Ohio | **Public Utilities Commission**

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Case No. Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Increase in Gas Rates.	:	Case No. 18-298-GA-AIR
PUCO Cas In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Alternative Rate Plan.	:	Case No. ~~19~~ 18-299-GA-ALT
In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Alternative Rate Plan.	:	Case No. 18-49-GA-ALT

List of exhibits being filed:

Company Exhibit

5.0 Direct Testimony of Michael J. Vilbert

5.1 Supplemental Direct Testimony of Michael J. Vilbert

5.2 Second Supplemental Direct Testimony of Michael J. Vilbert

5.3 Revised Schedules Sponsored by Michael J. Vilbert

Reporter's Signature: ______

Date Submitted: ______

BEFORE THE PUBLIC UTILITIES COMMISSION OF OHIO

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In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Increase in Gas Rates.	:	Case No. 18-298-GA-AIR
In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Alternative Rate Plan.	:	Case No. 19-299-GA-ALT
In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc. For Approval of an Alternative Rate Plan.	:	Case No. 18-49-GA-ALT

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PROCEEDINGS

before Gregory Price and Patricia Schabo, Attorney Examiners, at the Public Utilities Commission of Ohio, 180 East Broad Street, Room 11-A, Columbus, Ohio, called at 10:00 a.m. on Friday, February 1, 2019.

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VOLUME III

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VEDO EXHIBIT NO. 5.0

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc., for Approval of an Increase in Gas Rate	)	Case No. 18-0298-GA-AIR
In the Matter of the Application of Vectren Energy Delivery of Ohio, Inc., for Approval of an Alternative Rate Plan	)	Case No. 18-0299-GA-ALT

DIRECT TESTIMONY OF
MICHAEL J. VILBERT
ON BEHALF OF
VECTREN ENERGY DELIVERY OF OHIO, INC.

____	Management policies, practices, and organization
____	Operating income
____	Rate base
____	Allocations
X	Rate of return (Cost of Common Equity Capital)
____	Rates and tariffs
____	Other

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Direct Testimony of
Michael J. Vilbert

I. INTRODUCTION AND SUMMARY

Q1. Please state your name and address for the record.

A1. My name is Michael J. Vilbert. My business address is The Brattle Group, 201 Mission Street, Suite 2800, San Francisco, CA 94105, USA.

Q2. Please summarize your background and experience.

A2. I am a Principal Emeritus of The Brattle Group ("Brattle"), an economic, environmental and management consulting firm with offices in Boston, Washington, London, San Francisco, Madrid, Rome, Toronto, and New York City. My work concentrates on financial and regulatory economics. I hold a B.S. from the U.S. Air Force Academy and a Ph.D. in finance from the Wharton School of Business at the University of Pennsylvania. Appendix A provides more detail on my qualifications.

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

A3. I have been asked by Vectren Energy Delivery of Ohio, Inc. ("Vectren" or the "Company") to estimate the cost of capital for the Company. Specifically, I provide return on equity ("ROE") estimates derived from a sample of comparable risk, regulated gas local distribution utility companies ("gas LDCs"). I also consider the financial risk of the Company's capital structure ratio as of December 31, 2017 to arrive at my recommendation for the allowed ROE.

Q4. Are you sponsoring any exhibits?

A4. Yes, I am sponsoring Attachment A which includes the following schedules:

Attachment	Schedule	Description
A	D5	Cost of Common Shareholders' Equity
A	D5.1	Table of Contents
A	D5.2	Classification of Companies by Assets

A	D5.3	Market Value of the Expanded Sample
A	D5.4	Capital Structure Summary of the Expanded Sample
A	D5.5	Estimated Growth Rates of the Expanded Sample
A	D5.6	DCF Cost of Equity of the Expanded Sample
A	D5.7	Overall After-Tax DCF Cost of Capital of the Expanded Sample
A	D5.8	DCF Cost of Equity at Vectren's Capital Structure
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A	D5.12	Risk Positioning Cost of Equity at Vectren's Capital Structure
A	D5.13	Hamada Adjustment to Obtain Unlevered Asset Beta
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A	D5.15	Risk-Positioning Cost of Equity using Hamada-Adjusted Betas
A	D5.16	Risk Premiums Determined by Relationship Between Authorized ROEs and Long-term Treasury Bond Rates
A	D5.17	Academic Literature on Financial Risk Adjustments

Q5. Were these exhibits and schedules prepared by you or under your direction?

A5. Yes.

Q6. Can you summarize the parts of your background and experience that are *particularly relevant to your testimony on these matters?*

A6. Brattle's specialties include financial economics, regulatory economics, and the gas, water, and electric industries. I have worked in the areas of cost of capital, investment risk, and related matters for many industries, regulated and unregulated alike, in many forums. A partial list of the regulators before which I have testified or filed cost of capital testimony include the Arizona Corporation Commission, the Pennsylvania Public Utility Commission, the Public Service Commission of West

Virginia, the Tennessee Regulatory Authority, the Public Service Commission of Wisconsin, the South Dakota Utilities Commission, the California Public Utilities Commission, and the Federal Energy Regulatory Commission ("FERC"). I have also testified in Canada before the Canadian National Energy Board, the Alberta Energy and Utilities Board, the Ontario Energy Board, the Quebec Régie de l'énergie, and the Labrador & Newfoundland Board of Commissioners of Public Utilities. I have testified previously before the Public Utilities Commission ("Commission") of Ohio. Appendix A contains more information on my professional qualifications.

Q7. What are the steps in your analysis?

A7. To estimate the Company's cost of capital, I analyzed a sample of gas LDCs, identified as being similar in risk and business operations to Vectren, specifically the regulated gas local distribution business. I estimate the ROE for each sample company using both the risk positioning and the discounted cash flow ("DCF") approaches. The risk positioning approach consists of analyses based upon the Capital Asset Pricing Model ("CAPM") and the Empirical CAPM ("ECAPM"). The ROE estimates from both models are then combined with market value capital structure information and the market costs of debt and preferred stock for each sample company to compute each firm's overall cost of capital, i.e., its after-tax weighted-average cost of capital ("ATWACC"). I also provide an ROE estimate based upon the risk premium model.

Q8. What is the result of the cost of capital estimation process?

A8. The result of this process is a sample average ATWACC for each cost of equity estimation method. I then report the cost of equity consistent with the sample's average estimated ATWACC as if the sample's average market-value capital structure had been one with a 50.6 percent equity ratio, which was Vectren's equity ratio as of December 31, 2017. This procedure results in a ROE that is consistent with both the financial risk inherent in the Company's capital structure and the market-determined information on the sample's average overall cost of capital.

Q9. Do you present any other methods to take differences in financial risk into account?

A9. Yes. Other than the ATWACC method, I use the method originally proposed by Professor Robert S. Hamada to account for the differences in financial risk through adjustments to the beta estimate for a firm.[1] This procedure is common amongst finance practitioners and well-established in academic literature. I present this method, which I refer to as the Hamada adjustment procedures, for the risk positioning analyses alongside the ATWACC method in order to further inform my recommendations that account for differences in the financial risk between the companies in my sample and Vectren.

Q10. How does the ongoing uncertainty in the financial markets affect the cost of capital for a regulated utility?

A10. The cost of capital is higher than a mechanical implementation of the ROE estimation models may suggest. Although economic conditions have improved substantially since the start of the crisis in about mid-2008, uncertainty remains in the capital markets due, in part, to the disappointing rate of economic growth, not only in the U.S., but also worldwide. Worries about the low interest rate outlook in Europe and Japan as well as the United Kingdom's exit from the European Union have added to the concern. In addition, long-term government bond yields, which had dropped dramatically after the 2008-2009 credit crisis to unusually low levels, remain depressed relative to both historical levels and forecasts of future interest rates. The increased volatility in the stock market at the beginning of February 2018 demonstrates that substantial uncertainty remains in the capital markets.

As a result, bond yield spreads remain higher than before the credit crisis,[2] both for riskier assets as well as for less risky investments such as investment grade-rated

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[1] Hamada, R.S., "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stock," *The Journal of Finance*, 27(2), 1971, pp. 435-452. See Attachment A, Schedule No. D5-17 at 56-74.

[2] The yield spread in this case is the difference between the yield on a risky corporate debt security and the yield on U.S. Treasury debt of comparable maturity.

utility debt, as illustrated in Table 1 below. Although the capital market indices have returned to and have now exceeded their pre-crisis levels, the recovery remains fragile in part because of the weakness in parts of the rest of the world. I discuss economic conditions and the effect of the credit crisis on the cost of capital and its various components, including the long-term risk-free interest rate, in more detail in Section III below.

This uncertainty in the financial markets also affects the results of the estimation models, because both the risk positioning model and the DCF model are based upon the assumption that economic conditions are stable. That assumption is not currently met, so estimating the cost of capital under current conditions is more complicated than it would normally be.

Q11. Do you adjust your analyses to account for the remaining market uncertainty?

A11. Yes. Because the uncertainty in financial markets affects the cost of capital for all companies, including regulated utilities such as Vectren, I modified the parameters of the risk positioning model to recognize the effect of the increased volatility in the capital markets as well as the overall decline in long-term risk-free interest rates on the cost of capital. Specifically, I analyzed scenarios using two different estimates of the market risk premium ("MRP") and risk-free interest rate for use in the risk positioning model. These scenarios are discussed in more detail below. Further, given the current economic uncertainty and the downward bias it creates in the CAPM model results, I also place substantial weight on the results of the DCF analyses in determining the range of reasonableness for the ROE, for reasons explained later in this testimony.

Q12. Can you summarize your findings about the expanded sample's costs of capital?

A12. The sample ROE estimates range from a low of 9.1 percent to a high of 13.7 percent, but I believe that the estimates at the lower end of the range are not reliable because they do not fully consider the effect of the ongoing uncertainty in the financial markets and the downward pressure on the risk-free interest rate. Conversely, the estimates at the upper end of the range reflect the adjustment for the ongoing uncertainty in the capital market and are more reliable. For a regulated natural gas LDC of average business risk and with an equity ratio consistent with Vectren's equity ratio of approximately 50.6 percent, the best estimate of the range for the cost of equity is from 10 percent to 11 percent.

Q13. What ROE do you recommend for the Company in this proceeding?

A13. I recommend that the Company be allowed an ROE of 10¾ percent on the equity financed portion of its rate base.[3] This is above the midpoint of the range of 10 percent to 11 percent that I believe is reasonable for the sample companies comparable to Vectren's financial and business risk because I believe that Vectren is of somewhat greater risk than the average company in the sample. In addition, the current market uncertainty associated with new tariffs and the effect of the recent reductions in corporate income tax rates have increased risks for regulated utilities beyond what a mechanical review of the historical record would indicate. Moreover, the rating agencies have recognized that the new tax law puts pressure on regulated companies' credit metrics which is an additional factor to consider when determining the allowed ROE for Vectren.[4]

Q14. How is your testimony organized?

A14. Section II formally defines the cost of capital and touches on the principles relating to estimating the cost of capital and the effect of capital structure on the cost of equity. Section III discusses the current capital market conditions and the effect of income

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3 I report my recommended ROE to the nearest ¼ percentage point because I do not believe that the cost of capital can be estimated more precisely than that even though the model results can be reported to several decimal places.

4 "Moody's changes outlooks on 25 US regulated utilities primarily impacted by tax reform," Moody's Investor Service, Global Credit Research, January 19, 2018, and "Tax reform is credit negative for sector, but impact varies by company," Moody's Investor Service, Sector Comment, January 24, 2018. Also "U.S. Tax Reform: For Utilities' Credit Quality, Challenges Abound," S&P Global Ratings, Rating Direct, January 24, 2018; and "Tax Reform Impact on the U.S. Utilities, Power & Gas Sector: Tax Reform Creates Near-Term Credit Pressure for Regulated Utilities and Holding Companies," Fitch Ratings, Special Report, January 24, 2018.

tax reform on the cost of capital. Section IV discusses the selection of the expanded sample, and Section V presents the methods used to estimate the cost of capital for the sample; provides the associated numerical analyses; and explains the basis of my conclusions for the sample's overall costs of capital. Section VI concludes my testimony. The calculations supporting my analyses are provided in Exhibit No. D.5.

II. COST OF CAPITAL THEORY

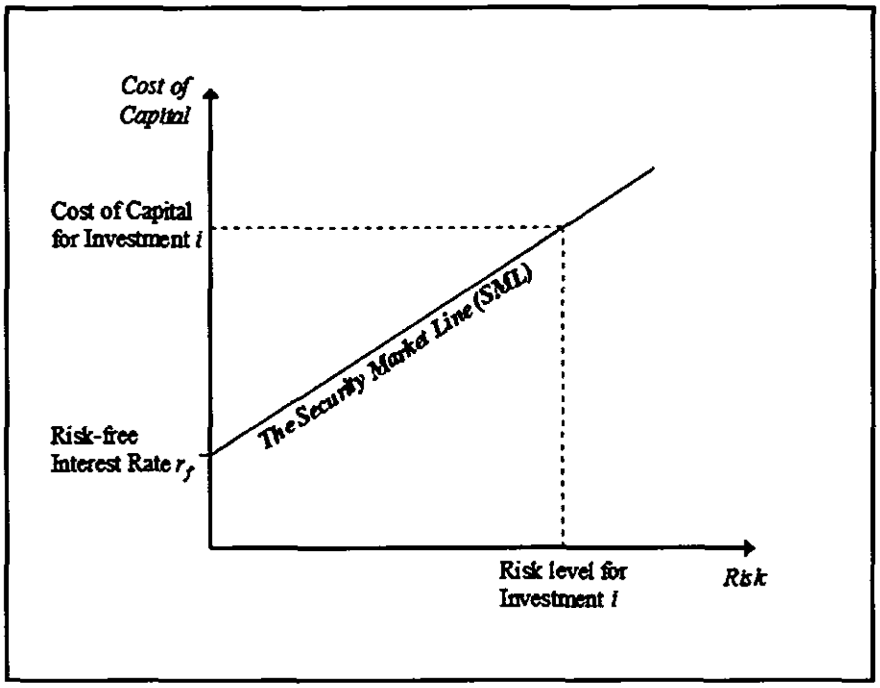
A. COST OF CAPITAL AND RISK

Q15. How is the "cost of capital" formally defined?

A15. The cost of capital is defined as 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," as in the definition of the cost of capital itself, refer to the probability-weighted average over all possible outcomes.

The definition of the cost of capital recognizes a tradeoff between risk and return that can be represented by 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 required.

Figure 1
The Security Market Line



Q16. Why is the cost of capital relevant in rate regulation?

A16. It has become routine in U.S. rate regulation to accept the "cost of capital" as the right expected rate of return on utility investments.[5] That practice is viewed as consistent with the U.S. Supreme Court's opinions in Bluefield Water Works & Improvement Co. v. Public Service Commission of West Virginia, 262 U.S. 679 (1923), and Federal Power Commission v. Hope Natural Gas Co., 320 U.S. 591 (1944).

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

[5] A formal link between the cost of capital as defined by financial economics and the right expected rate of return for utilities is set forth by Stewart C. Myers, *Application of Finance Theory to Public Utility Rate Cases*, *Bell Journal of Economics & Management Science* 3:58-97 (1972).

does a disservice not just to investors but, importantly, to customers as well. 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.

More important for customers, however, are the broader economic consequences of providing an inadequate return to the company's investors. In the short run, deviations from the expected rate of return on the rate base from the cost of capital may seemingly create a "zero-sum game"—investors gain if customers are overcharged, and customers gain if investors are shortchanged. But in fact, in the short run, such actions may adversely affect the utility's ability to provide stable and favorable rates because some potential efficiency investments may be delayed or because the company is forced to file more frequent rate cases. Moreover, in the long run, inadequate returns are likely to cost customers—and society generally—far more than may be saved in the short run. Inadequate returns lead to inadequate investment, whether for maintenance or for new plant and equipment. Without access to investor capital, the company may be forced to forgo opportunities to maintain, upgrade, and expand its systems and facilities in ways that decrease long run costs. Indeed, the cost to consumers of an undercapitalized industry can be far greater than any short-run gains from shortfalls in the cost of capital. This is especially true in capital-intensive industries (such as the natural gas distribution industry), which feature systems that take a long time to decay. Such long-lived infrastructure assets cannot be repaired or replaced overnight, because of the time necessary to plan and construct the facilities. Thus, it is in the customers' interest not only to make sure the return investors expect does not exceed the cost of capital, but also to make sure that the return does not fall short of the cost of capital. In fact, research has shown that there is a positive correlation between allowed ROEs from the regulators and customer satisfaction ratings.[6] In other words, the customers of utilities in more supportive regulatory environments have higher satisfaction in the quality of service.

6 Barclay's Research, "North America Power & Utilities: March Preview/February Review," February 17, 2017.

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 sets rates so investors expect to earn the cost of capital on average treats both customers and investors fairly, and acts in the long-run interests of both groups.

B. Relationship Between Capital Structure and the Cost of Equity

Q17. What did you mean by the "ATWACC" mentioned earlier?

A17. The ATWACC is calculated as the weighted average of the after-tax cost of debt capital and the cost of equity. Specifically, the following equation pertains:[7]

$$ATWACC = r_D \times (1 - T_c) \times \%D + r_E \times \%E \qquad (1)$$

where $r_D =$ market cost of debt,
$r_E =$ market cost of equity,
$T_C =$ corporate income tax rate,
$\%D =$ percent debt in the capital structure, and
$\%E =$ percent equity in the capital structure

The ATWACC is commonly referred to as the WACC in financial textbooks and is used in investment decisions.[8] The return on equity consistent with the sample's overall cost of capital estimate (the ATWACC), the market cost of debt, the corporate income tax rate, and the amount of debt and common equity in the capital structure can be determined by solving Equation (1) for r_E. Alternatively, if r_E is given and the capital structure is not, one can solve for $\%E$ instead. Having determined the

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[7] The equation is shown with only debt and common equity. If the capital structure has preferred equity, add the following term ($r_P \times \%P$) to the right-hand side of the equation.

[8] See, for example, Brealey, Myers and Allen (2017), *Principles of Corporate Finance, 12th Edition*, McGraw-Hill Irwin, New York, pp. 448-453.

ATWACC for the sample companies, I can apply that same ATWACC or an ATWACC adjusted for risk differences to the regulated entity, in this case Vectren.[9]

Q18. Why is the ATWACC relevant to these proceedings?

A18. The ATWACC is one of several procedures in my analysis; it is important because it allows a comparison between the sample companies' costs of capital estimates and the cost of capital for Vectren. Two otherwise identical companies with different capital structures will typically have different costs of equity because the risks to equity holders depend on the financial leverage (i.e., the amount of debt in the capital structure of the company). This makes it difficult to compare cost-of-equity estimates among companies that have different capital structures. The effect of varying financial leverage on the risk-return tradeoffs of companies means that simply averaging individual cost-of-equity estimates across a sample generally does not provide meaningful information about an appropriate representative cost of capital for the industry. Thus it is generally incorrect to compute a sample average return on equity when estimating the cost of capital. However, two otherwise identical companies with different capital structures will generally have comparable ATWACC values. The "apples to apples" comparability of ATWACC across companies with different capital structures makes it a consistent measure of the representative cost of capital in an industry.

Q19. How does the ATWACC approach differ from procedures where the cost of equity and the regulatory capital structure are determined separately?

A19. The ATWACC approach avoids inconsistencies that could arrive from estimating the cost of equity for each of the sample firms without explicit consideration of the financial risk inherent in the market-value capital structure underlying those costs. If the sample's average cost of equity is used to estimate the cost of equity for the company in question, inconsistencies are likely to arise, because this method makes

[9] I refer to the ATWACC to distinguish it from the WACC used in regulatory proceedings which is the weighted-average of the after-tax cost of equity and the *pre-tax* cost of debt instead of the after-tax cost of debt.

no adjustment for any differences among the capital structures of the sample firms used to estimate the cost of equity and the regulatory capital structure used to set rates. Consequently, the sample's estimated return on equity does not necessarily correspond to the financial risk faced by investors in the subject company, in this case Vectren. If the sample's estimated cost of equity were adopted without consideration of differences in financial risk, it could lead to an unjust and inappropriate rate of return.

Q20. Why is it necessary to consider the sample companies' capital structures as well as the regulatory capital structure in your analysis?

A20. Briefly, the cost of equity and the capital structure are inextricably entwined in that the use of debt increases the financial risk of the company and therefore increases the cost of equity. The more debt, the higher is the cost of equity for a given level of business risk. Rate regulation has in the past often focused on the individual components of the cost of capital. In particular, it has treated as separate questions what the "right" cost of equity capital and "right" capital structure should be. The cost of capital depends primarily on the business the firm is in, while the costs of the debt and equity components depend not only on the business risk, but also on the distribution of revenue between debt and equity. The cost of capital is thus the more basic concept. Although the overall cost of capital is constant (ignoring taxes and costs of excessive debt), the distribution of the costs among debt and equity is not. Reporting the average cost of equity estimates from the sample without consideration of the differences in financial risk may result in material errors in the allowed return for Vectren.

Q21. What is the basis for the development of the ATWACC method?

A21. Computing the ATWACC—called the weighted-average cost of capital in textbooks—is the fundamental method used by financial economists to measure the cost of capital. It is a standard topic taught in graduate level courses in corporate finance and is based upon the work of Professors Franco Modigliani and Merton

Miller. Each separately won the Nobel Prize in Economics, in part, for developing the theories underlying the method.

It is critical to keep in mind that the ATWACC method is one useful tool to assist in the analysis of the cost of capital. All cost of capital witnesses estimate the cost of equity using the DCF or the risk positioning models, and all must interpret the results relative to the risk of the regulated company at issue. The purpose of the ATWACC method is to allow an "apples to apples" comparison of the results of the sample companies by adjusting for differences in financial risk due to differences in capital structure. The ATWACC is sometimes mischaracterized in regulatory proceedings and incorrectly criticized, possibly because the critics do not like the method's results, but it is the standard methodology in finance. It is consistent with the use of rate base measured on the basis of original cost (i.e., book value), and does not require a regulator to "rubber stamp" the current market value of the regulated company's stock as is sometimes asserted.

Q22. Is the use of the ATWACC method unconventional?

A22. No. The ATWACC is presented in every textbook on corporate finance of which I am aware.[10] These textbooks calculate the ATWACC in exactly the same way as I do.

Q23. Is the ATWACC approach used by other regulators?

A23. Yes, a number of regulators in the U.S. and in countries around the world rely upon the ATWACC to set rates. Some aspects of the regulatory procedures in these countries may vary, but they all rely upon a book value measure of rate base and a market determined cost of capital to set rates. The countries include the United Kingdom, Australia, New Zealand, and Ireland among others. These countries

[10] See, for example, Brealey, Myers and Allen (2017), *Principles of Corporate Finance, 12th Edition*, McGraw-Hill Irwin, New York, Chapter 19, Ross, Westerfield, Jaffe, and Roberts (2008), *Corporate Finance*, 5th Canadian edition, McGraw-Hill Ryerson, Toronto, Chapter 13, Bodie, Kane and Marcus (2009), *Investments*, McGraw-Hill Irwin, New York, 8th ed., 2009, Chapter 18, and Koller, Goedhart and Wessels (2005), *Valuation*, 4th ed., John Wiley & Sons, Inc. Chapter 5. See Attachment A, Schedule No. D5.17 at 75-91 for the excerpt from *Valuation* textbook.

apparently regard the ATWACC as proper regulatory policy and appropriate for setting rates in a regulatory proceeding.

Q24. What regulators in the U.S. use the ATWACC approach?

A24. Although use of the ATWACC is not prevalent in the U.S., it is used by some regulators. The Surface Transportation Board ("STB") uses the ATWACC method to determine revenue adequacy for railroads, as does the Federal Communication Commission to set rates for local exchange carriers. Florida uses a very similar method to regulate small water companies, and the Colorado Division of Property Taxation uses the ATWACC to value property. The FERC used the ATWACC (calculated as I do) as a discount rate in a valuation dispute.[11] In a decision, the Alabama Public Service Commission said

> [t]he Commission recognizes that the ATWACC analysis is not a prevalent methodology in the United States; however, the focus of that methodology on the relationship between the market value and the associated financial risk of the utility is compelling.[12]

Q25. Is financial risk properly measured by the market value or book value capital structure?

A25. The notion that financial leverage is and should be measured on a market value basis is supported in every textbook on corporate finance of which I am aware.[13] Further, the view is not just an ivory-tower creation. Professional valuation books and guides advocate the use of market value capital structure.[14] Morningstar and Duff and

[11] Order Conditionally Accepting Tariff Revisions, Subject to Compliance Filings, Docket No. ER14-2940-000, PJM Interconnection, L.L.C., issued November 28, 2014.

[12] Report and Order, *In re: Public Proceedings established to consider any necessary modifications to the Rate Stabilization and Equalization mechanism applicable to the electric service of Alabama Power Company*, Dockets 18117 and 18416, August 21, 2013, p. 20.

[13] See, *e.g.*, Richard A. Brealey, Stewart C. Myers, and Franklin Allen, 2017, *Principles of Corporate Finance*, 12th edition, McGraw-Hill Irwin, at p. 467; Stephen A. Ross, Randolph W. Westerfield, and Jeffrey Jaffe, 2002, *Corporate Finance*, 6th edition, McGraw-Hill Irwin, at p.386; and Mark Grinblatt and Sheridan Titman, 1998, *Financial Markets and Corporate Strategy*, 1st edition, Irwin/McGraw-Hill, at p. 464.

[14] See, *e.g.*, Tom Copeland, Tim Koller, and Jack Murrin, 2000, *Valuation: Measuring and managing the value of companies*, 3rd edition John Wiley & Sons, p. 204; and Shannon P. Pratt and Alina V.

Phelps—both off-the-shelf cost of capital providers using *Ibbotson* data and analysis—also use market-value capital structure in cost of capital estimates.[15] Similar views were also endorsed by legal decisions on bankruptcy proceedings.[16] Financial risk is a function of the market value capital structure. There is simply no debate in academic or business circles about this point.

Every day experience also indicates that market value is the measure of financial risk. The variability of your return on your investment in your home depends upon the size of your mortgage relative to the appraised (i.e., market) value of your house. For example, if you have a $100,000 mortgage on a house that is worth $200,000 in the current market, you have 50 percent equity in your home. This is true even if the "book value" of the house—the original cost of construction—is only $150,000. It is also the case that the larger the percentage of the appraised value that is financed with a mortgage, the larger will be variability in your equity return as the home value varies. It is the variability of the market value of the house that affects the home owner's risk; the "book value" of the house does not change.

Q26. Can you provide academic evidence that financial leverage is and should be measured on a market value basis?

A26. Yes. The impact of financial leverage on cost of equity has been developed since the 1958 paper by Prof. Franco Modigliani and Merton Miller ("MM"), two economists who eventually won Nobel Prizes in part for their body of work on the effects of debt on firm value.[17] One key corollary of the MM theorems and their various extensions is that cost of equity increases as financial leverage increases. Although the exact

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Niculita, 2008, *Valuation a business: The analysis and appraisal of closely held companies*, 5th edition, McGraw-Hill, at pp. 216 – 217.

15 See, *e.g.*, Morningstar, *Duff & Phelps 2016 Valuation Handbook – Guide to Cost of Capital*, at p. 15.

16 See, *e.g.*, Bernstein, Stan, Susan H. Seabury, and Jack F. Williams, 2008, "Squaring bankruptcy valuation practice with *Daubert* Demands," *ABI Law Review*, at p. 190.

17 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. See Attachment A, Schedule No. D5.17 at 92-129. For a modern textbook exposition of the capital structure theories, see Brealey, Myers, and Allen, *op cit.*, Chapter 17.

speed of increase in cost of equity differs by models of capital structure, it is universally accepted that as a firm adds debt, its cost of equity increases as a result.

While acknowledging that the cost of equity increases with financial leverage, some people assert that financial risk is measured on a book value basis. This belief is wrong for two reasons. First, in MM's classic paper and subsequent extensions of their original paper, financial leverage has been consistently measured on a market value basis. This is because MM's basic insight is that, under perfect market conditions, financial leverage does not increase the *market value* of a firm as long as different combinations of debt and equity can be selected by the investors themselves.[18] To implement such a self-help financial engineering, investors have to be able to buy and sell debt and equity to achieve their desired combination. The prices at which they transact are, by definition, *market prices.* Second, as a more practical matter, economists generally prefer to use market values because they convey timely information, rather than historical data, about the assets. Business decisions on investment, capital budgeting, and financing are all based on real time market value information.

Q27. Are there any other academic articles that discuss how a company's cost of equity changes as its capital structure changes?

A27. Yes, there are many others. An important example is from Professor Robert S. Hamada, who addressed this issue in "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks."[19] Professor Hamada's adjustment method is consistent with the ATWACC approach, and I present results using this method to provide further insight on the range of ROE estimates after adjusting for financial leverage. I find that the resulting ROE estimates using the Hamada adjustment procedure are similar to those estimates using the ATWACC approach, so the

[18] In developing the theory, MM assume that investors can adjust the capital structures of their portfolios at no cost.

[19] *The Journal of Finance*, Vol. 27, No. 2, Papers and Proceedings of the Thirtieth Annual Meeting of the American Finance Association, New Orleans, Louisiana, December 27- 29, 1971 (May, 1972), pp. 435-452. See Attachment A, Schedule No. D5.17 at 56-74.

Commission should rely on estimates from either procedure to appropriately recognize the impact that differences in leverage have on the cost of equity. Both approaches are widely accepted in academic literature and commonly used amongst finance practitioners. I have included a subset of the academic literature which discusses these financial risk adjustment procedures in Exhibit D5.17.

The alternative Hamada adjustment procedures account for the impact of financial risk recognizing that, under general conditions, the value of a firm can be decomposed into its value with and without a tax shield (Value of Firm = Present Value of Cash Flows without Tax Shield plus Value of Tax Shield).

Assuming that the CAPM is valid, Professor Hamada showed the following relationship between the beta for a firm with no leverage (e.g., 100 percent equity financing) and a firm with leverage is as follows:[20]

$$\beta_L = \beta_U + \frac{D}{E}(1 - \tau_c)(\beta_U - \beta_D) \qquad (2)$$

Where β_L is beta associated with the "levered cost of capital"—the required return on assets if the firm's assets are financed with debt and equity—β_U is the beta associated with an unlevered firm—assets are financed with 100% equity and zero debt—, and β_D is the beta on the firm's debt. Finally, τ_c is the corporate income tax rate. Since the beta on an investment grade firm's debt is much lower than the beta of its assets (i.e.,$\beta_D < \beta_U$), this equation embodies the fact that increasing financial leverage (and thereby increasing the debt to equity ratio) increases the systematic risk of levered equity (β_L).

An alternative formulation derived by Harris and Pringle (1985) provides the following equation:

$$\beta_L = \beta_U + \frac{D}{E}(\beta_U - \beta_D) \qquad (3)$$

[20] Technically, the relationship requires that there are no additional costs to leverage and that the book value capital structure is fixed.

Unlike Equation (2), Equation (3) does not include an adjustment for the corporate tax deduction. However, both equations account for the fact that increased financial leverage increases the systematic risk of equity that will be measured by its market beta. Both equations allow an analyst to adjust for differences in financial risk by translating back and forth between β_L and β_U. In principle, Equation (2) is more appropriate for use with regulated utilities, which are typically deemed to maintain a fixed book value capital structure. However, I employ both formulations when adjusting my CAPM and ECAPM estimates for financial risk, and consider the results as sensitivities in my analysis.

It is clear that the beta of debt needs to be determined as an input to either Equation (2), or Equation (3). Rather than estimating debt betas, I note that the standard financial textbook of Professors Berk & DeMarzo report a debt beta of 0.05 for A rated debt and a beta of 0.10 for BBB rated debt[21] while other academic literature has reported debt betas of 0.25.[22] I consider this range of 0.05 to 0.25 to be reasonable for debt betas.

Using the estimated debt betas, the levered equity beta of each sample company can be computed (in this case by *Value Line*) from market data and then translated to an unlevered beta at the company's market value capital structure. The unlevered betas for the sample companies are comparable on an "apples to apples" basis, since they reflect the systematic risk inherent in the assets of the sample companies, independent of their financing. The unlevered betas are averaged to produce an estimate of the industry's unlevered beta. To estimate the cost of equity for the regulated target company, this estimate of unlevered beta can be "re-levered" to the regulated company's capital structure, and the CAPM can be reapplied with this levered beta, which reflects both the business and financial risk of the target company.

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[21] Berk, J. & DeMarzo, P., *Corporate Finance, 2nd Edition*. 2011 Prentice Hall, p. 389.

[22] "Explaining the Rate Spread on Corporate Bonds," Edwin J. Elton, Martin J. Gruber, Deepak Agarwal, and Christopher Mann, *The Journal of Finance*, February 2001, pp. 247-277. See Attachment A, Schedule No. D5.17 at 130-160.

Hamada adjustment procedures are ubiquitous among finance practitioners when using the CAPM to estimate discount rates.

III. IMPACT OF CURRENT ECONOMIC CONDITIONS

Q28. What is the topic of this section of your testimony?

A28. This section addresses the effect of the current economic situation on the cost of capital and the adjustments to my standard procedures required to estimate the cost of capital more accurately. I also address the effect of the recently enacted Tax Cuts and Jobs Act of 2017 in increasing the risk faced by regulated utilities.

A. Anomalous Capital Markets Conditions Persist

Q29. Do you believe that capital markets are "back to normal"?

A29. No. Although the Federal Reserve has decided to raise the target range for the federal funds rate to a range of 1 to 1¼ percent since the beginning of 2017[23] and volatility in the financial markets has lessened, economic conditions are not yet back to normal as measured by their status prior to the 2008-2009 credit crisis. For example, although the spreads between U.S. utility bond yields and government bond yields ("yield spread") has narrowed from their peak at the height of the crisis, yield spreads are still elevated relative to the spread before the crisis. This is especially true for lower-rated bonds, including BBB-rated utility bonds. This is, in part, the result of a deliberate policy by the Fed to lower long-term as well as short-term bond yields in an effort to induce investors to move to riskier assets such as stocks.[24]

Q30. Please describe in more detail how the yield spread between U.S. government and utility bonds has changed since the start of the credit crisis.

A30. Although the yield spread on utility bonds has declined from the height of the 2008-2009 credit crisis, the yield spread still remains elevated in relation to pre-crisis levels in response to world economic events and the efforts of the Fed. The yield spread on

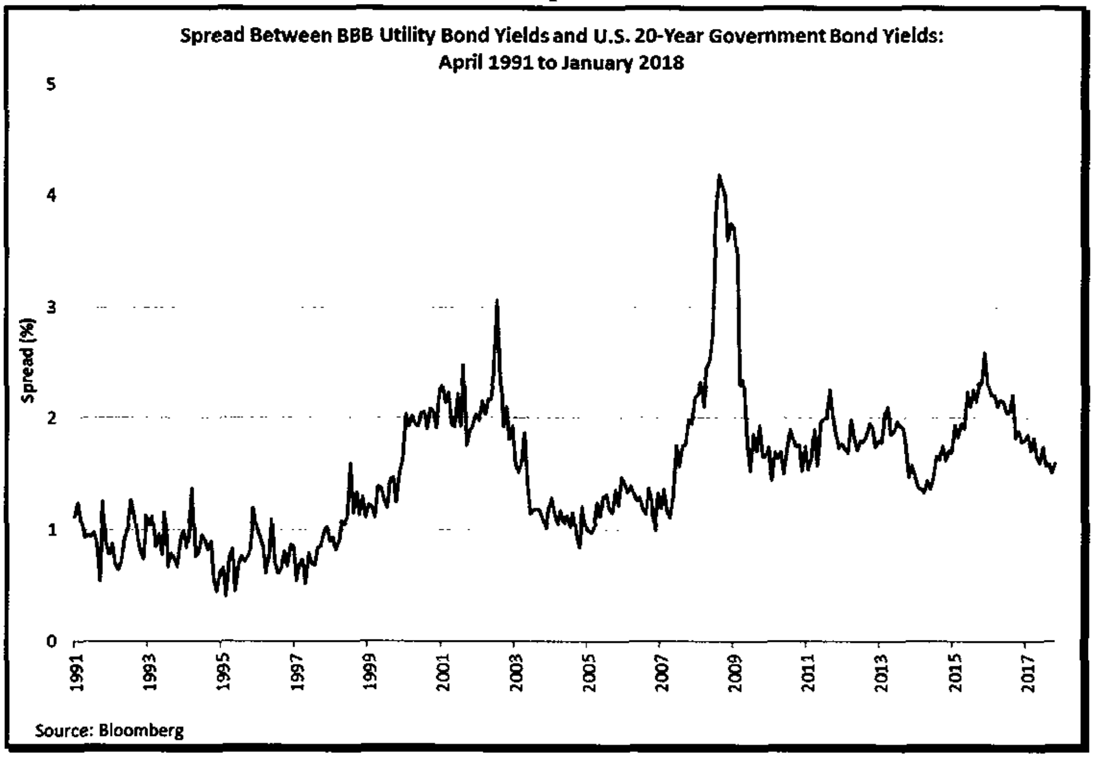
[23] See Federal Open Market Committee, Press Release, September 20, 2017.

