BEFORE THE
MICHIGAN PUBLIC SERVICE COMMISSION

DTE ELECTRIC COMPANY	**)**	
	)	
	)	Case No. U-20836
	)	
	)	

DIRECT TESTIMONY

OF

DR. BENTE VILLADSEN

LIST OF TOPICS ADDRESSED:

COST OF COMMON EQUITY CAPITAL

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I. INTRODUCTION AND PURPOSE

Q1. Please state your name, occupation, and business address for the record.

A1. My name is Bente Villadsen (she / her / hers). I am a Principal of The Brattle Group, whose business address is One Beacon Street, Suite 2600, Boston, Massachusetts, 02108.

Q2. Briefly describe your present responsibilities at The Brattle Group.

A2. As a Principal, it is my responsibility to research and direct research into the utility industry as it pertains to cost of capital and related issues. It is also my responsibility to consult on utility industry issues and testify on utility industry matters. Among my other duties is the supervision and training of staff and ensuring that work products are of high quality and accurate.

Q3. Briefly describe your education and professional qualifications.

A3. I have more than 20 years of experience working with regulated utilities on cost of capital and related matters. My practice focuses on cost of capital, regulatory finance, and accounting issues. I am the co-author of the text, "Risk and Return for Regulated Industries"[1] and a frequent speaker on regulated finance at conferences and webinars.

1 Bente Villadsen, Michael J. Vilbert, Dan Harris, A. Lawrence Kolbe, "*Risk and Return for Regulated Industries*," Academic Press, 2017.

I have testified or filed expert reports on cost of capital in Alaska, Arizona, California, Hawaii, Illinois, Iowa, Michigan, New Mexico, New York, Ohio, Oregon, and Washington, as well as before the Bonneville Power Administration, Federal Energy Regulatory Commission, the Surface Transportation Board, the Alberta Utilities Commission, the Ontario Energy Board, Quebec's Régie de l'Énergie and Barbados' Fair Trading Commission. I have provided white papers on cost of capital to the British Columbia Utilities Commission, the Canadian Transportation Agency as well as to European and Australian regulators on cost of capital. I have testified or filed testimony on regulatory accounting issues before the Federal Energy Regulatory Commission ("FERC"), the Regulatory Commission of Alaska, the Michigan Public Service Commission, the Texas Public Utility Commission as well as in international and U.S. arbitrations and regularly provide advice to utilities on regulatory matters as well as risk management.

I hold a Ph.D. from Yale University and as BS/MS from University of Aarhus, Denmark. Appendix A contains more information on my professional qualifications as well as a list of my prior testimonies and publications.

Q4. What is the purpose of your testimony in this proceeding?

A4. DTE Electric Company ("DTE Electric" or the "Company") has asked me to estimate the cost of equity that the Michigan Public Service Commission (the "Commission") should allow DTE Electric an opportunity to earn on the equity-financed portion of its regulated utility rate base. My recommendation also considers the business and financial risk of the Company relative to the proxy companies to arrive at my recommendation for the allowed Return on Equity ("ROE").

Q5. Are you sponsoring any exhibits?

A5. Yes. I am sponsoring Exhibit A-14, Schedule D5.1 through Schedule D5.18, which contains the details of my analysis and supporting tables. Specifically, I sponsor the following exhibits:

Schedule	Description
D5.1	BV-1: Table of Contents
D5.2	BV-2: Classification of Companies by Assets
D5.3	BV-3: Market Value of the Sample
D5.4	BV-4: Capital Structure Summary of the Sample
D5.5	BV-5: Estimated Growth Rates of the Sample
D5.6	BV-6: DCF Cost of Equity of the Sample
D5.7	BV-7: Overall After-Tax DCF Cost of Capital of the Sample
D5.8	BV-8: DCF Cost of Equity at DTE Electric's Proposed Capital Structure
D5.9	BV-9: Risk-Free Rates
D5.10	BV-10: Risk Positioning Cost of Equity of the Sample
D5.11	BV-11: Overall After-Tax Risk Positioning Cost of Capital of the Sample
D5.12	BV-12: Risk Positioning Cost of Equity at DTE Electric's Proposed Capital Structure
D5.13	BV-13: Unlevered Asset Beta

D5.14 BV-14: Sample Average Asset Beta Relevered at DTE Electric's Proposed Capital Structure

D5.15 BV-15: Risk Positioning Cost of Equity using Levered Betas

D5.16 BV-16: Risk Premium Cost of Equity

D5.17 BV-17: FERC-based MRP

Q6. Were these Exhibits and the accompanying schedules prepared by you or under your supervision?

A6. Yes, they were.

II. SUMMARY OF CONCLUSIONS

Q7. Can you summarize your primary conclusions and opinions on the appropriate allowed ROE and business risk characteristics for DTE Electric?

