determine the cost of equity at Mohave's regulated capital

structure for each estimation method that is consistent with the sample's overall cost of capital information.

Q18. Is the use of market values to calculate the impact of capital structure on the risk of equity incompatible with use of a book-value rate base for a regulated company?

A18. No, no more than it is incompatible to use market-based cost of equity estimation methods (such as DCF or CAPM) with a book value rate base. That is, the cost of capital is the fair rate of return on regulatory assets for both investors and customers. Most regulatory jurisdictions in North America measure the rate base using the net book value of assets, not current replacement value or historical cost trended for inflation. But the jurisdictions still apply market-derived measures of the cost of equity to that net book value rate base.

The issue here is, what level of risk is reflected in that cost of equity estimate? That risk level depends on the sample company's market-value capital structure, not its book-value capital structure. *That risk level would be different if the sample company's market-value capital structure exactly equaled its book-value capital structure, so the estimated cost of equity would be different, too.*

Q19. Please sum up the implications of this section.

A19. The market risk, and therefore the cost, of equity depends directly on the market-value capital structure of the company or asset in question. It therefore is impossible to compare

validly the measured costs of equity of different companies without taking capital structure into account. Capital structure and the cost of equity are unbreakably linked, and any effort to treat the two as separate and distinct questions violates both everyday experience (e.g., with home mortgages) and basic financial principles.

Q20. How should a cost of capital analyst implement this principle?

A20. As discussed further in Appendix D, there has been a great deal of financial research on the effects of capital structure on the value of the firm. One of the key conclusions that result from the research is that no narrowly defined optimal capital structure exists within industries, although the typical range of capital structures does vary among industries.[5] Instead, there is a relatively wide range of capital structures within any industry in which fine-tuning the debt ratio makes little or no difference to the value of the firm, and hence to its overall after-tax cost of capital.

Accordingly, analysts should treat the market-value weighted average of the cost of equity and the after-tax current cost of debt, or the "ATWACC" for short,[6] as constant.

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[5] An exception is very high-risk industries that should avoid debt entirely, which makes their optimal capital structure zero percent debt.

[6] This quantity typically is called the "weighted-average cost of capital" or "WACC" in finance textbooks. The textbook WACC equals the *market*-value weighted average of the cost of equity and the *after-tax, current* cost of debt. However, rate regulation in North America has a legacy of working with another weighted-average cost of capital, the *book*-value weighted average of the cost of equity and the *before-tax, embedded* cost of debt. Accordingly, in regulatory settings it's useful to refer to the textbook WACC as the "ATWACC," or "after-tax weighted-average cost of capital." I follow that practice here.

Sample evidence should be analyzed to determine the sample's average ATWACC, which can be compared across different firms or industries. The economically appropriate cost of equity for a regulated firm is the quantity that, when applied to the *regulatory* capital structure, produces the same ATWACC. That value is the cost of equity that the sample would have had, estimation problems aside, if the sample's market-value capital structure had been equal to the regulatory capital structure in question.

THE COST OF CAPITAL FOR THE BENCHMARK SAMPLES

Q21. How is this section of your testimony organized?

A21. As noted in *Section II*, I estimate the cost of capital using two samples of comparable risk companies. This section first covers matters such as sample selection, market-value capital structure determination, and the sample companies' costs of debt. It then covers estimation of the cost of equity for the sample companies and the resulting estimates of the sample's overall after-tax cost of capital. Next, it analyzes these data to reach a conclusion on the overall cost of capital and the corresponding cost of equity at Mohave's regulatory capital structure for both of the benchmark samples.

A. PRELIMINARY DECISIONS

Q22. What preliminary decisions are needed to implement the above principles?

A22. I must select the benchmark samples, calculate the sample companies' market-value capital structures, and determine the sample companies' market costs of debt and preferred equity.

1. The Samples: Water Utilities and Gas Local Distribution Companies

Q23. Why do you use two samples?

A23. The overall cost of capital for a part of a company depends on the risk of the business in which the *part* is engaged, *not* on the overall risk of the parent company on a consolidated basis.

Estimating the cost of capital for Mohave's regulated assets is the subject of this proceeding. The ideal sample would be a number of companies that are publicly traded "pure plays" in the water production, storage, treatment, transmission, distribution and wastewater lines of business.[7] "Pure play" is an investment term referring to companies with operations only in one line of business. Publicly traded firms, firms whose shares are freely traded on stock exchanges, are ideal because the best way to infer the cost of capital is to examine evidence from capital markets on companies in the given line of business.

Therefore, for this case, a sample of companies whose operations are concentrated solely in the regulated portion of the water industry would be ideal. Unfortunately, the available sample of "water" utility companies in the U.S. is relatively small and has serious data deficiencies. See *Section IV.C.1* for a description of these deficiencies.

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[7] Most of the water utilities in *Value Line* have operations in the water as well as wastewater business.

To select my sample of comparable water and gas LDC companies, I start with those utilities that are listed as water utilities in *Value Line*.[8] Usually, I would apply several selection criteria to delete companies with unusual circumstances that may bias the cost of capital estimation and companies whose risk characteristics differ from those of the filing entity (Mohave water/wastewater). However, the application of such criteria would eliminate almost all the water utilities listed in *Value Line*. If I eliminate all utilities with annual revenues below $200 million, lack of bond ratings, or lack of growth forecast from IBES, I would be left with at most two companies (American States Water and California Water Services). Even these two companies have relatively low trading volumes and other data issues that make cost of capital estimation procedures less reliable.[9] A two company sample is simply too small to provide reliable results. Therefore, I keep all water utilities with data in my water utility sample, but I do report results for a sub sample that earn a large percentage of revenues from regulated activities.

Q24. What do you do to overcome the weaknesses of the water utility sample?

A24. To overcome the weaknesses of the water sample, I select a second sample of regulated utilities: gas LDC companies. Gas LDC companies, like water utilities, are regulated by

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[8] To select the water utility sample I include both the Standard and the Small and Mid-Cap Editions of *Value Line Investment Survey and Value Line Investment Survey - Plus Edition.* To select the gas LDC sample I include only the Standard Edition of *Value Line Investment Survey*.

[9] American States Water Co. has had some merger/acquisition activity.

state regulatory bodies, have large distribution investments, and serve a mix of residential, industrial, and commercial customers.

For the gas LDC sample, I also start with *Value Line's* universe of gas distribution companies but in this sample, I only include companies with an investment grade bond rating, no recent mergers or acquisitions, no recent dividend cuts, a high percentage revenues from regulated operations, and no other activity that could cause the estimation parameters to be biased. Additionally, I require the companies to have data from *Value Line*, IBES, and Compustat available.

Q25. What is the sample selection procedure for the gas local distribution companies?

A25. One reason for using the gas LDC sample is to generate a sample of regulated companies whose primary source of revenues is in the regulated portion of the natural gas industry to provide a check for the results of the water sample. Therefore, I started with the universe of publicly traded gas distribution utilities covered by *Value Line Investment Survey*, and eliminated those companies whose revenues from regulated natural gas distribution operations was less than 50 percent. The final sample includes eight companies. I also report results for a subsample of companies characterized by having generated more than 70 percent of their revenue from regulated activities. The subsample consists of four companies. Additional details of the sample selection process for each sample and subsample are described below as well as in Appendix B.

Q26. If the business risk of the gas LDC sample differs from the water sample, can you still rely on the cost of equity estimated for the gas LDC sample?

A26. Yes. If the business and financial risk of the two samples differ, then a cost of capital analyst can still make use of the information from the more reliable sample to evaluate the reliability of the estimates from the water sample. The inference would be based on information about the relative risk of the two industries.

Q27. Please elaborate on the way two samples with different business and financial risks can be compared.

A27. As mentioned above, the overall cost of capital for a part of a company depends on the risk of the business in which the *part* is engaged, *not* on the overall risk of the parent company on a consolidated basis. According to financial economics, the overall risk of a diversified company equals the market value weighted-average of the risks of its components.

Calculating the overall after-tax weighted average cost of capital for each sample company as described above allows the analyst to estimate the average overall cost of capital for the sample. The ATWACC captures both the business risk and the financial risk of the sample companies in one number. This allows comparison of the cost of capital between two samples on a much more informed basis. If the alternative (more reliable) sample is judged to have slightly different risk than the water sample, but the results show wide differences in the ATWACC estimates, the analyst should carefully consider the validity of

the water sample estimates, whether they are materially higher or lower than the alternative sample's estimates. Of course, the alternative sample could be the source of the error, but that is less likely because the alternative sample has been selected precisely because of its expected reliability.

Q28. Please compare the characteristics of the water utility sample and the gas LDC sample.

A28. The two samples differ primarily in that they operate in two different (regulated) industries, but they are very similar in terms of the percentage of revenues from regulated operations and the customers they serve. Both samples earn a large percentage of their revenue from regulated activities and serve a mix of residential, industrial, and other customers. However, the gas LDC sample has fewer of the data and estimation issues identified above for the water sample. Please refer to Appendix B for addition details comparing the two samples.

2. Market-Value Capital Structure

Q29. What capital structure information do you require?

A29. For reasons discussed below and in Appendix D, explicit evaluation of the market-value capital structures of the sample companies is vital for a correct interpretation of the market evidence on the return on equity. This requires estimates of the market values of common equity, preferred equity and debt, and the current market costs of preferred equity and debt.

Q30. Please describe how you calculate the market values of common equity, preferred equity and debt.

A30. I estimate the capital structure for each sample company by estimating the market values of common equity, preferred equity and debt from the most recent publicly available data. The details are in Appendix B.

Briefly, the market value of common equity is the price per share times the number of shares outstanding. For the risk positioning approach, I use the last five trading days of each year to calculate the market value of equity for the year. I then calculate the average capital structure over the corresponding five-year period used to estimate the "beta" risk measures for the sample companies. This procedure matches the estimated beta to the degree of financial risk present during its estimation period. In the DCF analyses, I use the average stock price over 15 trading days ending on the release date of the IBES growth rate forecasts utilized.[10]

The market value of debt is estimated at its book value. Because debt instruments generally are callable in the U.S., I do not expect the market and book value of debt to differ much. The market value of preferred stock for the samples is also set equal to its book value.

[10] IBES growth rates were as of October 17 or 28, 2005 for the water utility companies and as of October 14, 2005 for the gas LDC companies.

3. Market Costs of Debt and Preferred

Q31. How do you estimate the current market cost of debt?

A31. The market cost of debt for each company in the DCF analysis is the current yield reported in the Mergent Bond Record for an index of public utility company bonds with the same rating as the sample company.[11] Bond rating information was obtained from Compustat which reports Standard & Poor's bond ratings.[12] Calculation of the after-tax cost of debt uses the Company's estimated marginal income tax rate of 38.6 percent.

Q32. How do you estimate the market cost of preferred equity?

A32. For all sample companies, the preferred rating was assumed equal to the company's bond rating. The cost of a company's preferred equity was set equal to the yield on an index of preferred utility stock with the same rating. The data were obtained from Mergent Bond Record.

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[11] In the DCF analysis, the companies' current bond rating was used whereas the average bond rating over the past five years was used in the risk positioning models.

[12] For some companies in the water utility sample bond ratings were obtained from Moody's (www.moodys.com) or from Standard & Poor's webpage (www.standardandpoors.com). Details are in Workpaper #1 to Table No. BV-11.

B. COST OF EQUITY ESTIMATION METHODS

Q33. How do you estimate the cost of equity for your sample companies?

A33. Recall that the cost of capital is the expected rate of return in capital markets on alternative investments of equivalent risk. This definition leads me to address three key points in my estimation procedures. First, the cost of capital is an *expected* rate of return, it cannot be directly observed, but must be inferred from available evidence. Second, the cost of capital is determined *in capital markets* (such as the New York Stock Exchange). Therefore, capital market data provide the best evidence from which to draw inferences. Third, the cost of capital depends on the return offered by alternative investments *of equivalent risk*. Consequently, measures of risk that matter in capital markets are part of the evidence that I need to examine.

Q34. How does the above definition help you estimate the cost of capital?

A34. The definition of the cost of capital recognizes a tradeoff between risk and expected return; This is the security market line plotted above in Figure 1 above. Cost of capital estimation methods usually take one of two approaches: (1) they establish the location of the security market line and estimate the relative risk of the security, which jointly determine the cost of capital or (2) they try to identify a comparable-risk sample of companies and estimate the cost of capital directly. Looking at Figure 1, the first approach focuses directly on the

vertical axis, while the second focuses both on the security's position on the horizontal axis and on the position of the security market line.

The first type of approach is more direct, but ignores the wealth of information available on securities not thought to be of precisely comparable risk. The "discounted cash flow" or "DCF" model is an example. The second type of approach, sometimes known as "equity risk premium approach," requires an extra step - - positioning the security market line. Using the second approach allows me to use information from all traded securities rather than just those included in my sample. The capital asset pricing model ("CAPM") is an example. While both approaches can work equally well if conditions are right, one may be preferable to the other under certain circumstances. In particular, approaches that rely on the entire security market line are less sensitive to deviations from the assumptions that underlie the model, all else equal. In this case, I examine both DCF and risk positioning approach evidence for the water utility and gas LDC sample.

1. Risk Positioning Approach

Q35. Please explain the risk positioning method.

A35. The risk positioning method estimates the cost of equity as the sum of a current interest rate and a risk premium. It is therefore sometimes also known as the "risk premium" approach. This approach may sometimes be applied more or less formally. As an example of an informal application, an analyst may estimate the spread between interest rates and what is

believed to be a reasonable estimate of the cost of capital at a specific time, and then apply that spread to current interest rates to get a current estimate of the cost of capital.

More formal applications of the risk positioning approach take full advantage of the security market line depicted in Figure 1: they use information on a large number of traded securities to identify the security market line and derive the cost of capital for the individual security based on that security's relative risk. This reliance on the entire security market line makes the method less vulnerable to the kinds of problems that arise from using one stock at a time (such as the DCF method). The risk positioning approach is widely used and underlies most of the current research published in academic journals on the nature, determinants and magnitude of the cost of capital.

Section I of Appendix B to this testimony provides more detail on the principles that underlie the risk positioning approach. *Section II* of Appendix B provides the details of the risk positioning approach empirical estimates I obtain.

Q36. How are the "more formal" applications of the risk positioning approach implemented?

A36. The first step is to specify the current values of the benchmarks that determine the security market line. The second is to determine the security's, or investment's, relative risk. The third is to specify exactly how the benchmarks combine to produce the security market line, so the company's cost of capital can be calculated based on its relative risk.

a. Security Market Line Benchmarks

Q37. What benchmarks are used to determine the location of the security market line?

A37. The essential benchmarks that determine the security market line are the risk-free interest rate and the premium that a security of average risk commands over the risk-free rate. This premium is commonly referred to as the "market risk premium" ("MRP"), *i.e.*, the excess of the expected return on the average common stock over the risk-free interest rate. In the risk positioning approach, the risk-free interest rate and MRP are common to all securities. A security-specific measure of relative risk (beta) is estimated separately and combined with the MRP to obtain the company-specific risk premium.

Q38. What benchmark do you use for the MRP?

A38. I estimate two versions of the risk positioning model. The first version measures the market risk premium as the risk premium of average-risk common stocks over long-term Government bonds. The second version measures the market risk premium over short-term Treasury bills, which is the usual measure of the MRP used in capital market theories. To determine the cost of capital in a regulatory proceeding, the market risk premium should be used with a *forecast* of the same interest rate (*i.e.*, the short-term or long-term Government bond rate).

Q39. How do you estimate the MRP?

A39. Appendix B summarizes academic and empirical research on the MRP. However, as discussed in the appendix, there is currently little consensus on the "best practice" for estimating the MRP. (Note: this is not the same thing as saying that all practices are equally good). For example, the leading graduate textbook in corporate finance, expresses the view that a range between 5 to 8 percent is reasonable for the U.S.[13] Ibbotson Associates data from 1926 to 2004, the longest period reported, show an MRP average premium of stocks over Treasury bills is 8.6 percent.[14]

My testimony considers both the historical evidence and the results of scholarly studies of the factors that affect the risk premium for average-risk stocks in order to estimate the benchmark risk premium investors currently expect. In particular, I rely on historical differences between the S&P 500 Index ("S&P 500") and the risk-free rate.

Considering all the evidence, I conclude that S&P 500 stocks of average risk today command a premium of 8.0 percent over the short-term risk-free rate and 6.5 percent over the long-term Government rate. The estimation of the MRP is discussed in greater detail in Appendix B.

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[13] Richard A. Brealey, Stewart C. Myers and Franklin Allen, *Principles of Corporate Finance*, 8th ed., New York: McGraw-Hill/Irwin (2005), pp. 151-154.

[14] Ibbotson Associates, "*SBBI: Valuation Edition 2005 Yearbook.*"

Q40. How do you determine the risk-free rate you use?

A40. Ideally, the risk-free rate is the estimated risk-free rate over the period where rates will be in effect. For this proceeding, I use the current yield on long-term Government bonds and 30-day T-bills as an estimate for the long-term and short-term risk-free rate, respectively. Using an average of 15 trading days ending November 25, 2005, I obtain a short-term risk-free rate of 3.9% and a long-term risk-free rate of 4.85%, respectively.[15] The yields on both short-term and long-term government securities have been increasing in recent months and are expected to increase further.[16] Therefore, I believe my risk-free rates, if anything, underestimates risk-free rates going forward.

b. Relative Risk

Q41. What measure of relative risk do you use?

A41. I examine the "beta" of the stocks in question. Beta is a measure of the "systematic" risk of a stock — the extent to which a stock's value fluctuates more or less than average when the market fluctuates.

The basic idea behind beta is that risks that cannot be diversified away in large portfolios matter more than those that can be eliminated by diversification. Beta is a

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[15] See Workpaper #2 to Table No. BV-9.

[16] The Federal Reserve raised interest rates as recently as December 2005 (Press Release, December 13, 2005) and the Annual Energy Outlook 2006 (Early Release), EIA December 12, 2005 forecasts the 10-year Government bond rate to increase to 5.06 percent in 2006 and to 5.19 in 2007.

measure of the risks that *cannot* be eliminated by diversification. This concept is explored further in Appendix B.

Q42. What does a particular value of beta mean?

A42. By definition, a stock with a beta equal to 1.0 has average non-diversifiable risk: it goes up or down by 10 percent on average when the market goes up or down by 10 percent. Stocks with betas above 1.0 exaggerate the swings in the market: stocks with betas of 2.0 tend to fall 20 percent when the market falls 10 percent, for example. Stocks with betas below 1.0 are less volatile than the market. A stock with a beta of 0.5 will tend to rise 5 percent when the market rises 10 percent.

Q43. How do you estimate beta?

A43. For both samples, I use betas reported by *Value Line* for reasons discussed below.

c. Cost of Equity Capital Calculation

Q44. How do you combine the preceding steps to estimate the cost of equity?

A44. The most widely used approach to combine a risk measure with the benchmark market risk premium on common stocks to find a risk premium for a particular firm or industry is the Capital Asset Pricing Model. However, the CAPM is only one risk positioning technique.

In addition to the CAPM, I rely on an empirical variety of the model. Empirical research has long shown that the CAPM tends to overstate the actual sensitivity of the cost of capital to beta: low-beta stocks tend to have higher risk premia than predicted by the CAPM and high beta stocks tend to have lower risk premia than predicted. A number of variations on the original CAPM theory have been proposed to account for this finding.

This finding can be used directly to estimate the cost of capital, using beta to measure relative risk, without simultaneously relying on the CAPM. Here I examine results from both the CAPM and a version of the security market line based on the empirical finding that risk premia are related to beta, but are not as sensitive to beta as the CAPM predicts, to convert the betas into a risk premium. I refer to this latter model as the "ECAPM," where ECAPM stands for *Empirical* Capital Asset Pricing Model. The formula for the ECAPM is

$$k = r_f + \alpha + \beta \times (MRP - \alpha) \quad (1)$$

where k is the cost of capital, r_f is the risk-free interest rate, MRP is the market risk premium, β is the measure of relative risk, and α is the empirical adjustment factor.

Research supports values for α of from one to seven percent when using a short-term interest rate. I use baseline values of α of 2 percent for the short-term risk-free rate and 0.5 percent for the long-term risk-free rate. I also conduct sensitivity tests for different values of α. For the short-term risk-free rate I use values for α of 1, 2 and 3 percent. For the long-term risk-free rate I use values for α of 0, 0.5 and 1.5 percent. See Appendix B for a more

detailed discussion of the ECAPM model and Table B-1 for a summary of the empirical evidence on the size of the required adjustment.

Q45. Why is it appropriate to use the ECAPM model?

A45. Empirical tests of the CAPM have repeatedly shown that an investment's return is related to systematic risk, but that the increase in return for an increase in risk is *less* than is predicted. The empirical tests have also shown that the theoretical intercept, as measured by the return on Treasury bills, is too low to fit the data. In other words, the empirical tests indicate that the slope of the CAPM is too steep and the intercept is too low. The empirical data support the ECAPM. The ECAPM recognizes the consistent empirical observation that the CAPM underestimates (overestimates) the cost of capital for low (high) beta stocks. The ECAPM corrects the predictions of the CAPM to more closely match the results of the empirical tests. Ignoring the results of CAPM tests would lead to an estimate of the cost of capital that is likely to be less accurate than is possible.

Q46. Is the use of the ECAPM equivalent to adjusting the estimated betas for the sample companies?

A46. No. Fundamentally, this is *not* an adjustment (increase) in beta. This can easily be seen by the fact that the expected return on high beta stocks is lower with the ECAPM than when estimated by the CAPM. The ECAPM model is a recognition that the actual slope of the

risk-return tradeoff is flatter than predicted and the intercept higher based upon repeated empirical tests of the model.[17] Even if the beta of the sample companies were estimated accurately, the CAPM would still underestimate the required return for low beta stocks. Even if the ECAPM were used, the costs of equity would be underestimated if the betas were underestimated.

2. Discounted Cash Flow Method

Q47. Please describe the discounted cash flow approach.