[24] *Id.*

utility bonds, such as Bloomberg's BBB-rated utility bonds, has been substantially higher during most of the past eight years than prior to the credit crisis. For example, since the last major peak in November 2008, the spread between the yield on BBB-rated 20-year utility bonds and the yield on 20-year U.S. government bonds, as shown in Figure 2 below, has ranged from a low of 133 basis points to a high of 408 basis points, compared to a historical average of approximately 120 basis points.[25] Additionally, the average yield spread in 2016 of 218 basis points is highly unusual and has reached higher levels in only three of the past 25 years: in 2008 and 2009 during the credit crisis and in 2002 following the collapse of the tech bubble. The yield spread is slightly lower for January 2017 to January 2018 at 170 bps.

[25] Historical average ranges from the beginning availability of U.S. utility bond yield data (April of 1991) through the beginning of the financial crisis (December of 2007) accessed from Bloomberg as of January 31, 2018.

Figure 2
Bond Yield Spreads



1 In addition to the spike in the spread between utility and government bond yields, the
2 variability in bond yields is also high. BBB utility 20-year bond yields have varied
3 from a high of 4.63 percent to a low of 4.11 percent for a high-to-low difference of
4 approximately 52 basis points over the period January 2017 through January 2018.
5 Table 1 below presents the yield spreads for 20-year utility bonds over several
6 historical periods. Yield spreads have remained elevated compared to historical
7 averages.

Table 1
Comparison of Historical Bond Yield Spreads

Spreads between U.S. Utility Bond (20 year maturity) and U.S. Government Bond (20 year maturity) - %			
Periods	A-Rated Utility and Treasury	BBB-Rated Utility and Treasury	Notes
Period 1 - Average Apr-1991 - 2007	0.93	1.23	[1]
Period 2 - Average Aug-2008 - Jan-2018	1.51	1.98	[2]
Period 3 - Average Jan-2018	1.20	1.59	[3]
Period 4 - Average 15-Day (Jan 10, 2018 to Jan 31, 2018)	1.12	1.51	[4]
Spread Increase between Period 2 and Period 1	0.58	0.75	[5] = [2] - [1]
Spread Increase between Period 3 and Period 1	0.27	0.36	[6] = [3] - [1]
Spread Increase between Period 4 and Period 1	**0.19**	**0.28**	[7] = [4] - [1]

Sources and Notes:
Spreads for the periods are calculated from Bloomberg's yield data.
Average monthly yields for the indices were retrieved from Bloomberg as of January 31, 2018.

Q31. What is the implication of higher than normal yield spreads?

A31. A higher than normal yield spread is one indication of the higher cost of capital prevailing in the capital markets. Investors consider a risk-return tradeoff like the one displayed in Figure 1 (page 8) above and select investments based upon the desired level of risk. The expected return on debt (i.e., the cost of debt) is higher relative to government bond yields than is normally the case even for regulated utilities. Because debt is less risky than equity, the cost of equity is also higher relative to government bond yields than is usually observed. If this fact is not recognized, the traditional cost of capital estimation models will underestimate the cost of capital prevailing in the capital markets.

Q32. Haven't the U.S. stock markets reached record highs and interest rates begun to rise recently?

A32. Yes, the U.S. stock market has been trading at Price-to-Earnings ("P/E") levels which are above historical medians and government bond yields have increased since the U.S. presidential election and the Fed's increase of the federal funds rate. This does not mean, however, that economic conditions are fully back to normal. The recent volatility in the capital market demonstrates that substantial uncertainty remains.

Q33. What further evidence can you provide that U.S. medium- and long-term government bond yields are currently depressed?

A33. Annual yields on long-term U.S. government bonds have continued to be lower than historical values. For instance, the historical average of annual yields on long-term government bonds was 5.23 percent from 1926 to 2010, but the long-term government bond yield declined to just 2.72 percent in 2016.[26] The most recent 15-day average of long-term government bond yield is at 2.77 percent.

Although the U.S. Federal Reserve has discontinued its large-scale asset purchases program, which pushed down yields on medium and long-term U.S. government bonds, it still holds almost $4.4 trillion in assets from this purchasing program.[27] Until there is an intended unwinding of these holdings, uncertainty will persist.

Furthermore, elevated levels of uncertainty in the global capital markets continue to affect the U.S. economy, which remains sensitive to those disruptions. In other words, major capital markets globally have not yet returned to their pre-credit crisis status, and they continue to affect the U.S. capital markets. The European Central Bank (ECB) continues its accommodative stance, which targets a *negative* 0.4% interest rate[28] and continues to purchase billions of euros worth of assets each month (30 billion euros of assets purchased in January 2018),[29] and the Bank of Japan's policy, which has maintained a policy to keep yields on government debt "around zero percent" since September 2016,[30] represent divergent approaches from that

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26 See Duff & Phelps's Ibbotson *Stocks, Bonds, Bills, and Inflation ("SBBI") 2017 Valuation Yearbook* at 2-9.

27 Board of Governors of the Federal Reserve System, Credit and Liquidity Programs and the Balance Sheet, as of February 8, 2018.

28 European Central Bank, Key ECB Interest Rates, EUROPEAN CENTRAL BANK, https://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html (last visited on February 12, 2018).

29 European Central Bank, Asset purchase programmes, EUROPEAN CENTRAL BANK, https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html (last visited February 12, 2018).

30 See Roger Blitz, Leo Lewis, and Robin Harding, *Nervous investors put the Bank of Japan in the spotlight*, Financial Times, January 16, 2018. https://www.ft.com/content/f2ec1362-f7ab-11e7-88f7-5465a6ce1a00 .

currently of the Federal Reserve ("Fed"), which halted its asset purchases and has recently decided on a modest increase in interest rates. Dr. Janet Yellen's term as the chairman of the Fed came to a close in early February 2018, and Mr. Jerome Powell has replaced her as chairman. Mr. Powell is expected to maintain Dr. Yellen's policy of gradual interest rate increases. However, uncertainty persists concerning how monetary policy may change with the transition.[31] Finally, increased testing of ballistic missiles by North Korea has had noticeable impacts on the market, such as pushing down yields on 10-year U.S. Treasury Bonds as "investors sought safety."[32]

While U.S. capital markets may currently be benefiting from investors fleeing economic turmoil elsewhere, these global weaknesses underscore investors' lack of confidence in the global economy. These global weaknesses can affect the relatively more stable U.S. economy, and any aggressive action by the Fed on interest rates can easily exacerbate these weakened global economies, which in turn may affect U.S. capital markets.

Q34. Are interest rates and treasury yields expected to rise in the future?

A34. Yes. Since the beginning of 2017, the Fed has increased the federal funds target interest rate three times, which has increased yields on U.S. Treasury notes briefly, but for many reasons discussed above, yields on 30-year U.S. Treasury bonds are currently lower than at the beginning of 2017. While yields on the 10-year Treasury bond have increased from 2.43 percent in January 2017 to 2.8 percent in early February 2018, yields on the 30-year Treasury bond have declined from 3.02 percent to 2.88 percent.[33] However, economists and investors do not expect yields to persist at these unprecedented low levels indefinitely. According to the *Blue Chip Economic*

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[31] See Heather Long, *Who is Jerome Powell, Trump's pick for the nation's most powerful economic position?*, Washington Post, November 2, 2017.

https://www.washingtonpost.com/news/wonk/wp/2017/10/31/jerome-powell-trumps-pick-to-lead-fed-would-be-the-richest-chair-since-the-1940s/?utm_term=.d9e7ae80ab87.

[32] See *Financial Times* article "Flight to havens after North Korea missile launch", https://www.ft.com/content/5dab7a38-8c56-11e7-a352-e46f43c5825d.

[33] Bloomberg accessed as of January 31, 2018.

Indicators report dated October 10, 2017, the consensus economic projections for the yield on 10-year U.S. Treasury notes are 3.5 percent on average in 2019 to 2023 and 3.7 percent on average from 2024 to 2028.[34] These forecasts are substantially higher than the current yield on 10-year U.S. government notes.[35] This highlights the fact that current long-term and medium-term U.S. government bond yields are low relative to historical levels as well as compared to consensus forecasts of future rates. The unusually low current long-term government bond yields, along with elevated yield spreads due to risk aversion, must be considered when evaluating the results of the risk-positioning model, because the downward bias in the long-term risk-free interest rate will inappropriately lower the sample companies' ROE estimates generated by the CAPM method.

Q35. How do you adjust your cost of capital estimation methods to correct for current economic conditions?

A35. I make no adjustment to the DCF method. For the risk positioning method, I recognize the larger than average yield spreads on utility debt by adding a "yield spread adjustment" to the current long-term risk-free rate. This has the effect of increasing the intercept of the Security Market Line displayed in Figure 1 (page 8) above. I also present results from the risk positioning model by increasing the MRP over the 6.94 percent historical MRP. This has the effect of increasing the slope of the Security Market Line displayed in Figure 1 (page 8) above. I present a sensitivity test of the effect of an increase in the MRP to 7.94 percent, and yield spread adjustments of 20 basis points ("bps"). Table 4 (page 52) below lists the parameters of these two scenarios.

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[34] See *Blue Chip Economic Indicators*, dated October 10, 2017, page 14.

[35] See Schedule D5.9.

Q36. How do you estimate the increase in MRP needed to adjust for the increased cost of capital stemming from the current market turmoil?

A36. Estimating the MRP is always imprecise and controversial. Measuring the change in MRP due to the current economic situation is likely to be no different, but it is still necessary to estimate the MRP as carefully as possible given the change in economic conditions. Fortunately, there is a way to provide a quantitative benchmark for the required increase in MRP based upon a paper by Edwin J. Elton, et al., which documents that the yield spread on corporate bonds is normally a combination of a default premium, a tax premium, and a systematic risk premium.[36] As displayed in Table 1 (page 22) above, the yield spreads for A-rated and BBB-rated utility debt are currently elevated compared to the average for the period 1991-2007.

Q37. How do you use the information in Table 1 (page 22) concerning the increase in yield spreads to estimate the increase in the MRP?

A37. Table 1 (page 22) shows that recent yield spreads for A-rated and BBB-rated utility debt have increased by about 20 bps and 30 bps respectively for 20-year maturities. This means that investors require a higher return on investment grade utility debt relative to the return on U.S. Government debt than before the credit crisis. Some of the increase in yield spread for A-rated debt may be due to an increase in default risk (although this is more likely a component of the larger increase in BBB-rated utility spreads).[37] The increase in A-rated utility yield spread is due to a combination of an increase in the systematic risk premium on A-rated debt and the downward pressure on the yield of risk-free debt due to the flight to safety. The increase in the default risk premium for A-rated debt is undoubtedly very small because A-rated utility debt has not been at the center of the wave of defaults based upon collateralized mortgage debt. This means that the vast majority of the increase in yield spreads is due to a

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[36] "Explaining the Rate Spread on Corporate Bonds," Edwin J. Elton, Martin J. Gruber, Deepak Agarwal, and Christopher Mann, *The Journal of Finance*, February 2001, pp. 247-277. See Attachment A, Schedule No. D5.17 at 130-160.

[37] Although there is no increase in tax premium due to coupon payments, there may be some increase due to a small tax effect resulting from the probability of increased capital gains taxes when the debt matures.

combination of the increased systematic risk premium and the downward pressure on the yields of government debt. In other words, either the MRP has increased or the risk-free rate is under estimated, or, alternatively, both. In my analysis, I assume that there has been at least a 20 bps increase in utility spreads, due to either an increase in the MRP (which drives the increase in systematic risk premium), or to downward pressure on the risk-free rate. While this is slightly higher than the observed 19 bps increase in the yield spread over the latest 15 days, I believe this estimate is conservative when the recent downturn in the stock market is considered.

Q38. How do you allocate the increase in the yield spread (not due to the estimated increase in default risk) to the increase in systematic risk or to the under estimation of the risk-free rate due to downward pressure on government bond yields?

A38. There is no precise way to allocate the increase in yield spread between the increase in systematic risk and the underestimation of the risk-free rate arising from downward pressure on government bond yields; however, assuming a debt beta of 0.25[38] means that an increase in the MRP of one percentage point translates into a ¼ percentage point increase in the risk premium on debt (i.e. 0.25 (beta) times 1 percentage point (increase in MRP) = ¼ percentage point). The relationship among the increased yield spread for A-rated utilities ($\Delta\,spread$), the underestimation of the expected risk-free rate (Δ), and the required adjustment to the market risk premium ($\Delta\,MRP$) can be represented as follows.

$$\Delta spread - \Delta = 0.25 \cdot \Delta MRP$$

A 25 bps increase in the yield spread is therefore consistent with a 100 bps increase in the MRP if there were no underestimation of the risk free rate. Alternatively, it could represent an underestimation of the risk-free rate. The greater the increase in yield spread attributed to an increase in systematic risk, the larger the corresponding

[38] Elton, *et al.* estimate the average beta on BBB-rated corporate debt as 0.26 over the period of their study, and A-rated debt will have a lower beta than BBB-rated debt.

increase in the MRP and the smaller the effect of the downward pressure on the risk-free rate.

I consider two scenarios in my analysis. In the first scenario, I attribute the 20 bps increase in the yield spread entirely to an underestimation of the risk-free rate. In other words, a 20 bps increase in the yield spread is consistent with a 20 bps underestimation of the risk-free rate, assuming that none of the change in yield spread is driven by an increase in systematic risk. In the second scenario, I attribute a slightly higher 25 bps increase in the yield spread entirely to an underestimation of the MRP.[39]

Q39. Would the estimate of the effect of an increase in the MRP be different if the estimate of the beta of an A-rated bond were different?

A39. Yes. If the beta of an A-rated bond were higher, the increase in the systematic risk premium in the yield spread for each one percentage point increase in the MRP would be smaller. Alternatively, if the beta of an A-rated bond were lower, the increase in the systematic risk premium in the yield spread for each on percentage point increase in the MRP would be larger.[40] However, I believe that a beta estimate of 0.25 for A-rated utility debt is reasonable for this purpose, because the debt of any company is less risky than its equity. A beta estimate of 0.25 for A-rated utility debt is likely to be conservative, especially when compared to an average estimated beta of 0.75 (*Value Line* average beta) for the expanded sample. Moreover, a beta estimate of 0.25 is no doubt conservative because if the estimated beta were lower (as is likely) then the increase in the MRP necessary to result in a 20 bps increase in the yield spread would be higher. As noted above, the average estimated beta for BBB-rated debt was 0.26 at the time of the Elton et al study, and A-rated debt will have a lower estimated beta. Even if the average beta for BBB-rated debt is higher today than at

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39 The increase in the yield spread for BBB-rated utility debt is 28 bps and the beta of debt could easily be less than 0.25 so a 100 bps increase in the MRP is reasonable..

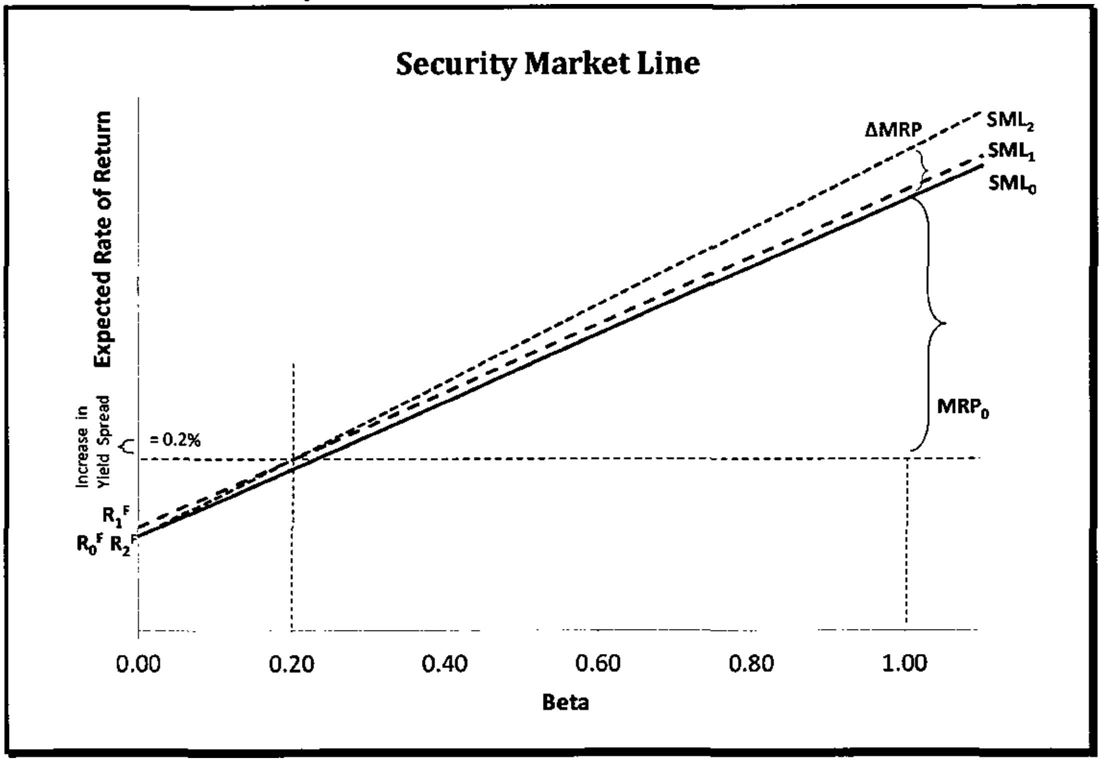
40 As noted above, the Berk and DeMarzo textbook reports average debt betas for A-rated debt to be 0.05.

the time of the Elton et al study, it is likely that an estimate of 0.25 for A-rated debt is reasonable.

Q40. Would you provide a graph of how the scenarios you consider affect the Security Market Line?

A40. Yes. See Figure 3 below. Scenario 1 (shown as SML_1 in Figure 3) attributes the entire increase in the yield spread on A-rated utility debt to underestimation of the risk free rate by shifting the Security Market line up in parallel fashion by 20 bps ($R_1^F - R_0^F$). Scenario 2 (shown as SML_2 in Figure 3) attributes the increase in the yield spread to an increase in the MRP by increasing the slope of the line by 1.0 percentage points (ΔMRP).

Figure 3
Security Market Line under Two Scenarios



Q41. Can you summarize your thoughts with regard to the MRP and the financial crisis?

A41. Yes. There remain serious concerns of a very slow growth recovery. Economic and political uncertainty continues in countries around the world, in an increasingly global economy. It is difficult to believe that the MRP has not increased from its level in more normal times, whether there is any particular agreed model for how to calculate the increase or not.

In light of these circumstances and the calculations described above, I submit that a 100 bps increase in the MRP presents a reasonable span of the adjustments that might be made. As discussed in the Empirical CAPM estimation below, I have analyzed two scenarios with alternative adjustments to the risk-free rate and the MRP. These scenarios recognize the simple reality that while the financial turmoil and interventions by the Fed and the U.S. government have made it more difficult to measure the cost of equity accurately, the required return on equity has increased, not decreased, as a naïve, mechanical implementation of the models might suggest.

Q42. What is the current evidence regarding market volatility?

A42. A measure of the market's expectations for volatility is the VIX, which measures the 30-day implied volatility of the S&P 500 index. This index is sometimes called the "investor fear gauge"[41] because it provides a market indication of how investors in stock index options perceive the likelihood of large swings in the stock market within the next month. As of February 7, 2018, the VIX stood at 28, substantially higher than the 1990-present average of 19 or the two year average of 13.5.[42]

In 2016 and 2017, the VIX displayed considerable short-term volatility. During that period the index reached as high as 28 and fell as low as 9. At the end of January 2018, the VIX stood at 13.5. However, it increased dramatically during the first week of February, reaching as high as 37. This demonstrates that, consistent with recent movements in the stock market, investors expect a high level of market volatility over the coming 30 days.

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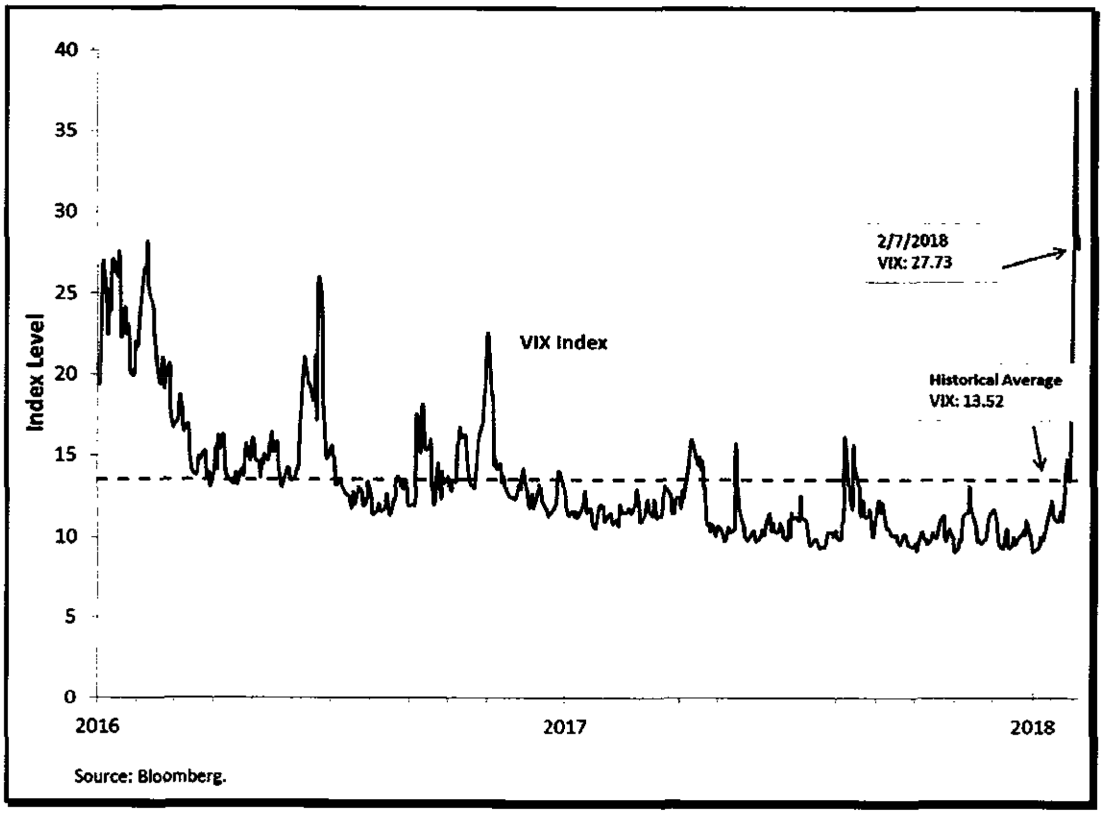
[41] See Rachel Koning Beals, *Stock market 'fear gauge' VIX remains up over 20% in wake of latest North Korean action*, MarketWatch, August 29, 2017.

[42] Bloomberg as of February 7, 2018.

Figure 4
Historical VIX Levels

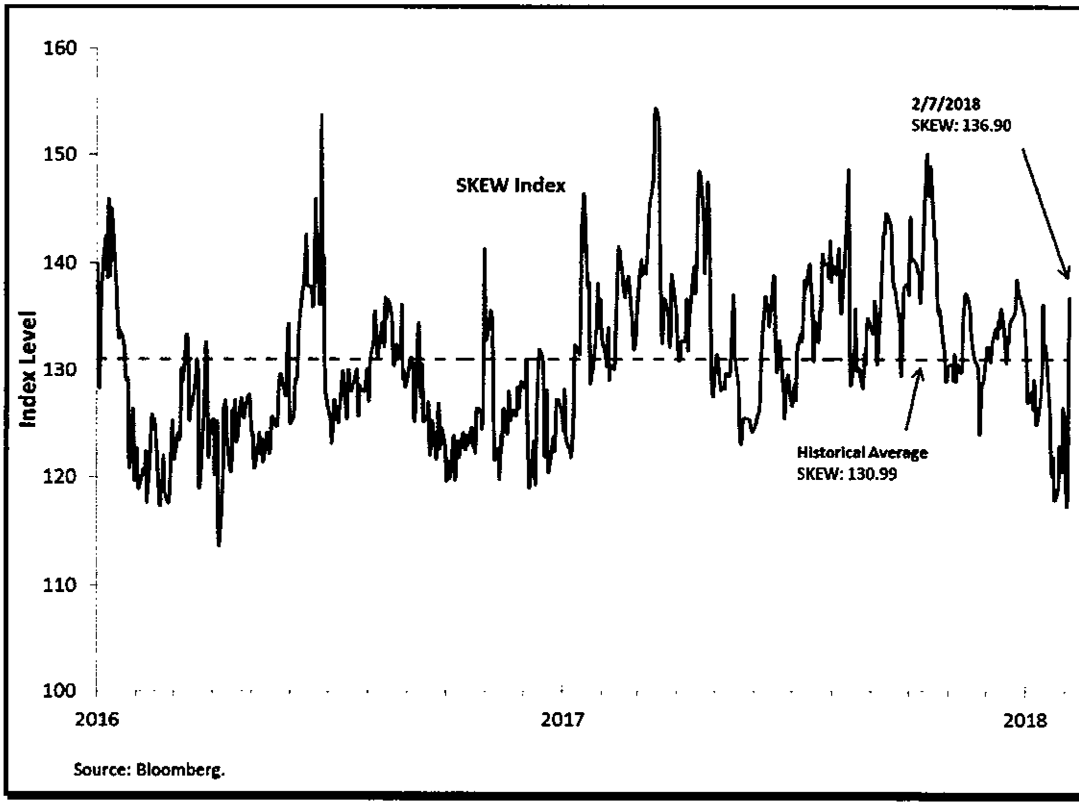


Q43. Are there other indications that investors are exhibiting elevated signs of risk aversion?

A43. Yes, the SKEW index measures the market's willingness to pay for protection against negative "black swan" stock market events (i.e., sudden substantial downturns). A SKEW value of 100 indicates outlier returns are unlikely, but as the SKEW value increases, the probability of outlier declines also increases. The SKEW currently stands at almost 137, while the index has averaged 119 since 1990, and 131 in the past two years.[43] This indicates that in addition to short-term volatility expectations being low, investors are exhibiting signs of elevated risk aversion over concerns of downside tail risk.

[43] Bloomberg as of February 7, 2018.

Figure 5
Historical SKEW Levels



B. THE NEW TAX LAW INCREASES RISKS FACING REGULATED UTILITIES

Q44. How will the Tax Cuts and Jobs Act of 2017 affect regulated utilities?

A44. The Tax Cuts and Jobs Act of 2017 (Public Law 115-97) ("TCJA"), signed into law on December 22, 2017, reduces the federal corporate marginal tax rate from 35 percent to 21 percent. Although the tax law is likely to be a net positive for investors in unregulated companies, it is likely that customers, rather than shareholders, of regulated companies will reap the majority of the benefits because the savings in income taxes will flow through to customers. The reduction in income tax will likely increase the risks facing regulated companies because the effect of the law will be a reduction in their cash flows.

Q45. How will the TCJA reduce the cash flows of regulated companies?

A45. The law can reduce cash flows for regulated companies in several ways. First, the reduction in the corporate tax rate reduces the income tax allowance needed, i.e., the ROE "gross up" for income tax is smaller. This results in a reduced revenue requirement and decreased pre-tax cash flows. Second, on an after tax basis, the benefit of any accelerated tax depreciation will go down in proportion to the reduction in tax rate, leading to a reduction in after-tax cash flows. Third, regulated utilities will need to refund Excess Deferred Income Taxes ("EDIT") to their customers through lower rates. The creation of EDIT relates to Accumulated Deferred Income Tax ("ADIT"), which represents the timing difference in depreciation for income tax and regulatory purposes. Typically, depreciation for tax purposes is accelerated relative to regulatory depreciation so that Deferred Income Tax "DIT" is positive in the early years of a regulated asset's life and negative in the later years. The assumption is that ADIT will be zero for any asset at the end of its regulatory life; however, that would not be true with a change in the corporate tax rate, unless EDIT is addressed. Because of the reduction in the corporate tax rate, the excess ADIT becomes EDIT that will be refunded to customers over the remaining life of the asset. As the EDIT is amortized, it will increase the rate base, but on net the return of EDIT will reduce the utility's cash flows, both before and after taxes, until the EDIT has been exhausted.[44] Finally, the law eliminates bonus depreciation. Bonus depreciation allows utilities to recognize additional depreciation for tax purposes during the first year of an asset's operation. While bonus depreciation reduces rate base, it creates an upfront increase in a utility's cash flows in the form of lower tax payments. Thus, the elimination of bonus depreciation will negatively impact some utilities' after tax cash flows.

[44] This is true because the return on a dollar of increased rate base is less than the cash flow from a dollar of depreciation.

Q46. How will the TCJA 2017 affect the expected volatility of cash flows for regulated companies?

A46. This example assumes that the revenue requirement has been adjusted to account for the lower corporate income tax rate. For regulated companies, the change in the income tax allowance will result in greater volatility of net income (and cash flow) because the regulatory income tax allowance provides a "buffer" against the impact of variations in expected costs and expected revenue on net income. Consider for example the effect on net income of a 10 percent increase in sales. All else equal, net income would increase by about 6.5 percent for a 35 percent income tax rate, (i.e. 0.10 times (1 – 0.35)), but would increase by 7.9 percent for a 21 percent income tax rate. The change would be similar for a decrease in revenue. Moreover, the variation in net income is likely to be systematic in that variations in revenue are generally related to variations in the economy. Recall that systematic risk is the type of risk that affects the cost of capital.

Q47. How will the TCJA affect a regulated company's credit metrics?

A47. Credit metrics are likely to be negatively impacted due to a reduction in the regulated utilities' cash flow because cash flow metrics are closely observed by the ratings agencies. The reduction in income tax allowance, the expected refunds of EDIT, and the loss of bonus depreciation will reduce cash flow. Yet the tax reform has not impacted the amount of assets, a portion of which will be debt-financed, necessary to serve the utilities' customers. Decreases to the cash flow metrics, such as cash flow to debt ratios closely monitored by credit rating agencies to inform their credit opinions, negatively impacts the credit profile of many regulated utilities.[45] These effects suggest that the allowed ROE, the amount of equity in the capital structure, or

[45] "Moody's changes outlooks on 25 US regulated utilities primarily impacted by tax reform," Moody's Investor Service, Global Credit Research, January 19, 2018, and "Tax reform is credit negative for sector, but impact varies by company," Moody's Investor Service, Sector Comment, January 24, 2018. Also "U.S. Tax Reform: For Utilities' Credit Quality, Challenges Abound," S&P Global Ratings, Rating Direct, January 24, 2018; and "Tax Reform Impact on the U.S. Utilities, Power & Gas Sector: Tax Reform Creates Near-Term Credit Pressure for Regulated Utilities and Holding Companies," Fitch Ratings, Special Report, January 24, 2018.

possibly both should be increased to offset the negative effects of the income tax law. While the uncertainty surrounding the passage of a tax reform bill has been removed, it is unlikely that these impacts on the cost of capital will immediately appear in the estimation models. The law has not yet been in place for even one fiscal quarter. A longer period of market data and updates of analyst forecasts is needed before the cost of capital estimation models will begin to show the impacts of the new tax law.

IV. SAMPLE SELECTION

A. THE EXPANDED SAMPLE

Q48. What factors do you consider in selecting a proxy group?

A48. The cost of capital for any part of a company depends on the risk of the lines of 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, so selecting a sample concentrated in the regulated company's line of business is important. Vectren is a regulated gas distribution utility. Currently there is available only a relatively small sample of publicly-traded gas distribution utilities (five companies) whose primary business is distribution of natural gas under cost of service regulation and which meet my standard set of criteria for M&A activity.

Q49. What additional selection criteria did you apply?

A49. The companies must own substantial regulated assets, must not exhibit any signs of financial distress, and must not be involved in any substantial merger and acquisition ("M&A") activities that could bias the estimation process.[46] In general, this requires that over a five year study period and up to the date of the analysis, the sample

[46] This includes pending (but announced) M&A activity but adjusts for M&A activity that does not appear to bias the beta estimates substantively, (such as small, spaced-out transactions, transactions involving multiple parties or parent drop-downs). Notably, I include New Jersey Resources and South Jersey Industries, which were recently engaged in M&A, WGL Holdings, which is currently a target for acquisition by AltaGas, and Spire which engaged in large acquisitions in 2013 and 2014. My reasons for including these companies are explained in greater detail in my testimony.

companies have an investment grade credit rating, a high percentage of regulated assets (greater than 50 percent),[47] no significant merger activity, no dividend cuts, and no other activity that could cause the growth rates or beta estimates to be biased. Finally, I require that data from S&P or Moody's, *Value Line*, and Bloomberg—each widely known and utilized by investors—be available for all sample companies.

Q50. Can you summarize how you selected the expanded sample?

A50. I formed the sample from the universe of publicly traded natural gas distribution utilities as classified by the *Value Line Investment Survey Plus Edition*.[48] This resulted in an initial group of 17 companies. I then eliminated companies by applying additional selection criteria designed to remove companies with unique circumstances which may bias the cost of capital estimates. This ultimately yielded only five natural gas LDCs, which is too few for statistical reliance. Therefore, I expanded the initial sample to include certain gas LDCs involved in M&A activity during the last 5 years. This added 4 more utilities after screening for the criteria described below for a total of 9 companies in the expanded sample.

Q51. Why is it appropriate to expand the gas sample with companies with some M&A activity?

A51. The ideal sample would consist of regulated gas LDCs with no M&A activity during the past 5 years. Because my original screen yielded only 5 companies, I reviewed the data for gas LDCs involved in M&A activity during the last 5 years. This led me to add four additional companies to my sample – Spire, New Jersey Resources, South Jersey Industries, and WGL Holdings. Three years ago, Spire engaged in M&A that

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47 I use the Edison Electric Institute's methodology used for classification of electric utilities to determine the percentage of assets classified as regulated, mostly regulated or diversified, for the gas LDC companies in my sample. Specifically, and consistent with Edison Electric Institute's methodology, I applied the following asset percentage thresholds: Regulated - greater than 80 percent of total assets are regulated; Mostly Regulated - 50 to 80 percent of total assets are regulated; Diversified - less than 50 percent of total assets are regulated. I used company asset information as reported by S&P Capital IQ as of August 24th, 2017 or from the companies' most recent 10K for performing my calculation of asset classification for the sample companies.

48 The 17 companies are from *Value Line Investment Analyzer*, accessed as of November 9, 2017.

doubled the size of the company. While this would not affect the DCF analysis, it could affect the CAPM analysis. Based on a review of Bloomberg 3- and 5-year Betas for Spire, I concluded the merger had not materially affected the company's Beta.[49] Thus, I included it in both my DCF and CAPM estimates.

In April 2017, New Jersey Resources and South Jersey Industries announced interest in a merger. However, the parties subsequently terminated negotiations in October 2017. Moreover, the merger announcement had a small impact on the companies' equity valuations relative to general price movements in the equity market. In January 2017, AltaGas announced a still-pending acquisition of WGL Holdings. However, the announcement had a small impact on the company's equity valuations relative to general price movements in the equity market. For these reasons, I included New Jersey Resources, South Jersey Industries, and WGL Holdings in my full sample. To verify the appropriateness of including these companies, I also considered a subsample that excluded them.

B. Comparison of Vectren to the Expanded Sample Companies

Q52. What are the characteristics of the expanded sample companies you have chosen?

A52. The expanded sample is comprised of regulated companies whose primary source of revenues and majority of assets are in the regulated portion of the natural gas distribution industry. The final sample consists of the nine regulated natural gas LDCs listed in Table 2 below.

Q53. Can you describe the financial and regulatory characteristics of the sample in comparison to Vectren?

A53. Table 2 below reports the sample companies' annual revenues for the trailing twelve months ended December 2017 and the percentage of their assets devoted to regulated operations according to EEI's classifications of being either regulated ("R"), having

[49] Using both 3 and 5 years of historical data, Bloomberg reports a Beta of 0.64 for Spire.

greater than 80 percent regulated assets or mostly regulated ("M"), having 50-80 percent regulated assets. Table 2 also displays the Market Capitalization and the S&P Credit Rating for each company as of December 31, 2017, and the weighted average long-term (5-year) earnings growth rate estimate from Thomson Reuters IBES and *Value Line* for all of the companies in the expanded sample.

Table 2
Financial Characteristics of the Expanded Sample

U.S. Gas Sample							
Company	**DCF Subsample**	**Annual Revenues (USD million)**	**Regulated Assets**	**Market Cap. 2017 Q4 (USD million)**	**Betas**	**S&P Credit Rating (2016)**	**Long Term Growth Est.**
	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Atmos Energy	*	$2,868	R	$9,303	0.70	A	5.4%
Chesapeake Utilities	*	$585	M	$1,293	0.70	na	12.2%
ONE Gas Inc.	*	$1,519	R	$3,901	0.70	A	7.0%
South Jersey Inds.		$1,233	M	$2,516	0.85	BBB+	14.8%
Southwest Gas	*	$2,450	R	$3,860	0.80	BBB+	7.8%
Spire Inc.	*	$1,821	R	$3,677	0.70	A-	4.7%
New Jersey Resources		$2,292	M	$3,499	0.80	na	1.9%
Northwest Natural Gas	*	$764	R	$1,776	0.70	A+	8.8%
WGL Holdings Inc.		$2,388	R	$4,392	0.80	A	-0.4%
Full Sample Average		**$1,769**		**$3,802**	**0.75**		**6.9%**
Subsample Average		**$1,668**		**$3,968**	**0.72**		**7.6%**

Sources and Notes:
[1]-[2]: Denotes companies used in the CAPM and DCF subsamples.
[3]: Bloomberg as of January 31, 2018. Most recent four quarters.
[4]: See Table No. MV-GAS-2. Key:
R - Regulated (More than 80% of assets regulated).
M - Mostly Regulated (50%-80% of assets regulated).
[5]: See Table No. MV-GAS-3 Panels A through I.
[6]: See Supporting Schedule # 1 to Table No. MV-GAS-10.
[7]: S&P Credit Ratings from Research Insight as of 2017 Q4. Research Insight does not report S&P credit ratings for MGE Energy. I use the S&P ratings of MGEE's subsidiary, Madison Gas and Electric Company.
[8]: See Table No. MV-GAS-5.