A7. The determination of DTE Electric's ROE takes place during the ongoing impacts from the COVID-19 pandemic, which has led to unprecedented low Treasury bond yields and shifts in the relative risk of industries. At the same time, some economists have raised inflation fears as the last few months has seen larger increases in the Consumer Price Index ("CPI") than any time since November 1990.[2] Additionally, the full impact of hurricane Ida has yet to be seen, but it may interrupt the supply of natural gas and oil – leading to changing prices or supply sources.[3]

As a result, measures of the premium investors require over and above the risk-free rate to invest in equity (the market risk premium) has increased relative to that of July 2019

[2] U.S. Bureau of Labor Statistics, "Economic News Release: Consumer Price Index Summary," November 10, 2021.
Consumer Price Index Summary - 2021 M10 Results (bls.gov)

[3] See, for example, Energy Information Administration, "EIA Expects Higher Natural Gas Prices as Production Reductions Remain Following Hurricane Ida," September 8, 2021.
U.S. Energy Information Administration (EIA) - Release

(the date of the data in my testimony in Case No. U-20561) and relative to December 2019 (when the record in Case No. U-20561 closed).[4] In that light, it is important to assure investors that the allowed ROE and capital structure is such that DTE Electric not only can raise needed capital but also provide a return that is comparable to those that investors expect. DTE Electric's most recent rate case, Case No. U-20561 resulted in a ROE of 9.9 percent on a 50% equity capital structure,[5] and the prior rate case order in Case No. U-20162 from May 2019 resulted in an ROE of 10.0 percent on a 50% equity capital structure.[6] Since 2019, the systematic risk of electric utilities, as measured by beta, has increased as has the market risk premium, while the risk-free rate as measured by government bonds has declined.[7]

Simply put, the financial markets have changed, which led equity investors to require a higher premium to hold equity instead of debt and for electric utilities such as DTE Electric the relative risk increased.

Therefore, it is important to recognize that the currently low Treasury yields are not reflective of a low cost of equity. Specifically, data on the forward-looking market risk premium and electric utilities' systematic risk point to a higher return on equity as of today than at the time of the Company's most recent rate case order, which was based on data as of July 2019. I therefore recommend a ROE of 10.25 percent, which is a modest increase over the most recently allowed ROE and very reasonable given the developments in capital markets.

I calculate DTE Electric's cost of equity using a sample of electric utilities and support the recommendation with an additional sample of highly regulated natural gas and

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4 Michigan Public Service Commission Order, Case No. U-20561, May 8, 2020, p. 5.

5 Michigan Public Service Commission Order, Case No. U-20561, May 8, 2020, pp. 166-177.

6 Michigan Public Service Commission, Order, Case No. U-20162, May 2, 2019, pp. 54, 67.

7 The average Value Line beta for the electric peers I use in U-20561 was 0.59; as of October 31, 2021, the average beta was 0.91. As of July 2019 (the date of the U-20561 filing), the forward-looking MRP as calculated by Bloomberg was 7.05%; as of October 31, 2021, the Bloomberg beta was 8.39%. Lastly, as of July 2019, the 20-year government bond yield was 2.36%; as of October 31, 2021, the yield was 2.03%. Source: Value Line Investment Survey, accessed November 15, 2021 and Bloomberg, accessed November 15, 2021.

water utilities, but note that the 10.25%, I recommend, is fully supported by the electric sample results.

To calculate the ROE that DTE Electric should be allowed an opportunity to earn, I used three distinct methods: (i) the Capital Asset Pricing Model (CAPM) and a variation thereof--the Empirical CAPM (ECAPM), (ii) the Discounted Cash Flow (DCF) model and a multi-stage variation, and (iii) a Risk Premium model. Each model has its pros and cons and I consider it important to consider multiple models.

Regarding business risk, I note that inflation fears, changing requirements for electric utilities along with the need for substantial capital spending leads to substantial business risk for electric utilities. For DTE Electric, which has no decoupling mechanism, any impact on load from the COVID-19 pandemic, energy efficiency, inflation pressures or economic downturns will result in the Company's cash flow being affected and more so than for electric utilities that do have a decoupling mechanism. I further discuss how these and other business risk factors affect the cost of equity in Section VI.

Based on my analyses of the three different cost of equity models, current market conditions, and DTE Electric's specific risks, I find that a reasonable return on equity for DTE Electric at the current time is 10.25 percent. This conclusion is based on the following observations:

- The results from the implementation of the three models using the electric sample result in the following ranges:

Figure 1: Summary of Electric Estimates at 50% Equity

	Low	High
CAPM / ECAPM	10.25%	11.50%
DCF	9.50%	10.50%
Risk Premium	9.80%	9.90%

Based on my analysis, I conclude as follows:

- DTE Electric has higher business risk than the comparable electric utilities because of (1) the lack of a decoupling mechanism; (2) the presence of potential drop in demand from customer choice; and (3) its ownership of nuclear generation, representing approximately 10% of its generation capacity.[8]

- Betas have increased as has the forward-looking market risk premium, so that the Cost of Equity is higher today than what is reflected in the data the Commission reviewed in its May 2020 decision regarding DTEE's allowed ROE (9.9% in Case No. U-20561).