A47. The DCF model takes the first approach to cost of capital estimation, i.e., to attempt to estimate the cost of capital in one step. The method assumes that the market price of a stock is equal to the present value of the dividends that its owners expect to receive. The method also assumes that this present value can be calculated by the standard formula for the present value of a cash flow stream:

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \ldots + \frac{D_T}{(1+k)^T} \qquad (2)$$

where "P_0" is the current market price of the stock; "D_i" is the dividend cash flow expected at the end of period I; "k" is the cost of capital; and "T" is the last period in which a dividend cash flow is to be received. The formula just says that the stock price is equal to the sum of

[17] Many investment firms make an adjustment to the beta. A commonly used adjustment is the Merrill Lynch adjustment which adjusts betas 1/3 towards one. This type of adjustment is intended to compensate for sampling errors in the beta estimation, not for empirical fact that CAPM tend to overestimate the sensitivity of the cost of capital to beta. See Appendix B for a more detailed explanation.

the expected future dividends, each discounted for the time and risk between now and the time the dividend is expected to be received.

Most DCF applications go even further, and make very strong (*i.e.*, unrealistic) assumptions that yield a simplification of the standard formula, which then can be rearranged to estimate the cost of capital. Specifically, if investors expect a dividend stream that will grow *forever* at a steady rate, the market price of the stock will be given by a very simple formula,

$$P_0 = \frac{D_1}{(k - g)} \tag{3}$$

where "D_1" is the dividend expected at the end of the first period, "g" is the perpetual growth rate, and "P_0" and "k" are the market price and the cost of capital, as before. Equation (3) is a simplified version of Equation (2) that can be solved to yield the well known "DCF formula" for the cost of capital:

$$k = \frac{D_1}{P_0} + g = \frac{D_0 \times (1 + g)}{P_0} + g \tag{4}$$

where "D_0" is the current dividend, which investors expect to increase at rate g by the end of the next period, and the other symbols are defined as before. Equation (4) says that if Equation (3) holds, the cost of capital equals the expected dividend yield plus the (perpetual) expected future growth rate of dividends. I refer to this as the simple DCF model. Of

course, the "simple" model is simple because it relies on very strong (*i.e.*, very unrealistic) assumptions.

Q48. Are there other versions of the DCF models besides the "simple" one?

A48. Yes. There are many variations on the DCF models that may rely on less strong assumptions in that they allow growth rates to vary over time. I consider a variant of the DCF model that uses the companies' individual growth rates during the first five years, converges to a perpetual growth rate in years 6-10 and then uses the GDP growth rate as the perpetual growth rate after year 10 for all companies. This is a variant of the "multi-stage" DCF method. The DCF models are described in detail in *Section I* of Appendix C. (*Section II* of Appendix C provides the details of my empirical DCF results.)

Q49. What are the merits of the DCF approach?

A49. The DCF approach is conceptually sound if its assumptions are met, but can run into difficulty in practice because those assumptions are so strong, and hence so unlikely to correspond to reality. Two conditions are well known to be necessary for the DCF approach to yield a reliable estimate of the cost of capital: the variant of the present value formula that is used must actually match the variations in investor expectations for the dividend growth path; and the growth rate(s) used in that formula must match current investor expectations. Less frequently noted conditions may also create problems. (See Appendix C for details.)

Q50. Do you agree that estimating the right growth rate is the most difficult part for the implementation of the DCF approach?

A50. Yes. Finding the right growth rate(s) is the usual "hard part" of a DCF application. The original approach to estimation of *g* relied on average historical growth rates in observable variables, such as dividends or earnings, or on the "sustainable growth" approach, which estimates *g* as the average book rate of return times the fraction of earnings retained within the firm. But it is highly unlikely that these historical averages over periods with widely varying rates of inflation and costs of capital will equal current growth rate expectations. This is particularly true for the water sample as many companies in the industry are engaged in merger, acquisition or other restructuring activities.

Moreover, the constant growth rate DCF model *requires* that dividends and earnings grow at the same rate for companies that earn their cost of capital on average.[18] It is inconsistent with the theory on which the model is based to have different growth rates in earnings and dividends over the period when growth is assumed to be constant. If the growth in dividends and earnings were expected to vary over some number of years before settling down into a constant growth period, then it would be appropriate to estimate a

[18] Why must the two growth rates be equal in a steady-growth DCF model? Think of earnings as divided between reinvestment, which funds future growth, and dividends. If dividends grow faster than earnings, there is less investment and slower growth each year. Sooner or later dividends will equal earnings. At that point, growth is zero because nothing is being reinvested (dividends are constant). If dividends grow slower than earnings, each year a bigger fraction of earnings are reinvested. That makes for ever faster growth. Both scenarios contradict the steady-growth assumption. So if you observe a company with different expectations for dividend and earnings growth, you know the company's stock price and its dividend growth forecast are inconsistent with the assumptions of the steady-growth DCF model.

multistage DCF model. In the multistage model, earnings and dividends can grow at different rates, but *must* grow at the same rate in the final, constant growth rate period. A difference between forecasted dividend and earnings rates therefore is a signal that the facts do not fit the assumptions of the simple DCF model.

Q51. How do you estimate the growth rates you use in your DCF analysis?

A51. I use earnings growth rate forecasts from IBES and *Value Line*. Analysts' forecasts are superior to using single variables in time series forecasts based upon historical data as has been documented and confirmed extensively in academic research. Please see *Section I* in Appendix C for a detailed discussion on this issue.

Q52. Are you aware that the Commission staff typically relies on an average of historical growth rates of earnings and dividends as well as forecasts of earnings and dividend growth rates to estimate the growth rate for the DCF model?

A52. Yes, but I do not believe that this is the best way to estimate the growth rate for use in the DCF model for the following reasons. First, as mentioned above, the model requires that dividends and earnings grow at the same rate at some point in the future in order to apply the model. The data on historical growth rates do not confirm this condition. Second, analysts have access to historical information and include that information in their forecast of

earnings growth rates. In other words, using historical data provides no additional information to that captured in analyst forecasts.

Finally, averaging wildly different growth rate estimates in the hopes of having the extremes cancel out calls into question whether the DCF model is applicable at this time to the sample companies.

Q53. What about the evidence that analyst earning growth forecasts have been optimistic (over estimated earnings and dividend growth) in the past?

A53. Although analyst forecasts have been optimistic on average in the past, this problem is less acute for regulated companies.[19] In addition, the use of a two-stage DCF model that substitutes the forecast growth of GDP mitigates analyst optimism by substituting the GDP growth rate for the potentially optimistic (or pessimistic) earnings forecasts of analysts.

Q54. How well are the constant-growth rate conditions necessary for the reliable application of the DCF likely to be met for the sample companies at present?

A54. The requisite conditions for the sample companies are not fully met at this time, particularly for the water sample. Of particular concern for this proceeding is the uncertainty about what investors truly expect the long-run outlook for the sample companies to be. The longest time period available for growth rate forecasts of which I am aware is five years. The long-run

[19] See, for example, L. K.C. Chan, J. Karceski, and J. Lakonishok (2003), "The Level and Persistence of Growth Rates," *Journal of Finance* 58(2), pp. 643-684.

growth rate (*i.e.*, the growth rate after the water industry settles into a steady state, which may be *beyond* the next five years for this industry) drives the actual results one gets with the DCF model. Unfortunately, this implies that unless the company or industry in question is stable, so there is little doubt as to the growth rate investors expect, DCF results in practice can end up being driven by the subjective judgment of the analyst who performs the work.

Of the eight companies in the water sample, two have no long-term IBES growth rates and three companies have three or fewer analysts providing forecasts (from *Value Line* or IBES).[20] The average long-term earnings forecasts vary from a low of 6.0 percent to a high of 9.7 percent. Additionally, the analysts' forecast for individual companies range widely. For example, growth forecasts for American States Water vary from 3.0 to 13.1 percent.[21] The growth rates for gas LDC sample vary less from an average of 4.3 to 7.1 percent and are consistent with the GDP growth forecast of 5.5 percent. However, this sample also includes companies for which analysts' forecasts vary widely. For example, analysts forecasts for Southwest Gas vary from 3.0 to 13.3 percent.[22] Of the eight companies in the gas LDC sample, five companies have three or fewer analysts' growth forecast. Thus, as discussed above the available data are far from being ideal. As discussed above, the two-stage DCF model adjusts for any over optimistic (or pessimistic) growth rate forecasts by

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[20] See Table BV-5 for details.

[21] See Table No. BV-5 and American States Water Co. IBES Tearsheet as of October 28, 2005. Note also that Southwest Water Co. has a medium IBES forecast of 7.0 percent but a Value Line forecast of 20.3 percent.

[22] See Table No. BV-15 and Southwest Gas IBES Tearsheet as of October 14, 2005.

adjusting the 5-year growth rate forecasts of the analysts toward the long-term GDP growth rate in the years after year 5. See Appendix C, *Section I* for a discussion of the two-stage model.

The DCF growth rates whether estimated from historical data or from analyst forecasts are likely to be affected by the fact that there has been a number of mergers and acquisitions in the water industry in recent years, and the industry is showing signs of becoming globalized.[23] Thus, the industry appears to be moving towards a larger degree of consolidation – at least among the privately held water utilities. Additionally, new environmental regulation may impact the industry as standards for water quality evolve over time, and there is potential for new safety and security requirements in the future. The industry has no federal regulator (other than for environmental and health issues), and state public utility commissions regulate most investor owned water utilities. Different regulatory bodies may lead to differing regulatory requirements for companies operating in adjacent parts of the country. Taken together, these factors mean that it may be some time before the

[23] Philadelphia Suburban (renamed Aqua America) completed the acquisition of AquaSource for about $195 million in July 2003. The company also acquired or merged with several local water utilities. Additionally, American Water Works acquired National Enterprises, Inc., Azurix, and the water and wastewater utility assets of Citizens Utilities. American Water Works, in turn, was acquired by RWE AG on January 10, 2003. Recently, the parent of American Water, RWE, has decided to sell American Water. Domestic energy companies have also invested in the water utility business, although presently many of those investments have or will be sold. Allete has sold its assets in Florida and North Carolina; Indianapolis Water Company was sold by NISource; Suez Lyonnaise des Eaux purchased the remaining shares of United Water Resource that it did not already own; and Thames Water purchased E'Town Corporation. (Sources: *Value Line Investment Survey*, January 30, 2004, *The Business Journal* and company web sites)

water industry settles into anything investors will see as a stable equilibrium necessary for the reliable application of the DCF model.

Such circumstances imply that a commission may often be faced with a wide range of DCF estimates, none of which can be well grounded in objective data on true long-run growth expectations, *because no such objective data now exist.* DCF for firms or industries in flux is *inherently* subjective with regard to the most important parameter, the long-run growth rate, that drives the answer.

In short, the unavoidable questions about the DCF model's strong assumptions cause me to view the DCF method as *inherently* less reliable than the risk positioning approach described above. This is particularly true because of the data problems discussed above. However, because the DCF method has been widely used in the past, I submit DCF evidence in this case. DCF estimates also serve as a check on the values provided by the risk positioning methods.

In this proceeding, I give little weight to the DCF results. However, I use the results as a check on the reasonableness of my risk positioning estimates.

C. THE SAMPLES AND RESULTS

1. The Water Utility Sample

Q55. Earlier you said that the sample of water utilities had serious data weaknesses. Please elaborate on these weaknesses.

A55. In attempting to apply the DCF model to the sample, two companies had no long-term growth forecasts from IBES and among the remaining six companies, two had no *Value Line* growth forecasts. The lack of data means that the discounted cash flow model only can be applied to six companies. Of these companies, the estimated cost of capital is based on three or fewer analysts for three of the companies. A similar lack of data exists when looking at the companies' bond ratings. For two of the eight companies, neither a Moody's nor a Standard and Poor's ("S&P") bond rating was found.[24]

The size of the companies in the water sample also makes cost of capital estimation difficult. Currently, only three companies have more than $500 million in market value of equity. More important, however, is the fact that the stock of these companies trades relatively infrequently. For example, three of the eight water utilities traded an average of less than 10,000 shares per trading day during the last five days of 2004 as well as during the year. Only Aqua America and Southwest Water had an average trading volume above 50,000 shares per day in 2004. This compares to an average trading volume of approximately 139,000 shares for the companies in the gas LDC sample.[25] Low trading

[24] For two of the six companies with a Moody's or Standard and Poor's bond rating, the bond rating was only found for some years during the most recent 5-year period. The rating for periods for which no bond rating was found was set equal to the rating for later periods. For companies without a bond rating, an A-rating is used in the analysis. The A-rating is consistent with the average for companies listed as water utilities in *Value Line* and followed by either Moody's or Standard and Poor's. Bond ratings were obtained from Compustat, www.standardandpoors.com, www.moodys.com, Mergent Bond Record, and S&P's Bond Rating books.

[25] Trading volume varies substantially within the gas LDC sample with KeySpan trading being by far the largest volume per day. The average trading volume of the gas LDC sample without KeySpan is around 87,500 shares per day.

volume causes concern because there may be a delay between the release of important information and the time that this information is reflected in prices. Such delay is well known to cause beta estimates to be statistically insignificant and possibly biased.

In addition to lack of data and the small size of the companies, there are firm-specific events that render the water utility sample less reliable than would be ideal. First, Aqua America (the largest of the companies) has gone through several mergers and acquisitions in recent years. Normally, I would not include companies with significant merger or acquisition activity in a sample because the individual information about the progress of the proposed merger is so much more important for the determination of the company's stock price than day-to-day market fluctuations. In practice, beta estimates for such companies tend to be too low. The growth rates for such companies may also be affected. Second, Southwest Water Co. earns only approximately 40 percent of its revenue from regulated activities. I therefore also report my results for the subsample of companies that do not include Southwest Water Co.

It is because of these weaknesses in the water sample that I also utilize a sample of natural gas LDCs.

The selection procedure for this sample was summarized earlier and details are provided in Appendix B.

2. Risk Positioning Cost of Capital Estimates

Q56. How is your testimony on the risk positioning approach cost of capital estimates organized?

A56. This section first describes the input data used in the CAPM and ECAPM models, then reports the resulting cost of equity estimates for the samples. The second section of Appendix B details the empirical analysis.

a. Interest Rate Forecasts

Q57. How did you determine the expected risk-free interest rate?

A57. As discussed above, I reviewed current constant maturity U.S. Government bond yield data available from the St. Louis Federal Reserve Bank. For the period November 3 to November 25, 2005, the average yield on 30-day Treasury bills was 3.91 percent and the average yield on long-term government bonds was 4.84 percent.[26] The Federal Reserve ("Fed") recently raised the federal funds rate to 4 ¼ percent, and the press releases associated with the increase, the Fed suggested that "further measured policy firming is likely to be needed ..."[27] Similarly, interest rate forecasts from the Energy Information Agency ("EIA") indicates that

[26] See Workpaper #2 to Table No. BV-9.

[27] Federal Reserve Board, Press Release, December 13, 2005.

the EIA expects rates to increase.[28] Therefore, I believe that my estimate of 3.9 percent and 4.85 percent for the short-term and long-term risk-free rates, respectively, are, if anything, underestimating the expected risk-free rates going forward.

b. Betas and the Market Risk Premium

Q58. What beta estimates did you use in your analysis for the samples?

A58. I rely upon the most recent betas estimated by *Value Line* for both the water sample and for the gas LDC sample.

Q59. Are the beta values reported by *Value Line* adjusted betas?

A59. Yes. *Value Line* reports betas that are adjusted about 1/3 towards one. For this proceeding, I reverse the *Value Line* adjustment. *Value Line* and many investment firms adjust the estimated betas. This type of adjustment is intended to compensate for sampling errors in the beta estimation, not for the empirical fact that the CAPM tends to overestimate the sensitivity of the cost of capital to beta. I use adjusted betas when the sample companies display statistically significant sensitivity to interest rate changes. Neither of the two samples in this proceeding display such sensitivity at this time, so I reverse the adjustment process to get "unadjusted" beta values.

[28] See The Annual Energy Outlook 2006 (Early Release), EIA December 12, 2005.

Q60. Please summarize the beta estimates you rely on.

A60. After reversing the *Value Line* adjustment procedure, the average estimated *Value Line* beta for the water sample is about .49 while the average for the gas LDC sample is about .59. The beta estimates for the sample companies are reported in Workpaper #1 to Tables No. BV-9 and BV-19.

Q61. What value do you use for the market risk premium?

A61. For the premium over the short-term risk-free interest rate I use 8.0 percent, while for the premium over the long-term risk-free interest rate I use 6.5 percent, for the reasons discussed above and in Appendix B.

Q62. Please explain the method to adjust for differences in capital structure.

A62. Starting with the ATWACC, the cost of equity for any capital structure within a broad range of capital structures can be determined by the following formula:

$$\text{Return on equity} = \frac{\text{ATWACC - Return on debt} \times \text{\% debt in capital structure} \times (1 - \text{tax rate})}{\text{\% equity in capital structure}}$$

This is the calculation that is displayed in Tables No. BV-11 and BV-21. The tables display the result of converting the sample average ATWACC to a return on equity for a specific capital structure. It is straightforward to determine the cost of equity consistent with capital structure utilizing this method.

c. Risk Positioning Results

Q63. What are the cost of equity estimates derived from the risk positioning approach for the water sample?

A63. Using the long-term interest rate in the two risk positioning models (CAPM and ECAPM), with two values of the ECAPM parameter (0.5% and 1.5%), I obtain three estimates of each sample company's cost of equity (Tables No. BV-9 and BV-19). The cost of equity estimates are combined with the estimates of the company's cost of debt and preferred to calculate the company's ATWACC (Tables No. BV-10 and BV-20). Tables No. BV-11 and BV-21 combines the sample average ATWACC with Mohave's capital structure, cost of debt, and tax rate to obtain the cost of equity at Mohave 's 40 percent equity. Panel A shows the cost of equity and ATWACC value for all water sample companies, while Panel B shows the results for the subsample of companies with significant revenue from regulated water utility activities. The cost of equity results are shown below in Table 2 below. Comparable ATWACC results are in Table B-2 at the end of Appendix B.

Table 2: Panel A

Risk Positioning Cost of Equity for All Companies in the Water Utility and Gas LDC Samples

Using Long-Term Risk-Free Rate	Water Utility	Gas LDC
CAPM	11.1%	11.1%
ECAPM (α = 0.5%)	*11.5%*	*11.4%*
ECAPM (α = 1.5%)	12.4%	12.0%

Source: Tables No. BV-11 and BV-21, Panel A.

Table 2: Panel B

Risk Positioning Cost of Equity for Companies with a High Percentage Regulated Revenue in the Water Utility and Gas LDC Samples

Using Long-Term Risk-Free Rate	Water Utility	Gas LDC
CAPM	11.2%	10.7%
ECAPM (α = 0.5%)	*11.6%*	*11.0%*
ECAPM (α = 1.5%)	12.5%	11.6%

Source: Table No. BV-11 and BV-21, Panel B.

Using the short-term interest rate in the two risk positioning models (CAPM and ECAPM) and using different values for the ECAPM parameter, α, I obtain four estimates

of each sample companies' cost of equity. These estimates are also displayed in Tables No. BV-11 and BV-21. As for the long-term interest rate, I summarize the cost of equity results below in Table 3. ATWACC results are displayed in Table B-2 in Appendix B.

Table 3: Panel A

Risk Positioning Cost of Equity for All Companies in the Water Utility and Gas LDC Samples

Using Short-Term Risk-Free Rate	**Water Utility**	**Gas LDC**
CAPM	10.7%	11.0%
ECAPM (α = 1%)	*11.6%*	*11.6%*
ECAPM (α = 2%)	12.4%	12.2%
ECAPM (α = 3%)	13.3%	12.8%

Source: Tables No. BV-11 and BV-21, Panel A.

Table 3: Panel B

Risk Positioning Cost of Equity for Companies with a High Percentage Regulated Revenue in the Water Utility and Gas LDC Samples

Using Short-Term Risk-Free Rate	Water Utility	Gas LDC
CAPM	11.3%	10.6%
ECAPM (α = 1%)	*12.1%*	*11.2%*
ECAPM (α = 2%)	12.9%	11.8%
ECAPM (α = 3%)	13.7%	12.3%

Source: Table No. BV-11 and BV-21, Panel B.

Q64. Please summarize your findings from the risk positioning model.

A64. Focusing on the middle ECAPM (α = .50% for the long-term model and α = 1% for the short-term model), I find that the water sample's cost of equity of bit above 11½ percent. However, it is more correct to say that the sample results indicate a range of values from about 11¼ to 11¾ percent. Looking at the gas LDC sample the average cost of equity estimates fall in the range of approximately 11 to 11¾ percent. While the gas LDC subsample's cost of equity estimate is below that of the full sample this result is driven entirely by one company, Southwest Gas, that appears to be in flux.[29] If I look at the

[29] Current IBES and *Value Line* growth forecasts for Southwest Gas vary widely (See Table No. BV-15). Additionally, a merger was proposed and cancelled in 2000-01.

subsample without Southwest Gas, the resulting cost of equity estimates are 50 to 60 basis points higher and comparable to those for the full gas LDC sample. Because the subsample's results are driven by one company (without which the results are comparable to those for the full sample), I give results obtained from the full gas LDC sample's the most weight. I discuss the assessment of Mohave's cost of equity in the concluding section.

3. The DCF Cost of Capital Estimates

Q65. What steps do you take in your DCF analyses?

A65. Given the above discussion of DCF principles, the steps are to collect the data, estimate the sample companies' costs of equity at their current capital structures, and then to adjust the sample's estimates to Mohave's 40 percent equity ratio.

a. Growth Rates

Q66. What growth rate information do you use?

A66. For reasons discussed above and in Appendix C, historical growth rates today are not as relevant as forecasted of current investor expectations for these samples. I therefore use rates forecast by security analysts.

The ideal in a DCF application would be a detailed forecast of future dividends, year by year well into the future until a true steady state (constant) dividend growth rate was

reached, based on a large sample of investment analysts' expectations. I know of no source of such data. Dividends are ultimately paid from earnings, however, and earnings forecasts from a number of analysts are available for a few years. Investors do not expect dividends to grow in lockstep with earnings, but for companies for which the DCF approach can be used reliably (*i.e.*, for relatively stable companies whose prices do not include the option-like values described in Appendix C), they do expect dividends to track earnings over the long-run. Thus, use of earnings growth rates as a proxy for expectations of dividend growth rates is a common practice.