Q54. How does the business risk of Vectren compare to that of the sample?

A54. Vectren's business is concentrated in regulated natural gas distribution services. Its annual revenues are $2.6 billion with a market capitalization of about $5.5 billion, so it is slightly larger than the average company in the sample. Vectren's beta is 0.75 which is the sample average. Regulatory policy plays a role in the business risk of the Company. It also has a credit rating of A- which is comparable to those of the sample companies, but Vectren's credit rating outlook has been revised to negative from stable due to the negative expected effect of the TCJA and due to the

Company's large capital spending plan.[50] Vectren's service is heavily dependent upon manufacturing and heavy industry as well as the ongoing viability of Wright Patterson Air Force Base. Vectren's unique risks are discussed further in the testimony of Company witness, Colleen Ryan.

C. Capital Structure

Q55. What regulatory capital structure is Vectren requesting in this proceeding?

A55. Vectren had a regulatory capital structure consisting of approximately 50.6 percent equity and 49.4 percent debt as of December 31, 2017,[51] as supported by company witness Patrick Edwards and set forth in Schedule D-1A. The expanded sample averages about 51 percent equity and 49 percent debt on a book basis. The highest percent of book equity for the companies in the sample is 62 percent equity (ONE Gas Inc.) and the lowest is 43 percent equity (WGL Holdings Inc.). My recommended range for ROE is a function of Vectren's capital structure, the sample average ATWACC estimates, the Hamada adjustment procedures, and the relative risk of the Company compared to the sample.

V. COST OF CAPITAL ESTIMATES

Q56. How do you estimate the sample companies' costs of equity?

A56. As noted earlier, I apply two general methodologies—risk positioning and DCF—both of which are standard ways of estimating a company's cost of equity. For my CAPM (risk positioning) based estimates, I consider a range of sensitivities to reflect well-documented empirical deficiencies in the CAPM when used in conjunction with an equity market index. These sensitivities are called the Empirical CAPM. I also report results generated by two versions of the DCF approach: the single-stage and the multistage DCF models.

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[50] S&P Global Ratings, *RatingsDirect*, "Vectren Corp. and Subsidiaries Outlooks Revised To Negative From Stable; 'A-' Ratings Affirmed," March 9, 2018.

[51] By regulatory capital structure, I mean the capital structure used to set rates in this proceeding.

A. The CAPM-Based Estimates

Q57. Can you explain the CAPM?

A57. Modern models of capital market equilibrium express the cost of equity as the sum of a risk-free rate and a market risk premium. The CAPM is the longest-standing and most widely used of these theories. To implement the model requires specification of (1) the current values of the benchmarks that determine the Security Market Line [see Figure 1, (page 8)]; (2) the relative risk of a security or investment; and (3) how the benchmarks combine to produce the Security Market Line. Given these specifications, the company's cost of capital can be calculated based on its relative risk. Specifically, the CAPM states that the cost of capital for an investment, S (e.g., a particular common stock), is given by the following equation:

$$r_s = r_f + \beta_s \times MRP \quad (4)$$

where r_S is the cost of capital for investment S;
r_f is the risk-free interest rate;
β_S is the beta risk measure for the investment S; 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 than safe securities. It says that the Security Market Line starts at the risk-free interest rate (that is the return on a zero-risk security, the y-axis intercept in Figure 1 (page 8), equals the risk-free interest rate). Further, it says that the risk premium of a security over the risk-free rate equals the product of the beta of that security and the risk premium on a value-weighted portfolio of all investments, which by definition has average risk.

1. The Risk-free Interest Rate

Q58. What interest rates do your calculations require?

A58. Modern capital market theories of risk and return (e.g., the theoretical version of the CAPM as originally developed) use the short-term risk-free rate of return as the starting benchmark, but regulatory bodies frequently use a version of the risk positioning model that is based upon the long-term risk-free rate. In this proceeding, I rely upon the long-term version of the risk positioning model. Accordingly, the implementation of my procedures requires use of long-term U.S. Treasury bond interest rates. For this reason, I use a risk-free rate based on the forecasted value from *Blue Chip Economic Indicators*. Specifically, I use the 3.4 percent yield on the 10-year U.S Treasury bond forecasted to be in effect in 2019,[52] and adjust upward by 54 bps, which is my estimate of the representative maturity premium for the 20-year over the 10-year Treasury Bond. The resulting value for the unadjusted risk-free rate is 3.94 percent.

Q59. Why didn't you use the version of the CAPM that relies on the short-term risk-free rate in this proceeding?

A59. Short-term Treasury bill yields remain at artificially low levels due to the efforts of the Fed to stimulate the economy. As a result, the risk positioning required ROE estimates using the short-term Treasury bill yields as the risk-free interest rate are unreasonably low. For example, the estimates are sometimes less than the corresponding company's current market cost of debt, which is unreasonable. A company's equity is always riskier than its debt and requires a higher expected return, because debt holders are paid before equity holders in the event of bankruptcy or other financial distress.

2. The Market Risk Premium

Q60. Why is a risk premium necessary?

A60. Experience (e.g., the recent credit crisis in stock markets worldwide and 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 Treasury bills, investors subject themselves not only to the risk of earning a return well below that which they expected in any year but

52 *Blue Chip Economic Indicators*, dated October 10, 2017.

also to the risk that they might lose much of their initial capital. This is fundamentally why investors demand a risk premium.

Q61. Has the estimate of the MRP been controversial over the recent past?

A61. Yes. Historically, the appropriate method to estimate the MRP was to consider the historical average realized return on the market minus the return on a risk-free asset over as long a series of time as possible; however, this procedure came under attack during the period of time generally referred to as the "tech bubble" when the stock markets in the U.S. reached very high valuation levels relative to traditional metrics of value. The period of the tech bubble also resulted in the average realized return on the market increasing to a very high level. Attempts to explain the high stock market valuation levels centered on the hypothesis that the MRP must be dramatically lower than previously believed, but this hypothesis conflicted with the fact that realized returns over the period were very high. The result was an academic debate on the level of the forward-looking MRP and how best to estimate it—a debate that has still not been fully resolved. As discussed in Section III, stock markets declined as a result of the credit crisis, and stock prices became extremely volatile. It is likely the MRP is now higher than the historical average realized return on the market minus the return on the risk-free asset.

Q62. How do these factors affect the cost of capital for the Company?

A62. The Company invests in long-lived assets which cannot be easily liquidated (they are hard physical assets that once put in place cannot easily be moved). Investment is a voluntary activity, and investors generally require an expected return that is consistent with the risk they take on; therefore, it could damage the ability to access capital if investors view the allowed rate of return as lower than the required rate of return. The problem is not avoided for subsidiary companies that are 100 percent parent owned because the parent company must consider the opportunity cost of capital when making investments. Investors expect managers to invest in projects which provide expected returns at least equal to the cost of capital.

Q63. What is your conclusion regarding the MRP?

A63. Historically, much of the controversy over market risk premium centered on various reasons why it may not be as high as frequently estimated. Although none of the arguments were completely persuasive in and of themselves, I generally gave some weight to these issues in past testimony and reduced my estimate of the MRP. Conversely, recent events have strongly suggested an increase in the MRP from its previous levels. I would typically consider an MRP of 7 percent over the long-bond rate as reasonable based on my review of the relevant academic literature. However, current market conditions—as reflected in elevated bond yield spreads as described above in Section III—suggest that a value of 7.5 percent or even 8.5 percent could be more appropriate at this time. I include two analyses using an MRP of 6.94 and 7.94 percent.[53]

3. Beta

Q64. Can you more fully explain beta?

A64. 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. That is, it measures the "systematic" risk of a stock—the extent to which a stock's value fluctuates more or less than average when the market fluctuates.

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 20 percent per year.[54] 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

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53 Duff and Phelps's *Ibbotson SBBI 2017 Valuation Yearbook* reports the realized arithmetic average MRP from 1926 to 2016 to be 6.94 percent.

54 See Brealey, Myers and Allen (2017), *Principles of Corporate Finance, 12th Edition*, McGraw-Hill Irwin, New York, p. 172.

individual stocks is eliminated by diversification. Some stocks go up when others go down, and the average portfolio return—whether positive or negative—is usually less extreme than that of many individual stocks within it. The fact that the market's actual annual standard deviation is so large means that, in practice, the returns on stocks are positively 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" in that even a well-diversified portfolio of stocks will experience changes in value caused by these shared risk factors. Single-factor equity risk premium models (such as the CAPM) are based upon the assumption that all of the systematic factors that affect stock returns can be considered simultaneously, through their impact on one factor: the market portfolio. Other models derive somewhat less restrictive conditions under which several factors might be individually relevant.

Again, 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.)

Q65. What does a particular value of beta signify?

A65. 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.

Q66. How is beta measured?

A66. 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. Many investment services report betas, including Bloomberg and the *Value Line Investment Survey*. Betas are not always calculated in precisely the same way, and therefore must be used with a degree of caution. However, the basic principle that a high beta indicates a risky stock has long been widely accepted by both financial theorists and investment professionals, and is universally reflected in all calculations of beta. *Value Line* calculates betas using five years of weekly return data for a company.[55] In my analyses for these proceedings, I present results using the beta estimates reported by *Value Line*.

Q67. What are the betas that you used for the sample companies?

A67. Table 3 below lists the *Value Line* betas I used to calculate my risk-positioning estimates of the cost of capital for the expanded sample.

Table 3
***Value Line* Betas for the Expanded Sample**

Company	Value Line Betas [1]
Atmos Energy	0.70
Chesapeake Utilities	0.70
ONE Gas Inc.	0.70
South Jersey Inds.	0.85
Southwest Gas	0.80
Spire Inc.	0.70
New Jersey Resources	0.80
Northwest Natural Gas	0.70
WGL Holdings Inc.	0.80
Average	0.75
Subsample Average	0.72

Sources and Notes:
[1]: From Valueline Investment Analyzer as of Jan 8, 2018

55 *Value Line* Glossary, http://www.valueline.com/Glossary/Glossary.aspx

4. The Empirical CAPM

Q68. What other equity risk premium model do you use?

A68. 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 premiums than predicted by the CAPM and high-beta stocks tend to have lower risk premiums than predicted. A number of variations on the original CAPM theory have been proposed to explain this finding, but the observation itself can also be used to estimate the cost of capital directly, using beta to measure relative risk by making a direct empirical adjustment to the CAPM.

This second model makes use of these empirical findings. It estimates the cost of capital with the equation,

$$r_S = r_f + \alpha + \beta_S \times (MRP - \alpha) \tag{5}$$

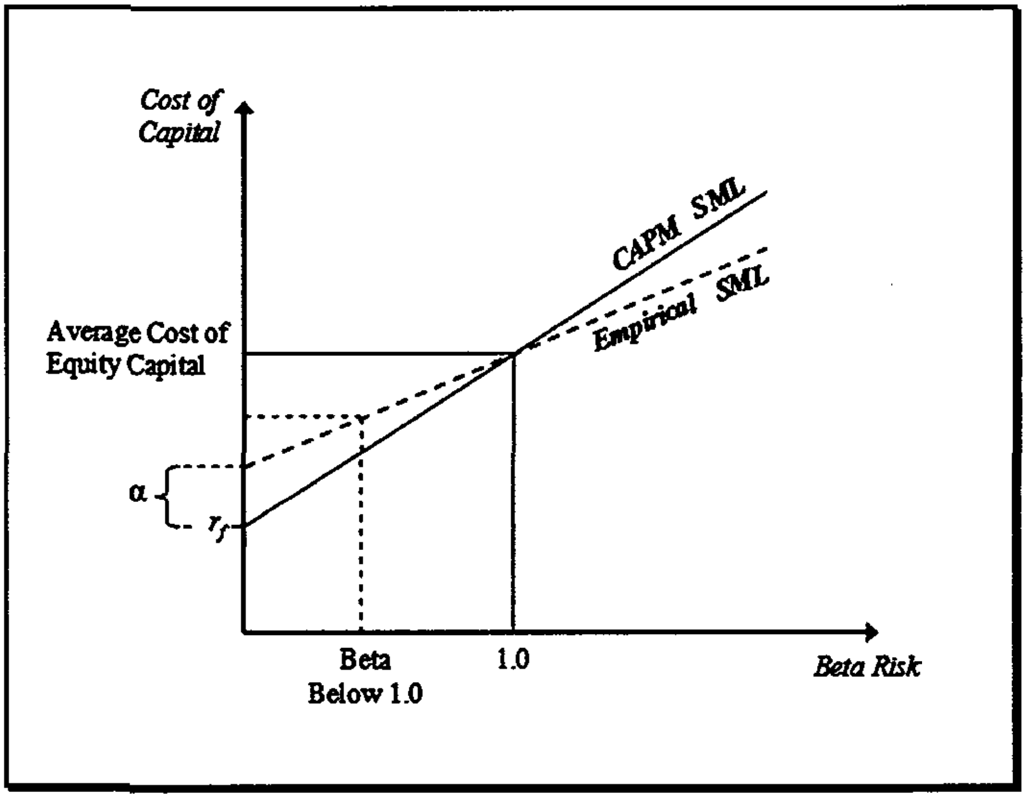
where α is the "alpha" adjustment of the risk-return line, a constant, and the other symbols are defined as for the CAPM (see Equation (4) above).

I label this model the Empirical Capital Asset Pricing Model, or "ECAPM." The alpha adjustment has the effect of increasing the intercept but reducing the slope of the Security Market Line in Figure 1 (page 8), earlier in my testimony which results in a Security Market Line that more closely matches the results of empirical tests. In other words, the ECAPM produces more accurate predictions of eventual realized risk premiums than does the CAPM.

Q69. Why is it appropriate to use the Empirical CAPM?

A69. The CAPM has not generally performed well as an empirical model, but its short-comings are directly addressed by the ECAPM. Specifically, the ECAPM recognizes the consistent empirical observation that the CAPM underestimates (overestimates) the cost of capital for low (high) beta stocks. In other words, the ECAPM is based on recognizing that the actual observed risk-return line is flatter and has a higher intercept than that predicted by the CAPM. The alpha parameter (α) in the ECAPM adjusts for this fact, which has been established by repeated empirical tests of the CAPM. The difference between the CAPM and the type of relationship identified in the empirical studies is depicted in Figure 6 below.

Figure 6
The Empirical Security Market Line



Q70. Does *Value Line* make any adjustments to the beta estimates it reports?

A70. Yes, but *Value Line*'s adjustments are fundamentally different and separate from the ECAPM adjustment I perform. *Value Line*'s adjustments do not correct for the issues raised by the empirical tests of the CAPM. The adjustment to beta corrects the estimate of the relative risk of the company, which is measured along the horizontal axis of the SML. The ECAPM adjusts the risk-return tradeoff (i.e., the slope) in the SML. In other words, the expected return (measured on the vertical axis) for a given level of risk (measured on the horizontal axis) is different from the predictions of the theoretical CAPM. Getting the relative risk of the investment correct does not adjust for the slope of the SML, nor does adjusting the slope correct for errors in the estimation of relative risk.

Q71. Can you explain further why using *Value Line*'s adjusted betas do not correct for the issues raised by empirical tests of the CAPM?

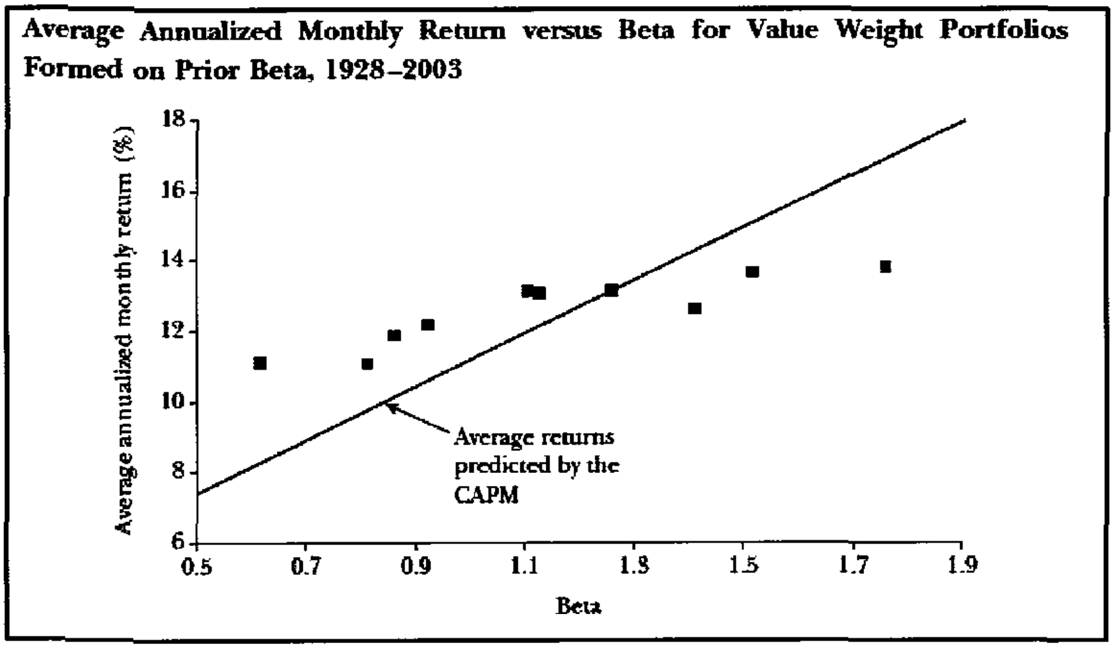
A71. Yes. It is because the issues raised by the empirical tests are completely independent from the reason betas are adjusted. The beta adjustment performed by *Value Line* is based on the method outlined by Professor Marshall Blume,[56] reflecting his empirical observation that historical measurements of a firm's beta are not the best predictors of what that firm's systematic risk *will be* going forward. Professor Blume was able to apply a consistent adjustment procedure to historical betas that increased their accuracy in *forecasting* eventual realized betas. Essentially, Professor Blume's adjustment transforms a historical beta into a better estimate of expected future beta. It is this expected "true" beta that drives investors' expected returns according to the CAPM. Therefore, it is appropriate to use *Value Line's* adjusted betas, rather than raw historical betas, when employing the CAPM to estimate the forward-looking cost of equity capital.

However, the backward-looking empirical tests of the CAPM that gave rise to the ECAPM did not suffer from bias in the measurement of betas. Researchers plotted realized stock portfolio returns against betas measured *over the same time period* to produce plots such as Figure 7 below, which comes from the 2004 paper by Professors Eugene Fama and Kenneth French.[57] The fact that betas and returns were measured contemporaneously means that the betas used in the tests were *already the best possible measure* of the "true" systematic risk over the relevant time period. In other words, no adjustments were needed for these betas. Despite this, researchers observed that the risk-return trade-off predicted by the CAPM was too steep to accurately explain the realized returns. As explained above the ECAPM explicitly corrects for this empirical observation.

[56] Blume, Marshall E. (1971), "On the Assessment of Risk," *The Journal of Finance*, 26, pp. 1-10.

[57] Fama, Eugene F. & French, Kenneth R, (2004), "The Capital Asset Pricing Model: Theory and Evidence," *Journal of Economic Perspectives, 18(3),* pp. 25-46.

Figure 7
Evidence from Empirical Tests of the CAPM[58]



Q72. Did the empirical tests that gave rise to the ECAPM use raw betas in their analyses?

A72. They did. However, this is simply because the researchers were able to measure raw betas and realized returns from the same historical period. In other words, no adjustment to the raw beta was necessary to evaluate the market return realized for the same historical period. Hence, the raw betas they measured accurately captured the systematic risk that impacted the returns they measured. In a sense, the measured betas and realized returns were already contemporaneous in the tests of the CAPM that identified the effect shown as illustrated in Figure 6 (page 48) and Figure 7 above.

[58] *Ibid.*, p. 33.

Q73. Does the use of adjusted betas in the ECAPM double count the adjustment to the estimated required return on equity?

A73. No. The Blume adjustment to beta and the ECAPM are separate adjustments with no redundancy between them. In fact, both adjustments are necessary to produce the most accurate possible forward-looking estimate of the required return on equity.

A rate of return analyst must use a historical measurement of beta to make a forecast of the expected *future* return on equity. Therefore, the analyst should first apply the Blume adjustment (as *Value Line* does) to get the best estimate of the systematic risk over the (future) period in which (s) he will estimate the ROE. Once the risk measurement is contemporaneous with the returns to be estimated, the analyst should apply the ECAPM to adjust for the empirical shortcomings of the CAPM.

Q74. Can you summarize the independent reasons for using adjusted betas and employing the ECAPM?

A74. Raw historical betas are adjusted to provide a better estimate of *expected* "true" betas, which are the appropriate measure of risk that predicts expected future returns in the CAPM. The ECAPM is used because empirical tests show that *even when the best possible estimate* of "true" beta is used, the CAPM tends to under-predict required returns for low-beta stocks and over-predict required returns for high-beta stocks.

These are independent but complementary adjustments supported by empirical tests of this model of financial theory. Both adjustments are appropriate when using risk-positioning models to estimate the cost of equity.

5. Results from the Risk Positioning Models

Q75. What are the parameters of the scenarios you considered in your risk positioning analyses?

A75. The parameters for the two scenarios are displayed in Table 4 below. The motivation for the scenarios is the empirical observation that the yield spread is higher than normal. The increased yield spread could be the result of an increase in the MRP or downward pressure on the yield of risk-free bonds due to a flight to quality or a combination of the two factors. Therefore, I reduce the risk-free rate for use with a higher estimate of the MRP as illustrated in Table 4. In other words, the approximately 20 bps increase in the yield spread is allocated between an increase in the MRP and the downward pressure on the risk-free rate according to the method described above in Section III. The more of the increase in yield spread that is allocated to the underestimation of the risk-free rate, the less the MRP is increased and vice versa.

Table 4
Risk Positioning Scenario Parameters

Parameters Used in CAPM-based Models		
	Scenario 1	**Scenario 2**
Risk-Free Interest Rate	4.1%	3.9%
Market Equity Risk Premium	6.9%	7.9%

Q76. Can you summarize the results from applying the CAPM and ECAPM methodologies to the sample?

A76. The results of the risk positioning analyses (the CAPM and the ECAPM) are presented in Table 5 below, using *Value Line*'s estimated betas for the expanded sample of companies. (The underlying calculations are also presented in Attachment A.[59]). For the ECAPM, there are two sensitivities: $\alpha = 0.5$ percent and $\alpha = 1.5$ percent. The columns display the scenario results for MRP estimates of 6.9 and 7.9 percent in accordance with the adjustments I made to reflect the elevated yield spread as described above. The long-term risk-free interest rate as of January 2018 was 3.94 percent before adjustments for the downward pressure on government yields due to the flight to safety. The ROE estimates in Table 5 reflect the ATWACC and Hamada adjustment procedure estimates adjusted for differences in capital structure between the sample companies and Vectren. Specifically, the ROE associated with each

[59] Results for the CAPM and ECAPM based on the ATWACC financial risk adjustment can be found in Attachment A, Schedule No. D5.12 at 49. Results for the CAPM and ECAPM based on the Hamada adjustment can be found in Attachment A, Schedule No. D5.15 at 52-53.

method and a capital structure with 50.6 percent equity is displayed in Table 5 for the *Value Line* betas.

Table 5
Risk Positioning Cost of Equity Estimates

Return on Equity Summary and Sensitivity Analysis U.S. Gas		
Estimated Return on Equity	Scenario 1 [1]	Scenario 2 [2]
Financial Risk Adjusted Method		
CAPM	10.4%	11.1%
ECAPM (α = 0.5%)	10.5%	11.2%
ECAPM (α = 1.5%)	10.8%	11.5%
Hamada Adjustment Without Taxes		
CAPM	10.4%	11.1%
ECAPM (α = 0.5%)	10.4%	11.1%
ECAPM (α = 1.5%)	10.5%	11.2%
Hamada Adjustment With Taxes		
CAPM	10.5%	11.2%
ECAPM (α = 0.5%)	10.5%	11.2%
ECAPM (α = 1.5%)	10.6%	11.3%

Sources and Notes:
Scenario 1: Long-Term Risk Free Rate of 4.14%, Long-Term Market Risk Premium of 6.94%.
Scenario 2: Long-Term Risk Free Rate of 3.94%, Long-Term Market Risk Premium of 7.44%.

Q77. What conclusions do you draw from the risk positioning model (i.e., CAPM and ECAPM) results?

A77. Of the risk positioning estimates, 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 and exhibits consider by using the ECAPM). Conversely, the ECAPM numbers deserve more weight, because this method adjusts for the empirical findings. The results for Scenario 1 do not fully adjust for the ongoing uncertainty in the capital markets and deserve less weight than the results for Scenario 2 in column [2]. Focusing on the ECAPM (Scenario One) results for the sample, the results range from 10.4 percent to 10.8 percent. The ECAPM risk positioning results for Scenario Two range from 11.1

percent to 11.5 percent. For Scenario 1, the results range from 10.4 percent to 10.8 percent. For Scenario 2, the results range from 11.1 percent to 11.5 percent.

B. Risk Premium Model Estimates

Q78. Did you estimate the cost of equity that results from an analysis of risk premiums implied by allowed ROE's in past utility rate cases?

A78. Yes. In this type of analysis, sometimes called the "risk premium model," the cost of equity capital for utilities is estimated based on the historical relationship between allowed ROE's in utility rate cases and the risk-free rate of interest at the time the ROE's were granted. These estimates add a "risk premium" implied by this relationship to the relevant (prevailing or forecast) risk-free interest rate:

$$Cost\ of\ Equity = r_f + Risk\ Premium \qquad (6)$$

Q79. What are the merits of this approach?

A79. First, it estimates the cost of equity from regulated entities as opposed to holding companies, so that the relied upon figure is directly applicable to a rate base. Second, the allowed returns are clearly observable to market participants, who will use this one data input to making investment decisions, so that the information is at the very least a good check on whether the return is comparable to that of other investments. Third, I analyze the spread between the allowed ROE at a given time and the then prevailing interest rate to ensure that I properly consider the interest rate regime at the time the ROE was awarded. This implementation ensures that I can compare allowed ROE granted at different times and under different interest rate regimes.

Q80. How did you use rate case data to estimate the risk premiums for your analysis?

A80. The rate case data from 1990-2017 is derived from Regulatory Research Associates.[60] Using this data I compared (statistically) the average allowed rate of return on equity granted by U.S. state regulatory agencies in natural gas distribution cases to the

[60] SNL Financial as of January 31, 2018.

average 20-year Treasury bond yield that prevailed in each quarter.[61] I calculated the allowed utility "risk premium" in each quarter as the difference between allowed returns and the Treasury bond yield, since this represents the compensation for risk allowed by regulators. Then I used the statistical technique of ordinary least squares ("OLS") regression to estimate the parameters of the linear equation:

$$Risk\ Premium = A_0 + A_1 \times (Treausury\ Bond\ Yield) \qquad (7)$$

I derived my estimates of A_0 and A_1 using standard statistical methods (OLS regression) and find that the regression has a high degree of explanatory power in a statistical sense (R^2=0.85) and the parameter estimates, A_0 equals 8.407 percent and A_1 equals -0.5611, are statistically significant. The negative slope coefficient reflects the empirical fact that regulators grant smaller risk premiums when risk-free interest rates (as measured by Treasury bond yields) are higher. This is consistent with past observations that the premium investors require to hold equity over government bonds increases as government bond yields decline. In the regression described above the risk premium declined by less than the increase in Treasury bond yields. Therefore, the allowed ROE on average declined by less than 100 basis points when the government bond yield declined by 100 basis points. Based on this analysis, current market conditions suggest an allowed ROE of 10.1 - 10.2 percent for an average risk natural gas LDC.[62]

Q81. What conclusions did you draw from your risk premium analysis?

A81. While the risk premium models based on historical allowed returns are not underpinned by fundamental finance principles in the manner of the CAPM or DCF models, I believe that this analysis, when properly designed and executed and placed in the proper context, can provide useful benchmarks for evaluating whether the

[61] I rely on the 20-year government bond to be consistent with the analysis using the CAPM to avoid confusion about the risk-free rate. While it is important to use a long-term risk-free rate to match the long-lived nature of the assets, the exact maturity is a matter of choice. Rate cases limited to natural gas distribution only (excludes rate cases for transmission or limited-issue rider).

[62] Results for the Risk Premium analysis can be found in Schedule D5.16.

estimated ROE is consistent with recent practice. My risk premium model cost of equity estimates demonstrate that the results of my DCF and CAPM analyses are in line with the allowed return of utility regulators. Because the risk premium analysis as implemented takes into account the interest rate prevailing during the quarter the decision was issued, it provides a useful benchmark for the cost of equity in any interest environment.

C. THE DCF BASED ESTIMATES

Q82. Can you describe the discounted cash flow approach to estimating the cost of equity?

A82. The DCF model takes the first approach to cost of capital estimation described above, i.e., to attempt to estimate the cost of capital in one step instead of estimating the cost of capital for the entire market and then determining the cost of capital for an individual investment. The DCF 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:

$$P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \cdots + \frac{D_T}{(1+r)^T} \qquad (8)$$

where P_0 is the current market price of the stock;
D_t is the dividend cash flow expected at the end of period t;
T is the last period in which a dividend cash flow is to be received; and
r is the cost of equity capital

The formula simply 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 strong 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, then the market price of the stock will be given by a very simple formula,

$$P_0 = \frac{D_1}{r-g} \tag{9}$$

where D_1 is the dividend expected at the end of the first period, g is the perpetual growth rate, and P_0 and r are the current market price and the cost of equity capital, as before.

Equation (9) is a simplified version of Equation (8) that can be solved to yield the well-known "DCF formula" for the cost of capital:

$$r = \frac{D_1}{P_0} + g = \frac{D_0}{P_0} \times (1+g) + g \tag{10}$$

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 (10) says that if Equation (9) 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 strong assumptions.[63]

Q83. Are there other versions of the DCF models in addition to the "simple" one?

A83. Yes. One such alternative version is the multistage DCF model. In its "simple" or constant growth rate formulation, the DCF model requires that dividends and earnings grow at a constant rate for companies that earn their cost of capital on average.[64] It is

63 In this context "strong" means assumptions that are unlikely to reflect reality but that also are not expected to have a large effect on the estimate.

64 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, then 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 more slowly 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

inconsistent with the theory on which this formulation is based to have varying growth rates in earnings and dividends. If, however, the growth rates for 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 utilize a 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.

Q84. What is your assessment of the DCF model?

A84. The DCF approach is grounded in solid finance theory. It is widely accepted by regulatory commissions and provides useful insight regarding the cost of capital based on forward-looking metrics. DCF estimates of the cost of capital complement those of the CAPM and the ECAPM because the two methods rely on different inputs and assumptions. The DCF method is particularly valuable in the current economic environment, because of the effects on capital market conditions of the Fed's efforts to maintain interest rates at historically low levels which bias the CAPM and ECAPM estimates downward.

However, I recognize that the DCF model, like most models, relies upon assumptions that do not always correspond to reality. For example, the DCF approach assumes that the variant of the present value formula that is used matches the variations in investor expectations for the growth of dividends, and that the growth rate(s) used in that formula match current investor expectations. Less frequently noted conditions, such as the value of real options incorporated in a company's market price, may create issues that the DCF model does not incorporate. Nevertheless, under current economic conditions, because of its forward looking nature, the strengths of the DCF method far outweigh any weaknesses the method may have.

growth, you know the company's stock price and its dividend growth forecast are inconsistent with the assumptions of the steady-growth DCF model.

Q85. What growth rate information do you use?

A85. The first step in my DCF analysis (either constant growth or multistage formulations) is to examine a sample of investment analysts' forecasted earnings growth rates from Thomson Reuters IBES and from *Value Line* for companies in the expanded sample.[65] For the long-term growth rate for the final, constant-growth stage of the multistage DCF estimates, I use the most recent long-run GDP growth forecast from Blue Chip Economic Indicators.[66]

Q86. How do these growth rates correspond to the theoretical criteria you discuss above?

A86. The constant-growth formulation of the DCF model, in principle, requires forecasted growth rates, but it is also necessary that the growth rates used go far enough out into the future so that it is reasonable to believe that investors expect a stable growth path afterwards. Under current economic conditions, I believe the forecasted growth rates of investment analysts provide the best available representation of the longer term, steady-state growth rate expectations of investors. Therefore, I feel these growth parameters available to apply to the simple, constant-growth DCF model provide useful estimates of the cost of capital.

Q87. Does the multistage DCF improve upon the simple DCF?

A87. Potentially, but the multistage method assumes a particular smoothing pattern and a long-term growth rate afterwards. These assumptions may not be a more accurate representation of investor expectation than those of the simple DCF. The smoother growth pattern, for example, might not be representative of investor expectations, in which case the multistage model would not increase the accuracy of the estimates. Indeed, amidst uncertainty in capital markets, assuming a simple constant growth rate may be preferable to attempting to model growth patterns in greater detail over

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[65] *Value Line* short-term (5 years) EPS growth rates are as of January 8. Thomson Reuters IBES growth rates are as of January 31, 2018. I develop a weighted-average growth rate weighted by the number of analysts and counting *Value Line* as one analyst.

[66] *Blue Chip Economic Indicators*, October 10, 2017.

multiple stages. While it is difficult to determine which set of assumptions comprises a closer approximation of the actual conditions of capital markets, I believe both forms of the DCF model provide useful information about the cost of capital.

Q88. What are the relative strengths and weaknesses of the DCF and risk-positioning methodologies?

A88. Current market conditions affect all cost of capital estimation models to some degree, but the DCF model has at least one advantage over the risk positioning models. Specifically, the DCF model reflects current market conditions more quickly because the market price of a company's stock changes daily. Dividend yields increase when market prices fall and reflect the increased cost of capital. The challenge for the DCF model is that the model requires forecasts of earnings growth rates that are based upon stable economic conditions which are required to satisfy the constant dividend growth rate assumption. Although the dividend yield quickly reacts to changes in the market, the growth rate estimates may be less precise during times of market uncertainty because future growth rates may be more volatile. Nevertheless, because dividend yields and forecast growth rates change quickly, the DCF model is likely to better reflect investors' current cost of capital expectations than the CAPM and ECAPM which relies upon 5 years of historical data.

Q89. What are the DCF estimates for the sample?

A89. The corresponding DCF estimates for the sample are presented in Table 6. For the full sample, the ROE estimate is 13.7 percent for the single-stage "simple DCF" model and 9.4 percent for the multistage model. For the subsample, the ROE estimate is 11.9 percent for the single-stage "simple DCF" model and 9.1 percent for the multistage model.[67]

[67] Calculations and results for the DCF analysis can be found in Schedule D5.5 to Schedule D5.8.

Table 6
DCF Cost of Equity Estimates

Full Sample	
Simple	13.7%
Multi-Stage	9.4%
Subsample	
Simple	11.9%
Multi-Stage	9.1%

I note that the results of the single-stage DCF can be influenced by high individual growth rates.

Q90. What conclusions do you draw from the DCF analysis?

A90. Although I made no adjustment for the current market conditions for the DCF model, the DCF cost of equity estimates are in line with those from the risk positioning models displayed above in Table 6. Specifically, the multistage DCF estimates are lower than the range suggested by the risk positioning analysis while the simple DCF estimates are somewhat higher. At this time, I believe that the DCF estimates indicate that the estimates from Scenario 2 for the risk positioning model are more reliable than those from Scenario 1. Moreover, I believe the forward-looking nature of the DCF model makes the DCF estimates less susceptible to downward biases in inputs that have resulted from the continued uncertainty in the economy and extremely low interest rate environment. Thus I rely more heavily on the DCF estimates than I would in normal economic times.

VI. CONCLUSIONS

Q91. Can you summarize the evidence from the expanded sample regarding the ROE for a natural gas distribution utility of average risk?

A91. Table 5 (page 53) and Table 6 above, summarize the results of the analyses for the risk positioning and DCF models for the sample companies. I also compare these results to the 10.1 – 10.2 percent allowed ROE for an average natural gas LDC suggested by the risk premium model. The results from the CAPM are less reliable than the results from the ECAPM because they do not consider the consistent empirical evidence that the CAPM underestimates the cost of capital for low beta companies, like those in the natural gas LDC sample. Similarly, the results for Scenario 1 are not as reliable as those from Scenario 2 because Scenario 1 ignores the increased MRP resulting from the ongoing uncertainty in the capital markets. As shown in Table 5 (page 53), the ECAPM results range from 10.5 to 11.5 percent. Based on the sample's full cost of capital estimates, which range from 9.1 percent (multi-stage DCF, subsample) to 13.7 percent (simple DCF, full sample), I believe a gas LDC company of average business and financial risk should have an allowed ROE in the range 10 percent to 11 percent.

Q92. What is your recommended range of the ROE for the Company?