Q8. How is the remainder of your testimony organized?

A8. Section III formally defines the cost of capital and explains the techniques for estimating it in the context of utility rate regulation. Section III.A discusses conditions and trends in capital markets and their impact on the cost of capital, including impacts on financial markets from the COVID-19 pandemic and rising inflation. Section V explains my analyses and presents the results. Section VI discusses DTE Electric's business risk characteristics, unique risks facing Michigan-based electric utilities, and other company-specific circumstances relevant to my recommended allowed ROE. Finally, Section VII concludes with a summary of my recommendations.

III. COST OF CAPITAL PRINCIPLES AND APPROACH

A. RISK AND THE COST OF CAPITAL

Q9. How is the "cost of capital" defined?

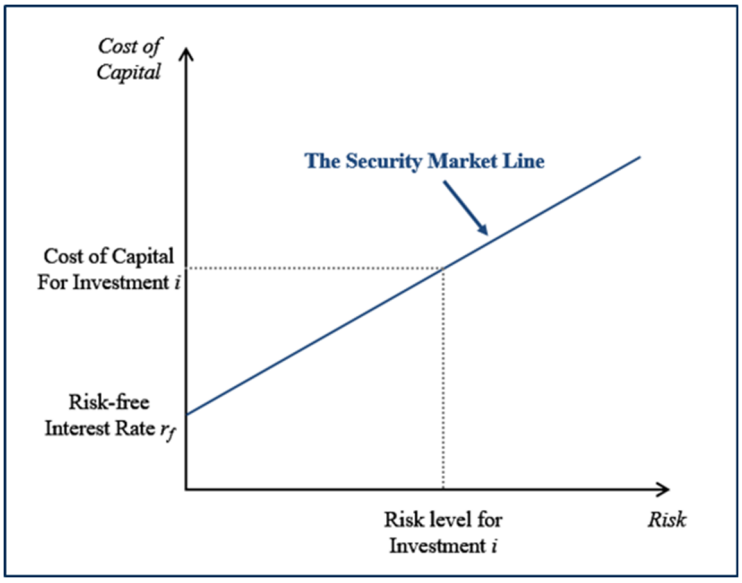
A9. The cost of capital is defined as the expected rate of return in capital markets on investments of equivalent risk. Cost of capital theory illustrates the direct relationship between risk and the expected rate of return – the higher the risk, the higher the cost of

[8] DTE Energy, 2020 10-K, p. 9.

capital required. This relationship is represented in the "security market risk-return line" (or "Security Market Line" for short), which is depicted in Figure 2 below.

The cost of capital is comprised of the cost of debt and equity. Specifically, when estimating the cost of equity for a given asset or business, two categories of risk are important: (1) business risk and (2) financial risk. Business risk reflects the degree to which the cash flows generated by a business (and its assets) vary in response to moves in the broader market. Financial risk reflects the risk from the level of debt within a business.

Figure 2: The Security Market Line



Q10. What factors contribute to systematic risk for an equity investment?

A10. When estimating the cost of equity for a given asset or business venture, two categories of risk are important. The first is business risk, which is the degree to which the cash flows generated by the business (and its assets) vary in response to moves in the broader market. In context of the CAPM, business risk can be quantified in terms of an "assets beta" or "unlevered beta." For a company with an assets beta of 1, the value of its enterprise will increase (decrease) by 1% for a 1% increase (decline) in the market index.

The second category of risk relevant for an equity investment depends on how the business enterprise is financed and is called financial risk. Section III.B below explains how financial risk affects the systematic risk of equity.

Q11. What are the guiding standards that define a just and reasonable allowed rate of return on rate-regulated utility investments?

A11. The seminal guidance on this topic was provided by the U.S. Supreme Court in the *Hope* and *Bluefield* cases,[9] which found that:

- The return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks;[10]
- The return should be reasonably sufficient to assure confidence in the financial soundness of the utility; and
- The return should be adequate, under efficient and economical management for the utility to maintain and support its credit and enable it to raise the money necessary for the proper discharge of its public duties.[11]

Q12. How does the standard for just and reasonable rate of return relate to the cost of capital?

A12. The first component of the *Hope* and *Bluefield* standard, as articulated above, is directly aligned with the financial concept of the opportunity cost of capital.[12] The cost of capital is the rate of return investors can expect to earn in capital markets on alternative investments of equivalent risk.[13]

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[9] Bluefield Water Works & Improvement Co. v. Public Service Com'n of West Virginia, 262 U.S. 679 (1923) ("Bluefield"), and Federal Power Com'n v. Hope Natural Gas Co., 320 U.S. 591 (1944) ("Hope").