Accordingly, the first step in my DCF analysis is to examine a sample of investment analysts' forecasted earnings growth rates from IBES and *Value Line* to the degree such forecasts are available. The details are in Appendix C. At present, *Value Line* data run through a 2008-2010 horizon which represents on average about a 4 year forecast (from the 4th quarter of 2005 to the end of 2009). IBES also provides a long-term earnings growth rate estimates. The longest-horizon forecasted growth rates from these sources underlie the simple DCF model (*i.e.*, the standard perpetual-growth model associated with the "DCF formula," dividend yield plus growth). Unfortunately, the longest growth forecast data only go out four to five years, which is too short a period to make the DCF model completely reliable.

b. Dividend and Price Inputs

Q67. What values do you use for dividends and stock prices?

A67. Dividends are for the 2nd quarter of 2005, the most recent dividend information available at the time of estimation.[30] This dividend is grown at the estimated growth rate and divided by the price described below to estimate the dividend yield for the simple DCF model.

Stock prices are an average of closing stock prices for the 15-day trading period ending on the day the IBES forecast is released. A 15-day stock price average is used to guard against anomalous price changes in any single day.

c. DCF Results

Q68. What are the DCF estimates for the samples?

A68. The data are used in the two versions of the DCF method to get sample company estimates at the sample company's capital structure. The resulting cost of equity at Mohave's 40 percent equity capital structure are shown in Table 4 below. These results are much higher on average than the risk positioning approach results. Corresponding ATWACC figures are shown in Appendix B.

[30] The 2nd quarter 2005 dividend information was obtained from Compustat.

Table 4: Panel A
Discounted Cash Flow Cost of Equity Estimates
for All Companies
in the Water Utility and Gas LDC Samples

	Water Utility	Gas LDC
Simple DCF Method (Quarterly)	15.4%	13.0%
Multi-Stage DCF Using the Long-Term GDP Forecast as the Perpetual Rate	12.1%	13.5%

Source: Tables No. BV-8 and BV-18.

Table 4: Panel B

Discounted Cash Flow After-Tax Weighted-Average Cost of Capital Estimates
for Companies with a High Percentage Regulated Revenue
in the Water Utility and Gas LDC Samples

	Water Utility	Gas LDC
Simple DCF Method (Quarterly)	15.1%	12.8%
Multi-Stage DCF Using the Long-Term GDP Forecast as the Perpetual Rate	12.5%	12.7%

Source: Tables No. BV-8 and BV-18.

Q69. Please summarize your findings from the DCF model.

A69. The results from the DCF model are uniformly higher than the results from the risk positioning model. The simple and multi-stage DCF results vary greatly for the water

sample while the results are comparable for the gas LDC sample. While I do not believe the DCF results are fully reliable at this time, I view the estimates as a confirmation that (1) the gas LDC sample provides more stable results than do the water utility sample and (2) the risk positioning results are reasonable.

MOHAVE'S COST OF EQUITY

Q70. What conclusions do you draw from the above data regarding each sample's cost of equity at Mohave's 40 percent equity ratio?

A70. The estimated costs of equity from the DCF model are substantially higher than the estimates from the risk positioning model for both samples. The simple DCF model that relies on company-specific growth rate forecasts vary significantly among companies and are less reliable because the long-run growth rate forecast drives the results, and there are *no* objective data on the long-run growth rate investors truly expect, *nor* on when the industry is expected to settle down into some sort of stable-growth equilibrium.

The cost of equity estimates that rely on the multi-stage DCF model are also uniformly higher than the risk positioning estimates for both samples. Although I do not rely upon the DCF model results for the water sample, I believe that DCF cost of capital estimates provide a useful check on the risk positioning results for the gas LDC sample. The uniformly higher DCF results suggest that the risk positioning estimates may be downward biased for the gas LDC sample.

Q71. Do you have any comments regarding the results of the risk positioning models?

A71. Yes. The relative risk measure, beta, used in the models is derived from 260 weeks (5 years) of historical data. Ordinarily, using historical data to estimate beta is not a serious problem because the overall business risk of an industry probably does not change rapidly. For an industry undergoing major changes, however, the beta estimates based upon the historical data may not capture the full changes in risk in the industry. This is true even though information on the probability and provisions of industry changes have been available some months ago. However, as explained in Appendix B, such "decoupling" of beta from the market appears to be a common feature of industries undergoing structural changes. This factor also suggests that the risk positioning estimates may be downward biased and is consistent with the information from the DCF models.

Q72. Given your view of the current value of the DCF method for this industry, what conclusions do you draw from the risk positioning results?

A72. The risk positioning results are summarized above in Tables 2 and 3. Of those results, the CAPM values deserve the least weight, because this method does not adjust for the empirical finding that the cost of capital is less sensitive to beta than predicted by the CAPM (which my testimony considers by using the ECAPM). Conversely, the ECAPM numbers deserve the most weight, because this method adjusts for the empirical findings. The cost of equity

estimates at a 40 percent equity thickness range from 10.7 to 13.7 percent for the water sample and subsample and from 10.6 to 12.8 percent for the gas LDC sample and subsample.

Focusing on the middle ECAPM (α = .50% for the long-term model and α = 1% for the short-term model), I find that for the full sample the cost of equity estimates for the water sample are 11.5 and 11.6 percent for the long-term and short-term estimate, respectively. For the gas LDC sample's these estimates are 11.4 and 11.6 percent. For the water sample, the estimates for the subsample are higher at 11.6 to 12.1 percent. The gas LDC subsample's estimates are lower at 11 to 11.2 percent. The lower results for the gas LDC subsample are driven by one company, Southwest Gas. If Southwest Gas is removed from the subsample, the results are comparable to those for the full sample. However, it is more correct to say that the estimates fall in a range. For both the water utility and gas LDC samples, a reasonable range is 11¼ to 11¾ percent with a midpoint of 11½ percent. The corresponding ATWACC is between 6½ and 6¾ percent which is consistent with Table Nos. BV-10 and BV-20. Because the water subsample exhibits slightly higher estimates than do the full sample while the gas LDC subsample exhibits slightly lower estimates than the full sample, it is difficult to draw a conclusion regarding the impact of having a higher percentage of regulatory revenues. This is particularly so because the results from the gas LDC subsample are driven by one company, Southwest Gas. If the company is removed from the subsample, the results become comparable to those for the full sample.

Based upon the evidence, the point estimates for the cost of equity for both samples is 11½ percent. Although the gas LDC subsample results are slightly lower than the full sample, I rely on the estimate for the full sample for the gas LDC sample because of subsample's results are driven by one company. In addition, the DCF results indicate that the cost of equity is, if anything, higher than estimated by the risk positioning methods. However, it is more correct to say that the cost of equity range is best approximated by a range of 11¼ to 11¾ for both samples. The corresponding point estimate for the overall cost of capital is between 6½ and 6¾ percent (6¼ to 7 percent range) for a capital structure with 40 percent equity.

As previously noted, in estimating the cost of equity I round to the nearest ¼ percent (25 basis points) because I do not believe that cost of capital estimates can be made more precisely than that.

Q73. Did you consider any other evidence when assessing the reasonableness of Mohave's requested 11.5 percent return on equity?

A73. Yes. I reviewed recent water utility decisions from the Arizona Corporation Commission and compared the rates of return on equity and the capital structures to Mohave's regulatory capital structure.

Q74. Please explain this procedure.

A74. I obtained data on ten recent Arizona decisions on water and wastewater utilities from the Company. This data is summarized in Table 5 below.

Table 5
Capital Structure and Allowed Rate of Return on Equity
in Recent Arizona Water Decisions

	Decision	Date	Common Equity	Allowed Rate of Return on Equity
Arizona Water Company	66849	03/2004	66.2%	9.2%
Bella Vista Water Company	65350	11/2002	68.1%	9.1%
Rio Rico Utilities	67279	10/2004	100.0%	8.7%
Las Quintas Serenas Water Co	67455	01/2005	100.0%	8.1%
Arizona Water Company	68302	11/2005	73.4%	9.1%
Clearwater Utilities	66782	02/2004	100.0%	9.1%
Arizona-American Water	67093	06/2004	39.9%	9.0%
Chaparral City Water	68176	09/2005	58.8%	9.3%
Forest Highlands	67983	07/2005	100.0%	8.1%
Pineview Water	67989	07/2005	51.0%	8.9%
Average			75.7%	8.9%
Average*			63.5%	9.1%

Source: Arizona-American Water.
* Excludes companies with 100 percent equity and Arizona-American Water.

Mohave's regulatory capital structure consists of 40 percent equity which is significantly lower than that of all but one company in the table. Therefore, Mohave has more market risk than most of the companies listed in Table 5. Consequently, the allowed return on equity for Mohave needs to be higher. To determine exactly how much higher, I calculate the ATWACC that corresponds to the capital structures and cost of equity in Table 5 using Mohave's current cost of debt and tax rate. I then determine the cost of equity that correspond to the calculated ATWACC at Mohave's 40 percent equity.[31] The result of this calculation is shown in Table 6 below.

[31] In performing this calculation, I assume that the rate base equals net book value. I understand that this in not true in Arizona but believe rates are calculated in a manner that produces similar results.

Table 6
Rate of Return on Equity that Provides the Same Cost to Customers at Mohave's 40% Equity Ratio as Allowed in Recent Arizona Water Decisions

Decision	Date	Common Equity	Allowed Rate of Return on Equity	Implied ATWACC	Implied Rate of Return at 40% Equity
66849	03/2004	66.2%	9.2%	7.2%	12.9%
65350	11/2002	68.1%	9.1%	7.3%	13.1%
67279	10/2004	100.0%	8.7%	8.7%	16.7%
67455	01/2005	100.0%	8.1%	8.1%	15.2%
68302	11/2005	73.4%	9.1%	7.6%	13.9%
66782	02/2004	100.0%	9.1%	9.1%	17.7%
67093	06/2004	39.9%	9.0%	5.6%	9.0%
68176	09/2005	58.8%	9.3%	6.9%	12.1%
67983	07/2005	100.0%	8.1%	8.1%	15.2%
67989	07/2005	51.0%	8.9%	6.2%	10.4%
		75.7%	8.9%	7.5%	13.6%
		63.5%	9.1%	7.0%	12.5%

Sources: Columns 1 through 4: Arizona American. Column 5 was calculated using Mohave's current cost of debt and tax rate. Column 6 was calculated using the ATWACC in Column 5 and Mohave's regulatory capital structure, cost of debt, and tax rate.

*) Excludes companies with 100 percent equity and Decision 67093.

Q75. What are the implications of Table 6?

A75. Ignoring companies with no debt and Arizona-American Water, the average rate of return on equity was 12.5 percent when measured at 40 percent equity. Therefore, if the Commission believes that Mohave's overall business risk is similar to that of the companies in Table 5, then Mohave's cost of equity is 12.5 percent.[32]

Q76. Based on the evidence what is your conclusion regarding Mohave's request for a 11.5 percent return on equity?

A76. Based on the results from my cost of capital estimation procedures and the evidence from recent Arizona decisions on water utilities' cost of equity, I conclude that an 11.5 percent return on equity is reasonable at 40 percent equity.

Q77. Does this conclude your testimony?

A77. Yes.

[32] I exclude companies with extreme capital structures from this analysis as I believe the ATWACC is flat only within a broad range of non-extreme capital structures. At extreme levels of debt or equity the ATWACC may be increasing/decreasing in the level of debt. I exclude Arizona-American to avoid comparing Mohave to its parent.

APPENDIX A: QUALIFICATIONS OF BENTE VILLADSEN

Bente Villadsen's work concentrates in the areas of finance and accounting. Her work has included analyses of the cost of capital, cost-of-service rate making, credit issues in the electric industry, valuations of power contracts, accounting disclosure, accounting principles, mark-to-market accounting, gain-of-sale accounting, and accounting for hybrid securities. Her recent work has included rate-regulated companies' allowed rates of return in the U.S. and Canada as well as mark-to-market valuation in the electric industry, a contract dispute in the petroleum industry and matters related to income tax disputes.

Dr. Villadsen holds a Ph.D. from Yale University's School of Management. She has a joint degree in mathematics and economics (BS and MS) from University of Aarhus in Denmark. Prior to joining *The Brattle Group*, she was a Professor of Accounting at the University of Iowa and at Washington University in St. Louis. Dr. Villadsen also worked as a consultant for Risoe National Laboratories in Denmark.

REPRESENTATIVE EXPERIENCE

ENERGY AND PUBLIC UTILITY FINANCE

- Dr. Villadsen has significant experience in estimating the cost of capital for major U.S. and Canadian utilities and pipelines. The work has been used in connection with the companies' rate hearings for the Federal Energy Regulatory Commission, the Canadian National Energy Board, state and provincial regulatory bodies. The work has been performed for pipelines, integrated electric utilities, non-integrated electric utilities, and water utilities.

- For a large integrated utility in the U.S., Dr. Villadsen participated in all aspects of the company's rate filing; emphasizing the company's cost of capital, incentive based rates, and certain regulatory accounting issues.

- She was part of a team evaluating the capital structure and cost of capital for a Canadian crown corporation.

- Bente Villadsen is currently involved in the valuation of long-term power contracts in the electric industry and in evaluating the impact of assumptions and models on financial information.

- Dr. Villadsen has been involved in several projects evaluating the impact of credit ratings on electric utilities. She was part of a team evaluated the impact of accounting fraud on an energy company's credit rating and assessing the company's credit rating but-for the accounting fraud.

- For a large electric utility, Dr. Villadsen modelled cash flow and analysed its financing decisions to determine the degree to which the company was in financial distress as a consequence of long-term energy contracts.

- For a large electric utility without generation assets, Dr. Villadsen assisted in the assessment of the risk added from offering its customers a price protection plan and being the provider of last resort (POLR).

- Dr. Villadsen is evaluating the appropriate regulatory framework and rates a utility should be able to charge for providing access to its facilities to outside companies.

ACCOUNTING AND CORPORATE FINANCE

- Dr. Villadsen filed testimony and rebuttal testimony in an arbitration proceeding between two major oil companies involved in a contract dispute. The testimony pertained to the equity method of accounting, the classification of debt versus equity and the distinction between categories of liabilities.

- Currently, she is working on two litigation matters involving the proper application of mark-to-market and derivative accounting in the energy industry. The work relates to the proper valuation of energy contracts and the application of accounting principles.

- Dr. Villadsen has worked on accounting issues in connection with several tax shelter cases. The focus of her work has been the application of accounting principles to evaluate intra-company transactions and the accounting treatment of security sales.

- She evaluated the accounting practices of a mortgage lender and the mortgage industry to assess the information available to the market and ESOP plan administrators prior to the company's filing for bankruptcy. A large part of the work consisted of comparing the company's and the industry's implementation of gain-of-sale accounting.

- Dr. Villadsen has modelled the cash flow of several companies to estimate the impact of specific (energy) contracts or to determine the impact of specific loans and to assess the companies viability going forward.

- She assisted in the estimation of net worth of individual segments for firms in the consumer product industry. Further, she built a model to analyse the segment's vulnerability to additional fixed cost and its risk of bankruptcy.

- For a large integrated oil company, Dr. Villadsen estimated the company's cost of capital and assisted in the analysis of the company's accounting and market performance.

- In connection with commercial litigation Dr. Villadsen estimated the cost of capital for companies in the chemical industry and for companies in the cement industry.

PUBLICATIONS

"Measuring Return on Equity Correctly: Why current estimation models set allowed ROE too low," *Public Utilities Fortnightly*, August 2005 (with A. Lawrence Kolbe and Michael J. Vilbert).

"The Effect of Debt on the Cost of Equity in a Regulatory Setting," (with A. Lawrence Kolbe and Michael J. Vilbert, and with "The Brattle Group" listed as author), published by the Edison Electric Institute (dated January 2005, issued April 2005)

"Communication and Delegation in Collusive Agencies," *Journal of Accounting and Economics*, Vol. 19, 1995.

"Beta Distributed Market Shares in a Spatial Model With an Application to the Market for Audit Services" (with M. Hviid), *Review of Industrial Organization*, Vol. 10, 1995.

PRESENTATIONS

"Current Issues in Cost of Capital," (with M.J. Vilbert). EEI Electric Rates Advanced Course, Madison, 2005.

"Issues for Cost of Capital Estimation," (with M.J. Vilbert). EEI Cost of Capital Conference, Chicago, 2004.

"Discussion of 'Are Performance Measures Other Than Price Important to CEO Incentives?'" Annual Meeting of the American Accounting Association, 2000.

"Contracting and Income Smoothing in an Infinite Agency Model: A Computational Approach," (with R.T. Boylan) Business and Management Assurance Services Conference, 2000.

"Computational Methods and Theoretical Accounting Research," Big 10 Doctoral Consortium, 1999.

"Discussion of "Analytical Research in Managerial Accounting," Annual Meeting of the American Accounting Association, 1996.

TESTIMONY

Affidavit and rebuttal affidavit in an arbitration proceeding on behalf of a major oil company regarding the equity method of accounting and classification of debt and equity, August and November, 2004.

APPENDIX B: EQUITY RISK PREMIUM APPROACH METHODOLOGY: DETAILED PRINCIPLES AND RESULTS

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Q1. What is the purpose of this appendix?

A1. The reviews the principles underlying the risk premium methodology and discusses the estimation of parameters. It also provides information on sample selection, input parameters, and the resulting cost of capital estimates.

THE EQUITY RISK PREMIUM APPROACH

Q2. How do you organize this section of the appendix?

A2. First, the appendix reviews the basics of the equity risk premium approach. Second, it discusses the individual components of the model: the risk premium, the relative risk of the company or line of business in question, the appropriate choice of interest rate, and the combination of these elements in a particular equity risk premium model. The appendix also provides details on the choice of parameters in the ECAPM model and details the ATWACC results obtained from the application of the risk positioning methodology.

A. THE BASIC EQUITY RISK PREMIUM MODEL

Q3. Please describe the equity risk premium model.

A3. The equity risk premium approach estimates the cost of equity as the sum of a current or forecast interest rate and a risk premium. (The model is sometimes referred to as the "risk premium" or the "risk positioning" approach.)

Formal applications of equity risk premium method implement theoretical finance model of cost of capital. Such models use information on securities to identify the security market line (Figure 1 in the body of the testimony) and derive the cost of capital for the individual security based on that security's relative risk. This equity risk premium approach

is widely used and underlies most of the current scholarly research on the nature, determinants and magnitude of the cost of capital.

Q4. How are the "theoretical finance models" implemented?

A4. The key parameters that determine the security market line are the risk-free interest rate, the premium that a security of average risk commands over the risk-free rate, and a measure of the relative risk of the security being examined. The premium that a security of average risk commands over the risk-free rate is commonly referred to as the "market risk premium" ("MRP"). It is measured as the excess of the expected return on the average common stock over the risk-free interest rate. In the equity risk premium approach the risk-free interest rate and MRP are common to all securities. The security-specific measure of relative risk (beta) is estimated separately and combined with the MRP to obtain the company-specific risk premium.

In principle, there may be more than one factor affecting the expected stock return, each with its own security-specific measure of relative risk and its own benchmark risk premium. For example, "multi-factor" models and the "arbitrage pricing theory" are common in the academic literature. These models estimate the cost of capital as the sum of a risk-free rate and several security-specific risk premiums. However, none of these alternative models has emerged as "the" improvement to use instead of the original, single-factor model. Therefore, I use the traditional single-factor model in this testimony.

Thus, the required elements in my implementation of the equity risk premium approach are the market risk premium, an objective measure of relative risk, the risk-free

rate that corresponds to the measure of the market risk premium, and a specific method to combine these elements into an estimate of the cost of capital.

B. MARKET RISK PREMIUM

Q5. Why is a risk premium necessary?

A5. Experience (*e.g.*, the U.S. market's October Crash of 1987) demonstrates that shareholders, even well diversified shareholders, are exposed to enormous risks. By investing in stocks instead of risk-free Government bills, investors subject themselves not only to the risk of earning a return well below those they expected in any year but also to the risk that they might lose much of their initial capital. This is why investors demand a risk premium.

In regulatory proceedings, both a long-term and a short-term version of the Capital Asset Pricing Model ("CAPM") are often reported. The first version measures the market risk premium as the risk premium of average risk common stocks over the long-term risk-free rate. The second version measures the risk premium relative to a short-term risk-free rate, which is the usual measure of the "market risk premium" used in capital market theories.

Q6. How do you estimate the MRP?

A6. There is presently little consensus on "best practice" for estimating the MRP. For example, the latest edition of the leading graduate textbook in corporate finance, after recommending use of the arithmetic average realized excess return on the market for many years (which for

a while was noticeably over 9 percent), now reviews the current state of the research and expresses the view that the a range between 5 to 8 percent is reasonable for the U.S.[1]

My testimony considers both the historical evidence and the results of scholarly studies of the factors that affect the risk premium for average-risk stocks in order to estimate the benchmark risk premium investors currently expect. Specifically, I consider the historical difference in returns between the Standard and Poor's 500 Index ("S&P 500") and the risk-free rate and recent academic research on the MRP.

Q7. Please summarize the recent literature on the MRP and the conclusions you draw from it?

A7. The new research challenges the conventional wisdom of using the arithmetic average historical excess returns to estimate the MRP. However, after reviewing the issues in the debate, I remain skeptical for several reasons that the market risk premium has declined substantially in the U.S.

First, despite eye-catching claims like "equity risk premium as low as three percent,"[2] and "the death of the risk premium,"[3] not all recent research arrives at the same conclusion. In his presidential address to the American Finance Association in 2001, Professor Constantinides seeks to estimate the unconditional equity premium based on average

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[1] Richard A. Brealey, Stewart C. Myers, and Franklin Allen, *Principles of Corporate Finance*, McGraw-Hill, 8th edition, 2005, pp. 151-154.

[2] Claus, J. and J. Thomas, (2001), "Equity Risk Premium as Low as Three Percent: Evidence from Analysts' Earnings Forecasts for Domestic and International Stocks," *Journal of Finance* 56:1629-1666.