A92. As noted above, I judge the Company to be of higher risk than the sample companies on average. I therefore recommend that the Company be allowed an ROE of 10¾ percent, with a range of 10½ to 11 percent, on the equity financed portion of its rate base.

Q93. Why doesn't your recommended range for the samples cover all of the estimates?

A93. I provide an estimate of a reasonable range of required ROE for the sample, and the range of uncertainty is based upon all of the analyses I have done, placing relatively more weight on more reliable methodologies and estimates. I do not try to include all of the resulting estimates in the range because I regard some of the estimates as more reliable than others. For example, the estimates based upon the CAPM are not as reliable as those based upon the ECAPM because the CAPM estimates do not account for the empirical observation that low beta stocks have higher costs of capital than estimated by the CAPM, and high beta stocks have lower costs of capital. Nor is it likely that the lowest estimates in the tables are as reliable as those in the upper end of the range because those estimates do not adequately consider the continued uncertainty in the financial markets.

Q94. Is there any other reason to support an allowed ROE of 10¾ percent?

A94. Yes. It is important to maintain Vectren's access to capital, and maintaining a solid credit rating and outlook is one important aspect to maintaining access to capital. Credit rating agencies are concerned about cash flows. The recent tax reform law will likely put downward pressure on credit ratings for regulated utilities. A supportive allowed return on equity is therefore important to signal an adequate level of stable cash flows and avoid putting downward pressure on Vectren's credit metrics. Maintaining a strong credit rating is particularly critical during a period forecast to have substantial capital investment for infrastructure. In addition, as the Fed continues to adjust its monetary policy, one can expect that the cost of capital will increase although the pace of such an increase cannot be predicted with certainty. This means that estimates at the upper end of the range are more representative of the going-forward cost of capital.

Q95. Does this conclude your prepared direct testimony?

A95. Yes.

QUALIFICATIONS OF MICHAEL J. VILBERT

Dr. Michael J. Vilbert is a Principal in the The Brattle Group's San Francisco office and has more than 20 years of experience as an economic consultant. He is an expert in cost of capital, financial planning and valuation who has advised clients on these matters in the context of a wide variety of investment and regulatory decisions. In the area of regulatory economics, he has testified or submitted testimony on the cost of capital for regulated companies in the water, electric, natural gas and petroleum industries in the U.S. and Canada. His testimony has addressed the effect of regulatory policies such as decoupling or must-run generation on a regulated company's cost of capital and the appropriate way to estimate the cost of capital for companies organized as Master Limited Partnerships. He analyzed issues associated with situations imposing asymmetric risk on utilities, the prudence of purchased power contracts, the economics of energy conservation programs, the appropriate incentives for investment in electric transmission assets and the effect of long-term purchased power agreements on the financial risk of a company. He has served as a neutral arbitrator in a contract dispute and analyzed the effectiveness of a company's electric power supply auction. He has also estimated economic damages and analyzed the business purpose and economic substance of tax related transactions, valued assets in arbitration for purchase at the end of the contract, estimated the stranded costs of resulting from the deregulation of electric generation and from the municipalization of an electric utility's distribution assets and addressed the appropriate regulatory accounting for depreciation and goodwill.

He received his Ph.D. in Financial Economics from the Wharton School of the University of Pennsylvania, an MBA from the University of Utah, an M.S. from the Fletcher School of Law and Diplomacy, Tufts University, and a B.S. degree from the United States Air Force Academy. He joined The Brattle Group in 1994 after a career as an Air Force officer, where he served as a fighter pilot, intelligence officer, and professor of finance at the Air Force Academy.

REPRESENTATIVE CONSULTING EXPERIENCE

- Dr. Vilbert served as the consulting expert in several cases for the U.S. Department of Justice and the Internal Revenue Service regarding the business purpose and economic substance of a series of tax related transactions. These projects required the analysis of a complex series of financial transactions including the review of voluminous documentary evidence and required expertise in financial theory, financial market as well as accounting and financial statement analysis.
- In a securities fraud case, Dr. Vilbert designed and created a model to value the private

placement stock of a drug store chain as if there had been full disclosure of the actual financial condition of the firm. He analyzed key financial data and security analysts'= reports regarding the future of the industry in order to recreate pro forma balance sheet and income statements under a variety of scenarios designed to establish the value of the firm.

- For pharmaceutical companies rebutting price-fixing claims in antitrust litigation, Dr. Vilbert was a member of a team that prepared a comprehensive analysis of industry profitability. The analysis replicated, tested and critiqued the major recent analyses of drug costs, risks and returns. The analyses helped develop expert witness testimony to rebut allegations of excess profits.

- For an independent electric power producer, Dr. Vilbert created a model that analyzed the reasonableness of rates and costs filed by a natural gas pipeline. The model not only duplicated the pipeline=s rates, but it also allowed simulation of a variety of Awhat if@ scenarios associated with cost recovery under alternative time patterns and joint cost allocations. Results of the analysis were adopted by the intervenor group for negotiation with the pipeline.

- For the CFO of an electric utility, Dr. Vilbert developed the valuation model used to support a stranded cost estimation filing. The case involved a conflict between two utilities over the responsibility for out-of-market costs associated with a power purchase contract between them. In addition, he advised and analyzed cost recovery mechanisms that would allow full recovery of the stranded costs while providing a rate reduction for the company=s rate payers.

- Dr. Vilbert has testified as well as assisted in the preparation of testimony and the development of estimation models in numerous cost-of-capital cases for natural gas pipeline, water utility and electric utility clients before the Federal Energy Regulatory Commission (AFERC@) and state regulatory commissions. These have spanned standard estimation techniques (e.g., Discounted Cash Flow and Risk Positioning models). He has also developed and applied more advanced models specific to the industries or lines of business in question, e.g., based on the structure and risk characteristics of cash flows, or based on multi-factor models that better characterize regulated industries.

- Dr. Vilbert has valued several large, residual oil-fired generating stations to evaluate the possible conversion to natural gas or other fuels. In these analyses, the expected pre- and post-conversion station values were computed using a range of market electricity and fuel cost conditions.

- For a major western electric utility, Dr. Vilbert helped prepare testimony that analyzed the prudence of QF contract enforcement. The testimony demonstrated that the utility had not been compensated in its allowed cost of capital for major disallowances stemming from QF contract management.

- Dr. Vilbert analyzed the economic need for a major natural gas pipeline expansion to the Midwest. This involved evaluating forecasts of natural gas use in various regions of the United States and the effect of additional supplies on the pattern of natural gas pipeline use. The analysis was used to justify the expansion before the FERC and the National Energy Board of Canada.

- For a Public Utility Commission in the Northeast, Dr. Vilbert analyzed the auction of an electric utility=s purchase power agreements to determine whether the outcome of the auction was in the ratepayers= interest. The work involved the analysis of the auction procedures as well as the benefits to ratepayers of transferring risk of the PPA payments to the buyer.

- Dr. Vilbert led a team tasked to determine whether bridge tolls were "just and reasonable" for a non-profit port authority. Determination of the cost of service for the authority required estimation of the value of the authority's assets using the trended original cost methodology as well as evaluation of the operations and maintenance budgets. Investment costs, bridge traffic information and inflation indices covering a 75 year period were utilized to estimate the value of four bridges and a passenger transit line valued in excess of $1 billion.

- Dr. Vilbert helped a recently privatized railroad in Brazil develop an estimate of its revenue requirements, including a determination of the railroad=s cost of capital. He also helped evaluate alternative rate structures designed to provide economic incentives to shippers as well as to the railroad for improved service. This involved the explanation and analysis of the contribution margin of numerous shipper products, improved cost analysis and evaluation of bottlenecks in the system.

- For a utility in the Southeast, Dr. Vilbert quantified the company=s stranded costs under several legislative electric restructuring scenarios. This involved the evaluation of all of the company=s fossil and nuclear generating units, its contracts with Qualifying Facilities and the prudence of those QF contracts. He provided analysis concerning the impact of securitizing the company=s stranded costs as a means of reducing the cost to the ratepayers and several alternative designs for recovering stranded costs.

- For a recently privatized electric utility in Australia, Dr. Vilbert evaluated the proposed regulatory scheme of the Australian Competition and Consumer Commission for the company=s electric transmission system. The evaluation highlighted the elements of the proposed regulation which would impose uncompensated asymmetric risks on the company and the need to either eliminate the asymmetry in risk or provide additional compensation so that the company could expect to earn its cost of capital.

- For an electric utility in the Southwest, Dr. Vilbert helped design and create a model to estimate the stranded costs of the company=s portfolio of Qualifying Facilities and Power Purchase contracts. This exercise was complicated by the many variations in the provisions of the contracts that required modeling in order to capture the effect of changes in either the performance of the plants or in the estimated market price of electricity.

- Dr. Vilbert helped prepare the testimony responding to a FERC request for further comments on the appropriate return on equity for electric transmission facilities. In addition, Dr. Vilbert was a member of the team that made a presentation to the FERC staff on the expected risks of the unbundled electric transmission line of business.

- Dr. Vilbert and Mr. Frank C. Graves, also of The Brattle Group, prepared testimony evaluating an innovative Canadian stranded cost recovery procedure involving the auctioning of the output of the province=s electric generation plants instead of the plants themselves. The evaluation required the analysis of the terms and conditions of the long-term contracts specifying the revenue requirements of the plants for their entire forecasted remaining economic life and required an estimate of the cost of capital for the plant owners under this new stranded cost recovery concept.

- Dr. Vilbert served as the neutral arbitrator for the valuation of a petroleum products tanker. The valuation required analysis of the Jones Act tanker market and the supply and demand balance of the available U.S. constructed tanker fleet.

- Dr. Vilbert evaluated the appropriate Abareboat@ charter rate for an oil drilling platform for the renewal period following the end of a long-term lease. The evaluation required analysis of the market for oil drilling platforms around the world including trends in construction and labor costs and the demand for platforms in varying geographical environments.

- Dr. Vilbert and Dr. Villadsen, also of The Brattle Group, evaluated the offer to purchase the assets of Pentex Alaska Natural Gas Company, LLC on behalf of the Western Finance Group for presentation to the Board of the Alaska Industrial Development and Export Authority. The report compared the proposed purchase price with selected trading and transaction multiples of comparable companies.

PRESENTATIONS

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"Natural Gas Pipeline FERC ROE," INGAA Rate of Return Seminar, with Mike Tolleth, March 23, 2016.

"The Cost of Capital for Alabama Power Company," Public Service Commission public meeting, July 17, 2013.

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"Point – Counterpoint: The Regulatory Compact and Pipeline Competition," with (Jonathan Lesser, Continental Economics), Energy Bar Association, Western Meeting, February 22, 2013

"Introduction to Retail Rates," presented to California Water Services Company, 18-19 November 2010.

"Impact of the Ongoing Economic Crisis on the Cost of Capital of the U.S. Utility Sector", National Association of Water Companies: New York Chapter, Albany, NY, May 21, 2009.

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"Survey of Cost of Capital Practices in Canada," (with Bente Villadsen and Toby Brown), prepared for British Columbia Utilities Commission, May 2012.

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Direct testimony before the Public Utilities Commission of the State of Hawai'i on behalf of Young Brothers, Limited, Docket No. 2017-0363, on the cost of capital for Young Brothers regulated intrastate barge operations, March 2018.

Direct testimony before the Michigan Public Service Commission on behalf of the DTE Gas Company, Case No. U-18999, on the cost of common equity capital for DTE Gas Company's regulated natural gas distribution assets, February 2018.

Supplemental testimony before the Public Utilities Commission of the State of Hawai'i on behalf of Hawaiian Electric Company, Inc., Docket No. 2016-0328, with regard to the effect on the cost of capital of decoupling ratemaking that relaxes the linkage between revenue and kWh sales, February 2018.

Direct testimony before the Public Utilities Commission of the State of Hawai'i on behalf of Maui Electric Company, Limited, Docket No. 2017-0150, with regard to the effect on the cost of capital of decoupling ratemaking that relaxes the linkage between revenue and kWh sales, October 2017.

Rebuttal testimony before the California Public Utilities Commission on behalf of California-American Water Company, Application 15-07-019, Phase 3A and Phase 3b, on the economic effect on the Company and the applicability of a fine based upon California-American Water Company's administration of its tariff for the Monterey Water District, August 2017.

Direct and rebuttal testimony before the Corporation Commission of Oklahoma on behalf of Public Service Company of Oklahoma, Cause No. PUD201700151, on the cost of capital for Public Service Company of Oklahoma's regulated assets, June 2017 and October 2017.

Direct and rebuttal testimony before the California Public Utilities Commission on behalf of California Water Services Company, Application No. A.1704-006, on the cost of capital for California Water Services Company's regulated assets, April 2017 and August 2017.

Direct and rebuttal testimony before the Michigan Public Service Commission on behalf of the DTE Electric Company, (Case No. U-18255) on the cost of common equity capital for DTE Electric's regulated electric assets, April 2017 and September 2017.

Prepared direct testimony before the Federal Energy Regulatory Commission, Docket No. RP17-598-000 on behalf of Great Lakes Gas Transmission Limited Partnership, regarding the appropriate ROE to allow for its regulated natural gas pipeline assets, March 2017.

Prepared direct testimony before the North Carolina Utilities Commission, Docket No. G-39, Sub 38, on behalf of the Cardinal Pipeline Company, LLC regarding the appropriate allowed ROE for the Company's pipeline assets, March 2017.

Prepared direct testimony before the Federal Energy Regulatory Commission, Docket No. ER17-706-000 on behalf of Gridliance West Transco LLC, regarding Gridliance West's application pursuant to section 205 of the Federal Power Act regarding the appropriate ROE, cost of debt, and capital structure to allow Gridliance West Transco LLC to earn on the transmission facilities acquired from Valley Electric Association, December 2016.

Prepared direct testimony and supporting exhibits before the Federal Energy Regulatory Commission, Docket No. EC17-049-000, on behalf of Gridliance West Transco LLC, regarding GridLiance West's application pursuant to section 203 of the Federal Power Act (FPA) to acquire certain high voltage transmission facilities from Valley Electric Transmission Association, LLC (VETA) through its parent non-profit electric cooperative parent Valley Electric Association, Inc. (Valley Electric), December 2016.

Prepared direct testimony and supporting exhibits before the Federal Energy Regulatory Commission, Docket No. ER16-2632-000, on behalf of Trans Bay Cable LLC, regarding the appropriate ROE and capital structure to allow for its regulated electric transmission assets, September 2016.

Prepared direct and rebuttal testimony before the Public Utilities Commission of Hawai'i on the effect on the cost of capital of decoupling ratemaking that relaxes the linkage between revenue and kWh sales on behalf of Hawai'i Electric Light Company, Inc. Docket No. 2015-0170, August 2016 and June 2017.

Direct testimony before the Michigan Public Service Commission on behalf of the Detroit Thermal, LLC (Case No. U-18131) on the cost of common equity capital for Detroit Thermal's regulated steam service, July 2016.

Pre-filed direct testimony and supporting exhibits before the Rhode Island Public Utilities Commission on behalf of The Narragansett Electric Company d/b/a National Grid Docket No. 47xx regarding Petition for the Approval of Gas Capacity Contracts and Cost Recovery, June 2016.

Prepared direct testimony and supporting exhibits before the Federal Energy Regulatory Commission, Docket No. RP16-440-000, on behalf of ANR Pipeline Company, regarding the appropriate ROE to allow for its regulated natural gas pipeline assets, January 2016.

Pre-filed direct testimony before the Massachusetts Department of Public Utilities on behalf of Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid regarding the risk transfer inherent in signing long-term contracts for natural gas pipeline capacity, Docket No. D.P.U. 16-05, January 2016.

Direct and rebuttal testimony before the Michigan Public Service Commission on behalf of the DTE Electric Company (Case No. U-18014) on the cost of capital for DTE Electric Company's regulated electric assets, January 2016 and July 2016.

Rebuttal testimony before the Public Utility Commission of Texas on behalf of Ovation Acquisition I, L.L.C., Ovation Acquisition II, L.L.C., and Shary Holdings, L.L.C. concerning the adequacy of Oncor Electric Distribution Company's (Oncor) liquidity, access to capital and financial risk with regard to the proposed restructuring of Oncor, PUC Docket No. 451888, December, 2015.

Direct and rebuttal testimony before the Michigan Public Service Commission on behalf of the DTE Gas Company (Case No. U-17799) on the cost of capital for DTE Gas Company's natural gas distribution assets, December 2015 and May 2016.

Prepared direct testimony before the Federal Energy Regulatory Commission, Docket No. ER15-2594-000, on behalf of South Central MCN, LLC, regarding the appropriate ROE to include in the transmission rate formula (Formula Rate) to establish an annual transmission revenue requirement (ATRR) for transmission service over facilities that SCMCN will own in the Southwest Power Pool, Inc. (SPP) region, September 2015.

"Report on Gas LDC multiples," with Bente Villadsen, *Alaska Industrial Development and Export Authority*, May 2015.

Direct and reply testimony before the Regulatory Commission of Alaska on behalf of Cook Inlet Natural Gas Storage Alaska, LLC, Docket No. U-15-016 on the appropriate allocation of the proceeds from the sale of excess Found Native Gas discovered incidental to the construction of the storage facility, April 2015 and July 2015.

Direct testimony before the Michigan Public Service Commission on behalf of the Detroit Edison Electric Company (Case No. U-17767) on the cost of capital for DTE's electric utility assets, December 2014.

Direct and rebuttal testimony before the Washington Utilities and Transportation Commission on behalf of Puget Sound Energy, Inc. Docket Nos. UE-130137 and UG-130138 (consolidated) remand proceeding with regard to the effect of decoupling on the cost of capital, November 2014 and December 2014.

Initial and Reply Statement of Position before the Public Utilities Commission of Hawai'i In the Matter of Instituting an Investigation to Reexamine the Existing Decoupling Mechanisms for Hawaiian Electric Company, Inc., Hawai'i Electric Light Company, Inc., and Maui Electric Company, Limited, Docket No. 2013-0141, with Dr. Toby Brown and Dr. Joseph B. Wharton, May 2014 and September 2014.

Direct and rebuttal testimony before the Pennsylvania Public Utility Commission on behalf of Metropolitan Edison Company (Docket No. R-2014-2428745), Pennsylvania Electric Company (Docket No. R-2014-2428743), Pennsylvania Power Company (Docket No. R-2014-2428744), and West Penn Power Company (Docket No. R-2014-2428742) regarding the appropriate cost of common equity for the companies, September 2014 and December 2014.

Direct and rebuttal testimony before the Public Service Commission of West Virginia in the Matter of the Application of Monongahela Power Company and The Potomac Edison Company, Case No. 14-0702-E-42T for approval of a general change in rates and tariffs, June 2014 and October 2014.

Direct testimony before the Public Utilities Commission of Ohio in the Matter of the Determination of the Existence of Significantly Excessive Earnings for 2012 Under the Electric Security Plans of Ohio on behalf of the Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, Case No. 14-0828-EL-UNC, May 2014.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER14-1332-000, on behalf of DATC Path 15, LLC, regarding the appropriate ROE to include in the Submission of Revisions to Appendix I in TO Tariff Reflecting Updated TRR to be Effective February, 2014.

Direct testimony, rebuttal testimony and sur-surrebuttal testimony before the Arkansas Public Service Commission regarding the appropriate ROE to allow In the Matter of the Application of SourceGas Arkansas Inc., Docket No. 13-079-U for Approval of a General Change in Rates, and Tariffs, September 2013, March 2014, and April 2014.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER13-2412-000, on behalf of Trans Bay Cable LLC, regarding the appropriate ROE to include in the Submission of Revisions to Appendix I of the Trans Bay Transmission Owner Tariff to be Effective 11/23/2013, September 2013.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER13-2412-000, on behalf of Trans Bay Cable LLC, regarding the appropriate ROE to include in the Submission of Revisions to Appendix I of the Trans Bay Transmission Owner Tariff to be Effective 11/23/2013, September 2013.
Presentation on behalf of Alabama Power Company with regard to the appropriate cost of capital for the Rate Stabilization and Equalization mechanism, Dockets 18117 and 18416, July 2013.

Direct testimony before the Public Utilities Commission of Ohio in the Matter of the Determination of the Existence of Significantly Excessive Earnings for 2012 Under the Electric Security Plans of Ohio on behalf of the Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, Case No. 13-1147-EL-UNC, May 2013.

Expert Report, with A. Lawrence Kolbe and Bente Villadsen, on cost of equity, non-recovery of operating cost and asset retirement obligations on behalf of the behalf of oil pipeline in arbitration, April 2013.

Direct and Rebuttal testimony before the Public Utilities Commission of the State of Colorado on behalf of Rocky Mountain Natural Gas LLC regarding the cost of capital for an intrastate natural gas pipeline, Docket No. 13AL-143G, with Advice Letter No. 77, January 2013 and October 2013.

Rebuttal Testimony before the Public Utilities Commission of the State of California on behalf of Southern California Edison regarding Application 12-04-015 of Southern California Edison Company (U 338-E) For Authority to Establish Its Authorized Cost of Capital for Utility Operations for 2013 and to Reset the Annual Cost of Capital Adjustment Mechanism , August 2012.

Direct testimony and supporting exhibits on behalf of Transcontinental Gas Pipeline Company, LLC, before the Federal Energy Regulatory Commission, on the Cost of Capital for Interstate Natural Gas Pipeline assets, Docket No. RP12-993-000, August 2012.

Direct Testimony before the North Carolina Utilities Commission on behalf of Cardinal Pipeline Company LLC, regarding the cost of capital for an intrastate natural gas pipeline, Docket G-39, Sub 28, August 2012.

Joint Rebuttal Testimony before the California Public Utility Commission on behalf of California American Water Company, regarding Application of California-American Water Company (U210W) for Authorization to increase its Revenues for Water Service, Application 10-07-007, and In the Matter of the Application of California-American Water Company (U210W) for an Order Authorizing and Imposing a Moratorium on New Water Service Connections in its Larkfield District, Application 11-09-016, August 2012.

Direct testimony before the Public Utilities Commission of Ohio, In the Matter of the Determination of the Existence of Significantly Excessive Earnings for 2011 Under the Electric Security Plan of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, Case No. 12-1544-EL-UNC, May 2012.

Deposition testimony in *Tahoe City Public Utility District, Plaintiff vs. Case No. SCV 27283 Tahoe Park Water Company, Lake Forest Water Company, Defendants*, May 2012.

Deposition testimony in *Primex Farms, LLC, Plaintiff, v. Roll International Corporation, Westside Mutual Water Company, LLC, Paramount Farming Company, LLC, Defendants*, April 2012.

Direct and rebuttal testimony before the Michigan Public Service Commission, Case No. U-16999, on behalf of Michigan Consolidated Gas Company, regarding cost of service for natural gas distribution assets, April 2012 and October 2012.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. PA10-13-000, on behalf of ITC Holdings Corp. regarding a rehearing for FERC Staff, Office of Enforcement, Division of Audits, Report on the appropriate accounting for goodwill for the acquisition of ITC Midwest assets from Interstate Power and Light Company, February 2012.

Rebuttal testimony before the Florida Public Service Commission, Docket No. 110138-EL, on behalf of Gulf Power, a Southern Company, on the method to adjust the return on equity for differences in financial risk, November 2011.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER12-296-000, on behalf of Public Service Electric and Gas Company on the Cost of Capital and for Incentive Rate Treatment for the Northeast Grid Reliability Transmission Project, October 2011.

Rebuttal Evidence before the National Energy Board in the matter of AltaGas Utilities Inc., 2010-2012 GRA Phase I, Application No. 1606694; Proceeding I.D. 904, October, 2011.

Report before the Arbitrator on behalf of Canadian National Railway Company in the matter of a Submission by Tolko Marketing and Sales LTD for Final Offer Arbitration of the Freight Rates and Conditions Associated with Respect to the Movement of Lumber by Canadian National Railway Company from High Level, Alberta to Various Destinations in the Vancouver, British Columbia Area, October, 2011.

Written direct and reply evidence before the National Energy Board in the matter of the National Energy Board Act, R.S.C. 1985, c. NB7, as amended, and the Regulations made thereunder; and in the matter of an application by TransCanada PipeLines Limited for orders pursuant to Part I and Part IV of the *National Energy Board Act*, for determining the overall fair return on capital in the business and services restructuring and Mainline 2012 – 2013 toll application, RH-003-2011, September 2011 and May 2012.

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Initial testimony before the Public Utilities Commission of Ohio, Case No. 11-4553-EL-UNC, In the Matter of the Determination of the Existence of Significantly Excessive Earnings for 2010 Under the Electric Security Plan of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, July 2011.

Rebuttal testimony before the Public Utilities Commission of the State of California, Docket No. A.10-09-018, on behalf of California American Water Company, on Application of California American Water Company (U210W) for Authorization to Implement the Carmel River Reroute and San Clemente Dam Removal Project and to Recover the Costs Associated with the Project in Rates, June 2011.

Direct and rebuttal testimony before the Public Utilities Commission of the State of California, Docket No. A.11-05-001, on behalf of California Water Service Company, on the Cost of Capital for Water Distribution Assets, April 2011 and September 2011.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER11-013-000, on behalf of the Atlantic Wind Connection Companies, on the Cost of Capital and Cost of Capital incentive adders for Electric Transmission Assets, December 2010.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. RP11-1566-000, on behalf Tennessee Gas Pipeline Company, on the Cost of Capital for Natural Gas Transmission Assets, November 2010.

Direct and rebuttal testimony before the Michigan Public Service Commission, In the matter of the application of The Detroit Edison Company, for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority, Case No. U-16472, October 2010 and April 2011.

Direct and rebuttal testimony before the Federal Energy Regulatory Commission, Docket No. RP10-1398-000, on behalf of El Paso Natural Gas Company, on the Cost of Capital for Natural Gas Transmission Assets, September 2010 and September 2011.

Direct testimony before the Public Utilities Commission of Ohio, Case No. 10-1265-EL-UNC, In the Matter of the Determination of the Existence of Significantly Excessive Earnings for 2009 Under the Electric Security Plan of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company, September 2010.

Direct testimony before the Michigan Public Service Commission, Case No. U-16400, on behalf of Michigan Consolidated Gas Company, regarding cost of service for natural gas distribution assets, July 15, 2010.

Direct testimony before the Oklahoma Corporation Commission, Cause No. PUD 201000050, on behalf of Public Service Company of Oklahoma, regarding cost of service for a regulated electric utility, June 2010.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER10-516-000, on behalf of South Caroline Gas and Electric Company, on the Cost of Capital for Electric Transmission Assets, December 2009.

Direct and Rebuttal Testimony before the California Public Utilities Commission regarding cost of service for San Joaquin Valley crude oil pipeline on behalf of Chevron Products Company, Docket Nos. A.08-09-024, C.08-03-021, C.09-02-007 and C.09-03-027, December 2009 and April 2010.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER10-159-000, on behalf of Public Service Electric and Gas Company, on the incentive Cost of Capital for the Branchburg-Roseland-Hudson 500 kV Line electric transmission project ("BRH Project"), October 2009.

Rebuttal testimony before the Florida Public Service Commission in re: Petition for Increase in Rates by Progress Energy Florida, Inc., Docket No. 090079-EI, August 2009.

Direct and rebuttal testimony before the State of New Jersey Board of Public Utilities in the Matter of the Petition of Public Service Electric and Gas Company for Approval of an Increase in Electric and Gas Rates and for Changes in the Tariffs for Electric and Gas Service, B.P.U.N.J.

No. 14 Electric and B.P.U.N.J No. 14 Gas Pursuant to N.J.S.A. 48:2-21 and N.J.S.A. 48:2-21.1 and for Approval of a Gas Weather Normalization Clause; a Pension Expense Tracker and for other Appropriate Relief BPU Docket No. GR09050422, June 2009 and December 2009.

Direct and rebuttal testimony before the Public Service Commission of Wisconsin, Docket No. 6680-UR-117, on behalf of Wisconsin Power and Light Company, on the cost of capital for electric and natural gas distribution assets, May 2009 and September 2009.

Written evidence before the Régie de l'Énergie on behalf of Gaz Métro Limited Partnership, Cause Tarifaire 2010, R-3690-2009, on the Cost of Capital for natural gas transmission assets, May 2009.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER09-681-000, on behalf of Green Power Express, LLP, on the Cost of Capital for Electric Transmission Assets, February 2009.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER09-548-000, on behalf of ITC Great Plains, LLC, on the Cost of Capital for Electric Transmission Assets, January 2009.

Written and Reply Evidence before the Alberta Utilities Commission in the matter of the Alberta Utilities Commission Act, S.A. 2007, c. A-37.2, as amended, and the regulations made thereunder; and IN THE MATTER OF the Gas Utilities Act, R.S.A. 2000, c. G-5, as amended, and the regulations made thereunder; and IN THE MATTER OF the Public Utilities Act, R.S.A. 2000, c. P-45, as amended, and the regulations made thereunder; and IN THE MATTER OF Alberta Utilities Commission 2009 Generic Cost of Capital Hearing, Application No. 1578571/Proceeding No. 85. 2009 Generic Cost of Capital Proceeding on behalf of AltaGas Utilities Inc., November 2008 and May 2009.

Written Evidence before the Alberta Utilities Commission in the matter of the Alberta Utilities Commission Act, S.A. 2007, c. A-37.2, as amended, and the regulations made thereunder; and IN THE MATTER OF the Gas Utilities Act, R.S.A. 2000, c. G-5, as amended, and the regulations made thereunder; and IN THE MATTER OF the Public Utilities Act, R.S.A. 2000, c. P-45, as amended, and the regulations made thereunder; and IN THE MATTER OF Alberta Utilities Commission 2009 Generic Cost of Capital Hearing, Application No. 1578571/Proceeding No. 85. 2009 Generic Cost of Capital Proceeding on behalf of NGTL, November 2008.

Direct and rebuttal testimony before the Public Service Commission of West Virginia, Case No. 08-1783-G-PC, on behalf of Dominion Hope Gas Company concerning the Cost of Capital for Gas Local Distribution Company assets, November 2008 and May 2009.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER09-249-000, on behalf of Public Service Electric and Gas Company, on the incentive Cost of Capital for Mid-Atlantic Power Pathway Electric Transmission Assets, November 2008.

Direct and rebuttal testimony before the Public Utilities Commission of Ohio, Case No. 08-935-EL-SSO, on behalf of Ohio Edison Company, The Toledo Edison Company, and The Cleveland Electric Illuminating Company, with regard to the test to determine Significantly Excessive Earnings within the context of Senate Bill No. 221, September 2008 and October 2008.

Direct and rebuttal testimony before the Public Service Commission of West Virginia, Case No. 08-0900-W-42t, on behalf of West Virginia-American Water Company concerning the Cost of Capital for Water Utility assets, July 2008 and November 2008.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER08-1233-000, on behalf of Public Service Electric and Gas Company, on the Cost of Capital for Electric Transmission Assets, July 2008.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER08-1207-000, on behalf of Virginia Electric and Power Company, on the incentive Cost of Capital for investment in New Electric Transmission Assets, June 2008.

Direct and rebuttal testimony before the Federal Energy Regulatory Commission, Docket No. RP08-426-000, on behalf of El Paso Natural Gas Company, on the Cost of Capital for Natural Gas Transmission Assets, June 2008 and August 2009.

Rebuttal testimony on the financial risk of Purchased Power Agreements, before the Public Utilities Commission of the State of Colorado, Docket No. 07A-447E, in the matter of the application of Public Service Company of Colorado for approval of its 2007 Colorado Resource Plan, June 2008.

Direct and rebuttal testimony before the California Public Utilities Commission, Docket No. A.08-05-003, on behalf of California-American Water Company, concerning Cost of Capital, May 2008 and August 2008.

Post-Technical Conference Affidavit on behalf of The Interstate Natural Gas Association of America in response to the Reply Comments of the State of Alaska with regard the FERC=s Proposed Policy Statement on to the Composition of Proxy Companies for Determining Gas and Oil Pipeline Return on Equity, Docket No. PL07-2-000, March, 2008.

Direct and rebuttal testimony on the Cost of Capital before the Tennessee Regulatory Authority, Case No. 08-00039, on behalf of Tennessee American Water Company, March and August 2008.

Comments in support of The Interstate Natural Gas Association of America=s Additional Initial Comments on the FERC=s Proposed Policy Statement with regard to the Composition of Proxy Companies for Determining Gas and Oil Pipeline Return on Equity, Docket No. PL07-2-000, December, 2007.

Written direct and reply evidence before the National Energy Board in the matter of the National Energy Board Act, R.S.C. 1985, c. NB7, as amended, and the Regulations made thereunder; and in the matter of an application by Trans Québec & Maritimes PipeLines Inc. ("TQM") for orders pursuant to Part I and Part IV of the *National Energy Board Act*, for determining the overall fair return on capital for tolls charged by TQM, December 2007 and September 2008, Decision RH-1-2008, dated March 2009.

Direct and rebuttal testimony before the California Public Utilities Commission, Docket No. A. 07-01-022, on behalf of California-American Water Company, on the Effect of a Water Revenue Adjustment Mechanism on the Cost of Capital, October 2007 and November 2007.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER08-92-000 to Docket No. ER08-92-003, on behalf of Virginia Electric and Power Company, on the Cost of Capital for Transmission Assets, October 2007.

Direct and Supplemental testimony before the Public Utilities Commission of Ohio, Case No. 07-829-GA-AIR, Case No. 07-830-GA-ALT, and Case No. 07-831-GA-AAM, on behalf of Dominion East Ohio Company, on the rate of return for Dominion East Ohio=s natural gas distribution operations, September 2007 and June 2008.

Direct and rebuttal testimony before the State Corporation Commission of Virginia, Case No. PUE-2007-00066, on behalf of Virginia Electric and Power Company on the cost of capital for its southwest Virginia coal plant, July 2007 and December 2007.

Direct testimony before the Public Service Commission of West Virginia, Case No. 07-0998-W-42T, on behalf of West Virginia American Water Company on cost of capital, July 2007.

Direct, supplemental and rebuttal testimony before the Public Utilities Commission of Ohio, Case No. 07-551-EL-AIR, Case No. 07-552-EL-ATA, Case No. 07-553-EL-AAM, and Case No. 07-554-EL-UNC, on behalf of Ohio Edison Company, The Toledo Edison Company, and The Cleveland Electric Illuminating Company, on the cost of capital for the FirstEnergy Company=s Ohio electric distribution utilities, June 2007, January 2008 and February 2008.

Direct testimony before the Public Utilities Commission of the State of South Dakota, Docket No. NG-07-013, on behalf of NorthWestern Corporation, on the Cost of Capital for NorthWestern Energy Company=s natural gas operations in South Dakota, June 2007.

Rebuttal testimony before the California Public Utilities Commission, Docket No. A. 07-01-036-39, on behalf of California-American Water Company, on the Cost of Capital, May 2007.

Direct and rebuttal testimony before the Public Service Commission of Wisconsin, Docket No. 5-UR-103, on behalf of Wisconsin Energy Corporation, on the Cost of Capital for Wisconsin Electric Power Company and Wisconsin Gas LLC, May 2007 and October 2007.

Direct and rebuttal testimony before the Tennessee Regulatory Authority, Case No. 06-00290, on behalf of Tennessee American Water Company, on the Cost of Capital, November, 2006 and April 2007.

Direct testimony before the Federal Energy Regulatory Commission, Docket No. ER07-46-000, on behalf of Northwestern Corporation on the Cost of Capital for Transmission Assets, October 2006.

Direct and supplemental testimony before the Federal Energy Regulatory Commission, Docket No. ER06-427-003, on behalf of Mystic Development, LLC on the Cost of Capital for Mystic 8 and 9 Generating Plants Operating Under Reliability Must Run Contract, August 2006 and September 2006.

Expert report in the United States Tax Court, Docket No. 21309-05, 34th Street Partners, DH Petersburg Investment, LLC and Mid-Atlantic Finance, Partners Other than the Tax Matters Partner, Petitioner, v. Commissioner of Internal Revenue, Respondent, July 28, 2006.

Direct and rebuttal testimony before the Pennsylvania Public Utility Commission, Return on Equity for Metropolitan Edison Company, Docket No. R-00061366 and Pennsylvania Electric Company, Docket No. R-00061367, April 2006 and August 2006.

Written evidence before the Ontario Energy Board, Cost of Capital for Union Gas Limited, Inc., Docket No. EB-2005-0520, January 2006.

Direct testimony before the Arizona Corporation Commission, Cost of Capital for Paradise Valley Water Company, a subsidiary of Arizona-American Water Company, Docket No. WS-01303A-05, May 2005.

Direct and rebuttal testimony before the Federal Energy Regulatory Commission on Energy Allocation of Debt Cost for Incremental Shipping Rates for Edison Mission Energy, Docket No. RP04-274-000, December 2004 and March 2005.

Direct and rebuttal testimony before the Public Service Commission of West Virginia, on Cost of Capital for West Virginia-American Water Company, Case No 04-0373-W-42T, May 2004.

Written evidence before the National Energy Board in the matter of the National Energy Board Act, R.S.C. 1985, c. NB7, as amended, (Act) and the Regulations made under it; and in the matter of an application by TransCanada PipeLines Limited for orders pursuant to Part IV of the *National Energy Board Act*, for approval of Mainline Tolls for 2004, RH-2-2004, January 2004.