[10] Hope, 320 U.S. at 603.

[11] Bluefield, 262 U.S. at 680.

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

[13] The opportunity cost of capital is also referred to as simply the "cost of capital," and can be equivalently described in terms of the "required return" needed to attract investment in a particular security or other

By investing in a regulated utility asset, investors are tying up some capital in that investment, thereby foregoing alternative investment opportunities. Hence, the investors are incurring an "opportunity cost" equal to the returns available on those alternative investments. The allowed return on equity needs to be at least as high as the expected return offered by alternative investments of equivalent risk or investors will choose these alternatives instead. If it is not, the utility's ability to raise capital and fund its operations will be negatively impacted. This is a fundamental concept in cost of capital proceedings for regulated utilities such as DTE Electric.

Q13. Please summarize how you considered risk when estimating the cost of capital.

A13. To evaluate comparable business risk, I looked to a proxy group of regulated electric, natural gas, and water utilities. The electric, natural gas and water utilities I considered have a high proportion of regulated assets and revenue, with the majority of the natural gas and water utilities having more than 80% of assets subject to regulation (predominantly by state commissions). Additionally, all utilities I consider have a network of assets that are used to serve end customers and they are capital intensive (meaning that each dollar in revenue requires substantial investment in fixed assets). As discussed previously, I also look at a sub-group of electric utilities, which have a similarly high capital expenditure profile like DTE Electric. Further, (as explained in Section III.B below) I analyzed and adjusted for differences in financial risk due to different levels of financial leverage among the proxy companies. I also analyzed and adjusted for differences between the capital structures of the proxy companies and the regulatory capital structure that will be applied to DTE Electric for ratemaking purposes. To determine where in the estimated range DTE Electric's ROE reasonably falls, I compared the business risk of DTE Electric to that of the proxy group companies.

asset (i.e., the level of expected return at which investors will find that asset at least as attractive as an alternative investment).

B. FINANCIAL RISK AND THE COST OF EQUITY

Q14. How does financial risk affect the estimation of a fair return on equity?

A14. Regardless of the method used to calculate the cost of equity (versions of the CAPM, DCF and risk premium), an issue in regulatory proceedings is how to apply data from a benchmark set of comparable securities when estimating a fair return on equity for the target/regulated company.[14] It may be tempting to simply estimate the cost of equity capital for each of the proxy companies (using one of the above approaches) and average them. After all, the companies were chosen to be comparable in their business risk characteristics, so why would an investor necessarily prefer equity in one to the other (on average)?

The problem with this argument is that it ignores the fact that underlying asset risk (*i.e.*, the risk inherent in the lines of business in which the firm invests its assets) for each company is typically divided between debt and equity holders. The firm's debt and equity are therefore financial derivatives of the underlying asset return, each offering a differently structured claim on the cash flows generated by those assets. Even though the risk of the underlying assets may be comparable, a different capital structure splits that risk differently between debt and equity holders.

The relative structures of debt and equity claims are such that higher degrees of debt financing increase the variability of returns on equity, *even when the variability of asset returns remains constant*. Consequently, otherwise identical firms with different capital structures will impose different levels of risk on their equity holders. Stated differently, increased leverage adds financial risk to a company's equity.[15]

14 This is also a common valuation problem in general business contexts.

15 I refer to this effect in terms of financial risk because the additional risk to equity holders stems from how the company chooses to finance its assets. In this context financial risk is distinct from and independent of the business risk associated with the manner in which the firm deploys its cash flow generating assets. The impact of leverage on risk is conceptually no different than that faced by a homeowner who takes out a mortgage. The equity of a homeowner who finances his home with 90% debt is much riskier than the equity of one who only finances with 50% debt.

If the companies in a proxy group are truly comparable in terms of the systematic risks of the underlying assets, then the **overall cost of capital of each company** should be about the same across companies (except for sampling error), so long as they do not use extreme leverage or no leverage. This is because a firm's asset value (and return) is allocated between equity and debt holders. The expected return to the underlying asset is therefore equal to the value weighted average of the expected returns to equity and debt holders – which is the overall cost of capital or the expected return on the assets of the firm as a whole.[16]

Q15. What is the theoretical basis supporting the notion that the overall cost of capital for each company should be about the same, regardless of capital structure?

A15. The notion that the overall cost of capital is constant across a broad middle range of capital structures is based upon the Modigliani-Miller theorem that choice of financing does not affect the firm's value. Franco Modigliani and Merton Miller eventually won Nobel Prizes in part for their work on the effects of debt.[17] Their 1958 paper made what is in retrospect a very simple point: if there are no taxes and no risk to the use of excessive debt, use of debt will have no effect on a company's operating cash flows (*i.e.*, the cash flows to investors as a group, debt and equity combined). If the operating cash flows are the same regardless of whether the company finances mostly with debt or mostly with equity, then the value of the firm cannot be affected at all by the debt ratio. In cost of capital terms, this means the overall cost of capital is constant regardless of the debt ratio, too.