[3] Arnott, R. and R. Ryan, (2001), "The Death of the Risk Premium," *Journal of Portfolio Management* 27(3):61-84.

historical stock returns.[4] (Note that this address was based upon evidence just before the major fall in market value.) He adjusts the average returns downward by the change in price-earnings ratio because he assumes no change in valuations in an unconditional state. His estimates for 1926 to 2000 and 1951 to 2000 are 8.0 percent and 6.0 percent, respectively, over the 3-month T-bill rate. In another published study in 2001, Professors Harris and Marston use the DCF method to estimate the market risk premium for the U.S. stocks.[5] Using analysts' forecasts to proxy for investors' expectation, they conclude that over the period 1982-1998 the MRP over the **long-term risk-free rate** is 7.14 percent. As yet another example, the paper by Drs. Ibbotson and Chen (2003) adopts a supply side approach to estimate the forward looking long-term sustainable equity returns and equity risk premium based upon economic fundamentals. Their equity risk premium **over the long-term risk-free rate** is estimated to be 3.97% in geometric terms and 5.90% on an arithmetic basis. They conclude their paper by stating that their estimate of the equity risk premium is "far closer to the historical premium than being zero or negative."[6]

Second, Professor Ivo Welch surveyed a large group of financial economists in 1998 and 1999. The average of the estimated MRP was 7.1 percent in Prof. Welch's first survey[7] and 6.7 percent in his second survey which was based on a smaller number of individuals.

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4 Constantinides, G.M. (2002), "Rational Asset Prices," *Journal of Finance* 57:1567-1591.

5 Robert S. Harris and Felicia C. Marston (2001), The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts, *Journal of Applied Finance* 11 (1) 6-16.

6 Ibbotson, R. and P. Chen (2003), "Stock Market Returns in the Long Run: Participating in the Real Economy," *Financial Analyst Journal*, 59(1):88-98. Cited figures are on p. 97.

7 Ivo Welch (2000), "Views of Financial Economists on the Equity Premium and on Professional Controversies," *Journal of Business*, 73(4):501-537. The cited figures are in Table 2 p. 514.

However, a more recent survey by Prof. Welch reported only a 5.5 percent MRP.[8] In characterizing these results Prof. Welch notes that "[T]he equity premium consensus forecast of finance and economics professors seems to have dropped during the last 2 to 3 years, a period with low realized equity premia."[9]

The above quotation from Prof. Welch emphasizes the caution that must attend survey data even from knowledgeable survey participants: the outcome is likely to change quickly with changing market circumstances. I do not believe that regulatory commissions should attempt to keep pace with such rapidly changing opinions.

Third, some of the evidence for negative or close to zero market risk premium simply does not make sense. Despite the relatively high valuation levels, stock returns remain much more volatile than Treasury bond returns. I am not aware of any empirical or theoretical evidence showing that investors would rationally hold equities and not expect to earn a positive risk premium for bearing the risk.

Fourth, I am unaware of a convincing theory for why the future MRP should have substantially declined. At the height of the stock market bubble in the U.S., many claimed that the only way to justify the high stock prices would be if the MRP had declined dramatically,[10] but this argument is heard less frequently now that the market has declined substantially. All else equal, a high valuation ratio such as price-earnings ratio implies a low required rate of return, hence a low MRP. However, there is considerable debate about

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[8] Ivo Welch (2001), "The Equity Premium Consensus Forecast Revisited," School of Management at Yale University working paper. The cited figure is in Table 2.

[9] *Ibid*., p. 8.

[10] See Robert D. Arnott and Peter L. Bernstein, "What Risk Premium is 'Normal'?", *Financial Analysts Journal* 58:64-85, for an example.

whether the high level of stock prices (despite the burst of the internet bubble in the last a couple of years) represents the transition to a new economy or is simply an "irrational exuberance," which cannot be sustained for the long term. If the former case is true, then the MRP may have decreased permanently. Conversely, the long-run MRP may remain the same even if expected market returns in the short-term are smaller.

Another common argument for a lower expected MRP is that the U.S. experienced very remarkable growth in the 20th century that was not anticipated at the start of the century. As a result, the average realized excess return is overestimated meaning the standard method of estimating the MRP would be biased upward. However, one recent study by Profs. Jorion and Goetzmann[11] finds, under some simplifying assumptions, that the so-called "survivorship bias" is only 29 basis points.[12] Furthermore, "[I]f investors have overestimated the equity premium over the second half of the last century, Constantinides (2002) argues that 'we now have a bigger puzzle on our hands'" Why have investors systematically biased their estimates over such a long horizon?[13]

A number of recent studies argue that the MRP is variable and depends on economic circumstances. For example, Mayfield (2004) estimates the MRP in a model that explicitly accounts for investment opportunities. He models the opportunities which are linked to market volatility. Using this model, Mayfield finds that the MRP varies with future changes

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[11] Jorion, P., and W. Goetzmann (1999), "Global Stock Markets in the Twentieth Century," *Journal of Finance* 54:953-980.

[12] Dimson, Marsh, and Staunton (2003) make a similar point when they comment on the equity risk premia for 16 countries based on returns between 1900 and 2001: "While the United States and the United Kingdom have indeed performed well, compared to other markets there is no indication that they are hugely out of line." p.4.

[13] Mehra, R., and E.C. Prescott (2003), "The Equity Premium in Retrospect," in *Handbook of the Economics of Finance*, Edited by G.M. Constantinides, M. Harris and R. Stulz, Elsevier B.V, p. 926

in investment opportunities. In Mayfield's (2004) model, he estimates the MRP to be 5.6 percent over the period 1940 to today.[14]

To sum up the above, I cite two passages from Profs. Mehra and Prescott's review of the theoretical literature on equity premium puzzle:[15]

> Even if the conditional equity premium given current market conditions is small, and there appears to be general consensus that it is, this in itself does not imply that it was obvious either that the historical premium was too high or that the equity premium has diminished.
>
> In the absence of this [knowledge of the future], and based on what we currently know, we can make the following claim: over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to substantially dominate that in T-bills for investors with a long planning horizon.

Q8. Is there other scholarly support for the conclusion?

A8. Yes. Another line of research was pursued by Steven N. Kaplan and Richard S. Ruback. They estimate the market risk premium in their article, "The Valuation of Cash Flow Forecasts: An Empirical Analysis."[16] Professors Kaplan and Ruback compare published cash flow forecasts for management buyouts and leveraged recapitalization over the 1983 to 1989 period against the actual market values that resulted from these transactions. One of their results is an estimate of the market risk premium over the long-term Treasury bond yield that is based on careful analysis of actual major investment decisions, not realized market returns. Their median estimate is 7.78 percent and their mean estimate is 7.97

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[14] E. Scott Mayfield (2004), "Estimating the Market Risk Premium," Journal fo Financial Economics 73, pp. 465-496.

[15] *Ibid,* p. 926.

[16] *Journal of Finance*, 50, September 1995, pp. 1059-1093.

percent.[17] This is considerably higher than my estimate of 6.5 percent. Even if the maturity premium of Treasury bonds over Treasury bills were only 1 percent, well below the best estimate of 1.5 percent the resulting estimate of the market risk premium over Treasury bills is higher than my estimate of 8.0 percent.

Q9. Do you consider evidence other than the academic articles discussed above?

A9. Yes. Ibbotson Associates *SBBI Valuation Edition 2005 Yearbook* reports long-run realized equity premiums. For the longest period available, from 1926 to 2004, Ibbotson Associates data show that the average premium of stocks over Treasury bills is 8.6 percent. For the "post-War" period, 1947-2004,[18] the market risk premium was 8.5 percent. I exclude 1946 from the period because its economic statistics are heavily influenced by the War years.[19] From an economic perspective is was not really a "post-War" year. The average premium of stocks over the income returns on long-term Government bonds is 7.2 percent for both the 1926 to 2004 and the 1947 to 2004 periods.

Q10. What is your conclusion regarding the MRP?

A10. Estimation of the MRP is controversial. There is no consensus on its value nor even how to estimate it. Given all of the information, I estimate the risk premium for average risk stocks to be 8.0 percent over Treasury bills and 6.5 percent over long-term Government bonds.

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[17] *Ibid*, p. 1082.

[18] Ibbotson Associates SBBI Valuation Edition 2005 Yearbook, Appendix A.

[19] During this period, the annual inflation reached 18 percent.

C. RELATIVE RISK

Q11. How do you measure relative risk?

A11. The risk measure I examine is the "beta" of the stocks in question. Beta is a measure of the "systematic" risk of a stock — the extent to which a stock's value fluctuates more or less than average when the market fluctuates. It is the most commonly used measure of risk in capital markets theories.

Q12. Please explain beta in more detail.

A12. The basic idea behind beta is that risks that cannot be diversified away in large portfolios matter more than those that can be eliminated by diversification. Beta is a measure of the risks that *cannot* be eliminated by diversification.

Diversification is a vital concept in the study of risk and return. (Harry Markowitz won a Nobel Prize for work showing just how important it was.) Over the long run, the rate of return on the stock market has a very high standard deviation, on the order of 15-20 percent per year since 1926.[20] However, many individual stocks have much higher standard deviations than this. The stock market's standard deviation is "only" about 15-20 percent because when stocks are combined into portfolios, some of the risk of individual stocks is eliminated by diversification. Some stocks go up when others go down, and the average portfolio return — positive or negative — is usually less extreme than that of individual stocks within it.

[20] This compares to a standard deviation of about 3 percent per year on Treasury bills (again since 1926),

In the limiting case, if the returns on individual stocks were completely uncorrelated with one another, the formation of a large portfolio of such stocks would eliminate risk entirely. That is, the market's long-run standard deviation would be not 15-20 percent per year, but virtually zero.

The fact that the market's actual annual standard deviation is so large means that, in practice, the returns on stocks *are* correlated with one another, and to a material degree. The reason is that many factors that make a particular stock go up or down also affect other stocks. Examples include the state of the economy, the balance of trade, and inflation. Thus, some risk is "non-diversifiable." Single-factor equity risk premium models derive conditions in which all of these factors can be considered simultaneously, through their impact on the market portfolio. Other models derive somewhat less restrictive conditions under which several of them might be individually relevant.

The basic idea behind all of these models is that risks that cannot be diversified away in large portfolios matter more than those that can be eliminated by diversification, because there are a large number of large portfolios whose managers actively seek the best risk-reward tradeoffs available. Of course, undiversified investors would like to get a premium for bearing diversifiable risk, but they cannot.

Q13. Why not?

A13. Well-diversified investors compete away any premium rates of return for diversifiable risk. Suppose a stock were priced especially low because it had especially high diversifiable risk. Then it would seem to be a bargain to well diversified investors. For example, suppose an industry is subject to active competition, so there is a large risk of loss of market share.

Investors who held a portfolio of all companies in the industry would be immune to this risk, because the loss on one company's stock would be offset by a gain on another's stock. (Of course, the competition might make the whole industry more vulnerable to the business cycle, but the issue here is the diversifiable risk of shifts in market share among firms.)

If the shares were priced especially low because of the risk of a shift in market shares, investors who could hold shares of the whole industry would snap them up. Their buying would drive up the stocks' prices until the premium rates of return for diversifiable risk were eliminated. Since all investors pay the same price, even those who are not diversified can expect no premium for bearing diversifiable risk.

Of course, substantial non–diversifiable risk remains, as the October Crash of 1987 demonstrates. Even an investor who held a portfolio of all traded stocks could not diversify against that type of risk. Sensitivity to such market–wide movements is what beta measures. That type of sensitivity, whether considered in a single- or multi-factor model, determines the risk premium in the cost of equity.

Q14. What does a particular value of beta signify?

A14. By definition, a stock with a beta equal to 1.0 has average non-diversifiable risk: it goes up or down by 10 percent on average when the market goes up or down by 10 percent. Stocks with betas below 1.0 moderate the swings in the market: stocks with betas of .75 tend to fall only 7.5 percent when the market falls 10 percent. Stocks with betas above 1.0 are more volatile than the market.

Q15. How is beta measured?

A15. The usual approach to calculating beta is a statistical comparison of the sensitivity of a stock's (or a portfolio's) return to the market's return. Several investment services report or sell betas, including *Value Line Investment Survey*. Betas are not always calculated the same way, and therefore must be used with a degree of caution. However, the basic point that a high beta indicates a risky stock remains valid and has long been widely accepted by both financial theorists and investment professionals.

Q16. Are there circumstances when the "usual approach" should not be used?

A16. There are at least two cases where the standard estimate of beta should be viewed skeptically.

First, companies in serious financial distress seem to "decouple" from their normal sensitivity to the stock market. The stock prices of financially distressed companies tend to change based more on individual news about their particular circumstances than upon overall market movements. Thus, a risky stock could have a low estimated beta if the company was in financial distress.

Second, similar circumstances seem to arise for companies "in play" during a merger or acquisition. Once again, the individual information about the progress of the proposed takeover is so much more important for that stock than day-to-day market fluctuations that, in practice, beta estimates for such companies seem to be too low.

Other circumstances that may cause a company's stock to decouple include an industry restructuring or major changes in a company's supply or output markets.

Q17. How reliable is beta as a risk measure?

A17. Scholarly studies have long confirmed the importance of beta for a stock's required rate of return. It is widely regarded as the best single risk measure available. The merits of beta as a single measure of risk have been challenged by widely publicized work by Professors Eugene F. Fama and Kenneth R. French.[21] However, despite the early press reports of their work as signifying that "beta is dead," it turns out that beta is still a potentially important explanatory factor (albeit one of several) in their work. Thus, beta remains alive and well as the best single measure of relative risk.

D. INTEREST RATE FORECAST

Q18. What interest rates do your procedures require?

A18. Modern capital market theories of risk and return use the short-term risk-free rate of return as the starting benchmark. My measures of the MRP incorporate this approach, since they represent the excess of the expected return on the market over the 30-day U.S. Treasury bill rate and over the long-term U.S. Government bond rate. Accordingly, implementation of my procedures requires use of a forecast of the 30-day Treasury bill rate and the long-term Government bond rate. As a proxy for a forecasted risk-free rate, I use the average over the most recent 15 trading days ending November 25, 2005 rounded to the nearest five basis points. The result is 3.90 percent for the short-term risk-free rate and 4.85 percent for the long-term risk-free rate. Because interest rates are likely to increase going forward these figures are, if anything, below the expected interest rates going forward. For example, *The*

[21] See for example, "The Capital Asset Pricing Model: Theory and Evidence," Eugene F. Fama and Kenneth R. French, University of Chicago Working Paper, June 2004.

Annual Energy Outlook 2006 from EIA forecasts the 10-year treasury note to increase to 5.06 percent in 2006.[22] If the current spread of about 30 basis points between 10-year and the 20-year treasury note remains, then the forecasted long-term interest rate for 2006 would be approximately 5.35 percent. (See Workpaper #2 to Table No. BV-9 for interest rate details)

E. COST OF CAPITAL MODELS

Q19. How do you combine the above components into an estimate of the cost of capital?

A19. By far the most widely used approach to estimation of the cost of capital is the "Capital Asset Pricing Model," and I do calculate CAPM estimates. However, the CAPM is only one equity risk premium approach technique, and I also use another.

Q20. Please start with the CAPM, by describing the model.

A20. As noted above, the modern models of capital market equilibrium express the cost of equity as the sum of a risk-free rate and a risk premium. The CAPM is the longest-standing and most widely used of these theories. The CAPM states that the cost of capital for investment I (*e.g.*, a particular common stock) is given by the following equation:

$$k_i = r_f + \beta_i \times \text{MRP} \qquad \text{(B-1)}$$

where k_i is the cost of capital for investment *I*, r_f is the risk-free interest rate, β_i is relative risk measure for investment *I*, and MRP is the market risk premium. The CAPM relies on the empirical fact that investors price risky securities to offer a higher expected rate of return

[22] Energy Information Agency, *The Annual Energy Outlook 2006 (Early Release)*, December 12, 2005 (Table 19).

than safe securities do. It says that the security market line starts at the risk-free interest rate (i.e., the return on a zero-risk security, the y-axis intercept in Figure 1 in the body of my testimony, equals the risk-free interest rate). It further says that the risk premium over the risk-free rate equals the product of beta and the risk premium on a value-weighted portfolio of all investments, which by definition has average risk.

Q21. What other equity risk premium approach model do you use?

A21. Empirical research has long shown that the CAPM tends to overstate the actual sensitivity of the cost of capital to beta: low-beta stocks tend to have higher risk premia than predicted by the CAPM and high-beta stocks tend to have lower risk premia than predicted. A number of variations on the original CAPM theory have been proposed to explain this finding. The difference between the CAPM and the type of relationship identified in the empirical studies is depicted in Figure B-1.

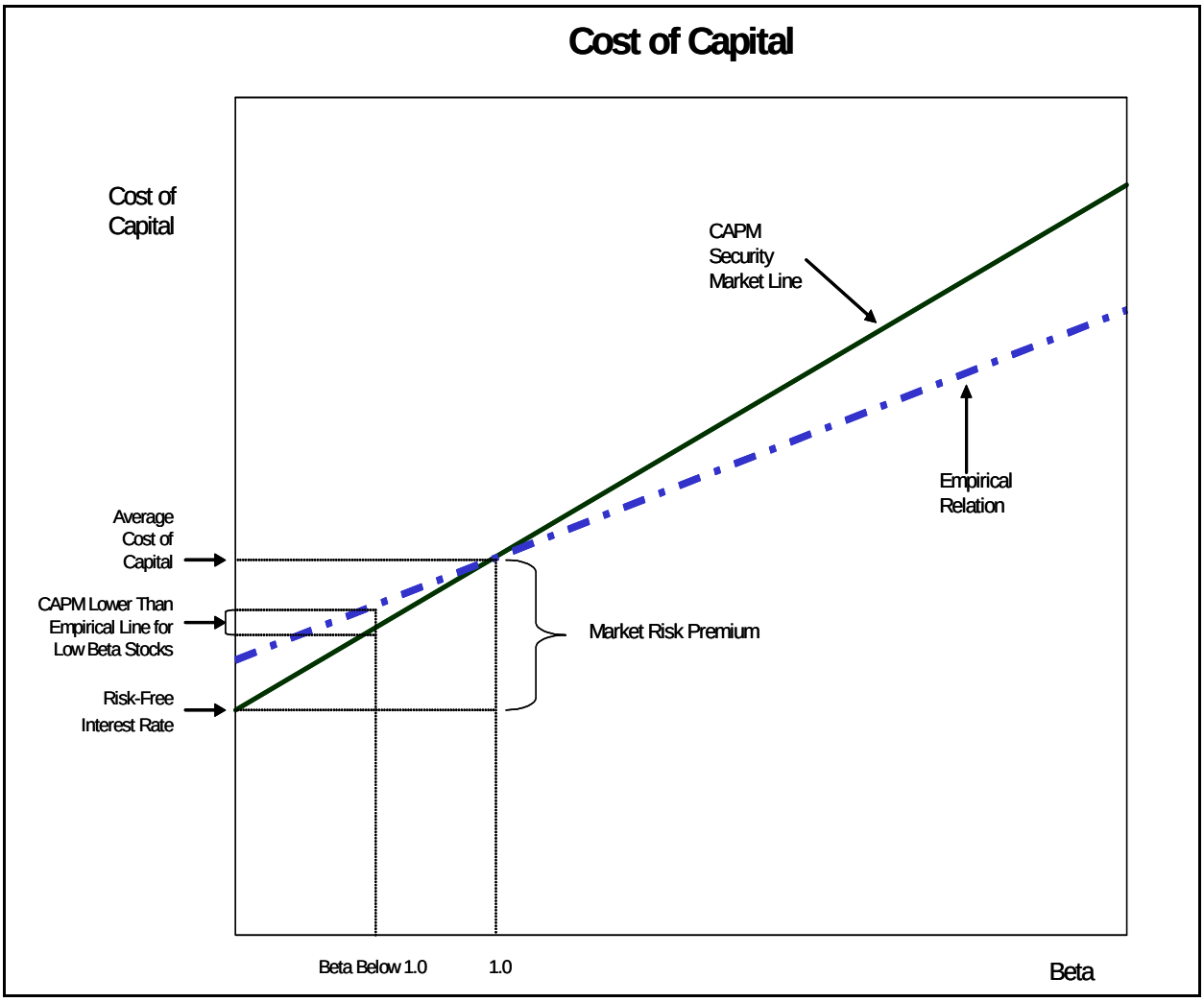

Figure B-1

The second model makes use of these empirical findings. It estimates the cost of capital using

$$k_i = r_f + \alpha + \beta_i \times (MRP - \alpha) \qquad \text{(B-2)}$$

where as before, k_i is the cost of capital for investment I, r_f is the risk-free interest rate, α is the empirical adjustment factor, β_i is the measure of relative risk, and MRP is the market risk premium. I refer to the model in (B-2) as the Empirical CAPM or ECAPM.

Research supports values for α of from one to seven percent when using a short-term interest rate. I set alpha (α) equal to 1, 2, and 3 percent which are values somewhat lower than that estimated empirically. For the long-term risk-free rate models, I set alpha equal to both 0.5 percent and 1.5 percent, but I rely more heavily on the 0.5 percent results. The use of a long-term risk-free rate incorporates some of the desired effect of using the ECAPM. That is, the long-term risk-free rate version of the Security Market Line has a higher intercept and a flatter slope than the short-term risk-free version which has been tested. Thus, it is likely that a lesser adjustment is needed for the long-term risk-free rate than for the short-term risk-free rate. A summary of the empirical evidence on the magnitude of alpha is provided in Table B-1 at the end of this appendix.

EMPIRICAL EQUITY RISK PREMIUM RESULTS

Q22. How is this part of the appendix organized?

A22. This section presents the full details of my equity risk premium approach analyses, which are summarized in the body of my testimony. This section discusses the sample selection process, calculation of the market value capital structures, and the forecasts of the short-term and the long-term risk-free interest rates. Next, it addresses the beta estimates, and the estimates of the MRP used. Finally, it reports the CAPM and ECAPM results for the samples' After-Tax Weighted-Average Cost of Capital (ATWACC), and describes the results of adjusting for differences between the samples' and Mohave's capital structures.

A. PRELIMINARY MATTERS

1. WATER UTILITY SAMPLE

Q23. How do you select your water utility sample companies?

A23. The overall cost of capital for a part of a company depends on the risk of the business in which the *part* is engaged, *not* on the overall risk of the parent company on a consolidated basis. According to financial theory, the overall risk of a diversified company equals the market value weighted-average of the risks of its components.