Direct and rebuttal reports before the Alberta Energy and Utilities Board in the matter of the Alberta Energy and Utilities Board Act, R.S.A. 2000, c. A-17, and the Regulations under it; in the matter of the Gas Utilities Act, R.S.A. 2000, c. G-5, and the Regulations under it; in the matter of the Public Utilities Board Act, R.S.A. 2000, c. P-45, as amended, and the Regulations under it; and in the matter of Alberta Energy and Utilities Generic Cost of Capital Hearing, Application No. 1271597, July 2003, November 2003, Decision 2004-052, dated July 2004.

Direct report before the Arbitration Panel in the arbitration of stranded costs for the Town of Belleair, FL, Case No. 000-6487-C1-007, April 2003.

Direct testimony before the Federal Energy Regulatory Commission on behalf of Florida Power Corporation, dba Progress Energy Florida, Inc. in Docket No. SC03-1-000, March 2003.

Direct testimony and hearing before the Arbitration Panel in the arbitration of stranded costs for the City of Winter Park, FL, In the Circuit Court of the Ninth Judicial Circuit in and for Orange County, FL, Case No. C1-01-4558-39, December 2002.

Direct reports before the Arbitration Board for Petroleum products trade in the Arbitration of the Military Sealift Command vs. Household Commercial Financial Services, fair value of sale of the Darnell, October 2002.

Direct and rebuttal reports before the Arbitration Panel in the arbitration of stranded costs for the City of Casselberry, FL, Case No. 00-CA-1107-16-L, July 2002.

Direct testimony (with William Lindsay) before the Federal Energy Regulatory Commission on behalf of DTE East China, LLC in Docket No. ER02-1599-000, April 2002.

Written evidence before the Public Utility Board on behalf of Newfoundland & Labrador Hydro - Rate Hearings, October 2001, Order No. P.U.7 (2002-2003), dated June 2002.

Written evidence, rebuttal, reply and further reply before the National Energy Board in the matter of an application by TransCanada PipeLines Limited for orders pursuant to Part I and Part IV of the *National Energy Board Act*, Order AO-1-RH-4-2001, May 2001, Nov. 2001, Feb. 2002.

Direct testimony before the Federal Energy Regulatory Commission on behalf of Mississippi River Transmission Corporation in Docket No. RP01-292-000, March 2001.

Direct testimony before the Alberta Energy and Utilities Board on behalf of TransAlta Utilities Corporation for approval of its 2001 transmission tariff, May 2000.

Direct testimony before the Federal Energy Regulatory Commission on behalf of Central Maine Power in Docket No. ER00-982-000, December 1999.

Direct and rebuttal testimony before the Alberta Energy and Utilities Board on behalf of TransAlta Utilities Corporation in the matter of an application for approval of its 1999 and 2000 generation tariff, transmission tariff, and distribution revenue requirement, Docket U99099, October 1998.

Schedule No. D5

10.75% Cost of Common Shareholders' Equity

Schedule No. D5.1

Table of Contents

Schedule No. D5.2

Classification of Companies by Assets

Company	Company Category
Atmos Energy	R
Chesapeake Utilities	M
ONE Gas Inc.	R
South Jersey Inds.	M
Southwest Gas	R
Spire Inc.	R
New Jersey Resources	M
Northwest Natural Gas	R
WGL Holdings Inc.	R

Sources and Notes:
Percent regulated determined based on respective company 2016 10-K information.
R = Regulated (greater than 80 percent of total assets are regulated).
M = Mostly Regulated (50 to 80 percent of total assets are regulated).
D = Diversified (less than 50 percent of total assets are regulated).

TOT_COMMON_EQY	$3,899	$3,899	$3,699	$3,272	$3,064	$2,661
BS_SH_OUT	106	106	105	102	101	91
15_day_Average	$82	$88	$74	$63	$55	$45
	$8,649	$9,303	$7,778	$6,398	$5,523	$4,061
	n/a	n/a	n/a	n/a	n/a	n/a
	$8,649	$9,303	$7,778	$6,398	$5,523	$4,061
	2.22	2.39	2.10	1.96	1.80	1.53
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$540	$540	$979	$863	$1,119	$1,300
BS_CUR_LIAB	$1,013	$1,013	$1,950	$1,515	$1,421	$2,014
BS_ST_PORTION_OF_LT_DEBT	$0	$0	$250	$0	$0	$500
	($474)	($474)	($720)	($652)	($302)	($214)
BS_ST_DEBT	$448	$448	$941	$763	$551	$690
	$448	$448	$720	$652	$302	$214
BS_LT_BORROW	$3,067	$3,067	$2,314	$2,455	$2,455	$1,956
	$3,515	$3,515	$3,285	$3,107	$2,757	$2,670
	$2,845	$2,845	$2,669	$2,770	$2,676	$2,426
	$2,460	$2,460	$2,460	$2,460	$2,460	$1,960
	$385	$385	$209	$310	$216	$466
	$3,900	$3,900	$3,494	$3,417	$2,973	$3,136
	$3,900	$3,900	$3,494	$3,417	$2,973	$3,136
	$12,549	$13,203	$11,272	$9,815	$8,496	$7,197
IOS						
	68.92%	70.46%	69.00%	65.19%	65.00%	56.43%
	-	-	-	-	-	-
	31.08%	29.54%	31.00%	34.81%	35.00%	43.57%

espective balance sheet information and 15-day average prices ending at period end.
r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

TOT_COMMON_EQY	$464	$464	$446	$358	$300	$279
BS_SH_OUT	16	16	16	15	15	14
15_day_Average	$73	$79	$68	$56	$49	$39
	$1,192	$1,293	$1,104	$851	$710	$570
	n/a	n/a	n/a	n/a	n/a	n/a
	$1,192	$1,293	$1,104	$851	$710	$570
	2.57	2.79	2.48	2.38	2.36	2.04
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$149	$149	$141	$112	$122	$126
BS_CUR_LIAB	$339	$339	$334	$280	$194	$222
BS_ST_PORTION_OF_LT_DEBT	$12	$12	$12	$9	$9	$11
	($178)	($178)	($181)	($159)	($63)	($84)
BS_ST_DEBT	$203	$203	$210	$173	$88	$106
	$178	$178	$181	$159	$63	$84
BS_LT_BORROW	$201	$201	$137	$149	$158	$118
	$392	$392	$330	$317	$230	$213
	$162	$162	$165	$181	$137	$133
	$146	$146	$154	$162	$122	$110
	$16	$16	$11	$19	$15	$23
	$407	$407	$341	$336	$245	$236
	$407	$407	$341	$336	$245	$236
	$1,599	$1,700	$1,446	$1,188	$955	$806
IOS						
	74.53%	76.06%	76.39%	71.70%	74.34%	70.69%
	-	-	-	-	-	-
	25.47%	23.94%	23.61%	28.30%	25.66%	29.31%

espective balance sheet information and 15-day average prices ending at period end.
er, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

TOT_COMMON_EQY	$1,932	$1,932	$1,888	$1,842	$1,794	n/a
BS_SH_OUT	52	52	52	52	52	n/a
15_day_Average	$70	$75	$64	$49	$42	n/a
	$3,644	$3,901	$3,324	$2,577	$2,188	n/a
	n/a	n/a	n/a	n/a	n/a	n/a
	$3,644	$3,901	$3,324	$2,577	$2,188	n/a
	1.89	2.02	1.76	1.40	1.22	n/a
BS_PFD_EQY	$0	$0	$0	$0	$0	n/a
	$0	$0	$0	$0	$0	n/a
BS_CUR_ASSET_REPORT	$446	$446	$569	$483	$668	n/a
BS_CUR_LIAB	$392	$392	$444	$304	$392	n/a
BS_ST_PORTION_OF_LT_DEBT	$0	$0	$0	$0	$0	n/a
	$53	$53	$125	$179	$275	n/a
BS_ST_DEBT	$174	$174	$145	$13	$42	n/a
	$0	$0	$0	$0	$0	n/a
BS_LT_BORROW	$1,193	$1,193	$1,192	$1,192	$1,201	n/a
	$1,193	$1,193	$1,192	$1,192	$1,201	n/a
	$1,200	$1,200	$1,200	$1,300	$1,200	n/a
	$1,200	$1,200	$1,200	$1,200	$1,000	n/a
	$0	$0	$0	$100	$200	n/a
	$1,193	$1,193	$1,192	$1,292	$1,401	n/a
	$1,193	$1,193	$1,192	$1,292	$1,401	n/a
	$4,837	$5,094	$4,517	$3,868	$3,590	n/a
IOS						
	75.34%	76.58%	73.60%	66.61%	60.96%	n/a
	-	-	-	-	-	n/a
	24.66%	23.42%	26.40%	33.39%	39.04%	n/a

espective balance sheet information and 15-day average prices ending at period end.
r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

TOT_COMMON_EQY	$1,221	$1,221	$1,289	$1,038	$932	$827
BS_SH_OUT	80	80	79	71	68	65
15_day_Average	$30	$32	$34	$23	$29	$28
	$2,350	$2,516	$2,719	$1,648	$1,999	$1,805
	n/a	n/a	n/a	n/a	n/a	n/a
	$2,350	$2,516	$2,719	$1,648	$1,999	$1,805
	1.92	2.06	2.11	1.59	2.14	2.18
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$323	$323	$473	$431	$567	$483
BS_CUR_LIAB	$684	$684	$953	$832	$850	$765
BS_ST_PORTION_OF_LT_DEBT	$11	$11	$232	$29	$150	$21
	($350)	($350)	($247)	($372)	($134)	($261)
BS_ST_DEBT	$280	$280	$296	$432	$246	$354
	$280	$280	$247	$372	$134	$261
BS_LT_BORROW	$1,180	$1,180	$808	$997	$879	$701
	$1,471	$1,471	$1,287	$1,399	$1,163	$983
	$1,081	$1,081	$1,079	$1,059	$713	$682
	$1,047	$1,047	$1,036	$1,009	$701	$626
	$33	$33	$43	$49	$12	$56
	$1,505	$1,505	$1,331	$1,448	$1,174	$1,039
	$1,505	$1,505	$1,331	$1,448	$1,174	$1,039
	$3,855	$4,021	$4,049	$3,096	$3,173	$2,844
IOS						
	60.97%	62.58%	67.14%	53.23%	62.99%	63.47%
	-	-	-	-	-	-
	39.03%	37.42%	32.86%	46.77%	37.01%	36.53%

'espective balance sheet information and 15-day average prices ending at period end.
:r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
ıedule No. D5.6.

TOT_COMMON_EQY	$1,716	$1,716	$1,663	$1,594	$1,489	$1,415
BS_SH_OUT	48	48	47	47	47	46
15_day_Average	$75	$81	$76	$53	$60	$54
	$3,581	$3,860	$3,606	$2,528	$2,771	$2,506
	n/a	n/a	n/a	n/a	n/a	n/a
	$3,581	$3,860	$3,606	$2,528	$2,771	$2,506
	2.09	2.25	2.17	1.59	1.86	1.77
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$539	$539	$533	$558	$607	$495
BS_CUR_LIAB	$656	$656	$628	$535	$470	$434
BS_ST_PORTION_OF_LT_DEBT	$28	$28	$50	$19	$19	$11
	($89)	($89)	($45)	$43	$156	$72
BS_ST_DEBT	$111	$111	$0	$18	$5	$0
	$89	$89	$0	$0	$0	$0
BS_LT_BORROW	$1,732	$1,732	$1,550	$1,551	$1,631	$1,381
	$1,849	$1,849	$1,600	$1,571	$1,651	$1,392
	$1,680	$1,680	$1,646	$1,796	$1,463	$1,482
	$1,550	$1,550	$1,551	$1,657	$1,392	$1,319
	$130	$130	$94	$139	$71	$164
	$1,979	$1,979	$1,695	$1,710	$1,722	$1,556
	$1,979	$1,979	$1,695	$1,710	$1,722	$1,556
	$5,560	$5,839	$5,300	$4,238	$4,492	$4,062
IOS						
	64.40%	66.10%	68.03%	59.65%	61.68%	61.70%
	-	-	-	-	-	-
	35.60%	33.90%	31.97%	40.35%	38.32%	38.30%

espective balance sheet information and 15-day average prices ending at period end.
er, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

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TOT_COMMON_EQY	$2,079	$2,079	$1,797	$1,600	$1,534	$1,066
BS_SH_OUT	48	48	46	43	43	33
15_day_Average	$69	$76	$64	$58	$52	$45
	$3,322	*$3,677*	*$2,935*	*$2,533*	*$2,261*	*$1,482*
	n/a	n/a	n/a	n/a	n/a	n/a
	$3,322	$3,677	$2,935	$2,533	$2,261	$1,482
	1.60	1.77	1.63	1.58	1.47	1.39
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$853	$853	$816	$636	$816	$571
BS_CUR_LIAB	$1,211	$1,211	$1,342	$848	$1,082	$478
BS_ST_PORTION_OF_LT_DEBT	$106	$106	$250	$0	$115	$80
	($253)	($253)	($277)	($212)	($152)	$173
BS_ST_DEBT	$584	$584	$506	$377	$398	$94
	$253	$253	$277	$212	$152	$0
BS_LT_BORROW	$2,030	$2,030	$1,821	$1,852	$1,736	$833
	$2,389	$2,389	$2,348	$2,063	$2,003	$913
	$2,257	$2,257	$1,944	$1,937	$954	$453
	$2,084	$2,084	$1,852	$1,851	$913	$364
	$173	$173	$93	$86	$41	$88
	$2,562	$2,562	$2,441	$2,149	$2,044	$1,001
	$2,562	$2,562	$2,441	$2,149	$2,044	$1,001
	$5,884	$6,239	$5,376	$4,682	$4,305	$2,483
IOS						
	56.45%	58.93%	54.60%	54.09%	52.53%	59.68%
	-	-	-	-	-	-
	43.55%	41.07%	45.40%	45.91%	47.47%	40.32%

'espective balance sheet information and 15-day average prices ending at period end.
:r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
ıedule No. D5.6.

TOT_COMMON_EQY	$1,237	$1,237	$1,185	$1,144	$1,104	$882
BS_SH_OUT	87	87	86	86	85	84
15_day_Average	$39	$40	$36	$31	$30	$22
	$3,401	$3,499	$3,119	$2,663	$2,554	$1,892
	n/a	n/a	n/a	n/a	n/a	n/a
	$3,401	$3,499	$3,119	$2,663	$2,554	$1,892
	2.75	2.83	2.63	2.33	2.31	2.15
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$579	$579	$815	$589	$900	$898
BS_CUR_LIAB	$803	$803	$823	$575	$816	$1,053
BS_ST_PORTION_OF_LT_DEBT	$165	$165	$97	$11	$35	$70
	($58)	($58)	$89	$25	$120	($85)
BS_ST_DEBT	$266	$266	$285	$211	$254	$504
	$58	$58	$0	$0	$0	$85
BS_LT_BORROW	$997	$997	$1,027	$848	$703	$518
	$1,221	$1,221	$1,124	$859	$738	$672
	$732	$732	$584	$587	$557	$530
	$708	$708	$583	$558	$530	$480
	$24	$24	$1	$29	$27	$50
	$1,244	$1,244	$1,125	$888	$765	$722
	$1,244	$1,244	$1,125	$888	$765	$722
	$4,645	$4,743	$4,244	$3,551	$3,319	$2,615
IOS						
	73.21%	73.77%	73.49%	74.99%	76.95%	72.37%
	-	-	-	-	-	-
	26.79%	26.23%	26.51%	25.01%	23.05%	27.63%

espective balance sheet information and 15-day average prices ending at period end.
r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

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TOT_COMMON_EQY	$847	$847	$850	$781	$767	$752
BS_SH_OUT	29	29	29	27	27	27
15_day_Average	$57	$62	$60	$50	$49	$43
	$1,639	$1,776	$1,726	$1,369	$1,340	$1,155
	n/a	n/a	n/a	n/a	n/a	n/a
	$1,639	$1,776	$1,726	$1,369	$1,340	$1,155
	1.94	2.10	2.03	1.75	1.75	1.54
BS_PFD_EQY	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$0
BS_CUR_ASSET_REPORT	$200	$200	$288	$331	$363	$330
BS_CUR_LIAB	$203	$203	$275	$478	$469	$433
BS_ST_PORTION_OF_LT_DEBT	$22	$22	$40	$25	$40	$60
	$19	$19	$54	($122)	($67)	($42)
BS_ST_DEBT	$0	$0	$53	$270	$235	$188
	$0	$0	$0	$122	$67	$42
BS_LT_BORROW	$757	$757	$679	$569	$622	$682
	$779	$779	$719	$716	$729	$784
	$793	$793	$667	$757	$806	$835
	$719	$719	$602	$662	$742	$692
	$74	$74	$65	$95	$65	$143
	$853	$853	$785	$811	$793	$927
	$853	$853	$785	$811	$793	$927
	$2,492	$2,630	$2,511	$2,181	$2,133	$2,082
IOS						
	65.76%	67.54%	68.74%	62.79%	62.81%	55.48%
	-	-	-	-	-	-
	34.24%	32.46%	31.26%	37.21%	37.19%	44.52%

espective balance sheet information and 15-day average prices ending at period end.
er, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

TOT_COMMON_EQY	$1,503	$1,503	$1,439	$1,289	$1,243	$1,273
BS_SH_OUT	51	51	51	50	50	52
15_day_Average	$85	$86	$78	$63	$54	$39
	$4,340	$4,392	$3,985	$3,126	$2,660	$2,025
	n/a	n/a	n/a	n/a	n/a	n/a
	$4,340	$4,392	$3,985	$3,126	$2,660	$2,025
	2.89	2.92	2.77	2.43	2.14	1.59
BS_PFD_EQY	$28	$28	$28	$28	$28	$28
	$28	$28	$28	$28	$28	$28
BS_CUR_ASSET_REPORT	$986	$986	$1,095	$918	$1,028	$1,040
BS_CUR_LIAB	$1,489	$1,489	$1,422	$1,181	$1,033	$1,090
BS_ST_PORTION_OF_LT_DEBT	$250	$250	$0	$25	$20	$30
	($253)	($253)	($327)	($238)	$15	($20)
BS_ST_DEBT	$560	$560	$634	$528	$350	$443
	$253	$253	$327	$238	$0	$20
BS_LT_BORROW	$1,431	$1,431	$1,435	$946	$976	$599
	$1,934	$1,934	$1,762	$1,209	$996	$649
	$1,642	$1,642	$1,058	$809	$630	$759
	$1,444	$1,444	$944	$679	$524	$589
	$198	$198	$114	$130	$106	$170
	$2,132	$2,132	$1,876	$1,339	$1,102	$819
	$2,132	$2,132	$1,876	$1,339	$1,102	$819
	$6,500	$6,552	$5,889	$4,493	$3,790	$2,872
IOS						
	66.77%	67.04%	67.67%	69.58%	70.18%	70.50%
	0.43%	0.43%	0.48%	0.63%	0.74%	0.98%
	32.80%	32.53%	31.85%	29.79%	29.07%	28.51%

espective balance sheet information and 15-day average prices ending at period end.
r, 2017 balance sheet information and a 15-trading day average closing price ending on 1/31/2018.
edule No. D5.6.

Schedule No. D5.4

Capital Structure Summary of the Expanded Sample

Company	DCF Capital Structure			5-Year Average Capital Structure		
	Common Equity - Value Ratio [1]	Preferred Equity - Value Ratio [2]	Debt - Value Ratio [3]	Common Equity - Value Ratio [4]	Preferred Equity - Value Ratio [5]	Debt - Value Ratio [6]
Atmos Energy	68.9%	0.0%	31.1%	63.5%	0.0%	36.5%
Chesapeake Utilities	74.5%	0.0%	25.5%	73.2%	0.0%	26.8%
ONE Gas Inc.	75.3%	0.0%	24.7%	47.9%	0.0%	22.1%
South Jersey Inds.	61.0%	0.0%	39.0%	61.9%	0.0%	38.1%
Southwest Gas	64.4%	0.0%	35.6%	62.7%	0.0%	37.3%
Spire Inc.	56.5%	0.0%	43.5%	56.6%	0.0%	43.4%
New Jersey Resources	73.2%	0.0%	26.8%	74.3%	0.0%	25.7%
Northwest Natural Gas	65.8%	0.0%	34.2%	62.4%	0.0%	37.6%
WGL Holdings Inc.	66.8%	0.4%	32.8%	69.6%	0.7%	29.7%
Average	67.4%	0.0%	32.6%	63.6%	0.1%	33.0%
Subsample Average	67.6%	0.0%	32.4%	61.1%	0.0%	33.9%

Sources and Notes:

[1], [4]: Supporting Schedule #1 to Schedule No. D5.4.

[2], [5]: Supporting Schedule #2 to Schedule No. D5.4.

[3], [6]: Supporting Schedule #3 to Schedule No. D5.4.

Values in this table may not add up exactly to 100% because of rounding.

Schedule No. D5.5

Estimated Growth Rates of the Expanded Sample

Company	ThomsonOne IBES Estimate		Value Line			
	Long-Term Growth Rate	Number of Estimates	EPS Year 2017 Estimate	EPS Year 2020-2022 Estimate	Annualized Growth Rate	Combined Growth Rate
	[1]	[2]	[3]	[4]	[5]	[6]
Atmos Energy	6.5%	1	$3.80	$4.50	4.3%	5.4%
Chesapeake Utilities	n/a	n/a	$2.65	$4.20	12.2%	12.2%
ONE Gas Inc.	6.0%	1	$2.95	$4.00	7.9%	7.0%
South Jersey Inds.	n/a	n/a	$1.15	$2.00	14.8%	14.8%
Southwest Gas	n/a	n/a	$3.55	$4.80	7.8%	7.8%
Spire Inc.	4.5%	2	$3.80	$4.65	5.2%	4.7%
New Jersey Resources	n/a	n/a	$1.90	$2.05	1.9%	1.9%
Northwest Natural Gas	n/a	n/a	$2.25	$3.15	8.8%	8.8%
WGL Holdings Inc.	n/a	n/a	$3.50	$3.45	-0.4%	-0.4%

Sources and Notes:

[1] - [2]: Updated from ThomsonOne as of Jan 31, 2018.

[3] - [4]: From Valueline Investment Analyzer as of Jan 8, 2018.

[5]: ([4]/[3])^(1/4) - 1, where 4 is the number of years between 2021, the middle year of Value Line's 3-5 year forecast, and our study year 2017.

[6]: Weighted average growth rate.

Schedule No. D5.6

DCF Cost of Equity of the Expanded Sample

Panel A: Simple DCF Method (Quarterly)

Company	Stock Price [1]	Most Recent Dividend [2]	Quarterly Dividend Yield (t+1) [3]	Combined Long-Term Growth Rate [4]	Quarterly Growth Rate [5]	DCF Cost of Equity [6]
Atmos Energy	$81.51	$0.49	0.60%	5.4%	1.3%	7.9%
Chesapeake Utilities	$72.90	$0.33	0.46%	12.2%	2.9%	14.2%
ONE Gas Inc.	$69.72	$0.42	0.61%	7.0%	1.7%	9.6%
South Jersey Inds.	$29.55	$0.28	0.98%	14.8%	3.5%	19.3%
Southwest Gas	$75.01	$0.50	0.67%	7.8%	1.9%	10.7%
Spire Inc.	$68.72	$0.56	0.83%	4.7%	1.2%	8.2%
New Jersey Resources	$39.29	$0.27	0.70%	1.9%	0.5%	4.8%
Northwest Natural Gas	$57.07	$0.47	0.85%	8.8%	2.1%	12.4%
WGL Holdings Inc.	$84.73	$0.51	0.60%	-0.4%	-0.1%	2.1%

Sources and Notes:
[1]: Supporting Schedule #1 to Schedule No. D5.6.
[2]: Supporting Schedule #2 to Schedule No. D5.6.
[3]: ([2] / [1]) x (1 + [5]).
[4]: Schedule No. D5.5, [6].
[5]: {(1 + [4]) ^ (1/4)} - 1.
[6]: {([3] + [5] + 1) ^ 4} - 1.

B: Multi-Stage DCF (Using Blue Chip Economic Indicators, October 2017 U.S. GDP Growth Forecast as the Perpetual Rat

	Stock Price [1]	Most Recent Dividend [2]	Combined Long-Term Growth Rate [3]	Growth Rate: Year 6 [4]	Growth Rate: Year 7 [5]	Growth Rate: Year 8 [6]	Growth Rate: Year 9 [7]	Growth Rate: Year 10 [8]	GDP Long-Term Growth Rate [9]
	$81.51	$0.49	5.41%	5.21%	5.01%	4.80%	4.60%	4.40%	4.20%
	$72.90	$0.33	12.20%	10.87%	9.53%	8.20%	6.87%	5.53%	4.20%
	$69.72	$0.42	6.95%	6.50%	6.04%	5.58%	5.12%	4.66%	4.20%
	$29.55	$0.28	14.84%	13.06%	11.29%	9.52%	7.75%	5.97%	4.20%
	$75.01	$0.50	7.83%	7.23%	6.62%	6.02%	5.41%	4.81%	4.20%
	$68.72	$0.56	4.71%	4.63%	4.54%	4.46%	4.37%	4.29%	4.20%
	$39.29	$0.27	1.92%	2.30%	2.68%	3.06%	3.44%	3.82%	4.20%
;	$57.07	$0.47	8.78%	8.01%	7.25%	6.49%	5.73%	4.96%	4.20%
	$84.73	$0.51	-0.36%	0.40%	1.16%	1.92%	2.68%	3.44%	4.20%

ıle #1 to Schedule No. D5.6.
ıle #2 to Schedule No. D5.6.
5, [6].
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ıic Indicators, October 2017 U.S. This number is assumed to be the perpetual growth rate.
dule #3 to Schedule No. D5.6.

4th Quarter, 2017 Bond Rating [1]	4th Quarter, 2017 Preferred Equity Rating [2]	DCF Cost of Equity [3]	DCF Common Equity to Market Value Ratio [4]	Cost of Preferred Equity [5]	DCF Preferred Equity to Market Value Ratio [6]	DCF Cost of Debt [7]	DCF Debt to Market Value Ratio [8]	VVC Representat Income Tax Rat [9]
A	-	7.9%	68.9%	-	0.0%	3.9%	31.1%	21.0%
na	-	14.2%	74.5%	-	0.0%	NA	25.5%	21.0%
A	-	9.6%	75.3%	-	0.0%	3.9%	24.7%	21.0%
BBB	-	19.3%	61.0%	-	0.0%	4.2%	39.0%	21.0%
BBB	-	10.7%	64.4%	-	0.0%	4.2%	35.6%	21.0%
A	-	8.2%	56.5%	-	0.0%	3.9%	43.5%	21.0%
na	-	4.8%	73.2%	-	0.0%	NA	26.8%	21.0%
A	-	12.4%	65.8%	-	0.0%	3.9%	34.2%	21.0%
A	A	2.1%	66.8%	3.9%	0.4%	3.9%	32.8%	21.0%
		11.3%	65.3%	NA	0.0%	4.0%	34.7%	21.0%
		9.8%	66.2%	NA	0.0%	3.9%	33.8%	21.0%

ı Research Insight.
sumed equal to debt ratings.
ˈl A, [6].
:o Schedule No. D5.11, Panel C.

[7]: Supporting Schedule #2 to Schedule No. D5.11, Panel B.
[8]: Schedule No. D5.4, [3].
[9]: VVC Effective Corporate Tax Rate.
[10]: ([3] x [4]) + ([5] x [6]) + {[7] x [8] x (1 - [9])}. A strikethrough indicates the utility was excluded from the full s average calculation as a result of its cost of equity not exceeding its cost of debt by 100 basis points.

4th Quarter, 2017 Bond Rating [1]	4th Quarter, 2017 Preferred Equity Rating	DCF Cost of Equity [3]	DCF Common Equity to Market Value Ratio [4]	Cost of Preferred Equity [5]	DCF Preferred Equity to Market Value Ratio [6]	DCF Cost of Debt [7]	DCF Debt to Market Value Ratio [8]	VVC Representat Income Tax Rat [9]
A	-	6.9%	68.9%	-	0.0%	3.9%	31.1%	21.0%
na	-	7.3%	74.5%	-	0.0%	NA	25.5%	21.0%
A	-	7.2%	75.3%	-	0.0%	3.9%	24.7%	21.0%
BBB	-	11.6%	61.0%	-	0.0%	4.2%	39.0%	21.0%
BBB	-	7.7%	64.4%	-	0.0%	4.2%	35.6%	21.0%
A	-	7.8%	56.5%	-	0.0%	3.9%	43.5%	21.0%
na	-	6.7%	73.2%	-	0.0%	NA	26.8%	21.0%
A	-	8.8%	65.8%	-	0.0%	3.9%	34.2%	21.0%
A	A	6.1%	66.8%	3.9%	0.4%	3.9%	32.8%	21.0%
		8.0%	65.5%	3.9%	0.1%	4.0%	34.4%	21.0%
		7.7%	66.2%	NA	0.00%	3.9%	33.8%	21.0%

ı Research Insight.
sumed equal to debt ratings.
·l B, [10].

:o Schedule No. D5.11, Panel C.

[7]: Supporting Schedule #2 to Schedule No. D5.11, Panel B.
[8]: Schedule No. D5.4, [3].
[9]: VVC Effective Corporate Tax Rate.
[10]: ([3] x [4]) + ([5] x [6]) + {[7] x [8] x (1 - [9])}. A strikethrough indicates the utility was excluded from the full s average calculation as a result of its cost of equity not exceeding its cost of debt by 100 basis points.

Schedule No. D5.8

DCF Cost of Equity at Vectren's Capital Structure

	Overall After -Tax Cost of Capital [1]	VVC Representative Base Deemed % Debt [2]	Representative Cost of A Rated Utility Debt [3]	VVC Representative Income Tax Rate [4]	VVC Representative Base Deemed % Equity [5]	Estimated Return on Equity [6]
ample						
le DCF Quarterly	8.4%	49.4%	3.9%	21.0%	50.6%	13.7%
-*Stage DCF - Using Long-Term GDP Growth Forecast as* erpetual Rate	6.3%	49.4%	3.9%	21.0%	50.6%	9.4%
ample						
e DCF Quarterly	7.5%	49.4%	3.9%	21.0%	50.6%	11.9%
-Stage DCF - Using Long-Term GDP Growth Forecast as erpetual Rate	6.1%	49.4%	3.9%	21.0%	50.6%	9.1%

es and Notes:

chedule No. D5.7; Panels A-B, [10].

'VC Assumed Capital Structure.

ased on an A rating. Yield from Bloomberg as of January 31, 2018.

'VC Effective Corporate Tax Rate.

'VC Assumed Capital Structure.

[1] - ([2] x [3] x (1 - [4]))} / [5].

Schedule No. D5.9

Risk-Free Rates

[1]	Consensus 10-Year Forecast	3.40%
	U.S. Government Bond Yields	
[2]	20-Year	4.81%
[3]	10-Year	4.27%
[4]	Maturity Premium	0.54%
[5]	Consensus 10-Year Forecast Adjusted to 20-year Horizon	3.94%

Sources and Notes:

[1]: Bluechip Consensus Forecast in October 2017.

[2]-[3]: Supporting Schedule # 1 to Schedule No. D5.9. Averages of monthly bond yields from September 1992 through September 2017.

[4]: [2] - [3].

[5]: [1] + [4].

Schedule No. D5.10

Risk Positioning Cost of Equity of the Expanded Sample

l A: Scenario 1 - Long-Term Risk Free Rate of 4.14%, Long-Term Market Risk Premium of 6.

Company	Long-Term Risk-Free Rate [1]	Value Line *Betas* [2]	Long-Term Market *Risk Premium* [3]	CAPM Cost of *Equity* [4]	ECAPM (1.5%) Cost of Equity [5]
Atmos Energy	4.14%	0.70	6.94%	9.0%	9.4%
Chesapeake Utilities	4.14%	0.70	6.94%	9.0%	9.4%
ONE Gas Inc.	4.14%	0.70	6.94%	9.0%	9.4%
South Jersey Inds.	4.14%	0.85	6.94%	10.0%	10.3%
Southwest Gas	4.14%	0.80	6.94%	9.7%	10.0%
Spire Inc.	4.14%	0.70	6.94%	9.0%	9.4%
New Jersey Resources	4.14%	0.80	6.94%	9.7%	10.0%
Northwest Natural Gas	4.14%	0.70	6.94%	9.0%	9.4%
WGL Holdings Inc.	4.14%	0.80	6.94%	9.7%	10.0%
Average	4.14%	75.00%	6.94%	9.3%	9.7%
Subsample Average	4.14%	72.00%	6.94%	9.1%	9.6%

Sources and Notes:
[1]: Vilbert Direct Testimony.
[2]: Bloomberg as of January 31, 2018.
[3]: Vilbert Direct Testimony.
[4]: [1] + ([2] x [3]).
[5]: ([1] + 1.5%) + [2] x ([3] - 1.5%).

Schedule No. D5.10

Risk Positioning Cost of Equity of the Expanded Sample

l B: Scenario 2 - Long-Term Risk Free Rate of 3.94%, Long-Term Market Risk Premium of 7.

Company	Long-Term Risk-Free Rate [1]	Value Line Betas [2]	Long-Term Market Risk Premium [3]	CAPM Cost of Equity [4]	ECAPM (1.5%) Cost of Equity [5]
Atmos Energy	3.94%	0.70	7.94%	9.5%	9.9%
Chesapeake Utilities	3.94%	0.70	7.94%	9.5%	9.9%
ONE Gas Inc.	3.94%	0.70	7.94%	9.5%	9.9%
South Jersey Inds.	3.94%	0.85	7.94%	10.7%	10.9%
Southwest Gas	3.94%	0.80	7.94%	10.3%	10.6%
Spire Inc.	3.94%	0.70	7.94%	9.5%	9.9%
New Jersey Resources	3.94%	0.80	7.94%	10.3%	10.6%
Northwest Natural Gas	3.94%	0.70	7.94%	9.5%	9.9%
WGL Holdings Inc.	3.94%	0.80	7.94%	10.3%	10.6%
Average	3.94%	75.00%	7.94%	9.9%	10.3%
Subsample Average	3.94%	71.67%	7.94%	9.6%	10.1%

Sources and Notes:
[1]: Vilbert Direct Testimony.
[2]: Bloomberg as of January 31, 2018.
[3]: Vilbert Direct Testimony.
[4]: [1] + ([2] x [3]).
[5]: ([1] + 1.5%) + [2] x ([3] - 1.5%).

CAPM Cost of Equity [1]	ECAPM (1.5%) Cost of Equity [2]	5-Year Average Common Equity to Market Value Ratio [3]	Weighted - Average Cost of Preferred Equity [4]	5-Year Average Preferred Equity to Market Value Ratio [5]	Weighted-Average Cost of Debt [6]	5-Year Average Debt to Market Value Ratio [7]	VVC Representative Income Tax Rate [8]	Overall A Cost of ((CAP [9]
9.0%	9.4%	63.5%	-	0.0%	3.95%	36.5%	21.0%	6.9
9.0%	9.4%	73.2%	-	0.0%	-	26.8%	21.0%	NA
9.0%	9.4%	47.9%	-	0.0%	3.89%	22.1%	21.0%	5.0
10.0%	10.3%	61.9%	-	0.0%	4.19%	38.1%	21.0%	7.5
9.7%	10.0%	62.7%	-	0.0%	4.07%	37.3%	21.0%	7.3
9.0%	9.4%	56.6%	-	0.0%	3.89%	43.4%	21.0%	6.4
9.7%	10.0%	74.3%	-	0.0%	-	25.7%	21.0%	NA
9.0%	9.4%	62.4%	-	0.0%	3.89%	37.6%	21.0%	6.8
9.7%	10.0%	69.6%	3.89%	0.7%	3.89%	29.7%	21.0%	7.7
9.3%	9.7%	63.6%	3.9%	0.1%	4.0%	33.0%	21.0%	6.8
9.1%	9.5%	61.1%	-	0.0%	3.9%	33.9%	21.0%	6.5

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[6]: Supporting Schedule #2 to Schedule No. D5.11, Pane [9]-[10] A strikethrough indicates the utility was excluded from the full sample average cal
].
[7]: Schedule No. D5.4, [6]. as a result of its cost of equity not exceeding its cost of debt by 100 basis points

[8]: VVC Effective Corporate Tax Rate

ule No. D5.11 [9]: ([1] x [3]) + ([4] x [5]) + {[6] x [7] x (1 - [8])}.

[10]: ([2] x [3]) + ([4] x [5]) + {[6] x [7] x (1 - [8])}.