Obviously, the simple and elegant Modigliani-Miller theorem makes some counterfactual assumptions: no taxes and no cost of financial distress from excessive debt. However, subsequent research, including some by Modigliani and Miller,[18]

16 As this is on an after-tax basis, the cost of debt reflects the tax value of interest deductibility.

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.

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

showed that while taxes and costs to financial distress affect a firm's incentives when choosing its capital structure as well as its overall cost of capital,[19] the latter can still be shown to be constant across a broad range of capital structures.[20]

This reasoning suggests that one could compute the overall cost of capital for each of the proxy companies and then average to produce an estimate of the overall cost of capital associated with the underlying asset risk. Assuming that the overall cost of capital is constant, one can then re-arrange the overall cost of capital formula to estimate what the implied cost of equity is at the target company's capital structure on a book value basis.[21]

Q16. What other methods do you use to account for financial risk when determining the cost of equity?

A16. An alternative approach to account for the impact of financial risk is to examine the impact of leverage on beta in the CAPM. The so-called Hamada method allows a financial analyst to adjust for differences in financial risk by first translating the equity beta obtained from market data into an asset beta (or a zero-debt beta) using the comparable companies leverage and second re-levering (or translating) the asset beta for the comparable companies into an equity beta for the target company using the regulated entity's capital structure. [22]

19 When a company uses a high level of debt financing, for example, there is significant risk of bankruptcy and all the costs associated with it. The so-called costs of financial distress that occurs when a company is over-leveraged can increase its cost of capital. In contrast a company can generally decrease its cost of capital by taking on reasonable levels of debt, owing in part to the deductibility of interest from corporate taxes.

20 This is a simplified treatment of what is generally a complex and on-going area of academic investigation. The roles of taxes, market imperfections and constraints, etc. are areas of on-going research and differing assumptions can yield subtly different formulations for how to formulate the weighted average cost of capital that is constant over all (or most) capital structures.

21 Market value capital structures are used in estimating the overall cost of capital for the proxy companies.

22 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.

While there are several versions of the Hamada adjustment procedures as discussed in the Appendix, the need to consider leverage is ubiquitous among finance practitioners when using the CAPM to estimate discount rates.

C. APPROACH TO ESTIMATING THE COST OF EQUITY

Q17. How do you approach your estimation of the cost of equity for DTE Electric?

A17. To analyze the cost of equity for DTE Electric, I evaluate companies of comparable business risk by choosing a proxy group of publicly traded regulated electric utilities as well as a group of highly regulated natural gas distribution and water utilities. These non-electric utilities are relevant because they generally face similar regulation as do electric utilities and similar to electric utilities are very capital intensive and serve a mixture of residential, commercial and industrial customers. Specifically, I use three models to analyze the cost of equity for DTE Electric: (1) the Capital Asset Pricing Model (CAPM) as well as an Empirical version thereof, the ECAPM, (2) the Discounted Cash Flow (DCF) models (single-stage and multi-stage), and (3) the Risk Premium. With the recent changes in financial markets, I consider two implementations of the CAPM / ECAPM – based on a historical and a forward-looking market risk premium (MRP) to determine a fair and reasonable ROE for DTE Electric. Section V further explains my analyses and results.

Q18. How does your approach and the models you employ compare to what the Commission has considered in prior DTE Electric proceedings?

A18. The Commission has in past decisions considered the DCF, CAPM, and Risk Premium models, as do I. Additionally, the Commission has recognized that "atypical market conditions" deserve consideration when setting the ROE.[23] The Commission also stated that it will "continue to monitor a variety of market factors in future applications, including market reactions to recent events and measures of volatility and uncertainty,

[23] Michigan Public Service Commission Order for Case No. U-18255, April 18, 2018, p. 33.

as well as measures of investor confidence, and the utility's risk profile."[24] I further discuss the current capital market condition and the impacts they have on determining DTE Electric's cost of equity capital in Sections IV and V below.

IV. CAPITAL MARKET CONDITIONS

Q19. What do you cover in this section?

A19. In this section, I address recent changes in capital market conditions and the impact on electric utilities risk. Specifically, I address (i) interest rate developments; (ii) investors perception of the market risk premium; (iii) recent changes in utilities systematic risk; and (iv) fears of inflation and the impact on cost of capital.

Q20. Please provide a summary of the data and developments discussed below.