Estimating the cost of capital for Mohave's regulated assets is the subject of this proceeding. The ideal sample would be a number of companies that are publicly traded "pure plays" in the water production, storage, treatment, transmission, distribution or waste water line of business. "Pure play" is an investment term referring to companies with operations only in one line of business. Publicly traded firms, firms whose shares are freely traded on stock exchanges, are ideal because the best way to infer the cost of capital is to examine evidence from capital markets on companies in the given line of business.

To construct a sample of comparable companies, I started with the universe of companies classified as water utility companies in *Value Line*.[23] Normally, I would apply several selection criteria to eliminate companies with unique circumstances that may affect the cost of capital estimates. For example, in most industries, I would eliminate companies with low annual revenues, no or non-investment grade bond ratings, lack of IBES or Compustat data, all companies with announced dividend cuts, and companies involved in significant merger, acquisition, or divesture activities over the last five years (2000 to today).

[23] Including both the Standard and the Small and Mid-Cap Editions of *Value Line Investment Survey and Value Line Investment Survey - Plus Edition.*

However, applying these procedures to the eight companies followed by *Value Line* would result in a sample of at most two companies.[24] I therefore use all eight companies in my analysis. I report results for both the full sample and for a subsample of companies that earn a high percentage of revenues from regulated water activities. Southwest Water Company earned less than 40 percent of its revenues from regulated water activities in 2004 and is therefore not included in this "highly regulated" sample. Companies in the subsample earned at least 86 percent of their revenue from regulated water utility activities in 2004.

Table No. BV-2 reports operating revenue shares from different lines of business in 2004 for these companies. (Table No. BV-1 provides an index to the other tables.)

Q24. Why do you usually eliminate companies currently involved in a merger from your samples?

A24. The stock prices of companies involved in mergers are often more affected by news relating to the merger than to movements in the stock market. In other words, the stock price "decouples" from its normal relationship to the stock market (the economy) which is the basis upon which a company's relative risk is calculated. Instead the stock price of a merger candidate is more affected by the latest speculation on the terms and probability of the merger.

[24] All but California Water and American States Water would be eliminates for lack of revenues, trading volume, or data. The two companies with data and significant revenues have some acquisition activities.

Q25. What are the water sample's data problems?

A25. First, of the eight companies followed by *Value Line*, three companies (Connecticut Water, Middlesex Water, and York Water) have 2004 revenues below $100 million. The stock of small companies frequently exhibit "thin trading" which means that their stock trades infrequently. During 2004, three companies (Connecticut Water, SJW Corp., and York Water) had an average trading volume of less than 10,000 shares per day. As a result, the measured beta is likely to be downward biased. Of the four companies with 2004 revenues above $100 million and an average trading volume in excess of 10,000 shares per day, two lack a bond rating for the most recent five years, and I have not found a bond rating for several others for some years (see Workpaper #1 to Table No. BV-10 for details).

Second, several companies lack long-term earnings forecasts. I do not include Connecticut Water Service Inc. and SJW Corp. in the sample when applying the forward-looking Discounted Cash Flow ("DCF") method because of a lack of recent earnings forecasts. However, I do include both Connecticut Water and SJW Corp. in the risk positioning method. To sum up, at most two companies have significant revenue, a bond rating for five years and IBES long-term growth forecast.

Third, the water industry has seen substantial merger activity in recent years. Philadelphia Suburban (renamed Aqua America) completed the acquisition of AquaSource for about $195 million in July 2003, and during 2004 Aqua America completed 29 acquisitions. Additionally, American Water Works acquired National Enterprises, Inc., Azurix, and the water and wastewater utility assets of Citizens Utilities. American Water Works, in turn, was acquired by the RWE AG on January 10, 2003. Recently, RWE announced plans to sell American Water. Domestic energy companies have also invested

in the water utility business, although presently many of those investments have or will be sold. Allete has sold its assets in Florida and North Carolina; Indianapolis Water Company was sold by NISource; Suez Lyonnaise des Eaux purchased the remaining shares of United Water Resource that it did not already own; and Thames Water purchased E'Town Corporation. California Water Services purchased Ka'anpali Water Corporation in 2003 and Southwest Water Co. acquired a Texas utility consisting of 86 water systems and 11 wastewater systems in 2004. [25]

These factors may all potentially affect the cost of equity estimates in not completely predictable ways. Because of the substantial data problems and lack of publicly traded water utilities, I am forced to rely on a sample with significant data problems or a sample with at most two companies (American States Water and California Water Services).[26]

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[25] Sources: *Value Line Investment Survey*, January 30, 2004 and January 28, 2005, *The Business Journal*, *http://ir.calwatergroup.com*, and company web sites.

[26] Several companies have multiple problems. For example, Connecticut Water has revenues below $100 million, exhibits thin trading, lacks bond ratings for the most recent five years and long-term earnings growth forecasts. Middlesex Water has revenues below $100 million, only one IBES forecast and no long-term *Value Line* earnings forecast. Aqua America Inc. lacks bond ratings. SJW Corp. exhibits thin trading, has no current IBES forecasts and lacks a bond rating. Southwest Water earned only 37% of its revenues from regulated activities and has no long-term *Value Line* forecast. York Water has revenues below $100 million, exhibits thin trading, and no long-term *Value Line* forecast.

2. GAS LOCAL DISTRIBUTION COMPANY SAMPLE

Q26. How do you select your gas local distribution company sample?

A26. To select this sample, I started with the universe of publicly traded gas distribution utilities covered by *Value Line*. This resulted in an initial group of 16 companies.[27] I then eliminated companies by applying additional selection criteria designed to eliminate companies with unique circumstances which may bias the cost of capital estimates. The final sample consists eight gas local distribution ("gas LDC") companies. Table No. BV-12 reports operating revenue shares from regulated activities for these companies for the period 2000-2004.

Q27. What are the selection criteria you applied?

A27. I eliminated all companies whose regulated revenues are not greater than 50 percent of total revenues because one goal for this sample was for the sample companies to derive the majority of their revenues from regulated activities. I also eliminated all companies whose Standard & Poor's bond rating was less than BBB per Compustat and companies with large mergers during the most recent four year period (October 2001 - November 2005). The screen for merger activity is any mention of merger activity in the analyst report section of *Value Line* or sizeable mergers found during a search of the companies' web pages.[28,29] To guard against measurement bias caused by "thin trading," I also restricted the sample to companies with total operating revenues greater than $300 million in 2004 and a market

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[27] The 16 companies are from *Value Line Investment Survey's* Standard Edition.

[28] Company web pages were searched in December 2003 for merger and acquisition activities during the 2001-2003 period and in November 2005 for merger and acquisition activities during the period 2004 through November 2005.

[29] For purposes of sample selection, a sizeable merger is defined to be one which would exceed 25 percent of the total capitalization of the company at the time of the merger announcement.

value in excess of $150 million as reported by *Value Line*.[30] Finally, I require that the companies have historical monthly return data available from Compustat for the relevant period.

Q28. What companies were eliminated from the gas LDC sample because their share of revenue from distribution activities is not above 50 percent?

A28. New Jersey Resources was eliminated from the sample because its revenue share from natural gas distribution is not above 50%.

Q29. Were any other companies eliminated?

A29. Yes. AGL Resources, Atmos Energy, Piedmont Natural Gas and Southern Union were eliminated for recent or current merger activities. Semco Energy was eliminated because of its non-investment grade bond rating. Nicor Inc. was eliminated from the sample because of its restatement of earnings for 1999-2001, and because Nicor settled regulatory compliance issues with the Federal Energy Regulatory Commission ("FERC") in 2003.[31] UGI Corp. was eliminated because it primarily sells propane which is non-regulated.

[30] As reported by *Value Line* on September 16, 2005.

[31] Nicor announced on Oct. 29, 2002 that its earnings for 1999-2001 would be revised downwards by $15-35 million. March 4, 2003, Nicor released its restated earnings for 1999-2001 along with 2002 earnings.

Q30. Do you report results for a subsample?

A30. Yes. To ensure the results are not biased by companies earning substantial revenues from non-regulated activities, I report results from a subsample of companies that earn at least 70 percent of their revenues from regulated gas activities. This sample consists of four companies: Cascade Natural Gas, Laclede Group, Northwest Natural Gas, and Southwest Gas. However, Southwest Gas have growth rates that vary widely from analyst to analyst.[32] Additionally, the company had a merger cancelled in 2000-01.

Q31. Please compare the characteristics of the water utility sample and the gas LDC sample.

A31. Both samples consists of companies with substantial capital investments in distribution facilities. Also, both samples earned a large percentage of their revenue from regulated activities and serve a mix of residential, industrial, and other customers. I.e., both samples consists primarily of state regulated distribution companies with a comparable customer mix. However, the gas LDC sample has fewer of the data and estimation issues identified above for the water sample.

For both the water/wastewater industry and the gas distribution industry, environmental cost are of importance. All gas LDC companies discuss environmental clean-up requirements in their 10-K. Similarly, regulatory requirements from federal and local authorities through, for example, the Clean Water Act of 1974 and EPA enforcement will likely require the water and wastewater industry to invest substantial amounts in

[32] For example, the mean long-term growth forecast from IBES analysts is 4.0 percent while the long-term growth forecast from *Value Line* is 13.3 percent. See Table No. BV-15 for details.

environmental infrastructure going forward.[33]

Q32. What do you conclude from the comparison of the water utility and the gas LDC samples?

A32. The two samples differ primarily in that they operate in two different (regulated) industries, but they are very similar in terms of the percentage of revenues from regulated operations and the customers they serve. The gas LDC sample provides a reasonable comparison sample for the water utility industry but without the substantial data issues.

3. OTHER PRELIMINARY MATTERS

Q33. What capital structure information do you require?

A33. For reasons discussed in my testimony and explained in detail in Appendix D, an explicit evaluation of the market-value capital structures of the sample companies versus the capital structure used for rate making is vital for a correct interpretation of the market evidence. This requires estimates of the market values of common and preferred equity and debt, and the current market costs of preferred equity and debt.

[33] According to *Value Line Investment Survey*, Water Utility Industry, January 28, 2005, updates to the infrastructure of water utilities are likely to grow into hundreds of billions of dollars over the next decade or two.

Q34. How do you calculate the market-value capital structures of the sample companies?

A34. I estimate the capital structure for each company by estimating the market values of common equity, preferred equity and debt from publicly available data. The calculations are in Panels A to H of Tables No. BV-3 and BV-13 for the water and gas LDC sample, respectively.

The market value of equity is straightforward: the price per share times the number of shares outstanding. The market value of debt is set equal to its book value because debt generally is callable in the U.S. The market value of preferred equity is also set equal to its book value because preferred equity makes up a very small portion (less than 1 percent) of the market value capital structures of the companies in the two samples.

For purposes of assessing financial risk to common shareholders, I add an adjustment for short-term debt to the debt portion of the capital structure. This adjustment is used only for those companies whose short-term (current) liabilities (net of the current portion of long-term debt) exceed their short-term (current) assets. I add an amount equal to the minimum of the difference between short-term liabilities and short-term assets or the amount of short-term debt. The reason for this adjustment is to recognize that when current liabilities exceed current assets, a portion of the companies long-term assets are being financed, in effect, by short-term debt. The output of these schedules is the market debt-to-value and preferred equity-to-value ratios. Table No. BV-3 and Table No. BV-13 report such calculations using the values at year end for the years 2000 to 2004 plus for 2nd Quarter 2005. The overall cost of capital calculation for the risk positioning estimates rely on the average of the market value capital structure computed for the years 2000 through 2nd Quarter 2005. The DCF

capital structure uses stock prices as of October, 2005[34] and balance sheet information for 2nd Quarter 2005.

Q35. How do you estimate the current market cost of debt?

A35. I use the current yields on indices of comparably rated utility bonds. The cost of debt for each company in the DCF analysis is the current yield reported by *Mergent Bond Record* for an index of bonds rated carrying the same rating as the company in question.[35] For the risk positioning method, the cost is the current yield corresponding to the five-year average debt rating for each company. The debt ratings for the companies in both samples are obtained from Compustat when available. If no rating was found in Compustat, S&P's website, Moody's website, or S&P's Bond Guide was used. Calculation of the after-tax cost of debt uses Mohave's estimated marginal income tax rate of 38.6 percent.

Q36. How do you estimate the current market cost of preferred equity?

A36. It is set equal to the yield on an index of comparably rated preferred stock. The sample companies are assumed to have the same preferred and bond rating.

[34] The stock price is the average over the most recent 15 trading days ending October 14, 2005 for the gas LDC sample companies, October 28, 2005 for all water utility companies other than Aqua America. For Aqua American the period ends October 17, 2005. These dates corresponds to the day of the IBES growth forecasts.

[35] For the purpose of assigning bond yields, I assume that S&P bond ratings are comparable to Moody's which underlies the yields reported in Mergent Bond Record.

B. BETAS AND THE MARKET RISK PREMIUM

1. BETA ESTIMATION PROCEDURES

Q37. Which betas do you use in your risk positioning models?

A37. I obtained beta estimates from Value Line Investment Survey.[36]

Q38. How does Value Line estimate the reported betas?

A38. *Value Line* estimates the reported betas using weekly data for a five year period. As the market index, *Value Line* uses the New York Stock Exchange. Also, Value Line reports so-called adjusted betas. I.e., the betas reported by Value Line are calculated as follows:

$$\beta_{\text{Value Line}} = .67 \times \beta + .35 \qquad \text{(B-3)}$$

where β is the standard beta estimate. To obtain standard betas, I reverse *Value Line's* adjustment to obtain standard betas, β. *Value Line's* and many investment firms adjust the estimated betas using a procedure similar to the one described in equation (B-3). This type of adjustment is intended to compensate for sampling errors in the beta estimation. It adjusts betas below one upwards and betas above one downwards.

Q39. Please summarize the beta estimates you rely on.

A39. After reversing the *Value Line* adjustment procedure, the average estimated *Value Line* beta for the water sample is about .49 while the average for the gas LDC sample is about .59. The beta estimates for the sample companies are reported in Workpaper #1 to Tables No. BV-9 and BV-19.

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[36] For the water utility sample, *Value Line* betas as of October 28, 2005 were used. For the gas LDC sample, *Value Line* betas as of September 16, 2005.

Q40. Are there any problems with betas at this point in time?

A40. Yes. Beta estimates are still impacted by the bubble in the stock market and tend to have low statistical significance. Additionally, utility stock betas have been inclining rapidly in recent months indicating that the industry is changing. This may indicate the current betas (relying on 260 weeks of data) may be downward biased.[37]

Q41. What beta values do you use in your analysis?

A41. After reversing the adjustment process discussed above, the current estimated *Value Line* betas range from 0.22 to 0.67 for the water sample and from 0.37 to 0.67 for the gas LDC sample (See Workpaper #1 to Tables No. BV-9 and No. BV-19).

2. MARKET RISK PREMIUM ESTIMATION

Q42. Given all of the evidence, what MRP do you use in your analysis?

A42. It is clear that market return information is volatile and difficult to interpret, but based on the collective evidence, the MRP I use for the short-term risk-free rate is 8 percent and for the long-term risk-free rate is 6.5 percent.

[37] During the past year or so, Value Line has increased its beta estimates for the water utility and gas LDC samples by an average of .05 and .07, respectively. <auditor: Check 1661>

D. COST OF CAPITAL ESTIMATES

Q43. Based on these data, what are the values you calculate for the overall cost of capital and the corresponding cost of equity for the water utility sample?

A43. Panels A and B of Table No. BV-9 present the cost of equity results using the equity risk positioning method at the sample companies' market value capital structures. The table contains two panels, Panel A for the long-term risk-free rate and Panel B for the short-term risk-free rate.

Q44. What does the water utility sample market data imply about cost of equity at Mohave's 40 percent equity ratio?

A44. The return on equity and the overall cost of capital for the various equity risk positioning methods are reported in Table No. BV-10, Panels A to G. Panels A through C utilize the long-term risk-free rate while Panels D through G use the short-term risk free rate. Panel A reports the CAPM results using the long-term risk-free rate, while Panels B and C report the ECAPM cost of equity results for the ECAPM parameters of 0.5 and 1.5 percent, respectively. Panel D reports the CAPM estimates using the short-term risk free rate. Panels E, F and G report ECAPM results using ECAPM parameters of 1, 2 and 3 respectively. Focusing on the middle version of the ECAPM, Panel B of Table No. BV-10 (ECAPM with a = 0.5%) shows the results using the long-term risk-free rate version of the model. For this table, the costs of equity for the water sample range from 6.7 to 9.4 percent for capital structures that average 67 percent equity. The sample average ATWACC is 6.6 percent for the full sample and 6.7 percent for the subsample.

In each panel, column eight reports the overall cost of capital for each company. The

last two rows of each panel report the sample averages. The first is for all companies in the water sample (average [a]), and the second is for the subsample of companies with significant revenue from regulated water activities (average [b]). The sample average ATWACCs from each panel of Table No. BV-10 are reproduced in column one of Table No. BV-11 which reports the cost of equity estimates for each of the risk positioning estimates that is consistent with the sample information and the capital structure of Mohave. Panel A of Table No. BV-11 reports the results for all sample companies. Panel B of the table summarizes the results for the subsample of companies that have a large percentage of revenues from regulated activities. The sample average ATWACCs are summarized in Table B-2 at the end of this appendix. The costs of equity at a 40 percent equity ratio are displayed in Tables 2 and 3 of my testimony.

Q45. What cost of equity values do you calculate for the gas LDC sample?

A45. The cost of equity estimates for the gas LDC sample are displayed on Panels A and B of Table No. BV-19. Panel A uses the long-term risk-free rate, and Panel B uses the short-term risk-free rate.

Q46. What does the gas LDC sample market data imply about the cost of equity at Mohave's 40 percent equity ratio?

A46. The cost of equity and the overall cost of capital for the various equity risk positioning methods are reported in Table No. BV-20 for the gas LDC sample. Panels A through C utilize the long-term risk-free rate. Panel A again reports the CAPM cost of equity results while Panels B and C report the ECAPM cost of equity results for the 0.5 and 1.5 percent

adjustment factors, respectively. Panels D through G to Table BV-20 utilize the short-term risk-free rate. Panel D report the CAPM cost of equity results, while Panels E, F and G report the ECAPM overall cost of capital results using 1, 2 and 3 percent adjustment factors. In each panel, column eight reports the overall cost of capital for each company. The last two lines of each panel report the sample averages for the full sample and the subsample of companies with an average of more than 70 percent of revenue for the last five years from regulated activities. Panel B of Table No. BV-20 shows the estimates using the middle version of the ECAPM (a = 0.5%) for the companies in the gas LDC sample. Using the long -term risk-free rate, the model results in costs of equity of 7.6 to 9.4 percent for capital structures that average about 58 percent equity for the full sample and 55 percent for the subsample. The sample average ATWACC is 6.6 percent for the full sample and 6.4 percent for the subsample. However, the subsample results is heavily influenced by one company, Southwest Gas. If Southwest Gas was dropped from the subsample, the results would be comparable to those from the full gas LDC sample. Because one company should not unduly influence the results, I weigh the full gas LDC sample more. The result is that the cost of equity at the Mohave's 40 percent equity thickness is comparable for both samples using all companies and for the gas LDC subsample. The estimates from the water utilities subsample are slightly higher.

The sample average ATWACC from each panel of Table No. BV-20 is reproduced in column one of Table No. BV-21 which reports the cost of equity estimates for each of the risk positioning estimates. Panel A reports the results for all sample companies. As with the water sample, Panel B reports the averages using only those companies that have a large percentage of revenue from regulated activities. The sample average ATWACCs and

corresponding costs of equity at a 40 percent equity ratio are displayed in Tables 2 and 3 of my testimony. I discuss the implications of the equity risk positioning results in the main body of my testimony.

Table No. B-1
Empirical Evidence on the Alpha (α) Factor in ECAPM[*)]

Author	Alpha (α) Estimate	Period relied upon
Black (1993)[1)]	1% for betas between zero and .80	1931-1991
Black, Jensen and Scholes (1972)[2)]	4.31%	1931-1965
Fama and McBeth (1972)	5.76%	1935-1968
Fama and French (1992)[3)]	7.32%	1941-1990
Litzenberger and Ramaswamy (1979)[4)]	5.32%	1936-1977
Litzenberger, Ramaswamy and Sosin (1980)	1.63% to 3.91%	1926-1978
Pettengill, Sundaram and Mathur (1995)[5)]	4.6%	1936-1990

*) The figures reported in this table are for the longest estimation period available and, when applicable, use the authors' recommended estimation technique (unbiased, efficient, consistent). Many of the articles cited also estimate alpha for sub-periods and those alphas may vary.

1) Black estimates alpha in a one step procedure rather than in an un-biased two-step procedure.

2) Black, Jensen and Scholes estimate a negative alpha for the subperiod 1931-39 which contain the depression years 1931-33 and 1937-39.

3) Calculated using Ibbotson's data for the 30-day treasury yield.

4) Relies on Lizenberger and Ramaswamy's before-tax estimation results. Comparable after-tax estimation results estimate alpha at 4.4%.

5) Pettengill, Sundaram and Mathur rely on total returns for the period 1936 through 1990 to estimate the alpha parameter and use 90-day treasuries. The 4.6% figure is calculated using auction averages 90-day treasuries back to 1941 as no other series were found this far back.

Sources:

Black, Fischer, "Beta and Return," *The Journal of Portfolio Management*, Fall 1993, 8-18.

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Litzenberger, Robert H. and Krishna Ramaswamy, "The Effect of Personal Taxes and Dividends on Capital Asset Prices, Theory and Empirical Evidence," *Journal of Financial Economics*, June 1979, pp. 163-195.

Litzenberger, Robert H. and Krishna Ramaswamy and Howard Sosin, "On the CAPM Approach to Estimation of a Public Utility's Cost of Equity Capital," *The Journal of Finance*, Vol. 35, No. 2, May 1980, pp. 369-387.

Pettengill, Glenn N., Sridhar Sundaram and Ike Mathur, "The Conditional Relation between Beta and Returns," *Journal of Financial and Quantitative Analysis*, Vol. 30, No. 1, March 1995, pp. 101-116.