CAPM Cost of Equity [1]	ECAPM (1.5%) Cost of Equity [2]	5-Year Average Common Equity to Market Value Ratio [3]	Weighted - Average Cost of Preferred Equity [4]	5-Year Average Preferred Equity to Market Value Ratio [5]	Weighted-Average Cost of Debt [6]	5-Year Average Debt to Market Value Ratio [7]	VVC Representative Income Tax Rate [8]	Overall A Cost of ((CAP [9]
9.5%	9.9%	63.5%	-	0.0%	3.95%	36.5%	21.0%	7.2
9.5%	9.9%	73.2%	-	0.0%	-	26.8%	21.0%	NA
9.5%	9.9%	47.9%	-	0.0%	3.89%	22.1%	21.0%	5.2
10.7%	10.9%	61.9%	-	0.0%	4.19%	38.1%	21.0%	7.9
10.3%	10.6%	62.7%	-	0.0%	4.07%	37.3%	21.0%	7.6
9.5%	9.9%	56.6%	-	0.0%	3.89%	43.4%	21.0%	6.7
10.3%	10.6%	74.3%	-	0.0%	-	25.7%	21.0%	NA
9.5%	9.9%	62.4%	-	0.0%	3.89%	37.6%	21.0%	7.1
10.3%	10.6%	69.6%	3.89%	0.7%	3.89%	29.7%	21.0%	8.1
9.9%	10.3%	63.6%	3.9%	0.1%	4.0%	33.0%	21.0%	7.1
9.6%	10.1%	61.1%	-	0.0%	3.9%	33.9%	21.0%	6.8

l. [6]: Supporting Schedule #2 to Schedule No. D5.11, Pane [9]-[10] A strikethrough indicates the utility was excluded from the full sample average calc
l. [7]: Schedule No. D5.4, [6]. as a result of its cost of equity not exceeding its cost of debt by 100 basis points
[8]: VVC Effective Corporate Tax Rate
lule No. D5.11 [9]: ([1] x [3]) + ([4] x [5]) + {[6] x [7] x (1 - [8])}.
[10]: ([2] x [3]) + ([4] x [5]) + {[6] x [7] x (1 - [8])}.

Schedule No. D5.12

Risk Positioning Cost of Equity at Vectren's Capital Structure

	Overall After-Tax Cost of Capital (Scenario 1) [1]	Overall After-Tax Cost of Capital (Scenario 2) [2]	VVC Representative Base Deemed % Debt [3]	Representative Cost of A-Rated Utility Debt [4]	VVC Representative Income Tax Rate [5]	VVC Representative Base Deemed % Equity [6]	Estimated Return on Equity (Scenario 1) [7]	Estimated Return on Equity (Scenario 2) [8]
Full Sample:								
CAPM	6.8%	7.1%	49.4%	3.9%	21.0%	50.6%	10.4%	11.1%
ECAPM (1.50%)	7.0%	7.3%	49.4%	3.9%	21.0%	50.6%	10.8%	11.5%
Subsample:								
CAPM	6.5%	6.8%	49.4%	3.9%	21.0%	50.6%	9.8%	10.4%
ECAPM (1.50%)	6.7%	7.0%	49.4%	3.9%	21.0%	50.6%	10.3%	10.9%

Sources and Notes:

[1]: Schedule No. D5.11; Panel A, [9] - [10].

[2]: Schedule No. D5.11; Panel B, [9] - [10].

[3]: VVC Assumed Capital Structure.

[4]: Based on a A rating. Yield from Bloomberg as of January 31, 2018.

[5]: VVC Effective Corporate Tax Rate.

[6]: VVC Assumed Capital Structure.

[7]: {[1] - ([3] x [4] x (1 - [5])}/ [6].

[8]: {[2] - ([3] x [4] x (1 - [5]))}/ [6].

Scenario 1: Long-Term Risk Free Rate of 4.14%, Long-Term Market Risk Premium of 6.94%.

Scenario 2: Long-Term Risk Free Rate of 3.94%, Long-Term Market Risk Premium of 7.94%.

Hamada Adjustment to Obtain Unlevered Asset Beta

	Value Line Betas [1]	Debt Beta [2]	5-Year Average Common Equity to Market Value Ratio [3]	5-Year Average Preferred Equity to Market Value Ratio [4]	5-Year Average Debt to Market Value Ratio [5]	VVC Representative Income Tax Rate [6]	Asset Beta: Without Taxes [7]	Asset B Ta [
	0.70	0.06	63.5%	0.0%	36.5%	21.0%	0.47	0
ities	0.70	n/a	73.2%	0.0%	26.8%	21.0%	n/a	r
	0.70	0.05	47.9%	0.0%	22.1%	21.0%	0.35	0
.s.	0.85	0.10	61.9%	0.0%	38.1%	21.0%	0.56	0
	0.80	0.08	62.7%	0.0%	37.3%	21.0%	0.53	0
	0.70	0.05	56.6%	0.0%	43.4%	21.0%	0.42	0
ources	0.80	n/a	74.3%	0.0%	25.7%	21.0%	n/a	r
al Gas	0.70	0.05	62.4%	0.0%	37.6%	21.0%	0.46	0
Inc.	0.80	0.05	69.6%	0.7%	29.7%	21.0%	0.57	0
erage	0.75	0.06	63.6%	0.00	33.0%	21.0%	0.48	0
age	0.72	0.06	61.1%	0.00	33.9%	21.0%	0.44	0

es:

Schedule # 1 to Schedule No. D5.10, [1].

Schedule #1 to Schedule No. D5.13, [7].

o. D5.4, [4].

o. D5.4, [5].

[5]: Schedule No. D5.4, [6].

[6]: VVC Effective Corporate Tax Rate

[7]: [1]*[3] + [2]*([4] + [5]).

[8]: {[1]*[3] + [2]*([4]+[5]*(1-[6]))} / {[3] + [4] + [5]*(1 -[6])}.

Schedule No. D5.14

Expanded Sample Average Asset Beta Relevered at Vectren's Capital Structure

	Asset Beta [1]	Assumed Debt Beta [2]	VVC Representative Base Deemed % Debt [3]	VVC Representative Income Tax Rate [4]	VVC Representative Base Deemed % Equity [5]	Estimated Equity Beta [6]
ll Sample:						
set Beta Without Taxes	0.48	0.05	49.4%	21.0%	50.6%	0.90
set Beta With Taxes	0.54	0.05	49.4%	21.0%	50.6%	0.91
bsample:						
set Beta Without Taxes	0.44	0.05	49.4%	21.0%	50.6%	0.83
set Beta With Taxes	0.51	0.05	49.4%	21.0%	50.6%	0.86

ırces and Notes:

: Schedule No. D5.13, [7] - [8].

: Debt Beta estimate for A-rated entities.Corporate Finance, Berk and Demarzo, Second Edition, p. 389.

: VVC Assumed Capital Structure.

: VVC Effective Corporate Tax Rate.

: VVC Assumed Capital Structure.

: [1] + [3]/[5]*([1] - [2]) without taxes, [1] + [3]*(1 - [4])/[5]*([1] - [2]) with taxes.

Schedule No. D5.15

Risk-Positioning Cost of Equity using Hamada-Adjusted Betas

Panel A: Scenario 1 - Long-Term Risk Free Rate of 4.14%, Long-Term Market Risk Premium of 6.94%

Company	Long-Term Risk-Free Rate [1]	Hamada Adjusted Equity Betas [2]	Long-Term Market Risk Premium [3]	CAPM Cost of Equity [4]	ECAPM (1.5%) Cost of Equity [5]
Full Sample:				capmlt	ecapmlt2
Asset Beta Without Taxes	4.14%	0.90	6.94%	10.4%	10.5%
Asset Beta With Taxes	4.14%	0.91	6.94%	10.5%	10.6%
Subsample:					
Asset Beta Without Taxes	4.14%	0.83	6.94%	9.9%	10.1%
Asset Beta With Taxes	4.14%	0.86	6.94%	10.1%	10.3%

Sources and Notes:
[1]: Vilbert Direct Testimony.
[2]: Schedule No. D5.14, [6].
[3]: Vilbert Direct Testimony.
[4]: [1] + ([2] x [3]).
[5]: ([1] + 1.5%) + [2] x ([3] - 1.5%).

Schedule No. D5.15

Risk-Positioning Cost of Equity using Hamada-Adjusted Betas

Panel B: Scenario 2 - Long-Term Risk Free Rate of 3.94%, Long-Term Market Risk Premium of 7.94%

Company	Long-Term Risk-Free Rate [1]	Hamada Adjusted Equity Betas [2]	Long-Term Market Risk Premium [3]	CAPM Cost of Equity [4]	ECAPM (1.5%) Cost of Equity [5]
Full Sample:				capmlt	ecapmlt2
Asset Beta Without Taxes	3.94%	0.90	7.94%	11.1%	11.2%
Asset Beta With Taxes	3.94%	0.91	7.94%	11.2%	11.3%
Subsample:					
Asset Beta Without Taxes	3.94%	0.83	7.94%	10.5%	10.8%
Asset Beta With Taxes	3.94%	0.86	7.94%	10.8%	11.0%

Sources and Notes:
[1]: Vilbert Direct Testimony.
[2]: Schedule No. D5.14, [6].
[3]: Vilbert Direct Testimony.
[4]: [1] + ([2] x [3]).
[5]: ([1] + 1.5%) + [2] x ([3] - 1.5%).

Schedule No. D5.16
Risk Premiums Determined by Relationship Between Authorized ROEs[1] and Long-term Treasury Bond Rates During the Period 1990-2017

Formula: Risk Premium = A_0 + (A_1 x Treasury bond Rate)

R Squared	0.8479
Estimate of intercept (A_0)	8.407%
Estimate of slope (A_1)	-0.5611

Equity Cost Estimate for Gas LDC		Predicted Risk Premium		Expected Treasury Bond Rate[2]	
10.2%	=	6.08%	+	4.14%	[3]
10.1%	=	6.20%	+	3.94%	[4]

Sources and Notes:
[1]: Authorized ROE Data sourced from SNL Financial.
[2]: Blue Chip consensus forecast 2019 10-yr T-bill Yield plus maturity premium
[3]: Estimate with expected treasury bond rate normalized with 0.20% utility yield spread adjustment
[4]: Estimate without treasury bond rate normalization.
See regression results for derivation of regression coefficients A_0 and A_1.

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Academic Literature on Financial Risk Adjustments

THE EFFECT OF THE FIRM'S CAPITAL STRUCTURE ON THE SYSTEMATIC RISK OF COMMON STOCKS

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I. INTRODUCTION

ONLY RECENTLY has there been an interest in relating the issues historically associated with corporation finance to those historically associated with investment and portfolio analyses. In fact, rigorous theoretical attempts in this direction were made only since the capital asset pricing model of Sharpe [13], Lintner [6], and Mossin [11], itself an extension of the Markowitz [7] portfolio theory. This study is one of the first empirical works consciously attempting to show and test the relationships between the two fields. In addition, differences in the observed systematic or nondiversifiable risk of common stocks, β, have never really been analyzed before by investigating some of the underlying differences in the firms.

In the capital asset pricing model, it was demonstrated that the efficient set of portfolios to any individual investor will always be some combination of lending at the risk-free rate and the "market portfolio," or borrowing at the risk-free rate and the "market portfolio." At the same time, the Modigliani and Miller (MM) propositions [9, 10] on the effect of corporate leverage are well known to the students of corporation finance. In order for their propositions to hold, personal leverage is required to be a perfect substitute for corporate leverage. If this is true, then corporate borrowing could substitute for personal borrowing in the capital asset pricing model as well.

Both in the pricing model and the MM theory, borrowing, from whatever source, while maintaining a fixed amount of equity, increases the risk to the investor. Therefore, in the mean-standard deviation version of the capital asset pricing model, the covariance of the asset's rate of return with the market portfolio's rate of return (which measures the nondiversifiable risk of the asset—the proxy β will be used to measure this) should be greater for the stock of a firm with a higher debt-equity ratio than for the stock of another firm in the same risk-class with a lower debt-equity ratio.[1]

This study, then, has a number of purposes. First, we shall attempt to link empirically corporation finance issues with portfolio and security analyses through the effect of a firm's leverage on the systematic risk of its common

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1. This very quick summary of the theoretical relationship between what is known as corporation finance and the modern investment and portfolio analyses centered around the capital asset pricing model is more thoroughly presented in [5], along with the necessary assumptions required for this relationship.

stock. Then, we shall attempt to test the MM theory, or at least provide another piece of evidence on this long-standing controversial issue. This test will not rely on an explicit valuation model, such as the MM study of the electric utility industry [8] and the Brown study of the railroad industry [2]. A procedure using systematic risk measures (β s) has been worked out in this paper for this purpose.

If the MM theory is validated by this procedure, then the final purpose of this study is to demonstrate a method for estimating the cost of capital of individual firms to be used by them for scale-changing or nondiversifying investment projects. The primary component of any firm's cost of capital is the capitalization rate for the firm if the firm had no debt and preferred stock in its capital structure. Since most firms do have fixed commitment obligations, this capitalization rate (we shall call it $E(R_A)$; MM denote it ρ^τ) is unobservable. But if the MM theory and the capital asset pricing model are correct, then it is possible to estimate $E(R_A)$ from the systematic risk approach for individual firms, even if these firms are members of a one-firm risk-class.[2]

With this statement of the purposes for this study, we shall, in Section II, discuss the alternative general procedures that are possible for estimating the effect of leverage on systematic risk and select the most feasible ones. The results are presented in Section III. And finally, tests of the MM versus the traditional theories of corporation finance are presented in Section IV.

II. Some Possible Procedures and the Selected Estimating Relationships

There are at least four general procedures that can be used to estimate the effect of the firm's capital structure on the systematic risk of common stocks. The first is the MM valuation model approach. By estimating ρ^τ with an explicit valuation model as they have for the electric utility industry, it is possible to relate this ρ^τ with the use of the capital asset pricing model to a nonleveraged systematic risk measure, ${}_A\beta$. Then the difference between the observed common stock's systematic risk (which we shall denote ${}_B\beta$) and ${}_A\beta$ would be due solely to leverage. But the difficulties of this approach for all firms are many.

The MM valuation model approach requires the specification, in advance, of risk-classes. All firms in a risk-class are then assumed to have the same ρ^τ—the capitalization rate for an all-common equity firm. Unfortunately, there must be enough firms in a risk-class so that a cross-section analysis will yield statistically significant coefficients. There may not be many more risk-classes (with enough observations) now that the electric utility and railroad industries have been studied. In addition, the MM approach requires estimating expected asset earnings and estimating the capitalized growth potential implicit in stock prices. If it is possible to consider growth and expected earnings without having

2. It is, in fact, this last purpose of making applicable and practical some of the implications of the capital asset pricing model for corporation finance issues that provided the initial motivation for this paper. In this context, if one is familiar with the fair rate of return literature for regulated utilities, for example, an industry where debt is so prevalent, adjusting correctly for leverage is not frequently done and can be very critical.

to specify their exact magnitude at a specific point in time, considerable difficulty and possible measurement errors will be avoided.

The second approach is to run a regression between the observed systematic risk of a stock and a number of accounting and leverage variables in an attempt to explain this observed systematic risk. Unfortunately, without a theory, we do not know which variables to include and which variables to exclude and whether the relationship is linear, multiplicative, exponential, curvilinear, etc. Therefore, this method will also not be used.

A third approach is to measure the systematic risk before and after a new debt issue. The difference can then be attributed to the debt issue directly. An attractive feature of this procedure is that a good estimate of the market value of the incremental debt issue can be obtained. A number of disadvantages, unfortunately, are associated with this direct approach. The difference in the systematic risk may be due not only to the additional debt, but also to the reason the debt was issued. It may be used to finance a new investment project, in which case the project's characteristics will also be reflected in the new systematic risk measure. In addition, the new debt issue may have been anticipated by the market if the firm had some long-run target leverage ratio which this issue will help maintain; conversely, the market may not fully consider the new debt issue if it believes the increase in leverage is only temporary. For these reasons, this seemingly attractive procedure will not be employed.

The last approach, which will be used in this study, is to assume the validity of the MM theory from the outset. Then the observed rate of return of a stock can be adjusted to what *it would have been* over the same time period had the firm no debt and preferred stock in its capital structure. The difference between the observed systematic risk, ${}_{B}\beta$, and the systematic risk for this adjusted rate of return time series, ${}_{A}\beta$, can be attributed to leverage, if the MM theory is correct. The final step, then, is to test the MM theory.

To discuss this more specifically, consider the following relationship for the dollar return to the common shareholder from period $t-1$ to t:

$$(X - I)_t(1 - \tau)_t - p_t + \Delta G_t = d_t + cg_t \tag{1}$$

where X_t represents earnings before taxes, interest, and preferred dividends and is assumed to be unaffected by fixed commitment obligations; I_t represents interest and other fixed charges paid during the period; τ is the corporation income tax rate; p_t is the preferred dividends paid; ΔG_t represents the change in capitalized growth over the period; and d_t and cg_t are common shareholder dividends and capital gains during the period, respectively.

Equation (1) relates the corporation finance types of variables with the market holding period return important to the investors. The first term on the left-hand-side of (1) is profits after taxes and after interest which is the earnings the common and preferred shareholders receive on their investment for the period. Subtracting out p_t leaves us with the earnings the common shareholder would receive from currently-held assets.

To this must be added any change in capitalized growth since we are trying to explain the common shareholder's market holding period dollar return. ΔG_t

must be added for growth firms to the current period's profits from existing assets since capitalized growth opportunities of the firm—future earnings from new assets over and above the firm's cost of capital which are already reflected in the stock price at $(t-1)$—should change over the period and would accrue to the common shareholder. Assuming shareholders at the start of the period estimated these growth opportunities on average correctly, the expected value of ΔG_t would not be zero, but should be positive. For example, consider growth opportunities five years from now which yield more than the going rate of return and are reflected in today's stock price. These growth opportunities will become one year closer to fruition at time t than at time $t-1$ so that their present value would become larger. ΔG_t then represents this increase in the present value of these future opportunities simply because it is now four years away rather than five.[3]

Since the systematic risk of a common stock is:

$$_B\beta = \frac{\operatorname{cov}(R_{B_t}, R_{M_t})}{\sigma^2(R_{M_t})} \tag{2}$$

where R_{B_t} is the common shareholder's rate of return and R_{M_t} is the rate of return on the market portfolio, then substitution of (1) into (2) yields:

$$_B\beta = \frac{\operatorname{cov}\left[\dfrac{(X-I)(1-\tau)_t - p_t + \Delta G_t}{S_{B_{t-1}}}, R_{M_t}\right]}{\sigma^2(R_{M_t})} \tag{2a}$$

where $S_{B_{t-1}}$ denotes the market value of the common stock at the beginning of the period.

The systematic risk for the same firm over the same period *if* there were no debt and preferred stock in its capital structure is:

$$_A\beta = \frac{\operatorname{cov}(R_{A_t}, R_{M_t})}{\sigma^2(R_{M_t})}$$

$$= \frac{\operatorname{cov}\left[\dfrac{X(1-\tau)_t + \Delta G_t}{S_{A_{t-1}}}, R_{M_t}\right]}{\sigma^2(R_{M_t})} \tag{3}$$

where R_{A_t} and $S_{A_{t-1}}$ represent the rate of return and the market value, respectively, to the common shareholder if the firm had no debt and preferred stock. From (3), we can obtain:

$$_A\beta S_{A_{t-1}} = \frac{\operatorname{cov}[X(1-\tau)_t + \Delta G_t, R_{M_t}]}{\sigma^2(R_{M_t})} \tag{3a}$$

3. Continual awareness of the difficulties of estimating capitalized growth, or changes in growth, especially in conjunction with leverage considerations, for purposes such as valuation or cost of capital is a characteristic common to students of corporation finance. This is the reason for the emphasis on growth in this paper and for presenting a method to neutralize for differences in growth when comparing rates of return.

Next, by expanding and rearranging (2a), we have:

$$_B\beta S_{B_{t-1}} = \frac{\text{cov}\,[X(1-\tau)_t + \Delta G_t, R_{M_t}]}{\sigma^2(R_{M_t})} - \frac{\text{cov}\,[I(1-\tau)_t, R_{M_t}]}{\sigma^2(R_{M_t})} - \frac{\text{cov}\,(p_t, R_{M_t})}{\sigma^2(R_{M_t})} \tag{2b}$$

If we assume as an empirical approximation that interest and preferred dividends have negligible covariance with the market, at least relative to the (pure equity) common stock's covariance, then substitution of the LHS of (3a) into the RHS of (2b) yields:[4]

$$_B\beta S_{B_{t-1}} = {_A\beta} S_{A_{t-1}} \tag{4}$$

or

$$_A\beta = \left(\frac{S_B}{S_A}\right)_{t-1} {_B\beta} \tag{4a}$$

Because $S_{A_{t-1}}$, the market value of common stock *if* the firm had no debt and preferred stock, is not observable since most firms do have debt and/or preferred stock, a theory is required in order to measure what this quantity *would have been* at $t-1$. The MM theory [10] will be employed for this purpose, that is:

$$S_{A_{t-1}} = (V - \tau D)_{t-1}. \tag{5}$$

Equation (5) indicates that if the Federal government tax subsidy for debt financing, τD, where D is the market value of debt, is subtracted from the observed market value of the firm, V_{t-1} (where V_{t-1} is the sum of S_B, D and the observed market value of preferred), then the market value of an unleveraged firm is obtained. Underlying (5) is the assumption that the firm is near its target leverage ratio so that no more or no less debt subsidy is capitalized already into the observed stock price. The conditions under which this MM relationship hold are discussed carefully in [4].

It is at this point that problems in obtaining satisfactory estimates of $_A\beta$ develop, since (4) theoretically holds only for the next period. As a practical matter, the accepted, and seemingly acceptable, method of obtaining estimates of a stock's systematic risk, $_B\beta$, is to run a least squares regression between a stock's and market portfolio's *historical* rates of return. Using past data for $_B\beta$, it is not clear which *period's* ratio of market values to apply in (4a) to estimate the firm's systematic risk, $_A\beta$. There would be no problem if the market value ratios of debt to equity and preferred stock to equity remained relatively stable over the past for each firm, but a cursory look at these data reveals that this is not true for the large majority of firms in our sample. Should we use the market value ratio required in (4a) that was observed at the start of our regression period, at the end of our regression period, or some kind of average over the period? In addition, since these different observed ratios will give us different estimates for $_A\beta$, it is not clear, without some criterion, how we should select from among the various estimates.

4. This general method of arriving at (4) was suggested by the comments of William Sharpe, one of the discussants of this paper at the annual meeting. A much more cumbersome and less general derivation of (4) was in the earlier version.

It is for this purpose—to obtain a standard—that a more cumbersome and more data demanding approach to obtain estimates of ${}_A\beta$ is suggested. Given the large fluctuations in market leverage ratios, intuitively it would appear that the firm's risk is more stable than the common stock's risk. In that event, a leverage-free rate of return time series for each firm should be derived and the market model applied to this time series directly. In this manner, the beta coefficient would give us a *direct* estimate of ${}_A\beta$ which can then be used as a criterion to determine if any of the market value ratios discussed above can be applied to (4a) successfully.

For this purpose, the "would-have-been" rate of return for the common stock if the firm had no debt and preferred is:

$$R_{A_t} = \frac{X_t(1-\tau)_t + \Delta G_t}{S_{A_{t-1}}}. \tag{6}$$

The numerator of (6) can be rearranged to be:

$$X_t(1-\tau)_t + \Delta G_t \equiv [(X-I)_t(1-\tau)_t - p_t + \Delta G_t] + p_t + I_t(1-\tau)_t.$$

Substituting (1):

$$X_t(1-\tau)_t + \Delta G_t = [d_t + cg_t] + p_t + I_t(1-\tau)_t.$$

Therefore, (6) can be written as:

$$R_{A_t} = \frac{d_t + cg_t + p_t + I_t(1-\tau)_t}{S_{A_{t-1}}}. \tag{7}$$

Since $S_{A_{t-1}}$ is unobservable for the firms with leverage, the MM theory, equation (5), will be employed; then:

$$R_{A_t} = \frac{d_t + cg_t + p_t + I_t(1-\tau)_t}{(V-\tau D)_{t-1}}. \tag{8}$$

The observed rate of return on the common stock is, of course:

$$R_{B_t} = \frac{(X-I)_t(1-\tau)_t - p_t + \Delta G_t}{S_{B_{t-1}}} = \frac{d_t + cg_t}{S_{B_{t-1}}}. \tag{9}$$

Equation (8) is the rate of return to the common shareholder of the same firm and over the same period of time as (9). However, in (8) there are the underlying assumptions that the firm never had any debt and preferred stock and that the MM theory is correct; (9) incorporates the exact amount of debt and preferred stock that the firm actually did have over this time period and no leverage assumption is being made. Both (8) and (9) are now in forms where they can be measured with available data. One can note that it is unnecessary to estimate the change in growth, or earnings from current assets, since these should be captured in the market holding period return, $d_t + cg_t$.

Using CRSP data for (9) and both CRSP and Compustat data for the components of (8), a time series of yearly R_{A_t} and R_{B_t} for $t = 1948\text{-}1967$ were derived for 304 different firms. These 304 firms represent an exhaustive sample of the firms with complete data on both tapes for all the years.

A number of "market model" [1, 12] variants were then applied to these data. For each of the 304 firms, the following regressions were run:

$$R_{Ait} = {}_A\alpha_i + {}_A\beta_i R_{Mt} + {}_A\epsilon_{it} \quad (10a)$$

$$R_{Bit} = {}_B\alpha_i + {}_B\beta_i R_{Mt} + {}_B\epsilon_{it} \quad (10b)$$

$$\ln(1 + R_{Ait}) = {}_{AC}\alpha_i + {}_{AC}\beta_i \ln(1 + R_{M_t}) + {}_{AC}\epsilon_{it} \quad (10c)$$

$$\ln(1 + R_{Bit}) = {}_{BC}\alpha_i + {}_{BC}\beta_i \ln(1 + R_{M_t}) + {}_{BC}\epsilon_{it} \quad (10d)$$

$$i = 1, 2, \ldots, 304$$
$$t = 1948\text{-}1967$$

where R_{Mt} is the observed NYSE arithmetic stock market rate of return with dividends reinvested, α_i and β_i are constants for each firm-regression, and the usual conditions are assumed for the properties of the disturbance terms, ϵ_{it}. Equations (10c) and (10d) are the continuously-compounded rate of return versions of (10a) and (10b), respectively.[5]

III. The Results

An abbreviated table of the regression results for each of the four variants, equations (10a)-(10d), summarized across the 304 firms is shown in Table 1.

The first column designated "mean" is the average of the statistic (indicated by the rows) over all 304 firms. Therefore, the mean ${}_A\hat{\alpha}$ of 0.0221 is the intercept term of equation (10a) averaged over 304 different firm-regressions. The second and third columns give the deviation measures indicated, of the 304 point estimates of, say, ${}_A\hat{\alpha}$. The mean standard error of estimate in the last column is the average over 304 firms of the individual standard errors of estimate.

The major conclusion drawn from Table 1 is the following mean β comparisons:

$${}_B\hat{\beta} > {}_A\hat{\beta}, \text{ i.e., } 0.9190 > 0.7030$$

$${}_{BC}\hat{\beta} > {}_{AC}\hat{\beta}, \text{ i.e., } 0.9183 > 0.7263.$$

The directional results of these betas, assuming the validity of the MM theory, are not imperceptible and clearly are not negligible differences from the investor's point of view. This is obtained in spite of all the measurement and data problems associated with estimating a time series of the RHS of (8) for

5. Because the R_{M_t} used in equations (10) is defined as the observed stock market return, and since adjusting for capital structure is the major purpose of this exercise, it was decided that the same four regressions should be replicated on a leverage-adjusted stock market rate of return. The major reason for this additional adjustment is the belief that the rates of return over time and their relationship with the market are more stable when we can abstract from all changes in leverage and get at the underlying risk of all firms.

For the 221 firms (out of the total 304) whose fiscal years coincide with the calendar year, average values for the components of the RHS of (8) were obtained for each year so that R_{M_t} could be adjusted in the same way as for the individual firms—a yearly time series of stock market rates of return, if all the firms on the NYSE had no debt and no preferred in their capital structure, was derived. The results, when using this adjusted market portfolio rate of return time series, were not very different from the results of equations (10), and so will not be reported here separately.

TABLE 1
SUMMARY RESULTS OVER 304 FIRMS OF EQUATIONS (10a)-(10d)

	Mean	Mean Absolute Deviation*	Standard Deviation	Mean Standard Error of Estimate
${}_A\hat{\alpha}$	0.0221	0.0431	0.0537	0.0558
${}_A\hat{\beta}$	0.7030	0.2660	0.3485	0.2130
${}_A\hat{R}^2$	0.3799	0.1577	0.1896	
${}_A\hat{\rho}$	0.0314			
${}_B\hat{\alpha}$	0.0187	0.0571	0.0714	0.0720
${}_B\hat{\beta}$	0.9190	0.3550	0.4478	0.2746
${}_B\hat{R}^2$	0.3864	0.1578	0.1905	
${}_B\hat{\rho}$	0.0281			
${}_{AC}\hat{\alpha}$	0.0058	0.0427	0.0535	0.0461
${}_{AC}\hat{\beta}$	0.7263	0.2700	0.3442	0.2081
${}_{AC}\hat{R}^2$	0.3933	0.1586	0.1909	
${}_{AC}\hat{\rho}$	0.0268			
${}_{BC}\hat{\alpha}$	−0.0052	0.0580	0.0729	0.0574
${}_{BC}\hat{\beta}$	0.9183	0.3426	0.4216	0.2591
${}_{BC}\hat{R}^2$	0.4012	0.1602	0.1922	
${}_{BC}\hat{\rho}$	0.0262			

* Defined as: $\frac{\sum_{i=1}^{N} |x_i - \bar{x}|}{N}$, where $N = 304$. $\hat{\rho}$ = first order serial correlation coefficient.

each firm. One of the reasons for the "traditional" theory position on leverage is precisely this point—that small and reasonable amounts of leverage cannot be discerned by the market. In fact, if the MM theory is correct, leverage has explained as much as, roughly, 21 to 24 per cent of the value of the mean β.

We can also note that if the covariance between the asset and market rates of return, as well as the market variance, was constant over time, then the systematic risk from the market model is related to the expected rate of return by the capital asset pricing model. That is:

$$E(R_{A_t}) = R_{F_t} + {}_A\beta[E(R_{M_t}) - R_{F_t}] \tag{11a}$$

$$E(R_{B_t}) = R_{F_t} + {}_B\beta[E(R_{M_t}) - R_{F_t}] \tag{11b}$$

Equation (11a) indicates the relationship between the expected rate of return for the common stock shareholder of a debt-free and preferred-free firm, to the systematic risk, ${}_A\beta$, as obtained in regressions (10a) or (10c). The LHS of (11a) is the important $\rho\tau$ for the MM cost of capital. The MM theory [9, 10] also predicts that shareholder expected yield must be higher (for the same real firm) when the firm has debt than when it does not. Financial risk is greater, therefore, shareholders require more expected return. Thus, $E(R_{B_t})$ must be greater than $E(R_{A_t})$. *In order for this MM prediction to be true, from (11a)* and (11b) it can be observed that ${}_B\beta$ must be greater than ${}_A\beta$, which is what we obtained.

Using the results underlying Table 1, namely the firm and stock betas, as the criterion for selecting among the possible observed market value ratios that can be used, if any, for (4), the following cross-section regressions were run:

$$({}_{B}\beta)_i = a_1 + b_1 \left(\frac{S_A}{S_B} {}_{A}\beta \right)_i + u_{1i} \qquad i = 1, 2, \ldots, 102 \tag{12a}$$

$$({}_{BC}\beta)_i = a_2 + b_2 \left(\frac{S_A}{S_B} {}_{AC}\beta \right)_i + u_{2i} \qquad i = 1, 2, \ldots, 102 \tag{12b}$$

$$({}_{A}\beta)_i = a_3 + b_3 \left(\frac{S_B}{S_A} {}_{B}\beta \right)_i + u_{3i} \qquad i = 1, 2, \ldots, 102 \tag{13a}$$

$$({}_{AC}\beta)_i = a_4 + b_4 \left(\frac{S_B}{S_A} {}_{BC}\beta \right)_i + u_{4i} \qquad i = 1, 2, \ldots, 102 \tag{13b}$$

Because the preferred stock market values were not as reliable as debt, only the 102 firms (out of 304) that did not have preferred in any of the years were used. The test for the adequacy of this alternative approach, equation (4), to adjust the systematic risk of common stocks for the underlying firm's capital structure, is whether the intercept term, a, is equal to zero, and the slope coefficient, b, is equal to one in the above regressions (as well as, of course, a high R^2)—these requirements are implied by (4). The results of this test would also indicate whether future "market model" studies that only use common stock rates of return without adjusting, or even noting, for the firm's debt-equity ratio will be adequate. The total firm's systematic risk may be stable (as long as the firm stays in the same risk-class), whereas the common stock's systematic risk may not be stable merely because of unanticipated capital structure changes—the data underlying Table 3 indicate that there were very few firms which did not have major changes in their capital structure over the twenty years studied.

The results of these regressions, when using the average S_A and average S_B over the twenty years for each firm, are shown in the first column panel of Table 2. These regressions were then replicated twice, first using the December 31, 1947 values of S_{A_i} and S_{B_i} instead of the twenty-year average for each firm, and then substituting the December 31, 1966 values of S_{A_i} and S_{B_i} for the 1947 values. These results are in the second and third panels of Table 2.[6]

From the first panel of Table 2, it appears that this alternative approach via (4a) for adjusting the systematic risk for the firm's leverage is quite

6. The point should be made that we are not merely regressing a variable on itself in (12) and (13). (12a) and (12b) can be interpreted as correlating the ${}_{B}\beta_i$ obtained from (10b) and (10d)—the LHS variable in (12a) and (12b)—against the ${}_{B}\beta_i$ obtained from rearranging (4)—the RHS variable in (12a) and (12b)—to determine whether the use of (4) is as good a means of obtaining ${}_{B}\beta_i$ as the direct way via the equations (10). We would be regressing a variable on itself only if the ${}_{A}\beta_i$ were calculated using (4a), and then the ${}_{A}\beta_i$ thus obtained, inserted into (12a) and (12b).

Instead, we are obtaining ${}_{A}\beta_i$ using the MM model in *each* of the twenty years so that a leverage-adjusted 20 year time series of R_{A_i} is derived. Of course, if there were no data nor measurement problems, and if the debt-to-equity ratio were perfectly stable over this twenty year period for each firm, then we should obtain perfect correlation in (12a) and (12b), with a = 0 and b = 1, as (4) would be an identity.

TABLE 2
RESULTS FOR THE EQUATIONS (12a), (12b), (13a), AND (13b)*

	Using 20-Year Average for $\left(\frac{S_A}{S_B}\right)_i$			Using 1947 Value for $\left(\frac{S_A}{S_B}\right)_i$			Using 1966 Value for $\left(\frac{S_A}{S_B}\right)_i$		
	a	b	R^2	a	b	R^2	a	b	R^2
Eq. (12a)	−0.022 (0.021)	1.062 (0.021)	0.962	0.150 (0.048)	0.842 (0.045)	0.781	0.085 (0.041)	0.905 (0.038)	0.849
	constant suppressed	1.042 (0.009)	0.962	constant suppressed	0.966 (0.021)	0.781	constant suppressed	0.976 (0.017)	0.849
Eq. (12b)	−0.003 (0.013)	1.016 (0.013)	0.984	0.159 (0.047)	0.816 (0.044)	0.773	0.124 (0.037)	0.843 (0.034)	0.859
	constant suppressed	1.014 (0.005)	0.984	constant suppressed	0.952 (0.019)	0.773	constant suppressed	0.947 (0.015)	0.859

	Using 20-Year Average for $\left(\frac{S_B}{S_A}\right)_i$			Using 1947 Value for $\left(\frac{S_B}{S_A}\right)_i$			Using 1966 Value for $\left(\frac{S_B}{S_A}\right)_i$		
	a	b	R^2	a	b	R^2	a	b	R^2
Eq. (13a)	0.030 (0.016)	0.931 (0.017)	0.969	0.112 (0.028)	0.843 (0.030)	0.888	0.080 (0.027)	0.898 (0.030)	0.902
	constant suppressed	0.960 (0.007)	0.969	constant suppressed	0.948 (0.015)	0.888	constant suppressed	0.976 (0.014)	0.902
Eq. (13b)	0.007 (0.010)	0.979 (0.011)	0.988	0.119 (0.026)	0.852 (0.028)	0.902	0.063 (0.026)	0.942 (0.029)	0.911
	constant suppressed	1.004 (0.012)	0.911	constant suppressed	0.967 (0.013)	0.902	constant suppressed	1.005 (0.012)	0.911

* Standard error in parentheses.

satisfactory (at least with respect to our sample of firms and years) only if long-run averages of S_A and S_B are used. The second and third panels indicate that the equations (8) and (10) procedure is markedly superior when only one year's market value ratio is used as the adjustment factor. The annual debt-to-equity ratio is much too unstable for this latter procedure.

Thus, when forecasting systematic risk is the primary objective—for example, for portfolio decisions or for estimating the firm's cost of capital to apply to prospective projects—a long-run forecasted leverage adjustment is required. Assuming the firm's risk is more stable than the common stock's risk,[7] and if there is some reason to believe that a better forecast of the firm's future leverage can be obtained than using simply a past year's (or an average of past years') leverage, it should be possible to improve the usual extrapolation forecast of a stock's systematic risk by forecasting the total firm's systematic risk first, and then using the independent leverage estimate as an adjustment.

IV. Tests of the MM vs. Traditional Theories of Corporation Finance

To determine if the difference, ${}_B\beta - {}_A\beta$, found in this study is indeed the correct effect of leverage, some confirmation of the MM theory (since it was assumed to be correct up to this point) from the systematic risk approach is needed. Since a direct test by this approach seems impossible, an indirect, inferential test is suggested.