A20. First, I focus the discussion on the expected developments in interest rates, which directly impact the cost of equity as estimated by two standard models (the CAPM and risk premium model). Interest rates also may impact indirectly the DCF method as investors' expectations concerning interest rates may impact stock prices and growth. Second, I discuss investor expectations as to the market risk premium, *i.e.*, the return over and above the risk-free rate that investors require to hold equity. This measure again affects the inputs to the financial models and the interpretation of the results. Third, I address the recent changes in electric utilities systematic risk. Fourth, I discuss growth and inflation expectations, which directly affect the DCF model, as well the other models through the expected interest rate developments.

Q21. Why do you discuss capital market conditions in a testimony aimed at determining DTE Electric's ROE?

A21. Capital market conditions are important to cost of equity estimation methodologies and can affect the inputs to the cost of equity models. Inputs to the DCF models are affected by the economy in general as economic growth will affect growth rates and utility stock

[24] Michigan Public Service Commission Order for Case No. U-20561, May 8, 2020, pp. 177.

prices. Consequently, the capital market developments affect the growth rates, dividend yield, and the assessment of estimates' reasonableness.

Furthermore, the risk-free rate is an input to the risk premium model and CAPM, so that recent and expected developments in government bond yields are important to assess the validity of any measure of the risk-free rate. Although current interest rates in capital markets are low, interest rates are expected to increase. As the risk-free rate directly impacts the estimated cost of equity, it is the expected risk-free rate over the period during which rates will be in effect that is needed to estimate the ROE for DTE Electric.

A. INTEREST RATES

Q22. How do interest rates affect the cost of equity?

A22. The current interest rate environment affects the cost of equity estimation in several ways. Most directly, the CAPM takes as one of its inputs a measure of the risk-free rate.[25] The estimated cost of equity using the CAPM decreases (increases) by one percentage point when the risk-free rate decreases (increases) by one percentage point. Therefore, to the extent that prevailing government yields are depressed due to economic uncertainties related to COVID-19 or the monetary policy responses, using current yields as the risk-free rate will depress the CAPM estimate below what is representative of the forward-looking cost of equity. Therefore, the allowed fair return on equity for DTE Electric should reflect the future interest rate environment, specifically the environment at the time the rates being set in this proceeding will be in effect.

[25] See Figure 2.

Q23. What are the relevant developments regarding interest rates?

A23. Current interest rates on 10-year U.S. Government bonds remain low at 1.58 percent,[26] despite significant improvement since the historic low levels in 2020, due to flight-to-quality behaviors by investors as well as the Federal Reserve's expansion of its quantitative easing programs. Interest rates on 10-year U.S. Government bonds were at 1.86 percent at the end of 2019.[27] As large parts of the economy began to shut down in response to the pandemic, investors fled riskier assets for safer assets. This demand for U.S. government bonds caused bond yields to decrease rapidly. On March 9, 2020, the entire U.S. yield curve fell below 100 bps for the first time in history and the 10-year U.S. government bond yield hit a record low of 0.339 percent.[28] Since then, long-term government bond yields have increased somewhat—10 year U.S. Government bonds as of January 26, 2021 was 1.05 percent.[29] Later that month, the Federal Reserve lowered the federal funds target rate to the 0 to 0.25 percent range, and announced "unlimited" quantitative easing to support the financial markets.[30] Since then, the U.S. government bond yields have risen but still remain near historic lows and below end of 2019 levels. The current 10-year U.S. Government bond yields are at 1.58%.[31]

Looking forward, treasury bonds are forecasted to increase, which is depicted in Figure 3 below. Blue Chip Economic Indicators' (BCEI) October 2021 edition forecasts that the yield on 10-year treasury bonds will increase. Specifically, BCEI projects the 10-year government bond yield will be 1.9, 2.3 and 2.5 percent in 2022, 2023 and 2024, respectively (Figure 3). [32] Because the risk-free rate is an input to several cost of equity

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26 Bloomberg as of October 31, 2021.

27 Bloomberg as of October 31, 2021 and Federal Reserve, FRED assessed December 3, 2020.

28 Sunny Oh, "Treasury yield curve sinks below 1% after oil and coronavirus worries rout stocks," *Market Watch*, March 9, 2020, accessed March 31, 2020, https://www.marketwatch.com/story/30-year-treasury-yield-tumbles-below-1-after-oil-and-coronavirus-worries-rout-stocks-2020-03-09