Table B-2: Risk Positioning After-Tax Weighted-Average Cost of Capital
Panel A: for All Companies in the Water Utility and Gas LDC Samples

	Water Utility	Gas LDC
Using Long-Term Risk-Free Rate		
CAPM	6.5%	6.5%
ECAPM (α = 0.5%)	*6.6%*	*6.6%*
ECAPM (α = 1.5%)	7.0%	6.8%
Using Short-Term Risk-Free Rate		
CAPM	6.3%	6.4%
ECAPM (α = 1%)	*6.7%*	*6.7%*
ECAPM (α = 2%)	7.0%	6.9%
ECAPM (α = 3%)	7.4%	7.0%

Source: Tables No. BV-11 and BV-21, Panel A.

Table B-2: Risk Positioning After-Tax Weighted-Average Cost of Capital

Panel B: for Companies with a High Percentage Regulated Revenue

	Water Utility	Gas LDC
Using Long-Term Risk-Free Rate		
CAPM	6.5%	6.3%
ECAPM (α = 0.5%)	*6.7%*	*6.4%*
ECAPM (α = 1.5%)	7.0%	6.7%
Using Short-Term Risk-Free Rate		
CAPM	6.6%	6.3%
ECAPM (α = 1%)	*6.9%*	*6.5%*
ECAPM (α = 2%)	7.2%	6.7%
ECAPM (α = 3%)	7.5%	7.0%

Source: Tables No. BV-11 and BV-21, Panel B.

APPENDIX C: DISCOUNTED CASH FLOW METHODOLOGY: DETAILED PRINCIPLES AND RESULTS

TABLE OF CONTENTS

SECTION **PAGE**

Q1. What is the purpose of this appendix?

A1. In this appendix, I review the principles underlying the discounted cash flow or "DCF" methodology and discuss the estimation of parameters. I also provide information on any differences between the samples used in the risk positioning method and in the DCF method, and on the resulting cost of capital estimates. Parts of the appendix intentionally repeats parts of the direct testimony to ensure the reader has a complete discussion in one place.

DISCOUNTED CASH FLOW METHODOLOGY PRINCIPLES

Q2. How is this section of the appendix organized?

A2. First, I discuss the general principles underlying the DCF approach. Second, I review the strengths and weaknesses of the DCF model. Third, I discuss the methods applicability to companies in the water and gas distribution industry at the current time.

A. SIMPLE AND MULTI-STAGE DISCOUNTED CASH FLOW MODELS

Q3. Please summarize the DCF model.

A3. The DCF model assumes that the current stock price is the discounted sum of future cash payments that accrue to shareholders. The method also assumes that this present value can be calculated by the standard formula for the present value of a cash flow stream:

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \ldots + \frac{D_T}{(1+k)^T} \qquad \text{(C-1)}$$

where "P_0" is the current market price of the stock; "D_i" is the dividend cash flow expected at the end of period *I*; "*k*" is the cost of capital; and "*T*" is the last period in which a dividend cash flow is to be received. The formula just says that the stock price is equal to the sum of the expected future dividends, each discounted for the time and risk between now and the time the dividend is expected to be received.

Most DCF applications go even further, and make very strong (*i.e.*, unrealistic) assumptions that yield a simplification of the standard formula, which then can be rearranged to estimate the cost of capital. Specifically, if investors expect a dividend stream that will grow *forever* at a steady rate, the market price of the stock will be given by a very simple formula,

$$P_0 = \frac{D_1}{(k - g)} \qquad \text{(C-2)}$$

where "D_1" is the dividend expected at the end of the first period, "*g*" is the perpetual growth rate, and "P_0" and "*k*" are the market price and the cost of capital, as before. Equation (C-3) is a simplified version of Equation (C-2) that can be solved to yield the well known "DCF formula" for the cost of capital:

$$k = \frac{D_1}{P_0} + g = \frac{D_0 \times (1 + g)}{P_0} + g \qquad \text{(C-3)}$$

where "D_0" is the current dividend, which investors expect to increase at rate *g* by the end of the next period, and the other symbols are defined as before. Equation (C-3) says that if Equation (C-2) holds, the cost of capital equals the expected dividend yield plus the (perpetual) expected future growth rate of dividends. I refer to this as the simple DCF

model. Of course, the "simple" model is simple because it relies on very strong (*i.e.*, very unrealistic) assumptions.

Q4. Are there other versions of the DCF models besides the "simple" one?

A4. Yes. There are many variations on the DCF models that may rely on less strong assumptions in that they allow growth rates to vary over time. I consider a variant of the DCF model that uses the companies' individual growth rates during the first five years, converges to a perpetual growth rate in years 6-10 and then uses the GDP growth rate as the perpetual growth rate after year 10 for all companies. This is a variant of the "multi-stage" DCF method. More formally, the "multi-stage" DCF approach solves the following equation for k:

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \ldots + \frac{D_T + P_{TERM}}{(1+k)^T} \qquad \text{(C-4)}$$

The terminal price, P_{TERM} is estimated as

where T is the last of the periods in which a near term dividend forecast is made and g_{LT} is

$$P_{TERM} = \frac{D_{T+1}}{(k - g_{LT})} \qquad \text{(C-5)}$$

the long-term growth rate. Thus, Equation (C-4) defers adoption of the very strong perpetual growth assumptions that underlie Equation (C-2) — and hence the simple DCF formula, Equation (C-3) — for as long as possible, and instead relies on near term knowledge to improve the estimate of *k*. I examine both simple and multi-stage DCF result.

Q5. What are the merits of the DCF model?

A5. The DCF approach is conceptually sound if its assumptions are met but can run into difficulty in practice because those assumptions are so strong, and hence so unlikely to correspond to reality. Two conditions are well-known to be necessary for the DCF approach to yield a reliable estimate of the cost of capital: the variant of the present value formula, Equation (C-1), that is used must actually match the variations in investor expectations for the dividend growth path; and the growth rate(s) used in that formula must match current investor expectations. Less frequently noted conditions may also create problems.

The DCF model assumes that investors expect the cost of capital to be the same in all future years. Investors may not expect the cost of capital to be the same, which can bias the DCF estimate of the cost of capital in either direction.

The DCF model only works for companies for which the standard present value formula works. The standard formula does *not* work for options (*e.g.*, puts and calls on common stocks), and so it will not work for companies whose stocks behave as options do. Option-pricing effects will be important for companies in financial distress, for example, which implies the DCF model will *understate* their cost of capital, all else equal.

It is too early to throw out the standard formula, if for no other reasons than that the evidence is still controversial and no one has offered a good replacement. But the evidence suggests that it must be viewed with more caution than financial analysts have traditionally applied. Simple models of stock prices may not be consistent with the available evidence on stock market volatility.

Q6. Do you agree that estimating the right growth rate is the most difficult part for the implementation of the DCF approach?

A6. Yes. Finding the right growth rate(s) is indeed the usual "hard part" of a DCF application. The original approach to estimation of *g* relied on average historical growth rates in observable variables, such as dividends or earnings, or on the "sustainable growth" approach, which estimates *g* as the average book rate of return times the fraction of earnings retained within the firm. But it is highly unlikely that historical averages over periods with widely varying rates of inflation, interest rates and costs of capital, such as in the relatively recent past, will equal current growth rate expectations. Moreover, the constant growth rate DCF model *requires* that dividends and earnings grow at the same rate. It is inconsistent for dividends to grow at a rate that differs from the growth in earnings because it would mean that dividends are becoming an ever increasing or decreasing percentage of earnings.

Most cost of capital experts rely on earnings growth rates, not dividend growth rates, for several reasons. First, although the model is derived from dividend growth rates, the more fundamental parameter is earnings growth because dividends are paid from earnings. Second, analyst forecasts of dividend growth rates are generally not available, but earnings growth forecasts are. Third, a better approach than relying on historical information is to use the growth rates currently expected by investment analysts, if an adequate sample of such rates is available. Analysts' forecasts are superior to time series forecasts based upon single

variable historical data as has been documented and confirmed extensively in academic research.[1]

If this approach is feasible and if the person estimating the cost of capital is able to select the appropriate version of the DCF formula, the DCF method should yield a reasonable estimate of the cost of capital for companies not in financial distress and without material option-pricing effects (always subject to recent concerns about the applicability of the basic present value formula to stock prices). However, for the DCF approach to work, the basic stable-growth assumption must become reasonable and the underlying stable-growth rate must become determinable *within the period for which forecasts are available*.

Q7. What is the so called "optimism bias" in the earnings growth rate forecasts of security analysts and what is its effect on the DCF analysis?

A7. Optimism bias is related to the observed tendency for analysts to forecast earnings growth rates that are higher than are actually achieved. This tendency to over estimate growth rates is perhaps related to incentives faced by analysts that provide rewards not strictly based upon the accuracy of the forecasts. To the extent optimism bias is present in the analysts' earnings forecasts, the cost of capital estimates from the DCF model would be too high.

[1] Lawrence D. Brown and Michael S. Rozeff (1978), "The Superiority of Analysts Forecasts as Measures of Expectations: Evidence from Earnings," *Journal of Finance*, Vol. XXXIII, No. 1, pp. 1-16. J. Cragg and B.G. Malkiel (1982), *Expectations and the Structure of Share Prices*, National Bureau of Economic Research, University of Chicago Press. R.S. Harris (1986), "Using Analysts' Growth Forecasts to Estimate Shareholder Required Rates of Return," *Financial Management*, Spring Issue, pp. 58-67. J. H. Vander Weide and W. T. Carleton (1988), "Investor Growth Expectations: Analysts vs. History," *Journal of Portfolio Management*, Spring, pp. 78-82. T. Lys and S. Sohn (1990), "The Association Between Revisions of Financial Analysts Earnings Forecasts and Security Price Changes," *Journal of Accounting and Economics*, vol 13, pp. 341-363.

Q8. Does optimism bias mean that the DCF estimates based upon analysts' earnings forecasts are completely unreliable?

A8. No. The effect of optimism bias is least likely to affect DCF estimates for large, rate regulated companies in stable segments of an industry. Furthermore, the magnitude of the optimism bias (if any) for regulated companies is not clear. In a recent paper, Chan, Karceski, and Lakonishok (2000)[2] sort companies on the basis of the size of the IBES forecasts to test the level of optimism bias. Utilities constitute 25 percent of the companies in lowest quintile, and by one measure the level of optimism bias is 4.0 percent. However, the 4.0 percent figure does not represent the complete characterization of the results in the paper. Table IX of the paper shows that the median IBES forecast for the first (lowest) quintile averages 6.0 percent. The realized "Income before Extraordinary Items" is 2.0 percent (implying a four percent upward bias in IBES forecasts), but the "Portfolio Income before Extraordinary Items" is 8.0 percent (implying a two percent downward bias in IBES forecasts).

The difference between the "Income before Extraordinary Items" and "Portfolio Income before Extraordinary Items" is whether individual firms or a portfolio are used in estimating the realized returns. The first is a simple average of all firms in the quintile while the second is a market value weighted-average. Although both measures of bias have their own drawbacks according to the authors,[3] the Portfolio Income measure gives more weight to the larger firms in the quintile such as regulated utilities. In addition, the paper

[2] L. K.C. Chan, J. Karceski, and J. Lakonishok (2003), "The Level and Persistence of Growth Rates," *Journal of Finance* 58(2):643-684.

[3] Chan, Karceski, and Lakonishok, *op. cit.*, p. 675.

demonstrates that "analysts' forecasts as well as investors' valuations reflect a wide-spread belief in the investment community that many firms can achieve streaks of high growth in earnings."[4] Therefore, it is not clear how severe the problem of optimism bias may be for regulated utilities or even whether there is a problem at all.

Finally, the multi-stage DCF model also adjusts for any over optimistic (or pessimistic) growth rate forecasts by substituting the long-term GDP growth rate for the 5-year growth rate forecasts of the analysts in further out years.

Q9. Please describe the multi-stage DCF model you use.

A9. The multi-stage model I use is presented in equation (C-4) above and assumes that the long-term perpetual growth rate for all companies in the two samples is the forecast long-term growth rate of the GDP.[5] This model allows growth rates to differ across companies during the first ten years before settling down to a single long-term growth rate. The growth rate for the first five years is the long-term growth rate provided in analysts' reports. After year five, the growth rate is assumed to converge linearly to the GDP growth rate. In other words, the growth rate in year 6 is adjusted by 1/6th of the difference between each company's 5-year growth rate forecast and the GDP forecast. The growth rate in year 7 is adjusted by an additional 1/6th so that the earning growth rate pattern converges on the long-term GDP growth rate forecast.

[4] Chan, Karceski, and Lakonishok, *op. cit*., p. 663.

[5] See Blue Chip Economic Indicators, October 10, 2005.

Q10. Why do you assume that the long-term growth rate of the sample companies will converge to the long-term growth rate of GDP?

A10. Recall that the DCF model assumes that dividends grow at a constant rate literally forever. If the growth rate of earnings (and therefore, dividends) were greater than (less than) the long-term growth rate of the economy, mathematically it would mean that the company (and the industry) would become an ever increasing (or decreasing) proportion of the economy. Therefore, the most logical assumption is that the company's earnings grow at the same rate as the economy on average over the long run.

Q11. How well are the conditions needed for DCF reliability met at present?

A11. The requisite conditions for the sample companies are not fully met at this time. Of particular concern for this proceeding is the uncertainty about what investors truly expect the long-run outlook for the sample companies to be. The longest time period available for growth rate forecasts of which I am aware is five years. The long-run growth rate (*i.e.*, the growth rate after an industry settles into a steady state) drives the actual results one gets with the DCF model. Unfortunately, this implies that unless the company or industry in question is stable, so there is little doubt as to the growth rate investors expect, DCF results in practice can end up being driven by the subjective judgment of the analyst who performs the work.

Uncertainty in an industry implies that a commission may often be faced with a wide range of DCF numbers, none of which can be well grounded in objective data on true long-run growth expectations, *because no such objective data now exist.* DCF for firms or

industries in flux is *inherently* subjective with regard to a parameter (the long-run growth rate) that drives the answer one gets.

In short, the unavoidable questions about the DCF model's strong assumptions cause me to view the DCF method as *inherently* less reliable than risk positioning approach described above. However, because the DCF method has been widely used in the past and in other forums when the industry's economic conditions were different from today's, I submit DCF evidence in this case. DCF estimates also serve as a check on the values provided by the risk positioning approach methods.

B. CONCLUSIONS ABOUT DCF

Q12. Please sum up the implications of this part of the appendix.

A12. The unavoidable questions about the DCF model's strong assumptions — whether the basic present value formula works for stocks, whether option pricing effects are important for the company, whether the right variant of the basic formula has been found, and whether the true growth rate expectations have been identified — cause me to view the DCF method as less reliable than the equity risk premium approach.

EMPIRICAL DCF RESULTS

Q13. How is this part of the appendix organized?

A13. This section presents the details of my DCF analyses, which are summarized in my direct testimony. The first part describes some preliminary matters, such as differences from the

samples used in the risk positioning method, calculation of sample capital structures, etc. Then it turns to the details of the DCF estimates themselves.

In particular, implementation of the simple DCF models described above requires an estimate of the current price, the dividend, and near-term and long-run growth rate forecasts. The simple DCF model relies only on a single growth rate forecast, while the multi-stage DCF model employs both near-term and long-run growth rate forecasts. The remaining parts of this section describe each of these inputs in turn.

A. PRELIMINARY MATTERS

Q14. In the Appendix B discussion of "preliminary matters," you discuss sample selection and the capital structure/cost of capital data you need to complete your risk premium analyses. What, if anything, is different when you use the DCF method?

A14. First, the sample companies to which the DCF approach is applied differ slightly for the water utility sample due to the availability of earnings forecasts. Two companies in the water utility sample, Connecticut Water Svc and SJW Corp, do not currently have long-term growth forecasts from IBES and are therefore excluded from the DCF analysis. In addition, the timing of the market value capital structure calculations is different in the DCF method and in the equity risk premium method. The equity risk premium method relies on the average capital structure over the past five years while the DCF approach uses only current data, so the relevant market value capital structure measure is the most recent that can be calculated. This capital structure is reported in columns 1- 3 of Table No. BV-4 for the water utility sample and Table No. BV-14 for the gas LDC sample.

B. GROWTH RATES

Q15. What growth rates do you use?

A15. For reasons discussed above, historical growth rates today are useless as forecasts of current investor expectations for the water industry or the gas LDC sample. I therefore use rates forecasted by security analysts.

The ideal in a DCF application would be a detailed forecast of future dividends, year by year well into the future, based on a large sample of investment analysts' expectations. I know of no source of such data. Dividends are ultimately paid from earnings, however, and earnings forecasts are available for a few years. Investors do not expect dividends to grow in lockstep with earnings, but for companies for which the DCF approach can be used reliably (*i.e.*, for relatively stable companies whose prices do not include the option-like values described previously), they do expect dividends to track earnings over the long-run. Thus, use of earnings growth rates as a proxy for expectations of dividend growth rates is a common practice.

Accordingly, the first step in my DCF analysis is to examine a sample of investment analysts' forecasted earnings growth rates from the Institutional Brokers Estimate System ("IBES") and from *Value Line* for both samples. Neither IBES nor *Value Line* provide analysts' forecast for all companies in the water utility sample. IBES provides a (recent) long-term growth forecast for six of the eight companies in the water utility sample. IBES does not provide recent long-term earnings growth rates forecasts for Connecticut Water Services or SJW Corp. The consensus forecast from IBES is based on one analyst's forecast for one company (Middlesex Water) and on two analysts' estimate for two companies

(American States Water and York Water).[6] Both IBES and *Value Line* provide long-term growth rates for all companies in the gas LDC sample. IBES and *Value Line* projected earnings growth rates for the companies in the water utility and the gas LDC samples are in Tables No. BV-5 and BV-15, respectively. The tables report IBES long-term growth forecast in column one, the number of analysts providing IBES growth forecasts in column two, *Value Line* growth forecasts are in column five, and column six combines IBES and *Value Line* growth forecasts. The combined growth forecasts weight the IBES forecasts by the number of analysts providing a forecasts and the *Value Line* forecast by one.[7]

In the simple DCF, I use the five-year average annual growth rate as the perpetual growth rate.[8] In the multi-stage DCF model, I implement the combined IBES and *Value Line* growth rates for fiscal years 2005-2010 while I rely on the long-term GDP growth as an estimate of the perpetual earnings for the two samples. I report the yearly growth rates for the multi-stage DCF model in Table No. BV-6, Panel B for the water sample and Table No. BV-16 for the gas LDC sample.

Q16. Do these growth rates correspond to the ideal you mentioned above?

A16. No. While forecasted growth rates are the quantity required in principle, the forecasts need to go far enough out into the future so that it is reasonable to believe that investors expect

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[6] See Table No. BV-5 for details.

[7] I treat the *Value Line* forecasts as though they overlap exactly with the forecasts from IBES. These growth rates underlie my simple and multi-stage DCF analyses.

[8] This growth rate is in column 6 in Table No. B-5 for the water sample and in Table No. BV-15 for the gas LDC sample.

a stable growth path afterwards. As can be seen in Table No. BV-5 for the water utility sample and in Table No. BV-15 for the gas LDC sample, the growth rate forecasts vary widely from company to company. For example, the mean IBES growth forecast for Southwest Water is 7.0 percent while the *Value Line* growth forecast is 20.3 percent.[9] Similarly, the mean IBES growth forecast for Southwest Gas is 4.0 percent while the *Value Line* forecast is 13.3 percent.[10] Also, for some companies, the five-year growth rate forecasts are significantly above or below the long-term GDP growth rate indicating lack of stability in growth rates. Overall, the growth rates indicates that some companies and maybe the industries have yet to reach a stable equilibrium which is required for the correct application of the DCF method.

It is clear that much longer detailed growth rate forecasts than currently available from IBES and *Value Line* would be needed to implement the DCF model in a completely reliable way for these two samples at this time; however, the general stability of the 5-year growth rate forecasts for the gas LDC sample indicates a higher degree of reliability than for the water sample at this time. I submit DCF evidence in this case for both the water utility sample and the gas LDC sample as a check on the equity risk premium approach estimates.

[9] See Table No. BV-5.

[10] See Table No. BV-15.

C. DIVIDEND AND PRICE INPUTS

Q17. What values do you use for dividends and stock prices?

A17. Dividend payments are for the 2nd quarter of 2005 as reported by Compustat. This dividend is grown at the estimated growth rate and divided by the price described below to estimate the dividend yield for the simple and multi-stage DCF models.

Stock prices are the average of the closing stock prices for the 15 trading days (approximately three weeks). For the water sample, the 15-days end on October 28, 2005 for all sample companies in the water sample except Aqua America Inc., which ends October 17, 2005. For the gas LDC sample, the 15-day end on October 14, 2005 for all companies. These dates correspond to the release dates of the IBES growth forecasts so that the information in growth rates and stock prices are contemporaneous. I use a 15-day average as a compromise. Using a longer period would be inconsistent with the principles that the DCF model relies on the current stock price. The DCF approach assumes the stock price is the present value of future expected dividends. Stock prices six months or a year ago reflect expectations at that time, which are different from those that underlie the current IBES and *Value Line* forecasts. At the same time, use of an average over a brief period as opposed to a single day helps guard against a company's price on a particular day price being unduly influenced by mistaken information, differences in trading frequency, and the like.

The closing stock price is used because it is at least as good as any other measure of the day's outcome, and may be better for DCF purposes. In particular, if there were any single price during the day that would affect investors' decisions to buy or sell a stock, I would suspect that it would be each day's closing price, not the high or low during the day.

The daily price changes reported in the financial pages, for example, are from close to close, not from high to high or from low to low.

D. COMPANY-SPECIFIC DCF COST OF CAPITAL ESTIMATES

Q18. What cost of equity estimates do these data yield?

A18. The cost of equity results for the simple and multi-stage DCF models are shown in Table No. BV-6 for the water utility sample and in Table No. BV-16 for the gas LDC sample. Panel A reports the results for the simple DCF method and Panel B reports the results for the multi-stage DCF method using the long-term GDP growth rate as the perpetual growth rate.

Q19. What information is provided in Table No. BV-7 and Table No. BV-17?

A19. In these tables, the capital structure, cost of equity estimates, and cost of debt estimates are combined to obtain the overall cost of capital for each sample company. The results are presented in Table No. BV-7 for the water utility sample and in Table No. BV-17 for the gas LDC sample. Panel A relies on the simple DCF cost of equity results, and Panel B relies on the multi-stage DCF cost of equity results.