The MM theory [9, 10] predicts that for firms in the same risk-class, the capitalization rate if all the firms were financed with only common equity, $E(R_A)$, would be the same—regardless of the actual amount of debt and preferred each individual firm had. This would imply, from (11a), that if $E(R_A)$ must be the same for all firms in a risk-class, so must ${}_A\beta$. And if these firms had different ratios of fixed commitment obligations to common equity, this difference in financial risk would cause their observed ${}_B\beta$s to be different.

The major competing theory of corporation finance is what is now known as the "traditional theory," which has contrary implications. This theory predicts that the capitalization rate for common equity, $E(R_B)$, (sometimes called the required or expected stock yield, or expected earnings-price ratio) is constant, as debt is increased, up to some critical leverage point (this point being a function of gambler's ruin and bankruptcy costs).[8] The clear implication of this constant, horizontal, equity yield (or their initial downward sloping cost of capital curve) is that changes in market or covariability risk are assumed not to be discernible to the shareholders as debt is increased. Then the traditional theory is saying that the ${}_B\beta$s, a measure of this covariability risk, would be the same for all firms in a given risk-class irregardless of differences in leverage, as long as the critical leverage point is not reached.

Since there will always be unavoidable errors in estimating the β's of indi-

7. A faint, but possible, empirical indication of this point may be obtained from Table 1. The ratio of the mean point estimate to the mean standard error of estimate is less for the firm β than for the stock β in both the discrete and continuously compounded cases.

8. This interpretation of the traditional theory can be found in [9, especially their figure 2, page 275, and their equation (13) and footnote 24 where reference is made to Durand and Graham and Dodd].

TABLE 3
INDUSTRY MARKET VALUE RATIOS OF PREFERRED STOCK (P) AND DEBT (D) TO COMMON STOCK (S)

Industry Number	Industry	Number of Firms		P/S			D/S			$\frac{P+D}{S}$	
20	Food and Kindred Products	30	Mean*		0.22			0.81			1.04	
			ROM**	0.00		1.18	0.00		3.55	0.00		4.13
			ROCR***	0.00		2.52	0.00		8.10	0.00		10.01
28	Chemicals and Allied Products	30	Mean		0.07			0.25			0.33	
			ROM	0.00		0.51	0.00		0.90	0.00		1.20
			ROCR	0.00		1.54	0.00		2.07	0.00		2.92
29	Petroleum and Coal Products	18	Mean		0.06			0.22			0.27	
			ROM	0.00		0.26	0.00		0.55	0.03		0.57
			ROCR	0.00		0.83	0.00		1.54	0.00		2.30
33	Primary Metals	21	Mean		0.14			0.54			0.68	
			ROM	0.00		1.31	0.00		1.95	0.00		3.04
			ROCR	0.00		4.69	0.00		6.20	0.00		7.49
35	Machinery, except Electrical	28	Mean		0.07			0.33			0.40	
			ROM	0.00		0.49	0.00		1.92	0.00		2.32
			ROCR	0.00		1.28	0.00		6.92	0.00		7.62

TABLE 3 (*Continued*)

Industry Number	Industry	Number of Firms		P/S (low)	P/S	P/S (high)	D/S (low)	D/S	D/S (high)	$\frac{P+D}{S}$ (low)	$\frac{P+D}{S}$	$\frac{P+D}{S}$ (high)
36	Electrical Machinery & Equipment	13	Mean		0.06			0.35			0.41	
			ROM	0.00		0.29	0.00		1.31	0.01		1.33
			ROCR	0.00		1.13	0.00		2.53	0.00		2.53
37	Transportation Equipment	24	Mean		0.08			0.38			0.47	
			ROM	0.00		0.54	0.00		0.93	0.00		1.32
			ROCR	0.00		2.33	0.00		3.76	0.00		6.09
49	Utilities	27	Mean		0.25			1.03			1.28	
			ROM	0.00		0.53	0.49		2.64	0.52		3.12
			ROCR	0.00		3.12	0.12		16.40	0.12		19.52
53	Dep't Stores, Order Houses & Vending Mach. Operators	17	Mean		0.13			0.49			0.62	
			ROM	0.00		0.38	0.01		1.52	0.01		1.87
			ROCR	0.00		1.09	0.00		3.19	0.00		3.66

* "Mean" refers to the average ratio over 20 years and over all firms in the industry.
** "Range of Means" (ROM) refers to the lowest firm's mean (over 20 years) ratio and the highest firm's mean (over 20 years) ratio in the industry.
*** "Range of Company Ranges" (ROCR) refers to the lowest and highest ratio in the industry, regardless of the year.

vidual firms and in specifying a risk-class, we would not expect to find a set of firms with identical systematic risk. But by specifying reasonable a priori risk-classes, if the individual firms had closer or less scattered ${}_A\beta$s than ${}_B\beta$s, then this would support the MM theory and contradict the traditional theory. If, instead, the ${}_B\beta$s were not discernibly more diverse than the ${}_A\beta$s, and the leverage ratio differed considerably among firms, then this would indicate support for the traditional theory.[9]

In order to test this implication, risk-classes must be first specified. The SEC two-digit industry classification was used for this purpose. Requiring enough firms for statistical reasons in any given industry, nine risk-classes were specified that had at least 13 firms; these nine classes are listed in Table 3 with their various leverage ratios.[10] It is clear from this table that our first requirement is met—that there is a considerable range of leverage ratios among firms in a risk-class and also over the twenty-year period.

Three tests will be performed to distinguish between the MM and traditional theories. The first is simply to calculate the standard deviation of the unbiased β estimates in a risk-class. The second is a chi-square test of the distribution of β's in an industry compared to the distribution of the β's in the total sample. Finally, an analysis of variance test on the estimated variance of the β's between industries, as opposed to within industries, is performed. In all tests, only the point estimate of β (which should be unbiased) for each stock and firm is used.[11]

The first test is reported in Table 4. If we compare the standard deviation of ${}_{AC}\beta$ with the standard deviation of ${}_{BC}\beta$ by industries (or risk-classes), we can note that $\sigma({}_{AC}\beta)$ is less than $\sigma({}_{BC}\beta)$ for eight out of the nine classes. The probability of obtaining this is only 0.0195, given a 50% probability that $\sigma({}_{AC}\beta)$ can be larger or smaller than $\sigma({}_{BC}\beta)$. These results indicate that the systematic risk of the firms in a given risk-class, if they were all financed only with common equity, is much less diverse than their observed stock's systematic risk. This supports the MM theory, at least in contrast to the traditional theory.[12]

9. The traditional theory also implies that $E(R_A)$ is equal to $E(R_B)$ for all firms. Unfortunately, we do not have a functional relationship between these traditional theory capitalization rates and the measured βs of this study. Clearly, since the ${}_A\beta$s were obtained assuming the validity of the MM theory, they would not be applicable for the traditional theory. In fact, no relationship between the ${}_A\beta$ and ${}_B\beta$ for a given firm, or for firms in a given risk-class, can be specified as was done for the capitalization rates.

10. The tenth largest industry had only eight firms. For our purpose of testing the uniformity of firm βs relative to stock βs within a risk-class, the use of the two-digit industry classification as a proxy does not seem as critical as, for instance, its use for the purpose of performing an MM valuation model study [8] wherein the ρ^τ must be pre-specified to be exactly the same for all firms in the industry.

11. Since these βs are estimated in the market model regressions with error, precise testing should incorporate the errors in the β estimation. Unfortunately, to do this is extremely difficult and more importantly, requires the normality assumption for the market model disturbance term. Since there is considerable evidence that is contrary to this required assumption [see 3], our tests will ignore the β measurement error entirely. But ignoring this is partially corrected in our first and third tests since means and variances of these point estimate βs must be calculated, and this procedure will "average out" the individual measurement errors by the factor 1/N.

12. Of course, there could always be another theory, as yet not formulated, which could be even

TABLE 4
MEAN AND STANDARD DEVIATION OF INDUSTRY β'S

Industry Number	Industry	Number of Firms		$_A\beta$	$_B\beta$	$_{AC}\beta$	$_{BC}\beta$
20	Food & Kindred Products	30	Mean β	0.515	0.815	0.528	0.806
			σ(β)	0.232	0.448	0.227	0.424
28	Chemicals & Allied Products	30	Mean β	0.747	0.928	0.785	0.946
			σ(β)	0.237	0.391	0.216	0.329
29	Petroleum & Coal Products	18	Mean β	0.633	0.747	0.656	0.756
			σ(β)	0.144	0.188	0.148	0.176
33	Primary Metals	21	Mean β	1.036	1.399	1.106	1.436
			σ(β)	0.223	0.272	0.197	0.268
35	Machinery, except Electrical	28	Mean β	0.878	1.037	0.917	1.068
			σ(β)	0.262	0.240	0.271	0.259
36	Electrical Machinery and Equipment	13	Mean β	0.940	1.234	0.951	1.164
			σ(β)	0.320	0.505	0.283	0.363
37	Transportation Equipment	24	Mean β	0.860	1.062	0.875	1.048
			σ(β)	0.225	0.313	0.225	0.289
49	Utilities	27	Mean β	0.160	0.255	0.166	0.254
			σ(β)	0.086	0.133	0.098	0.147
53	Department Stores, etc.	17	Mean β	0.652	0.901	0.692	0.923
			σ(β)	0.187	0.282	0.198	0.279

Our second test, the chi-square test, requires us to rank our 300 $_A\beta$s into ten equal categories, each with 30 $_A\beta$s (four miscellaneous firms were taken out randomly). By noting the value of the highest and lowest $_A\beta$ for each of the ten categories, a distribution of the number of $_A\beta$s in each category, by risk-class, can be obtained. This was then repeated for the other three betas. To test whether the distribution for each of the four β's and for each of the risk-classes follows the expected uniform distribution, a chi-square test was performed.[13]

Even with just casual inspection of these distributions of the betas by risk-class, it is clear that two industries, primary metals and utilities, are so highly skewed that they greatly exaggerate our results.[14] Eliminating these

more strongly supported than the MM theory. If we compare $\sigma(_A\beta)$ to $\sigma(_B\beta)$ by risk-classes in Table 4, precisely the same results are obtained as those reported above for the continuously-compounded betas.

13. By risk-classes, seven of the nine chi-square values of $_A\beta$ are larger than those of $_B\beta$, as are eight out of nine for the continuously-compounded betas. This would occur by chance with probabilities of 0.0898 and 0.0195, respectively, if there were a 50% chance that either the firm or stock chi-square value could be larger. Nevertheless, if we inspect the individual chi-square values by risk-class, we note that most of them are large so that the probabilities of obtaining these values are highly unlikely. For all four βs, the distributions for most of the risk-classes are nonuniform.

14. Primary metals have extremely large betas; utilities have extremely small betas.

two industries, and also two miscellaneous firms so that an even 250 firms are in the sample, new upper and lower values of the β's were obtained for each of the ten class intervals and for each of the four β's.

In Table 5, the chi-square values are presented; for the total of all risk-classes, the probability of obtaining a chi-square value less than 120.63 is over 99.95% (for $_A\beta$), whereas the probability of obtaining a chi-square value less than 99.75 is between 99.5% and 99.9% (for $_B\beta$). More sharply contrasting results are obtained when $_{AC}\beta$ is compared to $_{BC}\beta$. For $_{AC}\beta$, the probability of obtaining less than 128.47 is over 99.95%, whereas for $_{BC}\beta$, the probability of obtaining less than 78.65 is only 90.0%. By abstracting from financial risk, the underlying systematic risk is much less scattered when grouped into risk-classes than when leverage is assumed not to affect the systematic risk. The null hypothesis that the β's in a risk-class come from the same distribution as all β's is rejected for $_{AC}\beta$, but not for $_{BC}\beta$ (at the 90% level). Although this, in itself, does not tell us *how* a risk-class differs from the total market, an inspection of the distributions of the betas by risk-class underlying Table 5 does indicate more clustering of the $_{AC}\beta$s than the $_{BC}\beta$s so that the MM theory is again favored over the traditional theory.

The analysis of variance test is our last comparison of the implications of the two theories. The ratio of the estimated variance between industries to the estimated variance within the industries (the F-statistic) when the seven

TABLE 5
CHI-SQUARE RESULTS FOR ALL β'S AND ALL INDUSTRIES
(EXCEPT UTILITIES AND PRIMARY METALS)

Industry		$_A\beta$	$_B\beta$	$_{AC}\beta$	$_{BC}\beta$
Food and Kindred	Chi-Square	18.67	11.33	26.00	9.33
	$P\{\chi^2 <\}$* =	95-97.5%	70-75%	99.5-99.9%	50-60%
Chemicals	Chi-Square	9.33	10.67	12.00	7.33
	$P\{\chi^2 <\}$ =	50-60%	60-70%	75-80%	30-40%
Petroleum	Chi-Square	17.56	25.33	18.67	22.00
	$P\{\chi^2 <\}$ =	95-97.5%	99.5-99.9%	95-97.5%	99-99.5%
Machinery	Chi-Square	19.14	12.00	24.86	9.14
	$P\{\chi^2 <\}$ =	97.5-98%	75-80%	99.5-99.9%	50-60%
Electrical Machinery	Chi-Square	13.92	7.77	12.38	9.31
	$P\{\chi^2 <\}$ =	80-90%	40-50%	80-90%	50-60%
Transportation Equipment	Chi-Square	15.17	16.83	13.50	6.83
	$P\{\chi^2 <\}$ =	90-95%	90-95%	80-90%	30-40%
Dep't Stores	Chi-Square	14.18	3.59	14.18	3.59
	$P\{\chi^2 <\}$ =	80-90%	5-10%	80-90%	5-10%
Miscellaneous	Chi-Square	12.67	12.22	6.89	11.11
	$P\{\chi^2 <\}$ =	80-90%	80-90%	30-40%	70-75%
Total	Chi-Square	120.63	99.75	128.47	78.65
	$P\{\chi^2 <\}$ =	over 99.95%	99.5-99.90%	over 99.95%	90.0%

* Example: $P\{\chi^2 < 18.67\} = 95\text{-}97.5\%$ for 9 degrees of freedom.

industries are considered (again, the two obviously skewed industries, primary metals and utilities, were eliminated) is less for ${}_{B}\beta$ ($F = 3.90$) than for ${}_{A}\beta$ ($F = 9.99$), and less for ${}_{BC}\beta$ ($F = 4.18$) than for ${}_{AC}\beta$ ($F = 10.83$). The probability of obtaining these F-statistics for ${}_{A}\beta$ and ${}_{AC}\beta$ is less than 0.001, but for ${}_{B}\beta$ and ${}_{BC}\beta$ greater than or equal to 0.001. These results are consistent with the results obtained from our two previous tests. The MM theory is more compatible with the data than the traditional theory.[15]

V. Conclusions

This study attempted to tie together some of the notions associated with the field of corporation finance with those associated with security and portfolio analyses. Specifically, if the MM corporate tax leverage propositions are correct, then approximately 21 to 24% of the observed systematic risk of common stocks (when averaged over 304 firms) can be explained merely by the added financial risk taken on by the underlying firm with its use of debt and preferred stock. Corporate leverage does count considerably.

To determine whether the MM theory is correct, a number of tests on a contrasting implication of the MM and "traditional" theories of corporation finance were performed. The data confirmed MM's position, at least vis-à-vis our interpretation of the traditional theory's position. This should provide another piece of evidence on this controversial topic.

Finally, if the MM theory and the capital asset pricing model are correct, and if the adjustments made in equations (8) or (4a) result in accurate measures of the systematic risk of a leverage-free firm, the possibility is greater, without resorting to a fullblown risk-class study of the type MM did for the electric utility industry [8], of estimating the cost of capital for individual firms.

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15. All of our tests, it should be emphasized, although consistent, are only inferential. Aside from assuming that the two-digit SEC industry classification is a good proxy for risk-classes and that the errors in estimating the individual βs can be safely ignored, the tests rely on the two theories exhausting all the reasonable theories on leverage. But there is always the use of another line of reasoning. If the results of the MM electric utility study [8] are correct, and if these results can be generalized to all firms and to all risk-classes, then it can be claimed that the MM theory is universally valid. Then our result in Section III does indicate the correct effect of the firm's capital structure on the systematic risk of common stocks.

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Frameworks for Valuation

In Part One, we built a conceptual framework to show what drives value. In particular, a company's value is driven, first, by its ability to earn a return on invested capital (ROIC) greater than its weighted average cost of capital (WACC), and second, by its ability to grow. High returns and growth result in high cash flows, which in turn drives value.

Part Two offers a step-by-step guide for analyzing and valuing a company in practice, including technical details for properly measuring and interpreting the drivers of value. This chapter provides a high-level summary of valuation models based on discounted cash flow (DCF). We show how these models lead to *identical* results when applied correctly, and we illustrate how they differ in their ease of implementation.

Among the many ways to value a company (see Exhibit 5.1 on page 102 for an overview), we focus on two: enterprise DCF and discounted economic profit. When applied correctly, both valuation methods yield the same results; however, each model has certain benefits in practice. Enterprise DCF remains the favorite of many practitioners and academics because it relies solely on the flow of cash in and out of the company, rather than on accounting-based earnings (which can be misleading). Discounted economic profit is gaining in popularity because of its close link to economic theory and competitive strategy. Economic profit highlights whether a company is earning its cost of capital in a given year. Given the methods' identical results and complementary benefits of interpretation, we use both enterprise DCF and economic profit when valuing a company.

Both the enterprise DCF and economic profit models discount future streams at the weighted average cost of capital. WACC-based models work best when a company maintains a relatively stable debt-to-value ratio. If a company's debt-to-value mix is expected to change, WACC-based models can

hibit 5.1 Frameworks for DCF-Based Valuation

Model	Measure	Discount factor	Assessment
Enterprise discounted cash flow	Free cash flow	Weighted average cost of capital	Works best for projects, business units, and companies that manage their capital structure to a target level.
Economic profit	Economic profit	Weighted average cost of capital	Explicitly highlights when a company creates value.
Adjusted present value	Free cash flow	Unlevered cost of equity	Highlights changing capital structure more easily than WACC-based models.
Capital cash flow	Capital cash flow	Unlevered cost of equity	Compresses free cash flow and the interest tax shield in one number, making it difficult to compare performance among companies and over time.
Equity cash flow	Cash flow to equity	Levered cost of equity	Difficult to implement correctly because capital structure is embedded within cash flow. Best used when valuing financial institutions.

yield accurate results but are more difficult to apply. When the com- ʼs capital structure is expected to change significantly, we recommend lternative: adjusted present value (APV). Unlike WACC-based models, ʼ values the cash flow associated with capital structure (e.g., tax shields) rately from the cost of capital.

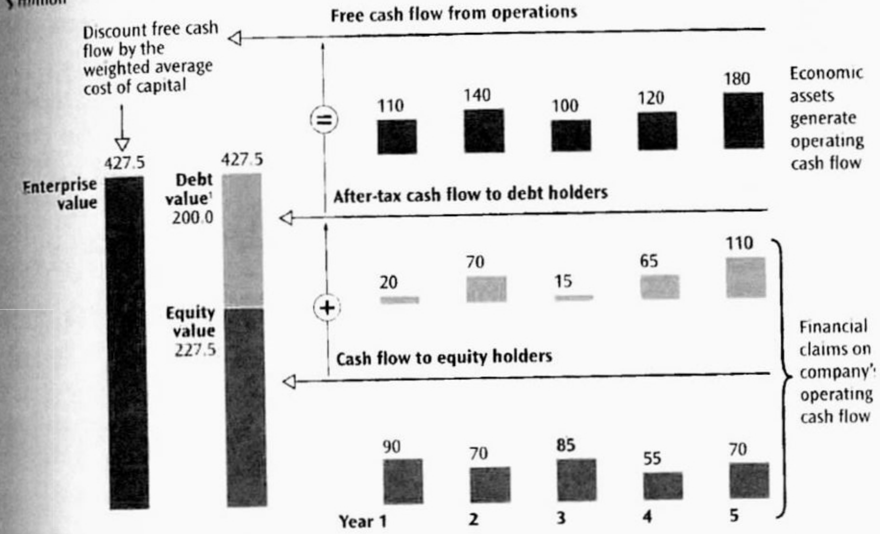
We conclude the chapter with a discussion of capital cash flow and eq- cash flow valuation models. Because these two valuation models com- gle operating performance and capital structure in cash flow, they lead e easily to mistakes in implementation. For this reason, we avoid capital flow and equity cash flow valuation models, except when valuing fi- cial institutions, where capital structure is considered part of opera- s (for how to value financial institutions, see Chapter 25).

ERPRISE DISCOUNTED CASH FLOW MODEL

rprise valuation models value the company's operating cash flows. Eq- valuation models, in contrast, value only the equity holder's claim nst operating cash flows. In the 1950s, two Nobel laureates, Franco ligliani and Merton Miller, postulated that the value of a company's iomic assets must equal the value of the claims against those assets.

Exhibit 5.2 Enterprise Valuation of a Single-Business Company

$ million



[1] Debt value equals discounted after-tax cash flow to debt holders plus present value of interest tax shield.

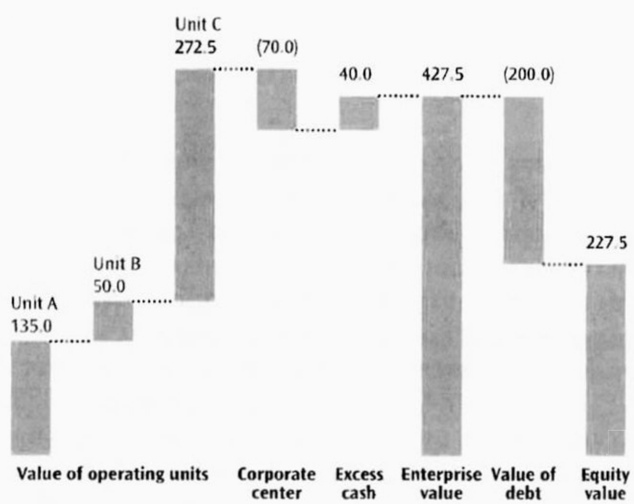
Thus, if we want to value the equity (and shares) of a company, we hav choices. We can value the company's operations and subtract the value nonequity financial claims (e.g., debt), or we can value the equity cash directly. In Exhibit 5.2, we demonstrate the relation between ente value and equity value. For this single-business company, equity can l culated either directly at $227.5 million or by estimating enterprise ($427.5 million) and subtracting debt ($200.0 million).

Although both methods lead to identical results when applied cor the equity method is difficult to implement in practice; matching cash flows with the correct cost of equity is challenging (for more o see the section on equity valuation later in this chapter). Consequer value a company's equity, we recommend valuing the enterprise fir then subtracting the value of any nonequity financial claims.[1]

In addition, the enterprise method is especially valuable wh tended to a multibusiness company. As shown in Exhibit 5.3 on pa the enterprise value equals the summed value of the individual op

[1] For financial institutions, such as banks and insurance companies, the choice, size, a ture of financial claims are directly linked to the company's operations (and thus are to separate). In these situations, we prefer the equity cash-flow method. The valuation cial institutions is addressed in Chapter 25.

3 Enterprise Valuation of a Multibusiness Company



the present value of the corporate center costs, plus the value of ing assets. Using enterprise discounted cash flow, instead of the h flow model, enables you to value individual projects, business even the entire company with a consistent methodology.

ıe a company's common stock using enterprise DCF:

ıe the company's operations by discounting free cash flow from rations at the weighted average cost of capital.

ıe nonoperating assets, such as excess marketable securities, nonsolidated subsidiaries, and other equity investments. Combining value of operating assets and nonoperating assets leads to enterse value.

ntify and value all nonequity financial claims against the comy's assets. Nonequity financial claims include (among others) ed- and floating-rate debt, pension shortfalls, employee options, l preferred stock.

otract the value of nonequity financial claims from enterprise ue to determine the value of common stock. To determine share ce, divide equity value by the number of shares outstanding.

Exhibit 5.4 Home Depot: Enterprise DCF Valuation

Year	Free cash flow (FCF) ($ million)	Discount factor (@ 9.3%)	Present value of FCF ($ million)
2004	1,930	0.915	1,766
2005	2,219	0.837	1,857
2006	2,539	0.766	1,944
2007	2,893	0.700	2,026
2008	3,283	0.641	2,104
2009	3,711	0.586	2,175
2010	4,180	0.536	2,241
2011	4,691	0.491	2,301
2012	5,246	0.449	2,355
2013	5,849	0.411	2,402
Continuing value	133,360	0.411	54,757
Present value of cash flow			75,928
Mid-year adjustment factor			1.046
Value of operations			**79,384**
Value of excess cash			1,609
Value of other nonoperating assets			84
Enterprise value			**81,077**
Value of debt			(1,365)
Value of capitalized operating leases			(6,554)
Equity value			**73,158**
Number of shares (at fiscal year-end 2003, million)			2,257
Estimated share value (in dollars)			**32.41**

To value Home Depot, future free cash flow is discounted to today's valu and then summed across years. For simplicity, the first year's cash flow discounted by one full year, the second by two full years, and so on. Sin cash flows are generated throughout the year, and not as a lump sum, di counting in full-year increments understates the appropriate discount fa tor. Therefore, we adjust the present value by half a year,[2] leading to tl value of operations of $79.4 billion.

To this value, add nonoperating assets (e.g., excess cash and other lon term nonoperating assets) to estimate Home Depot's enterprise value ($81 billion). From enterprise value, subtract the present value of nonequi

[2] A half-year adjustment is made to the present value for Home Depot because we assume ca flow is generated symmetrically around the midyear point. For companies dependent on ye

ɔnal debt and capitalized operating leases) to arrive at Home ıted equity value ($73.2 billion). Dividing the equity value by shares outstanding (2.3 billion) leads to an estimate of share 1. During the first half of 2004, Home Depot's stock price nid 30s.

ıtions

operations equals the discounted value of future free cash h flow equals the cash flow generated by the company's operıy reinvestment back into the business. Free cash flow is the ilable to *all* investors, and is *independent* of leverage. Consistent ınition, free cash flow must be discounted using the weighted of capital. The WACC is the company's opportunity cost of ɔresents a blended required return by the company's debt and 's.

next few pages, we outline the enterprise DCF valuation proȝh we present it sequentially, valuation is an iterative process. erations, we analyze the company's historical performance; ɔroject free cash flow over the short, medium, and long run; ıt the projected free cash flows at the weighted average cost

istorical performance Before projecting future cash flow, exɔmpany's historical financial performance. A good analysis will ꞉ key drivers of value: return on invested capital, growth, and ɔw. By thoroughly analyzing the past, we can document whether y has created value, whether it has grown, and how it compares ıpetitors.

ȝh ROIC and FCF are critical to the valuation process, they canɔuted directly from a company's reported financial statements. ƆIC and FCF are intended to measure the company's operating ꞇe, financial statements mix operating performance, nonoperatnance, and capital structure. Therefore, to calculate ROIC and 'eorganize the accountant's financial statements into new statet separate operating items, nonoperating items, and financial

꞉organization leads to two new terms: invested capital and net profits less adjusted taxes (NOPLAT). Invested capital represents or capital required to fund operations, without distinguishing ıpital is financed. NOPLAT represents the total after-tax operate generated by the company's invested capital, available to *all* fivestors.

Exhibit 5.5 presents the historical NOPLAT and invested capital for Home Depot and one of its direct competitors, Lowe's. To calculate ROIC, divide NOPLAT by average invested capital. In 2003, Home Depot's return on invested capital equaled 18.2 percent (based on a two-year average of invested capital), which exceeds its weighted average cost of capital of 9.3 percent. A detailed discussion of invested capital and NOPLAT, as well as an in-depth historical examination of Home Depot and Lowe's, is presented in Chapter 7.

Next, use the reorganized financial statements to calculate free cash flow, which will be the basis for our valuation. Defined in a manner consistent with ROIC, free cash flow relies on NOPLAT and the change in invested capital. Unlike the accountant's cash flow statement (provided in the company's annual report), free cash flow is independent of nonoperating items and capital structure.

Exhibit 5.6 on page 108 presents historical free cash flow for both Home Depot and Lowe's. As seen in the exhibit, Home Depot is generating nearly

Exhibit 5.5 Home Depot & Lowe's: Historical ROIC Analysis

$ million

	Home Depot			Lowe's		
	2001	2002	2003	2001	2002	2003
Net sales	53,553	58,247	64,816	22,111	26,491	30,838
Cost of merchandise sold	(37,406)	(40,139)	(44,236)	(15,743)	(18,465)	(21,231)
Selling, general and administrative	(10,451)	(11,375)	(12,658)	(4,053)	(4,859)	(5,671)
Depreciation	(756)	(895)	(1,075)	(517)	(626)	(758)
Operating lease interest	288	260	276	106	106	114
Adjusted EBITA	5,228	6,098	7,123	1,904	2,647	3,292
Adjusted taxes	(2,020)	(2,117)	(2,040)	(654)	(825)	(1,069)
NOPLAT	**3,208**	**3,981**	**5,083**	**1,250**	**1,822**	**2,223**
Invested capital						
Operating working capital	2,552	2,746	2,674	1,634	1,451	1,363
Net property and equipment	15,375	17,168	20,063	8,653	10,352	11,945
Capitalized operating leases	5,459	5,890	6,554	2,189	2,373	2,762
Net other assets	(216)	(247)	(524)	134	145	211
Invested capital (excluding goodwill)	23,170	25,557	28,767	12,611	14,321	16,281
Acquired intangibles and goodwill	419	575	833	0	0	0
Cumulative amortization and unreported goodwill	46	54	55	730	730	730
Invested capital (including goodwill)	**23,635**	**26,185**	**29,655**	**13,341**	**15,051**	**17,012**
ROIC excluding goodwill (average)	14.5%	16.3%	18.7%	10.9%	13.5%	14.5%
ROIC including goodwill (average)	14.3%	16.0%	18.2%	10.3%	12.8%	13.9%

5 Home Depot and Lowe's: Historical Free Cash Flow

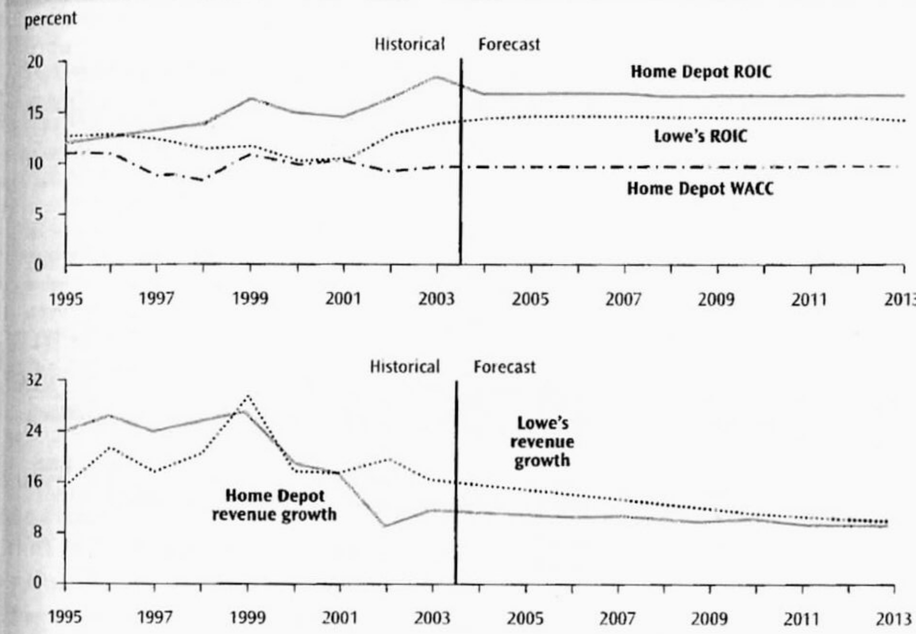
	Home Depot			Lowe's		
	2001	2002	2003	2001	2002	2003
	3,208	3,981	5,083	1,250	1,822	2,223
	756	895	1,075	517	626	758
/	3,964	4,876	6,157	1,767	2,448	2,981
operating working capital	834	(194)	72	(203)	183	88
enditures	(3,063)	(2,688)	(3,970)	(2,135)	(2,325)	(2,351)
capitalized operating leases	(775)	(430)	(664)	(547)	(184)	(389)
intangibles and goodwill	(113)	(164)	(259)	0	0	0
ease) in other operating assets	105	31	277	(7)	(11)	(66)
ease) in accumulated other sive income	(153)	138	172	3	0	0
ent	(3,165)	(3,307)	(4,372)	(2,889)	(2,336)	(2,719)
w	799	1,569	1,785	1,122	112	262
rest income	33	49	36	15	13	9
rease) in excess cash	(1,509)	383	(473)	(321)	(189)	(415)
rease) in nonoperating assets	9	(24)	23	13	(7)	(140)
operations	0	0	0	0	0	15
ailable to investors	(668)	1,977	1,371	(1,415)	(71)	(268)

	2001	2002	2003	2001	2002	2003
rest expense	17	23	38	123	125	121
se interest expense	177	162	170	66	65	71
crease) in debt	88	140	(44)	(903)	78	60
crease) in capitalized leases	(775)	(430)	(664)	(547)	(184)	(389)
t holders	(492)	(105)	(500)	(1,261)	85	(138)
	396	492	595	60	66	87
epurchased (issued)	(572)	1,590	1,276	(213)	(222)	(217)
ity holders	(176)	2,082	1,871	(154)	(156)	(130)
vailable to investors	(668)	1,977	1,371	(1,415)	(71)	(268)

n in free cash flow, whereas Lowe's free cash flow is barely posi-
s isn't necessarily a problem for Lowe's. The company's free cash
mall because it is reinvesting most of its gross cash flow to grow its

ng revenue growth, ROIC, and free cash flow To build an enter-

Exhibit 5.7 ROIC and Revenue Growth Projections



revenue growth for Home Depot and Lowe's. As the graphs demonstrate the two companies are transitioning from a period of high growth (25 per cent annually) into mature businesses with strong ROICs (well above Hom Depot's 9.3 percent cost of capital) and lower growth rates (currently 10 t 15 percent but falling to 5 percent over the next 10 years).

Free cash flow, which is driven by revenue growth and ROIC, provide the basis for enterprise DCF valuation. Exhibit 5.8 on page 110 shows summarized free cash flow calculation for Home Depot.[3] To forecast Hom Depot's free cash flow, start with forecasts of NOPLAT and invested cap tal. Over the short run (the first few years), forecast all financial statemen line items, such as gross margin, selling expenses, accounts receivabl and inventory. Moving farther out, individual line items become difficu to project. Therefore, over the medium horizon (5 to 10 years), focus on th company's key value drivers, such as operating margin, adjusted tax rat and capital efficiency. At some point, even projecting key drivers on

[3] Free cash flow does not incorporate any financing-related cash flows such as interest expen or dividends. A good stress test for an enterprise valuation model is to change future interc

.8 Home Depot: Free Cash Flow Summary

	Historical 2001	2002	2003	Forecast 2004	2005	2006
	3,208	3,981	5,083	5,185	5,741	6,342
	756	895	1,075	1,193	1,321	1,459
w	3,964	4,876	6,157	6,378	7,062	7,801
operating working capital	834	(194)	72	(294)	(318)	(344)
penditures	(3,063)	(2,688)	(3,970)	(3,399)	(3,708)	(4,036)
capitalized operating leases	(775)	(430)	(664)	(721)	(780)	(842)
n intangibles and goodwill	(113)	(164)	(259)	(92)	(99)	(107)
rease) in other operating assets	105	31	277	58	62	67
ease) in accumulated other isive income	(153)	138	172	0	0	0
ient	(3,165)	(3,307)	(4,372)	(4,448)	(4,843)	(5,261)
w	799	1,569	1,785	1,930	2,219	2,539

ear basis becomes meaningless. To value cash flows beyond this e a continuing-value formula, described next.

ig continuing value At the point where predicting the individual e drivers on a year-by-year basis becomes impractical, do not vary idual drivers over time. Instead, use a perpetuity-based continu- , such that:

$$\text{Operations} = \frac{\text{Present Value of Free Cash Flow}}{\textit{during} \text{ Explicit Forecast Period}} + \frac{\text{Present Value of Free Cash Flow}}{\textit{after} \text{ Explicit Forecast Period}}$$

ough many continuing-value models exist, we prefer the key value odel presented in Chapter 3. The key value driver formula is supe- lternative methodologies because it is based on cash flow and links v to growth and ROIC. The key value driver formula is:

$$\text{Continuing Value}_t = \frac{\text{NOPLAT}_{t+1}\left(1 - \frac{g}{\text{RONIC}}\right)}{\text{WACC} - g}$$

ula requires a forecast of net operating profits less adjusted taxes

Exhibit 5.9 Home Depot: Continuing Value

$ million

NOPLAT 2014	12,415
Return on incremental invested capital (RONIC)	9.3%
NOPLAT growth rate in perpetuity (g)	4.0%
Weighted average cost of capital (WACC)	9.3%

$$\text{Continuing Value}_t = \frac{\text{NOPLAT}_{t+1}\left(1 - \frac{g}{\text{RONIC}}\right)}{\text{WACC} - g}$$

$$= 133{,}360$$

forecast for return on new capital (RONIC), the weighted average cost capital (WACC), and long-run growth in NOPLAT (g).

Exhibit 5.9 presents an estimate for Home Depot's continuing valı Based on a final-year estimate of NOPLAT ($12.4 billion), return on nı investment equal to the cost of capital (9.3 percent), and a long-teı growth rate of 4 percent, the continuing value is estimated at $133.4 b lion. This value is then discounted into today's dollars and added to t value from the explicit forecast period to determine Home Depot's oper ing value (see Exhibit 5.4).