29 Federal Reserve Bank of St. Louis, January 26, 2021; https://fred.stlouisfed.org/series/DFII10.

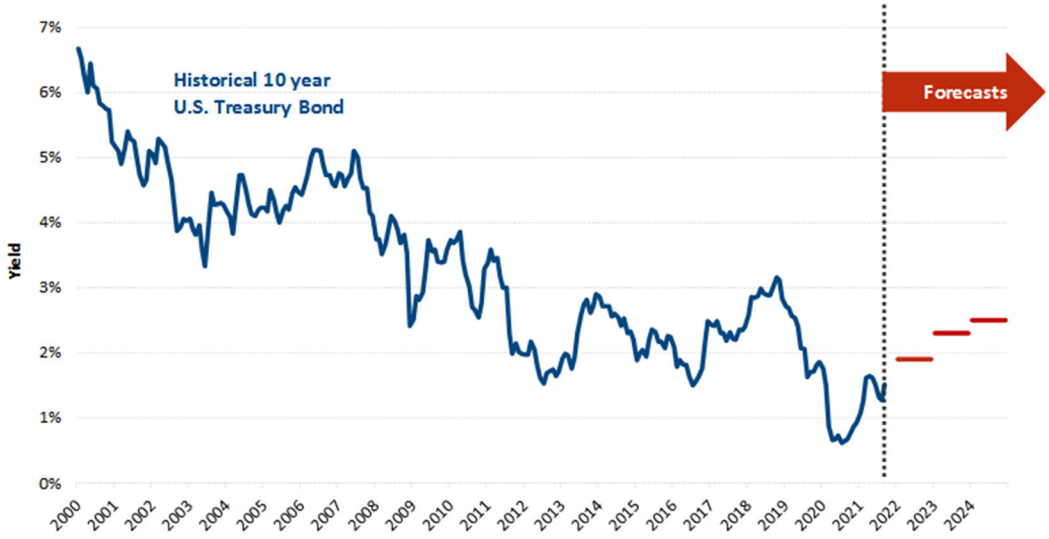
30 U.S. Federal Reserve, "Federal Reserve Announces Extensive New Measures to Support the Economy," Press Release, March 23, 2020.

31 Bloomberg as of October 31, 2021.

32 Wolters Kluwer Blue Chip Economic Indicators October 2021.

estimation models, the relationship between current and forecasted risk-free rates is an important consideration.

Figure 3: Historical and Projected Ten-Year Treasury Bond Yields[33]



Because the government bond yield is forecasted to increase over the period during which DET Electric's allowed ROE will be in effect, it is important to use the forecast to determine the cost of equity.[34]

B. Risk Premiums

Q24. What is the current evidence regarding market volatility?

A24. During the early months of COVID-19, financial markets became extremely volatile as shown in near-term common volatility measures, such as the VIX, which is frequently referred to as the market's fear index. The VIX reached an all-time high of 82.69 on March 16, 2020, which was higher than the peak of 80.86 during the Financial Crisis.

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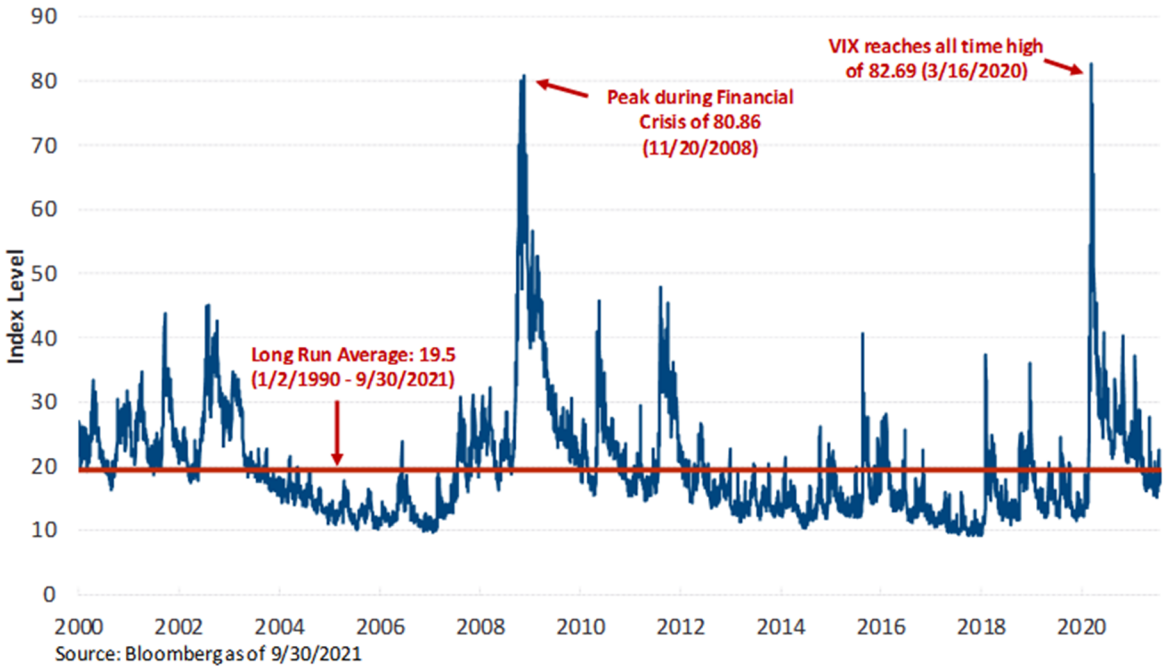
[33] Id.