For both samples, I also report the average for the subsample of companies that have a large percentage of revenue from regulated activities.[11]

[11] The 2004 revenues from regulated businesses is above 70 percent for both samples. (See Table No. BV-2 and Table No. BV-12.)

Q20. What do the values in Table No. BV-8 and Table No. BV- 18 imply about the cost of equity for the sample companies at Mohave's 40 percent equity ratio?

A20. The overall after-tax weighted-average cost of capital from these tables for both DCF methods and for the subsamples are reported in column one of Table No. BV-8 and Table No. BV-18. Column 6 of the tables reports the cost of equity consistent with Mohave's requested 40 percent equity thicknesses and the samples' average weighted-average cost of capital. The sample average ATWACCs are displayed in Table C-1 at the end of this appendix. The costs of equity at a 40 percent equity ratio are displayed in Table 4 of my direct testimony.

The implications of these numbers are discussed in my direct testimony, along with the findings of the equity risk premium approach.

Table C-1: Discounted Cash Flow After-Tax Weighted-Average Cost of Capital Estimates
Panel A: for All Companies
in the Water Utility and Gas LDC Samples

	Water Utility	Gas LDC
Simple DCF Method (Quarterly)	8.2%	7.2%
Multi-Stage DCF Using the Long-Term GDP Forecast as the Perpetual Rate	6.9%	7.4%

Source: Tables No. BV-8 and BV-18.

Table C-1: Discounted Cash Flow After-Tax Weighted-Average Cost of Capital Estimates
Panel B: for Companies with a High Percentage Regulated Revenue
in the Water Utility and Gas LDC Samples

	Water Utility	Gas LDC
Simple DCF Method (Quarterly)	8.1%	7.2%
Multi-Stage DCF Using the Long-Term GDP Forecast as the Perpetual Rate	7.0%	7.1%

Source: Tables No. BV-8 and BV-18.

APPENDIX D: EFFECT OF DEBT ON THE COST OF EQUITY

TABLE OF CONTENTS

SECTION **PAGE**

Q1. What is the purpose of this appendix?

A1. In this appendix, I provide details on the effects of debt on the cost of equity. First, I summarize a fairly large body of financial research on capital structure. Second, I elaborate on the example used in the main testimony.

AN OVERVIEW OF THE ECONOMIC LITERATURE

Q2. What is the focus of the economic literature on the effects of debt?

A2. The economic literature focuses on the effects of debt on the value of a firm. The standard way to recognize one of these effects, the impact of the fact that interest expense is tax-deductible, is to discount the all-equity after-tax operating cash flows generated by a firm or an investment project at a weighted average cost of capital, typically known in textbooks as the "WACC." The textbook WACC equals the *market*-value weighted average of the cost of equity and the *after-tax*, *current* cost of debt. However, rate regulation in North America has a legacy of working with another weighted-average cost of capital, the *book*-value weighted average of the cost of equity and the *before-tax*, *embedded* cost of debt. To distinguish the concepts, I refer to the after-tax weighted-average cost of capital as ATWACC.

Q3. How is this section of the appendix organized?

A3. It starts with the tax effects of debt. It then turns to other effects of debt.

A. TAX EFFECTS

Q4. What are the key findings in the literature regarding tax effects?

A4. Three seminal papers are vital for this literature. The first assumes no taxes and risk-free debt. The second adds corporate income taxes. The third adds personal income taxes.

1. Base Case: No Taxes, No Risk to High Debt Ratios

Q5. Please start by explaining the simplest case of the effect of debt on the value of a firm.

A5. The "base case," no taxes and no costs to excessive debt, was worked out in a classic 1958 paper by Franco Modigliani and Merton Miller, two economists who eventually won Nobel Prizes in part for their body of work on the effects of debt.[1] Their 1958 paper made what is in retrospect a very simple point: if there are no taxes and no risk to the use of excessive debt, use of debt will have no effect on a company's operating cash flows (i.e., the cash flows to investors as a group, debt plus equity combined). If the operating cash flows are the same regardless of whether the company finances mostly with debt or mostly with equity, then the value of the firm cannot be affected at all by the debt ratio. In cost of capital terms, this means the overall cost of capital is constant regardless of the debt ratio, too.

In the base case, issuing debt merely divides the cash flows into two pools, one for bondholders and one for shareholders. If the divided pools have different priorities in claims on the cash flows, the risks and costs of capital will differ for each pool. But the risk and overall cost of capital of the entire firm, the sum of the two pools, is constant regardless of the debt ratio. Thus,

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[1] Franco Modigliani and Merton H. Miller (1958), "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, 48, pp. 261-297.

$$r^*_1 = r_{A1} \quad \text{(D-1a)}$$

where r^*_1 is the overall after-tax cost of capital at any particular capital structure and r_{A1} is the all-equity cost of capital for the firm. (The "1" subscripts distinguish the case where there are no taxes from subsequent equations that consider first corporate and then both corporate and personal taxes.) With no taxes and no risk to debt, the overall cost of capital does not change with capital structure.

This implies that the overall cost of capital to the component costs of debt and equity is

$$r_{E1} \times (E/V) + r_D \times (D/V) = r^*_1 \quad \text{(D-1b)}$$

with the overall cost of capital (r^*) on the *right* side, as the *independent* variable, and the costs of equity (r_E) and debt (r_D) on the left side, as *dependent* variables determined by the overall cost of capital and by the capital structure (i.e., the shares of equity (E) and debt (D) in overall firm value (V=E+D)) that the firm happens to choose. Note that if equation (D-1a) were correct, the equation that solved it for the cost of equity would be,

$$r_{E1} = r^*_1 + (r^*_1 - r_D) \times (D/E) \quad \text{(D-1c)}$$

Note also that (D/E) gets exponentially higher in this equation as the debt-to-value ratio increases.[2] I.e., the cost of equity increases exponentially with leverage.

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[2] For example, at 20-80, 50-50, and 80-20 debt-equity ratios, (D/E) equals, respectively, (20/80) = 0.25, (50/50) = 1.0, and (80/20) = 4.0. The extra 30 percent of debt going from 20-80 to 50-50 has much less impact on (D/E) [i.e., by moving it from 0.25 to 1.0] than the extra 30 percent of debt going from 50-50 to 80-20 [i.e., by moving it from 1.0 to 4.0]. Since the cost of equity equals a constant risk premium (continued...)

2. Corporate Tax Deduction for Interest Expense

Q6. What happens when you add corporate taxes to the discussion?

A6. If corporate taxes exist with risk-free debt (and if only taxes at the corporate level matter, not taxes at the level of the investor's personal tax return), the initial conclusion changes. Debt at the corporate level reduces the company's tax liability by an amount equal to the marginal tax rate times interest expense. All else equal, this will add value to the company because more of the operating cash flows will end up in the hands of investors as a group. That is, if only corporate taxes mattered, interest would add cash to the firm equal to the corporate tax rate times the interest expense. This increase in cash would increase the value of the firm, all else equal. In cost of capital terms, it would reduce the overall cost of capital.

How much the value of the firm would rise and *how far* the overall cost of capital would fall would depend in part on how often the company adjusts its capital structure, but this is a second-order effect in practice. (The biggest effect would be if companies could issue riskless perpetual debt, an assumption Profs. Modigliani and Miller explored in 1963, in the second seminal paper;[3] this assumption could *not* be true for a real company.) Prof. Robert A. Taggart provides a unified treatment of the main papers in this literature and shows how various cases relate to one another.[4] Perhaps the most useful set of benchmark equations for the case where only corporate taxes matter are:

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[2] (...continued)
times the debt-equity ratio, the cost of equity grows ever more rapidly as you add more and more debt.

[3] Franco Modigliani and Merton H. Miller (1963), "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review*, 53, pp. 433-443.

[4] Robert A. Taggart, Jr. (1991), "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management* 20, pp. 8-20.

$$r^*_2 = r_{A2} - r_D \times t_C \times (D/V) \quad \text{(D-2a)}$$

$$r_{E2} \times (E/V) + r_D \times (D/V) \times (1 - t_C) = r^*_2 \quad \text{(D-2b)}$$

which imply for the cost of equity,

$$r_{E2} = r_{A2} + (r_{A2} - r_D) \times (D/E) \quad \text{(D-2c)}$$

where the variables have the same meaning as before but the "2" subscripts indicate the case that considers corporate but not personal taxes.

Note that Equation (D-2a) implies that when only corporate taxes matter, the overall after-tax cost of capital declines steadily as more debt is added, until it reaches a minimum at 100 percent debt (i.e., when D/V = 1.0). Note also that Equation (D-2c) still implies an exponentially increasing cost of equity as more and more debt is added. In fact, except for the subscript, Equation (D-2c) looks just like Equation (D-1c).

However, whether any value is added and whether the cost of capital changes at all also depends on the effect of taxes at the personal level.

3. Personal Tax Burden on Interest Expense

Q7. How do personal taxes affect the results?

A7. Ultimately, the purpose of investment is to provide income for consumption, so personal taxes affect investment returns. For example, in the U.S., municipal bonds have lower interest rates than corporate bonds because their income is taxed less heavily at the personal level. In general, capital appreciation on common stocks is taxed less heavily than interest on corporate bonds because (1) taxes on unrealized capital gains are deferred until the gains are realized, and (2) the capital gains tax rate is lower. Dividends are taxed less heavily than

interest, also, under current tax law.[5] The effects of personal taxes on the cost of common equity are hard to measure, however, because common equity is so risky.

Professor Miller, in his Presidential Address to the American Finance Association,[6] explored the issue of how personal taxes affect the overall cost of capital. The paper pointed out that personal tax effects could offset the effect of corporate taxes entirely.

Q8. Is it likely that the effect of personal taxes will completely neutralize the effect of corporate taxes?

A8. I do not believe so, although the likelihood of such a result would be increased if the current federal tax reductions on dividends and capital gains became permanent rather than expiring in 2008. However, personal taxes are important even if they do not make the corporate tax advantage on interest vanish entirely. Capital gains and dividend tax advantages definitely convey some personal tax advantage to equity, and even a partial personal advantage to equity reduces the corporate advantage to debt.

The Taggart paper explores the case of a partial offset, also. With personal taxes, the risk-free rate on the security market line is the after-personal-tax rate, which must be equal for risk-free debt and risk-free equity.[7] Therefore, the pre-personal-tax risk-free rate for equity will generally not be equal to the pre-personal-tax risk-free rate for debt. In

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[5] This provision is set to expire at the end of 2008. The House and Senate bills currently disagree on an extension hereof.

[6] Merton H. Miller (1977), "Debt and Taxes," *The Journal of Finance*, 32: 261-276, the third of the seminal papers mentioned earlier.

[7] As Prof. Taggart notes (his footnote 9), it is not necessary that a specific, risk-free equity security exist as long as one can be created synthetically, through a combination of long and short sales of traded assets. Such constructs are a common analytical tool in financial economics.

particular, $r_{fE} = r_{fD} \times [(1-t_D)/(1-t_E)]$, where r_{fE} and r_{fD} are the risk-free costs of equity and debt and t_E and t_D are the personal tax rates for equity and debt, respectively. In terms of the cost of debt, the Taggart paper's results imply that a formal statement of these effects can be written as:[8]

$$r^*_3 = r_{A3} - r_D \times t_N \times (D/V) \quad \text{(D-3a)}$$

$$r_{E3} \times (E/V) + r_D \times (D/V) \times (1-t_C) = r^*_3 \quad \text{(D-3b)}$$

which imply

$$r_{E3} = r_{A3} + \{r_{A3} - r_D \times [(1-t_D)/(1-t_E)]\} \times (D/E) \quad \text{(D-3c)}$$

Suppose, for example, that t_C = 0.35 percent, t_E = 7.7 percent and t_D = 40 percent. Then $[(1-t_D)/(1-t_E)] = 0.65 = (1-t_C)$. That condition corresponds to Miller's 1977 paper, in which the net personal tax advantage of equity fully offsets the net corporate tax advantage of debt. Note also that in that case, $t_N = 0$.[9] Therefore, if the personal tax advantage on equity fully offsets the corporate tax advantage on debt, Equation (D-3a) confirms that the overall after-tax cost of capital is a constant.

However, it is unlikely that the personal tax advantage of equity fully offsets the corporate tax advantage of debt. If taxes were all that mattered (i.e., if there were no other costs to debt), the overall after-corporate-tax cost of capital would still fall as debt was added, just not as fast.

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[8] The net all-tax effect of debt on the overall cost of capital, t_N, equals $\{[t_C + t_E - t_D - (t_C \times t_E)] / (1-t_E)\}$, where t_D is the personal tax rate on debt, as before. This measure of net tax effect is designed for use with the cost of debt in Equation (D-3a), which seems more useful in the present context. The Taggart paper works with a similar measure, but one which is designed for use with the cost of risk-free equity in the equivalent Taggart equation.

[9] In the above example, $t_N = \{[0.35+0.077-0.4-(0.35\times0.077)] / (1.0-0.077)\} = 0.0/0.923 = 0$.

Finally, note that the overall after-tax cost of capital, Equation (D-3b), still uses the corporate tax rate even when personal taxes matter. Equations (D-2b) and (D-3b) both correspond to the usual formula for the ATWACC. Personal taxes affect the way the cost of equity changes with capital structure -- Equation (D-3c) -- but not the formula for the overall after-tax cost of capital given that cost of equity.

B. NON-TAX EFFECTS

Q9. Please describe the non-tax effects of debt.

A9. If debt is truly valuable, firms should use as much as possible, and competition should drive firms in a particular industry to the same, optimal capital structure for the industry. If debt is harmful on balance, firms should avoid it. Neither picture corresponds to what we actually see. A large economic literature has evolved to try to explain why.

Part of the answer clearly are the costs of excessive debt. Here the results cannot be reduced to equations, but they are no less real for that fact. As companies add too much debt, the costs come to outweigh the benefits. Too much debt reduces or eliminates financial flexibility, which cuts the firm's ability to take advantage of unexpected opportunities or weather unexpected difficulty. Use of debt rather than internal financing may be taken as a negative signal by the market.

Even if the company is generally healthy, more debt increases the risk that the company cannot use all of the interest tax shields in a bad year. As debt continues to grow, this problem grows and others may crop up. Management begins to worry about meeting debt payments instead of making good operating decisions. Suppliers are less willing to extend trade credit, and a liquidity shortage can translate into lower operating profits.

Ultimately, the firm might have to go through the costs of bankruptcy and reorganization. Collectively, such factors are known as the costs of "financial distress."[10]

The net tax advantage to debt, if positive, is affected by costs such as a growing risk that the firm might have to bear the costs of financial distress. First, the expected present value of these costs offsets the value added by the interest tax shield. Second, since the likelihood of financial distress is greater in bad times when other investments also do poorly, the possibility of financial distress will increase the risks investors bear. These effects increase the variability of the value of the firm. Thus, firms that use too much debt can end up with a higher overall cost of capital than those that use none.

Other parts of the answer include the signals companies send to investors by the decision to issue new securities, and by the type of securities they issue. Other threads of the literature explore cases where management acts against shareholder interests, or where management attempts to "time" the market by issuing specific securities under different conditions. For present purposes, the important point is that no theory, whether based on taxes or on some completely different issue, has emerged as "the" explanation for capital structure decisions by firms. Nonetheless, despite the lack of a single "best" theory, there is a great deal of relevant empirical research.

Q10. What does that research show?

A10. The research does not support the view that debt makes a material difference in the value of the firm, at least not once a modest amount of debt is in place. If debt were truly valuable, competitive firms should use as much as possible without producing financial distress, and

[10] See, for example,

competitive firms that use less debt ought to be less profitable. The research shows exactly the opposite.

For example, Kestler[11] found that firms in the same industry in both the U.S. and Japan do not band around a single, "optimal" capital structure, and the most profitable firms are the ones that use the *least* debt. This finding comes despite the fact that both countries at the time (unlike the U.S. currently) had fully "classical" tax systems, in which dividends are taxed fully at both the corporate and personal level. Wald[12] confirms that high profitability implies low debt ratios in France, Germany, Japan, the U.K., and the U.S. Booth *et al.* find the same result for a sample of developing nations.[13] Fama and French[14] analyze over 2000 firms for 28 years (1965-1992, inclusive) and conclude, "Our tests thus produce no indication that debt has net tax benefits."[15] A recent paper by Graham[16] carefully analyzes the factors that might have led a firm not to take advantage of debt. It confirms that a large proportion of firms that ought to benefit substantially from use of additional debt, including large, profitable, liquid firms, appear not to use it "enough."

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[11] Carl Kester (1986), "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Concerns," *Financial Management*, 15:5-16.

[12] John K. Wald (1999), "How Firm Characteristics Affect Capital Structure: An International Comparison," *Journal of Financial Research*, 22:161-167.

[13] Laurence Booth *et al.* (2001), "Capital Structures in Developing Countries," *The Journal of Finance* Vol. LVI, pp. 87-130, finds at p. 105 that "[o]verall, the strongest result is that profitable firms use less total debt. The strength of this result is striking ..."

[14] Eugene F. Fama and Kenneth R. French (1998), "Taxes, Financing Decisions and Firm Value," *The Journal of Finance*, 53:819-843.

[15] *Ibid.*, p. 841.

[16] John R. Graham (2000), "How Big Are the Tax Benefits of Debt," *The Journal of Finance*, 55:1901-1942.

This research leaves us with only three options: either (1) apparently good, profit-generating managers are making major mistakes or deliberately acting against shareholder interests, (2) the benefits of the tax deduction on debt are less than they appear, or (3) the non-tax costs to use of debt offset the potential tax benefits. Only the first of these possibilities is consistent with the view that the tax deductibility of debt conveys a material cost advantage. Moreover, if the first explanation were interpreted to mean that otherwise good managers are acting against shareholder interests, either deliberately or by mistake, it would require the additional assumption that their competitors (and potential acquirers) let them get away with it.

Q11. Are there any explanations in the financial literature for this puzzle other than stupid or self-serving managers at the most profitable firms?

A11. Yes. For example, Stewart C. Myers, a leading expert on capital structure, made it the topic of his Presidential Address to the American Finance Association.[17] The poor performance of tax-based explanations for capital structure led him to propose an entirely different mechanism, the "pecking order" hypothesis. This hypothesis holds that the net tax benefits of debt (i.e., corporate tax advantage over personal tax disadvantage) are at most of a second order of importance relative to other factors that drive actual debt decisions.[18] Similarly,

[17] Stewart C. Myers (1984), "The Capital Structure Puzzle," *The Journal of Finance*, 39: 575-592. See also S. C. Myers and N. S. Majluf (1984), "Corporate Financing Decisions When Firms Have Information Investors Do Not Have," *Journal of Financial Economics* 13:187-222.

[18] See also Stewart C. Myers (1989), "Still Searching for Optimal Capital Structure," *Are the Distinctions Between Debt and Equity Disappearing?*, R.W. Kopke and E. S. Rosengren, eds., Federal Reserve Bank of Boston.

Baker and Wurgler (2002)[19] observe a strong and persistent impact that fluctuations in market value have on capital structure. They argue that this impact is not consistent with other theories. The authors suggest a new capital structure theory based on market timing -- capital structure is the cumulative outcome of attempts to time the equity market.[20] In this theory, there is no optimal capital structure, so market timing financing decisions just accumulate over time into the capital structure outcome. (Of course, this theory only makes sense if investors do not recognize what managers are doing.)

Q12. Do inter-firm differences within an industry explain the wide variations in capital structure across the firms in an industry?

A12. No. This view is contradicted by the empirical research. As mentioned before, it has long been found that the most profitable firms in an industry, i.e., those in the best position to take advantage of debt, use the least.[21] Graham (2000) carefully examines differences in firm characteristics as possible explanations for why firms use "too little" debt and concludes that such differences are *not* the explanation: firms that ought to benefit substantially from more debt by all measurable criteria, if the net tax advantage of debt is truly valuable, voluntarily do not use it.[22]

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[19] Malcolm Baker and Jeffrey Wurgler (2002), "Market Timing and Capital Structure," *The Journal of Finance* 57:1-32.

[20] *Ibid*., p. 29.

[21] For example, Kestler, *op. cit.* and Wald, *op. cit.*

[22] While not contradicting Graham's finding that differences in firm characteristics do not explain capital structure differences, Nengjiu Ju, Robert Parrino, Allen M. Poteshman, and Michael S. Weisbach, "Horses and Rabbits? Optimal Dynamic Capital Structure from Shareholder and Manager Perspectives," Working Paper, December 27, 2003 (forthcoming in the *Journal of Financial and Quantitative Analysis*),

(continued...)

Nor does the research support the view that firms are constantly trying to adjust their capital structures to optimal levels. Additional research on the pecking order hypothesis demonstrates that firms do not tend towards a target capital structure, or at least do not do so with any regularity, and that past studies that seemed to show the contrary actually lacked the power to distinguish whether the hypothesis was true or not.[23] In the words of the Shyam-Sunder - Myers paper p. 242, "If our sample companies did have well-defined optimal debt ratios, it seems that their managers were not much interested in getting there."

EXPANDED EXAMPLE

Q13. What topics do you cover in this section?

A13. The discussion in my testimony did not detail the impact of different starting points for the level of debt not did it address income earned on the investment, interest expense, or taxes. This section covers these topics. First, it discusses how the level of debt affects the cost of equity detail. Second, it discusses the effect of earning and income on the investment and interest expenses. Third, it addresses tax effects.

[22] (...continued)
looks at the issue in a different manner. Their paper uses a dynamic rather than static model to analyze the tradeoff between the tax benefits of debt and the risk of financial distress. It finds that bankruptcy costs by themselves are enough to explain observed capital structures, once dynamic effects are considered. This means debt is not as valuable as the traditional static analysis (of the sort used by Graham).

[23] Lakshmi Shyam-Sunder and Stewart C. Myers (1999), "Testing static tradeoff against pecking order models of capital structure," *Journal of Financial Economics* 51:219-244.

A. DETAILS OF DIFFERENT LEVELS OF DEBT

Q14. What happens if the investor finances the real estate purchase with 0 percent, 30 percent, 50 percent or 70 percent debt?

A14. Table D-1 below calculates the return on equity at each level of debt when real estate prices increases by 10 percent.