Alternative methods and additional details for estimating continui value are provided in Chapter 9.

Discounting free cash flow at the weighted average cost of capital To (termine the value of operations, discount each year's forecast of free ca flow for time and risk. When you discount any set of cash flows, make sı to define the cash flows and discount factor consistently. Since free ca flows are available to *all* investors, the discount factor for free cash flı must represent the risk faced by all investors. The weighted average cost capital (WACC) blends the required rates of return for debt (k_d) and equ (k_e) based on their market-based target values. For a company financ solely with debt and equity, the WACC is defined as follows:

$$\text{WACC} = \frac{D}{D+E} k_d(1 - T_m) + \frac{E}{D+E} k_e$$

Note how the cost of debt has been reduced by the marginal tax rate (T We do this because the interest tax shield has been *excluded* from free ca flow (remember, interest is tax deductible). Since the interest tax shield l value, it must be incorporated in the valuation. Enterprise DCF values ı tax shield by reducing the weighted average cost of capital.

Why move the interest tax shields from free cash flow to the cost of c

t 5.10 Home Depot: Weighted Average Cost of Capital

urce of pital	Proportion of total capital	Cost of capital	Marginal tax rate	After-tax opportunity cost	Contribution to weighted average
:bt	8.3	4.7	38.2	2.9	0.2
uity	91.7	9.9		9.9	9.1
ACC	**100.0**				**9.3**

uity, we can compare operating performance across companies and ne without regard to capital structure. By focusing solely on operave can develop a cleaner picture of historical performance, and this better forecasting.

hough applying the weighted average cost of capital is intuitive and ly straightforward, it comes with some drawbacks. If you discount re cash flows with a constant cost of capital, as most analysts do, implicitly assuming the company manages its capital structure to a ate. For example, if a company plans to increase its debt-to-value e current cost of capital will understate the expected tax shields. Al- the WACC can be adjusted for a changing capital structure, the pro- complicated. In these situations, we recommend an alternative l such as adjusted present value.

weighted average cost of capital for Home Depot is presented in Ex- 10. For simplicity, the cost of capital in this valuation is based on the y's current capital structure. Since Home Depot has very little debt, ighted average cost of capital (9.3 percent) is very close to Home s cost of equity (9.9 percent). Chapter 10 provides a more formal dis- of WACC and its components.

s cost of capital is used to discount each year's forecasted cash flow, as the continuing value. The result is the value of operations.

ying and Valuing Nonoperating Assets

measured properly, free cash flow from operations should not in- ny cash flows from nonoperating assets. Instead, nonoperating as- ould be valued separately. Nonoperating assets can be segmented o groups, marketable securities and illiquid investments.

(IAS) No. 39 (1998) require companies to report liquid debt and equity investments (e.g., excess cash and marketable securities) at a fair market value on the company's balance sheet.[4] Therefore, when valuing *liquid* nonoperating assets, use their most recent reported balance sheet value, rather than discount future nonoperating flows.

Illiquid investments, such as nonconsolidated subsidiaries When valuing a company from the inside, you should value illiquid investments by using enterprise DCF (i.e., project cash flow and discount at the appropriate cost of capital). If you are valuing the company from the outside, valuation of these assets is rough at best. Companies disclose very little information about illiquid investments, such as discontinued operations, excess real estate, nonconsolidated subsidiaries, and other equity investments.

For nonconsolidated subsidiaries, information disclosure depends on the level of ownership. When a company has some influence but not a con- trolling interest[5] in another company, it records its portion of the sub- sidiary's profits on its own income statement and the original investmen plus its portion of reinvested profits on its own balance sheet. Use this in formation to create a simple cash flow statement. To discount the cash flow use a cost of capital commensurate with the risk of the investment, not th parent company's cost of capital (this is why we recommend separation c operating and nonoperating assets).

When ownership is less than 20 percent, investments are reported a historical cost, and the company's portion of profits is recorded *only* whe paid out to the parent. In most situations, you will see nothing more tha the investment's original cost. In this case, use a multiple of the book valu or a tracking portfolio to value the investment. Further details for valuir nonoperating assets are covered in Chapter 11.

Identifying and Valuing Nonequity Claims

Add the value of nonoperating assets to the value of operations to det mine enterprise value. To estimate equity value, subtract any nonequ claims, such as debt, unfunded retirement liabilities, capitalized operat leases, and outstanding employee options. Common equity is a resid claimant, receiving cash flows only after the company has fulfilled m other contractual claims. In today's increasingly complex financial m kets, *many* claimants have rights to a company's cash flow before equ

[4] Liquid investments can appear as either current or long-term assets. Their placement dep on when management intends to sell the assets.

... this is generally accepted as between 20 percent and 5(

nd they are not always easy to spot. Enron collapsed in 2001 weight of hidden debt. The company signed agreements with the of its nonconsolidated subsidiaries, promising to cover loan if the subsidiaries could not.[6] Since the subsidiaries were not ed, the debt never appeared on Enron's balance sheet, and in- amatically overestimated the equity's value. When the loans osed in November 2001, the company's stock price fell by more rcent in a single week.

re the most common nonequity claims:

t: If available, use the market value of all outstanding debt, uding fixed and floating rate debt. If that information is un- ilable, the book value of debt is a reasonable proxy, unless the bability of default is high or interest rates have changed dramat- ly since the debt was originally issued. Any valuation of debt, vever, should be consistent with your estimates of enterprise ue. (See Chapter 11 for more details.)

funded retirement liabilities: The recent weak performance of global ck markets and the rising cost of health care have left many com- nies with retirement liabilities that are partially unfunded. Al- ough the actual shortfall is not reported on the balance sheet (only moothed amount is transferred to the balance sheet), the stock rket clearly values unfunded retirement liabilities as an offset inst enterprise value. Consider General Motors, which raised arly $20 billion in debt to fund its pension deficit. The company's ck price actually rose during the month when the new debt was nounced and issued. Investors knew a liability existed, even ough it wasn't on the balance sheet.

erating leases: These represent the most common form of off-balance- eet debt. Under certain conditions, companies can avoid capitaliz- g leases as debt on their balance sheet, although required payments ist be disclosed in the footnotes.

ntingent liabilities: Any other material off-balance-sheet contingen- es, such as lawsuits and loan guarantees, will be reported in the otnotes.

eferred stock: Although the name denotes equity, preferred stock in ell-established companies more closely resembles unsecured debt. erefore, preferred-stock dividends (which are often predeter- ined and required) should be valued separately, using an appropri- e risk-adjusted discount rate.

... Financial Obligations into Off-Book Vehicles Is

- *Employee options:* Each year, many companies offer their employee compensation in the form of options. Since options give the employe the right to buy company stock at a potentially discounted price, they can have great value. Employee options can be valued using tradi tional models, such as Black-Scholes, or advanced techniques such a lattice models.
- *Minority interest:* When a company controls a subsidiary but does no own 100 percent, the investment must be consolidated on the paren company's balance sheet, and the funding other investors provide i recognized on the parent company's balance sheet as minority inter est. When valuing minority interest, it is important to realize the m nority interest holder does not have a claim on the company's asset but rather a claim on the subsidiary's assets. Thus, minority intere must be valued separately and not as a percentage of company valu

The identification and valuation of nonequity financial claims are covere in detail in Chapter 11.

A common mistake made when valuing companies is to double-cou claims already deducted from cash flow. Consider a company with a pe sion shortfall. You have been told the company will make extra payments eliminate the liability. If you deduct the present value of the liability fro enterprise value, you should not model the extra payments within free ca flow; that would mean double-counting the shortfall (once in cash flow ar once as a claim), leading to an underestimate of equity value.

Valuing Equity

Once you have identified and valued all nonequity claims, we can subtra the claims from enterprise value to determine equity value. Home Depot h traditional debt ($1.4 billion) and capitalized operating leases ($6.6 billio To value Home Depot's common stock, we subtract each of these claims fr Home Depot's enterprise value (see Exhibit 5.4).

To determine Home Depot's share price, divide the estimated comm stock value by the number of undiluted shares outstanding. Do not use luted shares. We have already valued convertible debt and employee st options separately. If we were to use diluted shares, we would be doub counting the options' value.

At the end of fiscal year 2003, Home Depot had 2.3 billion shares o standing. Dividing the equity estimate of $73.2 billion by 2.3 billion sha generates an estimated value of $32 per share. The estimated share value sumes Home Depot can maintain its current ROIC over the forecast per and the growth rate will remain strong, decaying gradually over the next uring the first half of 2004, the Home Depot's actual stock price etween $32 and $38 per share.

MIC-PROFIT-BASED VALUATION MODELS

erprise DCF model is a favorite of academics and practitioners cause it relies solely on how cash flows in and out of the company. x accounting can be replaced with a simple question: Does cash hands? One shortfall of enterprise DCF, however, is that each ash flow provides little insight into the company's performance. ng free cash flow can signal either poor performance or investment future. The economic profit model highlights how and when the ıy creates value yet leads to a valuation that is identical to that of ise DCF.

stated in Chapter 3, economic profit measures the value created by ıpany in a single period and is defined as follows:

$$\text{Economic Profit} = \text{Invested Capital} \times (\text{ROIC} - \text{WACC})$$

OIC equals NOPLAT divided by invested capital, we can rewrite the n as follows:

$$\text{Economic Profit} = \text{NOPLAT} - (\text{Invested Capital} \times \text{WACC})$$

Exhibit 5.11, we present economic profit calculations for Home Depot ɔoth methods. Since Home Depot has been earning returns greater s cost of capital, its historical economic profit is positive. Given the ny's strong competitive position, we also project positive economic going forward. Not every company has positive economic profit. In ıany companies earn an accounting profit (net income greater than ɔut do not earn their cost of capital.

demonstrate how economic profit can be used to value a company— demonstrate its equivalence to enterprise DCF, consider a stream of ng cash flows valued using the growing-perpetuity formula:

$$\text{Value}_0 = \frac{\text{FCF}_1}{\text{WACC} - g}$$

Chapter 3, we transformed this cash flow perpetuity into the key driver model. The key value driver model is superior to the simple flow perpetuity model, because it explicitly models the relation be- ... Using a few additional algebraic

Exhibit 5.11 Home Depot: Economic Profit Summary

$ million

	Historical 2001	2002	2003	Forecast 2004	2005	2006
Method 1						
Return on invested capital	15.0%	16.8%	19.4%	17.5%	17.4%	17.4%
Weighted average cost of capital	10.1%	9.0%	9.3%	9.3%	9.3%	9.3%
Economic spread	4.9%	7.9%	10.1%	8.2%	8.1%	8.1%
Invested capital	21,379	23,635	26,185	29,655	32,910	36,43
Economic profit	**1,048**	**1,857**	**2,645**	**2,424**	**2,677**	**2,95**
Method 2						
Invested capital	21,379	23,635	26,185	29,655	32,910	36,43
Weighted average cost of capital	10.1%	9.0%	9.3%	9.3%	9.3%	9.3
Capital charge	2,159	2,124	2,438	2,761	3,064	3,39
NOPLAT	3,208	3,981	5,083	5,185	5,741	6,34
Capital charge	2,159	2,124	2,438	2,761	3,064	3,39
Economic profit	**1,048**	**1,857**	**2,645**	**2,424**	**2,677**	**2,95**

steps (see Appendix A) and the assumption that the company's ROIC new projects equals historical ROIC, we can transform the cash flow pe tuity into a key value driver model based on economic profits:

$$\text{Value}_0 = \text{Invested Capital}_0 + \frac{\text{Invested Capital}_0 \times (\text{ROIC} - \text{WACC})}{\text{WACC} - g}$$

Finally, we substitute the definition of economic profit:

$$\text{Value}_0 = \text{Invested Capital}_0 + \frac{\text{Economic Profit}_1}{\text{WACC} - g}$$

As can be seen in the economic-profit-based key value driver model operating value of a company equals its book value of invested capital the present value of all future value created. In this case, the future nomic profits are valued using a growing perpetuity, because the pany's economic profits are increasing at a constant rate over time. generally, economic profit can be valued as follows:

$$\text{Value}_0 = \text{Invested Capital}_0 + \sum_{t=1}^{\infty} \frac{\text{Invested Capital}_{t-1} \times (\text{ROIC}_t - \text{WACC})}{(1 + \text{WACC})^t}$$

ıce the economic profit valuation was derived directly from the free ow model (see Appendix B for a proof of equivalence), any valuation on discounted economic profits will be identical to enterprise DCF. ure equivalence, however, you must:

Use beginning-of-year invested capital (i.e., last year's value).

Use the same invested-capital number for both economic profit and ROIC. For example, ROIC can be measured either with or without goodwill. If you measure ROIC without goodwill, invested capital must also be measured without goodwill. All told, it doesn't matter how you define invested capital, as long as you are consistent.

hibit 5.12 presents the valuation results for Home Depot using eco- profit. Economic profits are explicitly forecasted for 10 years; the

bit 5.12 Home Depot: Economic Profit Valuation

ear	Invested capital[1] ($ million)	ROIC (percent)	WACC (percent)	Economic profit ($ million)	Discount factor (@ 9.3%)	Present value of economic profit ($ million)
004	29,655	17.5	9.3	2,424	0.915	2,217
005	32,910	17.4	9.3	2,677	0.837	2,241
006	36,432	17.4	9.3	2,950	0.766	2,259
007	40,235	17.4	9.3	3,242	0.700	2,271
008	44,329	17.3	9.3	3,556	0.641	2,278
009	48,729	17.3	9.3	3,890	0.586	2,281
2010	53,445	17.3	9.3	4,247	0.536	2,278
2011	58,488	17.2	9.3	4,627	0.491	2,270
2012	63,870	17.2	9.3	5,031	0.449	2,258
2013	69,600	17.2	9.3	5,458	0.411	2,241
Continuing value				57,671	0.411	23,679
Present value of economic profit						46,273
Invested capital[1] $_{2004}$						29,655
Invested capital plus present value of economic profit						75,928
Mid-year adjustment factor						1.046
Value of operations						**79,384**
Value of excess cash						1,609
Value of other nonoperating assets						84
Enterprise value						**81,077**
Value of debt						(1,365)
[illegible]						(6,554)

remaining years are valued using an economic profit continuing-value mula.[7] Comparing the equity value from Exhibit 5.4 with that of Ex 5.12, we see that the value of Home Depot's stock is the same, regardle the method.

The benefit of economic profit becomes apparent when we exa the drivers of economic profit, ROIC and WACC, on a year-by-year bas Exhibit 5.12. Notice how the valuation depends heavily on Home De ability to maintain current levels of ROIC (17.5 percent) well abov WACC (9.3 percent). If the company's markets become saturated, gr could become elusive, and some companies might compete on price to market share. If this occurs, ROICs will drop, and economic profits wi vert to zero. Explicitly modeling ROIC as a primary driver of econ profit will prominently display this analysis. Conversely, the free cash model fails to show this dynamic. Free cash flow could continue to even as ROIC falls.

Another insight generated by the economic profit model occurs comparing a company's value of operations with its invested capita Home Depot, the estimated operating value ($79.4 billion) exceeds the pany's invested capital ($29.7 billion) by more than $49.7 billion.

ADJUSTED PRESENT VALUE MODEL

When building an enterprise DCF or economic profit valuation, most cial analysts discount all future flows at a *constant* weighted average capital. Using a constant WACC, however, assumes the company ma its capital structure to a target debt-to-value ratio.

In most situations, debt grows in line with company value. But su the company planned to significantly change its capital structure. Ir companies with significant debt often pay it down as cash flow imp thus lowering their future debt-to-value ratios. In these cases, a val

[7] To calculate continuing value, you can use the economic-profit-based key value driver but only if RONIC equals historical ROIC in the continuing-value year. If RONIC going differs from the final year's ROIC, then the equation must be separated into current an economic profits:

$$\text{Continuing Value}_t = \underbrace{\frac{IC_t\,(ROIC_{t+1} - WACC)}{WACC}}_{\text{Current Economic Profits}} + \underbrace{\frac{PV(\text{Economic Profit}_{t+2})}{WACC - g}}_{\text{Future Economic Profits}}$$

such that

l on a constant WACC would overstate the value of the tax shields. Al- ;h the WACC can be adjusted yearly to handle a changing capital :ure, the process is complex. Therefore, we turn to an alternative l: adjusted present value.

he adjusted present value (APV) model separates the value of opera- into two components: the value of operations as if the company were all- / financed and the value of tax shields that arise from debt financing:[8]

$$\text{Adjusted Present Value} = \text{Enterprise Value as if the Company Was All-Equity Financed} + \text{Present Value of Tax Shields}$$

ıe APV valuation model follows directly from the teachings of ;liani and Miller, who proposed that in a market with no taxes (among things), a company's choice of financial structure will not affect the of its economic assets. Only market imperfections, such as taxes and ss costs, affect enterprise value.

hen building a valuation model, it is easy to forget these teachings. · this, imagine a company (in a world with no taxes) that has a 50-50 f debt and equity. If the company's debt has an expected return of 5 ıt and the company's equity has an expected return of 15 percent, ighted average cost of capital would be 10 percent. Suppose the com- lecides to issue more debt, using the proceeds to repurchase shares. the cost of debt is lower than the cost of equity, it would appear that g debt to retire equity should lower the WACC, raising the com- ; value.

is line of thinking is flawed, however. In a world without taxes, a ⁊ in capital structure would *not* change the cash flow generated by ions, nor the risk of those cash flows. Therefore, neither the com- ; enterprise value nor its cost of capital would change. So why : think it would? When adding debt, we adjusted the weights, but we to properly increase the cost of equity. Since debt payments have y over cash flows to equity, adding leverage increases the risk ity holders. When leverage rises, they demand a higher return. liani and Miller postulated this increase would perfectly offset the : in weights.

reality, taxes play a part in decision making, and capital structure therefore *can* affect cash flows. Since interest is tax deductible, prof- :ompanies can lower taxes by raising debt. But, if the company relies

book, we focus on the tax shields generated by interest. On a more general basis, the ıes *any* incremental cash flows associated with capital structure, such as tax shields,

too heavily on debt, the company's customers and suppliers may fear bank ruptcy and walk away, restricting future cash flow (academics call thi distress costs or deadweight costs). Rather than model the effect of capita structure changes in the weighted average cost of capital, APV explicitl measures and values the cash flow effects of financing separately.

To build an APV-based valuation, value the company as if it were al equity financed. Do this by discounting free cash flow by the unlevered co: of equity (what the cost of equity would be if the company had no debt). T this value, add any value created by the company's use of debt. Exhibit 5.1 values Home Depot using adjusted present value. Since we assume th: Home Depot will manage its capital structure to a target debt-to-value lev of 9.3 percent, the APV-based valuation leads to the same value for equity a

Exhibit 5.13 Home Depot: Valuation Using Adjusted Present Value

Year	Free cash flow ($ million)	Interest tax shield (ITS)	Discount factor (@ 9.5%)	Present value of FCF ($ million)	Present value of ITS ($ million)
2004	1,930	113	0.914	1,763	103
2005	2,219	120	0.835	1,852	100
2006	2,539	128	0.763	1,936	98
2007	2,893	136	0.697	2,016	95
2008	3,283	145	0.636	2,090	92
2009	3,711	153	0.581	2,158	89
2010	4,180	162	0.531	2,220	86
2011	4,691	171	0.485	2,276	83
2012	5,246	180	0.443	2,326	80
2013	5,849	189	0.405	2,369	77
Continuing value	129,734	3,626	0.405	52,550	1,469
Present value				73,557	2,372
Present value of FCF using unlevered cost of equity					73,557
Present value of interest tax shields (ITS)					2,372
Present value of FCF and ITS					75,928
Mid-year adjustment factor					1.046
Value of operations					**79,384**
Value of excess cash					1,609
Value of other nonoperating assets					84
Enterprise value					**81,077**
Value of debt					(1,365)
Value of capitalized operating leases					(6,554)
Equity value					**73,158**

rise DCF (see Exhibit 5.4) and economic profit (see Exhibit 5.12). A proof of equivalence between enterprise DCF and adjusted pres- :an be found in Appendix C. The following subsections explain tail.

: Cash Flow at Unlevered Cost of Equity

uing a company using the APV, we explicitly separate the unlev- : of operations (V_u) from any value created by financing, such as s (V_{txa}). For a company with debt (D) and equity (E), this relation is ::

$$V_u + V_{txa} = D + E \tag{1}$$

ond result of Modigliani and Miller's work is that the total risk of any's assets, real and financial, must equal the total risk of the fi- laims against those assets. Thus, in equilibrium, the blended cost l for operating assets (k_u, which we call the unlevered cost of eq- l financial assets (k_{txa}) must equal the blended cost of capital for and equity (k_e):

$$\underbrace{\frac{V_u}{V_u + V_{txa}} k_u}_{\text{Operating Assets}} + \underbrace{\frac{V_{txa}}{V_u + V_{txa}} k_{txa}}_{\text{Tax Assets}} = \underbrace{\frac{D}{D+E} k_d}_{\text{Debt}} + \underbrace{\frac{E}{D+E} k_e}_{\text{Equity}} \tag{2}$$

ıe corporate finance literature, academics combine Modigliani and two equations to solve for the cost of equity—to demonstrate the re- etween leverage and the cost of equity. In Appendix D, we alge- y rearrange equation 2 to solve for the levered cost of equity:

$$k_e = k_u + \frac{D}{E}(k_u - k_d) - \frac{V_{txa}}{E}(k_u - k_{txa})$$

; equation indicates, the cost of equity depends on the unlevered equity plus a premium for leverage, less a reduction for the tax de- lity of debt.

ıining the unlevered cost of equity with market data To use the -- need to discount projected free cash flow at the unlevered cost of

equation 2 can be observed. Only the values on the right—that is, those related to debt and equity—can be estimated directly. Because there are so many unknowns and only one equation, we must impose additional restrictions to solve for k_u.

Method 1: Assume k_{txa} equals k_u If you believe the risk associated with tax shields (k_{txa}) equals the risk associated with operating assets (k_u), equation 2 can be simplified dramatically (see Appendix D):

$$k_u = \frac{E}{D+E} k_d + \frac{D}{D+E} k_e \tag{3}$$

We can now determine the unlevered cost of equity because it now relie: solely on observable variables, that is, those related to debt and equity. Ir fact, k_u looks very similar to the weighted average cost of capital, without th‹ interest tax shield.

Equation 3 can be rearranged to solve for the levered cost of equity:

$$k_e = k_u + \frac{D}{E}(k_u - k_d) \tag{4}$$

Note that when the company has no debt ($D = 0$), k_e equals k_u. This i why k_u is referred to as the unlevered cost of equity.

Method 2: Assume k_{txa} equals k_d If you believe the risk associated wit tax shields (k_{txa}) is comparable to the risk of debt (k_d), equation 2 can be rı arranged to solve for the unlevered cost of equity:

$$k_u = \frac{D - V_{txa}}{D - V_{txa} + E} k_d + \frac{E}{D - V_{txa} + E} k_e \tag{5}$$

In this equation, k_u relies on observable variables, such as the market valı of debt, market value of equity, cost of debt, and cost of equity, as well as oı unobservable variable: the present value of tax shields (V_{txa}). To use equ tion 4, discount expected future tax shields at the cost of debt (to rema consistent) and *then* solve for the unlevered cost of equity.

Many practitioners further refine the last equation by imposing an adc tional restriction: that the absolute dollar level of debt is constant. If the dı lar level of debt is constant, the annual expected tax shield equals ($D \times k_d$)

, equals the marginal tax rate. Applying a no-growth perpetu-
illows us to value the tax shield:

$$V_{txa} = \frac{(D \times k_d) \times T_m}{k_d} = D \times T_m$$

, $D \times T_m$ for the value of the tax shield in the last equation leads to:

$$k_u = \frac{(1-T_m)D}{(1-T_m)D+E} k_d + \frac{E}{(1-T_m)D+E} k_e \qquad (6)$$

quation 6 is quite common in practice, its use is limited because
tions are extremely restrictive.

the appropriate formula Which formula should you use to for the unlevered cost of equity, k_u? It depends on how you see ıy managing its capital structure going forward and whether the free. If you believe the company will manage its debt-to-value to vel (the company's debt will grow with the business), then the ıe tax shields will track the value of the operating assets. Thus, tax shields will equal the risk of operating assets (k_{txa} equals k_u). ıty of companies have relatively stable capital structures (as a per- expected value), so we favor the first method.

believe the debt to equity ratio will not remain constant, then the ıterest tax shields will be more closely tied to the value of fore- ıt, rather than operating assets. In this case, the risk of tax shields ent to the risk of debt (when a company is unprofitable, it cannot est tax shields, the risk of default rises, and the value of debt this case, equation 5 better approximates the unlevered cost of eq- s situation occurs frequently in periods of high debt such as fi- istress and leveraged buyouts.

: Shields and Other Capital Structure Effects

ete an APV-based valuation, forecast and discount capital struc- effects such as tax shields, security issue costs, and distress costs. me Depot has little chance of default, we estimated the company's terest tax shields using the company's promised yield to maturity ginal tax rate (see Exhibit 5.14). To calculate the expected interest

Exhibit 5.14 Home Depot: Forecast of Interest Tax Shields

Year	Prior year net debt ($ million)	Expected interest rate (percent)	Interest payment ($ million)	Marginal tax rate (percent)	Interest tax shield ($ million)
2004	6,310	4.7	295	38.2	113
2005	6,737	4.7	315	38.2	120
2006	7,179	4.7	336	38.2	128
2007	7,637	4.7	357	38.2	136
2008	8,107	4.7	379	38.2	145
2009	8,589	4.7	402	38.2	153
2010	9,081	4.7	425	38.2	162
2011	9,579	4.7	448	38.2	171
2012	10,081	4.7	472	38.2	180
2013	10,583	4.7	495	38.2	189
Continuing value	11,082	4.7	518	38.2	198

payment in 2004, multiply the prior year's net debt of $6.3 billion by the expected yield of 4.7 percent (net debt equals reported debt plus capitalized operating leases minus excess cash). This led to an expected interest payment of $295 million. Next multiply the expected interest payment by the marginal tax rate of 38.2 percent, for an expected interest tax shield of $113 million in 2004.

Home Depot's conservative use of debt makes tax shield valuation straightforward. For companies with significant leverage, the company may not be able to fully use the tax shields (it may not have enough profits to shield). If there is a significant probability of default, you must model *expected* tax shields, rather than the tax shields based on promised interest payments. To do this, reduce each promised tax shield by the cumulative probability of default.

CAPITAL CASH FLOW MODEL

When a company actively manages its capital structure to a target debt-to value level, both free cash flow (FCF) and the interest tax shield (ITS) are discounted at the unlevered cost of equity, k_u:

$$V = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+k_u)^t} + \sum_{t=1}^{\infty} \frac{ITS_t}{(1+k_u)^t}$$

... School argued ther

inted by the same cost of capital.[10] He combined the two flows and d the resulting cash flow (FCF plus interest tax shields) capital cash CCF):

$$V = \text{PV(Capital Cash Flows)} = \sum_{t=1}^{\infty} \frac{\text{FCF}_t + \text{ITS}_t}{(1+k_u)^t}$$

iven that Ruback's assumptions match those of the weighted average f capital, the capital cash flow and WACC-based valuations will lead ntical results. In fact, we now have detailed three distinct but identical tion methods created solely around how they treat tax shields: WACC hield valued in the cost of capital), APV (tax shield valued separately), CF (tax shield valued in the cash flow).

lthough FCF and CCF lead to the same result when debt is propor- l to value, we believe free cash flow models are superior to capital cash models. Why? By keeping NOPLAT and FCF independent of leverage, an cleanly evaluate the company's operating performance over time across competitors. A clean measure of historical operating perfor- e leads to better forecasts.

H-FLOW-TO-EQUITY VALUATION MODEL

ich of the preceding valuation models, we determined the value of eq- indirectly by subtracting nonequity claims from enterprise value. The ty cash flow model values equity directly by discounting cash flows juity at the cost of equity, rather than at the weighted average cost of al.[11]

Exhibit 5.15 details the cash flows to equity for Home Depot. Cash flow juity can be computed by reorganizing free cash flow found in Exhibit or using the traditional method in Exhibit 5.15. In the traditional od, cash flow to equity starts with net income. Next, noncash expenses dded back, and investments in working capital, fixed assets, and non- ating assets are subtracted. Finally, any increases in nonequity financ- such as debt are added, and decreases in nonequity financing are racted. Alternatively, we can compute cash flow to equity as dividends

hard S. Ruback, "Capital Cash Flows: A Simple Approach to Valuing Risky Cash Flows," l Science Research Network (March 2000).

[illegible] method can be difficult to implement correctly because capital structure is em-

Exhibit 5.15 Home Depot: Equity Cash Flow Summary

$ million

	Historical 2001	2002	2003	Forecast 2004	2005	
Net income	3,044	3,664	4,304	4,796	5,318	5
Depreciation	756	895	1,075	1,193	1,321	1
Amortization	8	8	1	0	0	
Increase (decrease) in deferred taxes	(6)	173	605	214	237	
Gross cash flow	3,802	4,740	5,985	6,203	6,876	7
Investment in operating working capital	834	(194)	72	(294)	(318)	
Investment in net long-term assets	(3,224)	(2,683)	(3,780)	(3,433)	(3,745)	(4
Decrease (increase) in excess cash	(1,509)	383	(473)	(177)	(191)	
Investment in other nonoperating assets	9	(24)	23	(9)	(10)	
Increase (decrease) in short-term debt	207	(211)	509	(44)	(54)	
Increase (decrease) in long-term debt	(295)	71	(465)	(73)	(91)	
Cash flow to equity	**(176)**	**2,082**	**1,871**	**2,173**	**2,466**	**2**

	2001	2002	2003	2004	2005	
Dividends	396	492	595	663	735	
Share repurchases (issued)	(572)	1,590	1,276	1,510	1,731	1
Cash flow to equity	**(176)**	**2,082**	**1,871**	**2,173**	**2,466**	**2**

plus share repurchases minus new equity issues. Both methods ger identical results.

To value Home Depot, we discount projected equity cash flows at th of equity (see Exhibit 5.16 on p. 128). Unlike enterprise-based mode adjustments are made for nonoperating assets, debt, or capitalized ope leases. Rather, they are included as part of the equity cash flow.

Once again, note how the valuation, derived using equity cash f matches each of the prior valuations.[12] This occurs because we have mc

[12] When performing a stand-alone equity cash flow valuation, you can calculate the con value by using a simple growing perpetuity:

$$V_e = \frac{\text{Net Income}\left(1 - \dfrac{g}{\text{ROE}}\right)}{k_e - g}$$

To tie the free cash flow and equity cash flow models, you must convert free cash flow c ing-value inputs into equity cash flow inputs. We did this using:

$$\text{NOPLAT}\left(1 - \frac{g}{\text{ROIC}}\right)$$

5.16 Home Depot: Cash-Flow-to-Equity Valuation

Year	Cash flow to equity ($ million)	Discount factor (@ 9.9%)	Present value of CFE ($ million)
2004	2,173	0.910	1,978
2005	2,466	0.828	2,042
2006	2,788	0.754	2,101
2007	3,143	0.686	2,155
2008	3,530	0.624	2,203
2009	3,954	0.568	2,245
2010	4,416	0.517	2,282
2011	4,917	0.470	2,312
2012	5,459	0.428	2,336
2013	6,044	0.389	2,353
Continuing value	122,492	0.389	47,695
Present value of cash flow to equity			69,702
Midyear adjustment amount			3,456
Equity value			**73,158**

Depot's debt-to-value ratio at a constant level. If debt-to-value instead s over time, the equity model becomes difficult to implement and can conceptual errors. For example, if leverage is expected to rise, the cost ty must be adjusted to reflect the additional risk imposed on equity . Although formulas exist to adjust the cost of equity, many of the own formulas are built under restrictions that may be inconsistent e way you are implicitly forecasting the company's capital structure cash flows. This will cause a mismatch between cash flows and the equity, resulting in an incorrect valuation.

wittingly changing the company's capital structure when using the ow-to-equity model occurs too easily—and that is what makes the so risky. Suppose you plan to value a company whose debt-to-value s 15 percent. You believe the company will pay extra dividends, so you se debt to raise the dividend payout ratio. Presto! Increased divi- lead to higher equity cash flows and a higher valuation. Even though ing performance has not changed, the equity value has mistakenly sed. What happened? Using new debt to pay dividends causes a rise debt to value. Unless you adjust the cost of equity, the valuation will ncorrectly.

nother shortcoming of the direct equity approach occurs when valu- ... The direct equity approach requires allo-

OTHER APPROACHES TO DISCOUNTED CASH FLOW

You may also come across two variants of enterprise DCF:

1. Using real instead of nominal cash flows and discount rates
2. Discounting pretax cash flows instead of after-tax cash flows

These approaches are well suited only to limited circumstances.

Using Real Cash Flows and Discount Rates

Companies can be valued by projecting cash flow in real terms (e.g., in co stant 2004 dollars) and discounting this cash flow at a real discount r (e.g., the nominal rate less expected inflation). But most managers think terms of nominal rather than real measures, so nominal measures are oft easier to communicate. In addition, interest rates are generally quoted nc inally rather than in real terms (excluding expected inflation). Also, si historical financial statements are stated in nominal terms, projecting ture statements in real terms is difficult and confusing.

A second difficulty occurs when calculating and interpreting RC The historical statements are nominal, so historical returns on inves capital are nominal. But if the projections for the company use real rat than nominal forecasts, returns on new capital are also real. Projected turns on total capital (new and old) are a combination of nominal and r so they are impossible to interpret. The only way around this is to res historical performance on a real basis. This is a complex and ti consuming task. The extra insights gained rarely equal the effort (excep extremely high-inflation environments described in Chapter 22).

Discounting Pretax Cash Flow

For purposes of valuing internal investment opportunities, individual p ect cash flows are sometimes calculated without taxes. The pretax cash f is then discounted by a pretax "hurdle rate" (the market-based cost of c tal multiplied by 1 plus the marginal tax rate) to determine a pretax val

This method, however, leads to three fundamental inconsistencies. I the government calculates taxes on profits after depreciation, not on cash after capital expenditures. By discounting pretax cash flow at the pretax of capital, you implicitly assume capital investments are tax deductible v made, not as they are depreciated. Furthermore, short-term investments, as accounts receivable and inventory, are never tax deductible. Selling a p ... leads to incremental taxes, not holding inventory. By

:s in operating working capital are tax deductible. Finally, it can be : even when net investment equals depreciation, the final result will ard biased—and the larger the cost of capital, the larger the bias. occurs because the method is only an approximation, not a formal cal relation. Because of these inconsistencies, we recommend scounting pretax cash flows at a pretax hurdle rate.

TIVES TO DISCOUNTED CASH FLOW

oint, we have focused solely on discounted cash flow models. tional valuation techniques exist: multiples (comparables) and ns.

:hat you have been asked to value a company that is about to go lthough you project and discount free cash flow to derive an en- value, you worry that your forecasts lack precision. One way 'our DCF model in the proper context is to create a set of compara- e of the most commonly used comparables is the enterprise- earnings before interest, taxes, and amortization (EV/EBITA)

To apply the EV/EBITA multiple, look for a set of comparable es, and multiply a representative EV/EBITA multiple by the com- BITA. For example, assume the company's EBITA equals $100 mil- the typical EV/EBITA multiple in the industry is 15×. Multiplying)0 million leads to an estimated value of $1.5 billion. Is the enter- F valuation near $1.5 billion? If not, what enables the company to ter (or worse) returns or grow faster (or slower) than other com- 1 the industry?

ough the concept of multiples is simple, the methodology is mis- ood and often misapplied. Companies within an industry will ferent multiples for valid economic reasons. Computing a repre- e multiple ignores this fact. In addition, common multiples, such rice-to-earnings ratio, suffer from the same capital structure prob- equity cash flows. In Chapter 12, we demonstrate how to build and t forward-looking comparables, independent of capital structure er nonoperating items.

tions

have been named as a third recipient, but the Nobel Prize is not awarded posthumously.) Their model relies on what today's economists call a "repli- cating portfolio." They argued that if there exists a portfolio of traded secu- rities whose future cash flows perfectly mimic the security you are attempting to value, the portfolio and security must have the same price. As long as we can find a suitable replicating portfolio, we need not discount fu ture cash flows.

Given the model's power, there have been many recent attempts to translate the concepts of replicating portfolios to corporate valuation. This valuation technique is commonly known as real options. Unlike those for fi nancial options, however, replicating portfolios for companies and thei projects may be difficult to create. Therefore, although options-pricing models may teach powerful lessons, today's applications are limited. W cover valuation using options-based models in Chapter 20.

SUMMARY

This chapter described the most common DCF valuation models, with pa ticular focus on the enterprise DCF model and the economic profit mode We explained the rationale for each model and reasons why each model ha an important place in corporate valuation. The remaining chapters in Pa Two describe a step-by-step approach to valuing a company:

- Chapter 6: Thinking about Return on Invested Capital and Growt
- Chapter 7: Analyzing Historical Performance
- Chapter 8: Forecasting Performance
- Chapter 9: Estimating Continuing Value
- Chapter 10: Estimating the Cost of Capital
- Chapter 11: Calculating and Interpreting Results
- Chapter 12: Using Multiples for Valuation

These chapters explain the technical details of valuation, including how calculate free cash flow from the accounting statements and how to crea and interpret the valuation through careful financial analysis.