Table D-1: The Impact of Leverage on the Return on Equity

	100% Equity	70% Equity	50% Equity	30% Equity
Debt	$0	$30,000	$50,000	$70,000
Original Equity Investment	$100,000	$70,000	$50,000	$30,000
Increase in Market Value of Equity	$10,000	$10,000	$10,000	$10,000
Return on Equity Investment	10%	14.3%	20%	33.3%

Note that going from 70 percent equity down to 50 percent equity increases the return on the equity investment by 5.7 percent while going from 50 percent equity to 30 percent equity increases the return on equity by 13.3 percent. This illustrates a general point; the rate of return on equity increases more quickly at higher levels of debt than at lower levels. Investors demand a higher rate of return to bear more risk and debt magnifies equity's risk at an ever increasing rate. Therefore, the required rate of return goes up at an ever increasing rate as debt is added. This is not only basic finance theory, it is the everyday experience of

anyone who buys a home. The bigger the mortgage, the more percentage risk the equity faces from changes in housing prices.

B. THE IMPACT OF INCOME AND INTEREST

Q15. How does earning income from the investment and paying interest on debt affect the results?

A15. In the following, I ignore income taxes which I deal with in Section C. Assume the investor is receiving income, e.g., rent, from the real estate. Specifically, assume the investor receives $500 per month in income after all non-interest expenses ($6,000 per year). Also, assume that the expected appreciation is 5 percent per year, so the expected market value is $105,000 after one year. Then the expected rate of return from the real estate with all equity financing is:

$$\text{Expected Return on Equity @ 0\% Debt} = \frac{\text{Expected Net Income + Expected Appreciation}}{\text{Initial Investment}}$$

$$= \frac{\$6{,}000 + (\$105{,}000 - \$100{,}000)}{\$100{,}000} = 11\%$$

Now suppose that the mortgage interest rate were 5 percent. Then at a mortgage equal to 50 percent, or $50,000, interest expense would be ($50,000 x 0.05), or $2,500. The expected equity rate of return would be

$$\text{Expected Return on Equity @ 50\% Debt} = \frac{\text{Expected (Net Income + Appreciation) - Interest Expense}}{\text{Initial } \textit{Equity} \text{ Investment}}$$

$$= \frac{\$6{,}000 + \$5{,}000 - \$2{,}500}{\$50{,}000} = 17\%$$

The expected return on equity is higher as is the risk carried by equity.

Q16. Can you provide a more general illustration?

A16. Yes. Figure D-1 uses these assumptions at different mortgage levels to plot both (i) the expected rate of return on the equity in the dwelling, and (ii) the realized rate of return on that equity in a year if the dwelling value increases by 10 percent more than the expected 5 percent rate (i.e., if the value increases by 15 percent) or by 10 percent less than expected (i.e., if it decreases by 5 percent).[24]

[24] For simplicity, the figure assumes the debt's interest rate is independent of the debt proportion. This might not always be true, and in general would not be true for a corporation that issued debt. However, the general shape of the graphs remains the same.

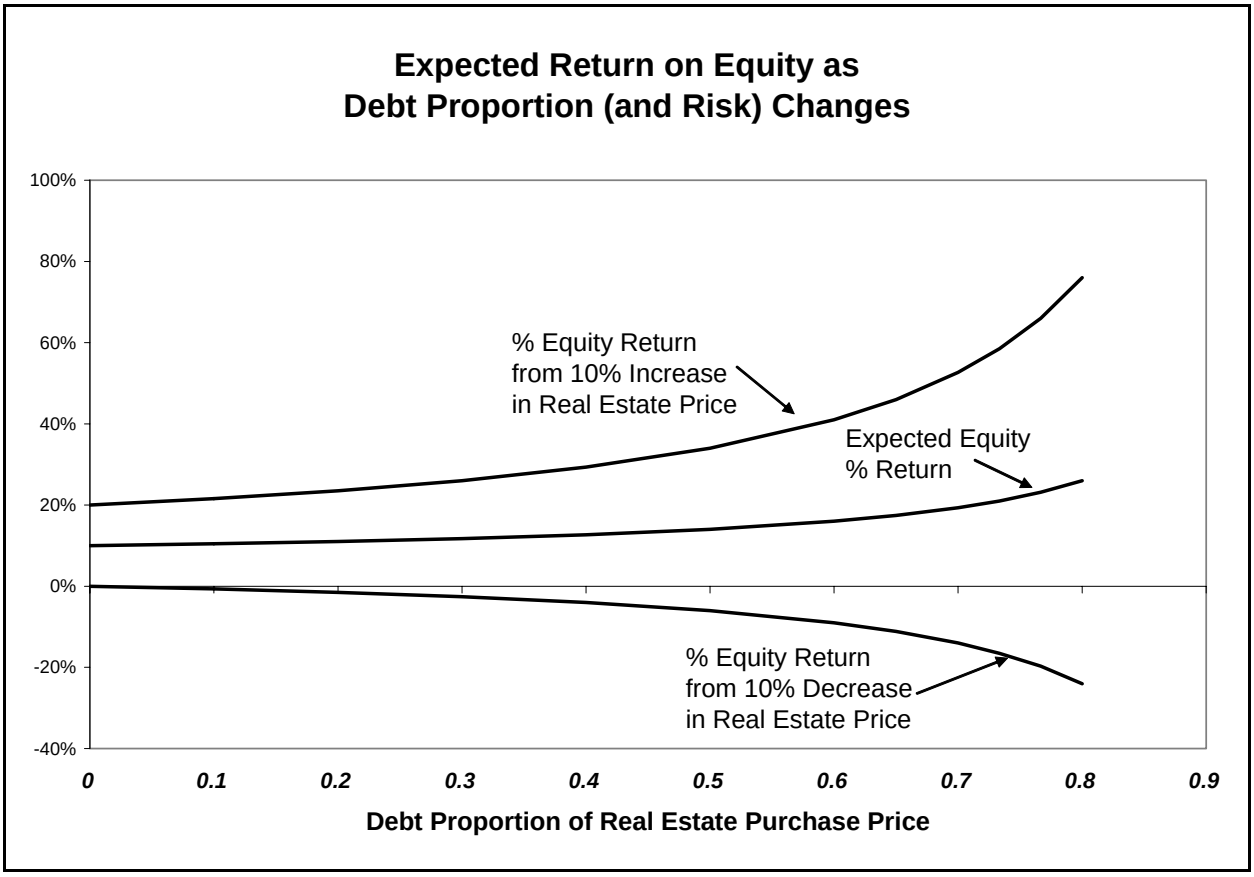

Figure D-1

The expected rate of return on equity increases at an increasing rate as the investor finances more and more of the real estate through loans (e.g., with a mortgage). Since equity bear all the risk of increases or decreases in real estate values (absent financial distress or bankruptcy), the amount of risk the buyer bears grows at an ever increasing rate at the mortgage percentage increases, too.

Q17. What are the implications of this example?

A17. Any time an individual or a company uses debt to finance part an investment, the same risk magnifies. For example, if an investor buy stocks "on margin" -- by borrowing part of the money used to buy the stock -- the expected rate of return will be higher as will the risks the

investor carries. As an everyday example, imagine investing your retirement savings in a stock portfolio bought with as much margin as possible. If you were lucky, you could end up living very well in retirement. But you would be taking a lot of risk of the opposite outcome, since your portfolio could decline by more than 100 percent of your initial investment.

The same risk-magnifying effects happen when companies borrow to finance part of their investments.

C. THE EFFECT OF TAXES

Q18. What is the impact of taxes?

A18. Analyzing the net effect of taxes in capital structure decisions by corporations is an important part of the financial research. (Other parts of that research address such issues as the risk of financial distress or bankruptcy, and the signals corporations send investors by the choice of how to finance new investments.) The bottom line is that taxes complicate the picture without changing the basic conclusion.

Q19. Please describe the potential impact of taxes.

A19. Interest expense is tax-deductible for corporations. That increases the pool of cash the corporation gets to keep out of its operating earnings (i.e., its earnings before interest expense). With no debt, 100 percent of operating income is subject to taxes. With debt, only the equity part of the operating income is subject to taxes.

All else equal, the extra money kept from operating income increases the value of the corporation. The standard way to recognize that increase in value is to use an after-tax

weighted-average cost of capital as a discount rate when valuing a company's operating cash flows.

Q20. Do personal taxes affect the value of debt, too?

A20. Yes, but in the other direction. One offset to debt's tax benefits at the corporate level is its higher tax burden at the personal level. Investors care about the money they get to keep after all taxes are paid, and while the corporation saves taxes by opting for debt over equity, individuals pay more taxes on interest than on capital gains from equity (and for now, on dividends as well).

Q21. Are there factors other than taxes matter?

A21. Absolutely. "All else" does not remain equal as more debt is added. The more debt, the more the non-tax effects of debt offset the tax benefits. Other costs include such effects as a loss of flexibility, the possibility of sending negative signals to investors, and a host of costs and risks associated with the danger of financial distress.

Q22. Does the tradeoff between the tax and non-tax effects of debt mean that firms have well-defined, optimal capital structures?

A22. No, this sort of "tradeoff" model does not explain actual corporate behavior. A substantial body of economic research confirms that real-world corporations act as if, after a moderate amount of debt is in place, the tax benefits of debt are not worth debt's other costs. In country after country and in industry after industry, the most profitable corporations in an industry tend to use the least debt. The research on this point is quite thorough, and the

finding that the most profitable companies tend to use the least debt in a given industry is robust. Yet these are the companies with the most operating income to shield from taxes, who would benefit most if interest tax shields were truly valuable net of debt's other costs. They also presumptively are the best-managed on average (else why are they the most profitable?).

This means it is unrealistic to suppose that more debt is always better, or that greater tax savings due to higher interest expense always add value to the firm on balance.

Q23. If the tradeoff model doesn't explain capital structure decisions by firms, is there a model that does?

A23. No single model as (yet) emerged as 'the" explanation of capital structure. However, several alternative models attempt to model the tradeoff (e.g., the "pecking order" hypothesis and "agency cost" explanations).

Q24. What does the absence of an agreed theory of capital structure in the financial literature imply about the overall effect of debt on the value of the firm?

A24. The findings of the financial literature mean that within an industry, there is no well-defined optimal capital structure. The use of some debt does convey some value advantage in most industries, but that advantage is offset by other costs as firms add more debt.[25] The range

[25] Note that if debt did increase the value of the firm materially, competition would tend to take that value away, since issuing debt is an easy-to-copy competitive strategy. Prices would fall as firms copied the strategy, lowering operating earnings and passing the net tax advantages to debt through to customers (just as happens under rate regulation). Therefore, if also there were a narrow range of optimal capital structures within an industry, competition would drive all firms in the industry to capital structures within that range. This does not happen in practice, which contradicts one or both of the assumptions, i.e., (1) (continued...)

of capital structures over which the value of the firm in any industry is maximized is wide and should be treated as flat. The location and level of that range, however, does vary from industry to industry, just as the overall cost of capital varies from industry to industry.

Figure D-2 illustrates the picture that emerges from the research. This figure shows the present value of an investment in each of four different industries. For simplicity, the investment is expected to yield $1.00 per year forever. For firms in relatively high-risk industries (Industry 1 in the graph, the lowest line), the $1.00 perpetuity is not worth much and any use of debt decreases firm value. For firms in relatively low-risk industries (Industry 4 in the graph), the perpetuity is worth more and substantial amounts of debt make sense. Industries 2 and 3 are intermediate cases.

The maximum net rate at which taxes can increase value in this figure equals 20 percent of interest expense, representing a balance between the corporate tax advantage to debt and the personal tax disadvantage. The figure plots the maximum possible impact of taxes on value as a separate line, starting at the all-equity value of the lowest-risk industry (Industry 4).

[25] (...continued)
that debt adds material value on balance, and/or (2) that there is a narrow range of optimal capital structures.

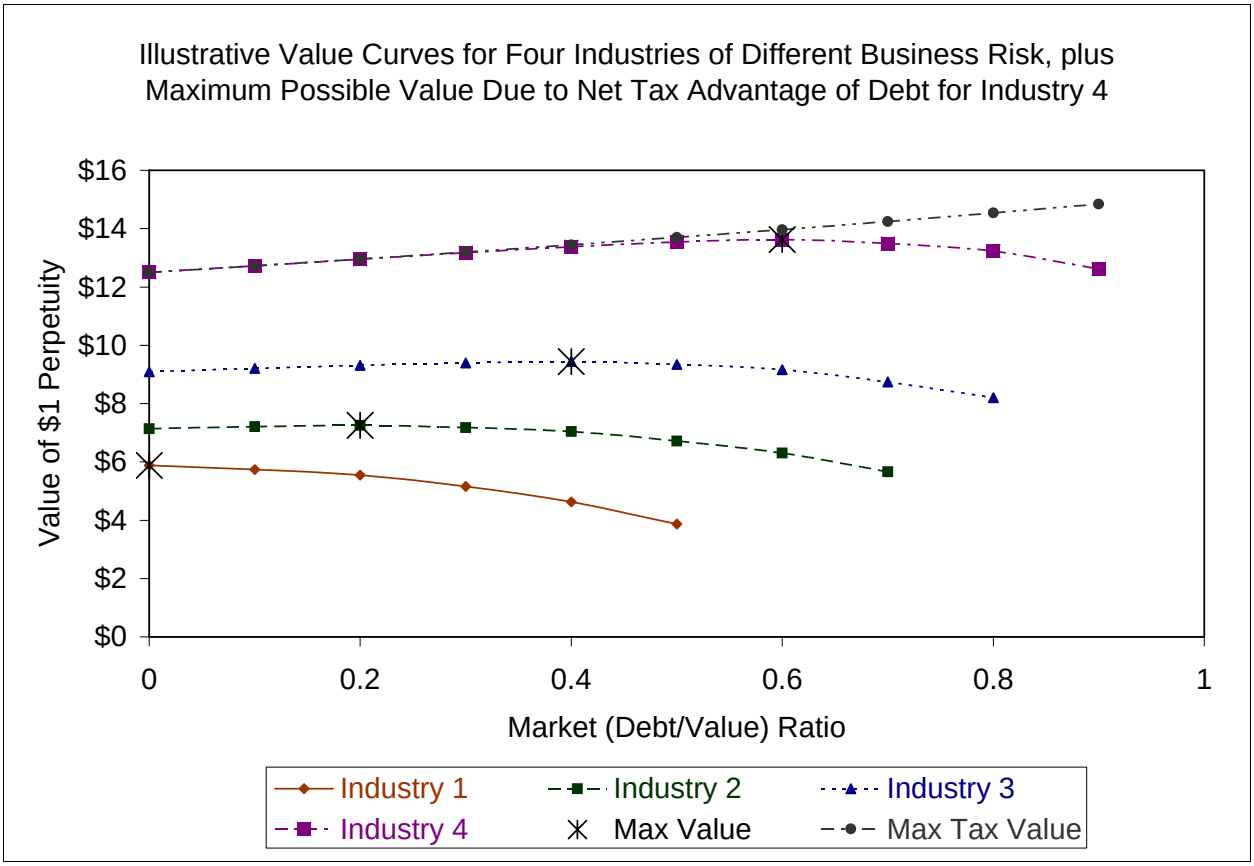

Figure D-2

Figure D-2 identifies a particular point as the maximum value on each of the four curves. However, the research shows that reliable identification of this maximum point, except in the extreme case where no debt should be used, is impossible. In accord with the research, the graph is prepared so that in none of the industries does a change in capital structure make much difference near the top of the curve. Even Industry 4, which increases in value at the maximum rate as quite a lot of debt is added, eventually must reach a broad range where changes in the debt ratio make little difference to firm value, given the research. For Industry 4, debt makes less than a 2 percent difference in the total value of the firm for debt-to-value ratios between 40 and 70 percent. (While these particular values are

illustrative, numbers of this order of magnitude are the only ones consistent with the research.)

Q25. What does this imply for the overall cost of capital?

A25. Figure D-3 plots the after-tax weighted-average costs of capital ("ATWACCs") that correspond to the value curves in Figure D-2. This picture just turns Figure D-2 upside down.[26] All the same conclusions remain, except that they are stated in terms of the overall cost of capital instead of the overall firm value. In particular, except for high-risk industries, the overall cost of capital is essentially flat across a broad middle range of capital structures for each industry, which is the only outcome consistent with the research. For Industry 4, for example, the ATWACC changes by less than 15 basis points for debt-to-value ratios between 40 and 70 percent.

[26] Note that the actual estimated ATWACC at higher debt ratios will tend to underestimate the ATWACC that corresponds to the value curves in Figure D-2, which are depicted in Figure D-3, and so will tend to overestimate the value of debt to the firm. The reason is that some of the non-tax effects of excessive debt, such as a loss of financial flexibility, may be hard to detect and not show up in cost of capital measurement.

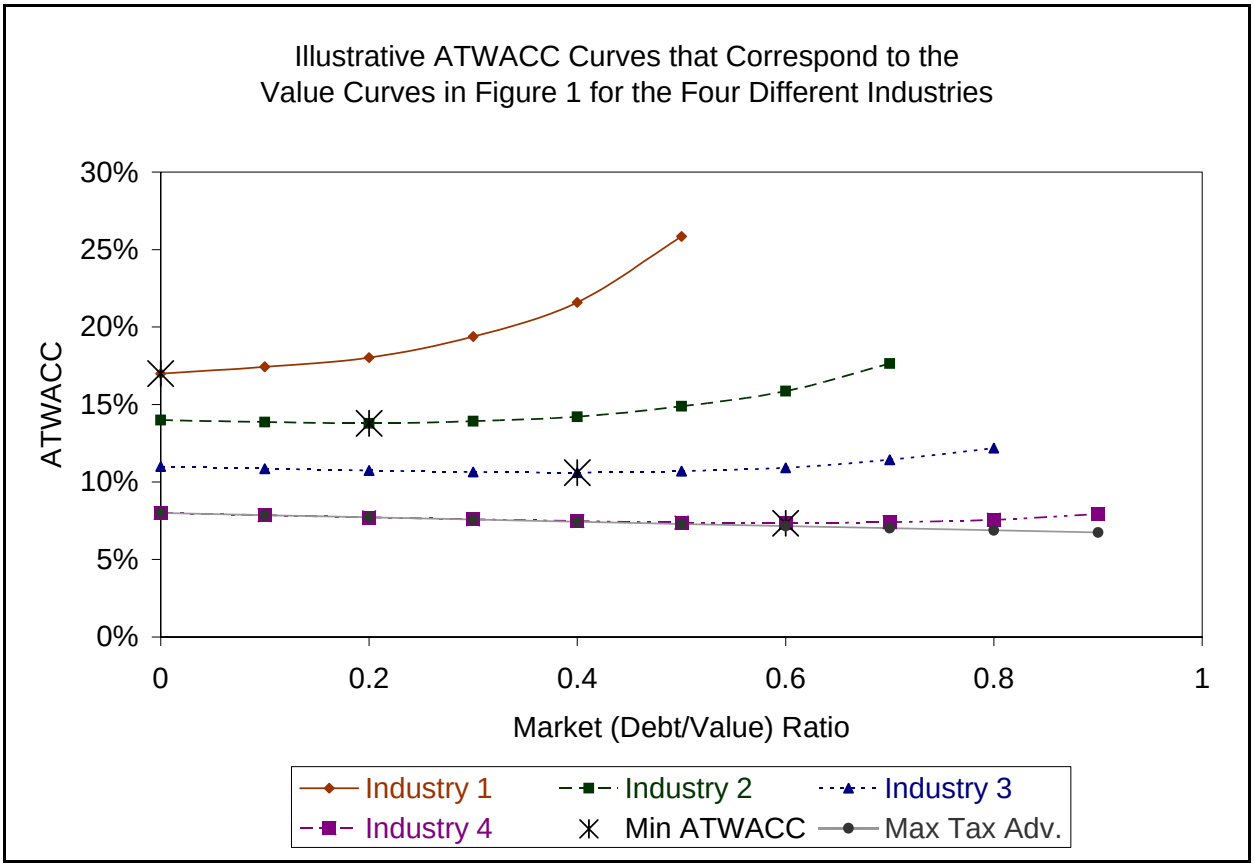

Figure D-3

Q26. How does this discussion relate to estimation of the right cost of equity for ratemaking purposes?

A26. When an analyst estimates the cost of equity for a sample of companies, s/he does so at the sample's actual market-value capital structure. That is, the sample evidence corresponds to ATWACCs that are already out somewhere in the broad middle range in which changes in the debt ratio have little or no impact on the overall value of the firm or the ATWACC.

An analyst therefore should assume the ATWACCs for the sample companies are literally flat. This assumption always provides the exact tradeoff between the cost of equity and capital structure at the literal minimum of the company's ATWACC curve. The

research shows that this minimum is actually a broad, flat region, as depicted above. If the company happens to be somewhat to one side or the other of the literal minimum within this region, the recommended procedure may lead to a small understatement or overstatement of the amount that the cost of equity will change as capital structure changes. The degree of this under- or overstatement, however, is very small compared to the inherent uncertainty in estimating the cost of equity in the first place. Otherwise, the financial research would have found very different results about the existence of a narrowly defined optimal capital structure.

D. COMBINED EFFECTS

Q27. Please summarize the implications for the combined impact of the tax and non-tax effects of debt.

A27. The most profitable firms do not behave as if the precise amount of debt they use makes any material difference to value, and competition does not force them into an alternative decision, as it would if debt were genuinely valuable. The explanation that fits the facts and the research is that within an industry, there is no well-defined optimal capital structure. Use of some debt does convey an advantage in most industries, but that advantage is offset by other costs as firms add more debt. The range of capital structures over which the value of the firm in any industry is maximized is wide and should be treated as flat. The location and level of that range, however, does vary from industry to industry, just as the overall cost of capital varies from industry to industry. To conclude that more debt does add more value, once the firm is somewhere in the normal range for the industry, is to conclude that corporate

management in general is either blind to an easy source of value or otherwise incompetent (and that their competitors let them get away with it).

The finding that there is no narrowly defined optimal capital structure implies that analysts should estimate the ATWACCs for a sample of companies in a given industry and treat the average ATWACC value as independent of capital structure (at least within a broad middle range of capital structures). The right cost of equity for a rate-regulated company in the same industry is the number that yields the same ATWACC at the capital structure used to set the revenue requirement, since that is the cost of equity that (estimation problems aside) the sample companies would have had if their market-value capital structures had been equal to the regulatory capital structure.