[34] In past cost of capital proceedings, I have considered the spread between utility bond yields and government bond yields to access the need for a normalization of the risk-free rate or an adjustment to the MRP. However, the spread is currently slightly above 100 bps, which is only slightly above the long run average. Therefore, I do not consider the impact of this spread in this testimony.

Since then, VIX has remained elevated for some time but has recently returned to its long-term average level of about 20, which is a bit above the pre-COVID-19 level.[35]

Figure 4: VIX: 2000 through September 2021

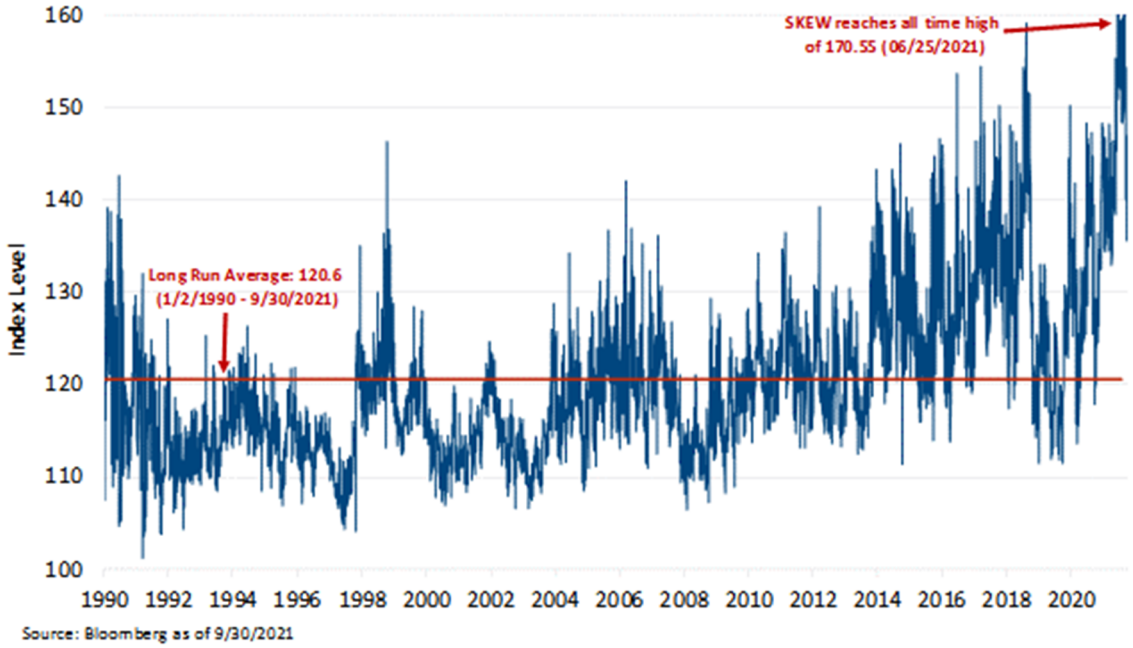


Similarly, the SKEW index, which measures the market's willingness to pay for protection against negative "black swan" stock market events (i.e., sudden substantial downturns),[36] shows that investors are cautious. A SKEW value of 100 indicates outlier returns are unlikely, but as the SKEW increases, the probability of outlier returns becomes more significant. Figure 5 below shows the development in the SKEW since 1990 and that the index has recently increased following a period of declining SKEW. The recent spike in the SKEW shows that investors continue to pay for protection against downside risks.

[35] As of September 30, 2021, the VIX was 23 and as of November 10, 2021 it was 19.

[36] For example, http://www.cboe.com/products/vi5.inde5.volatility/volatility-indicators/skew.

Figure 5: SKEW



Source: Bloomberg as of 9/30/2021

As both the VIX and SKEW measures are forward-looking, the variability in VIX and SKEW shows that investors expect volatility to continue (for at least a year) but are cautiously optimistic about investing in equity. The SKEW index spiked over 148.3 on June 30, 2020 and reached its historical high on June 25, 2021 at 170.55—well above the long-term average of 120. Such circumstances lead investors to require a higher premium to invest in assets or financial instruments that are not risk-free.

Q25. What is the Market Risk Premium (MRP)?

A25. In general, a risk premium is the amount of "excess" return—above the risk-free rate of return—that investors require to compensate them for taking on risk. As illustrated in Figure 2 the riskier the investment, the larger the risk premium investors will require.

The MRP is the risk premium associated with investing in the market as a whole. Since the so-called "market portfolio" embodies the maximum possible degree of

diversification for investors,[37] the MRP is a highly relevant benchmark indicating the level of risk compensation demanded by capital market participants. It is also a direct input necessary to estimating the cost of equity using the CAPM and other risk-positioning models.

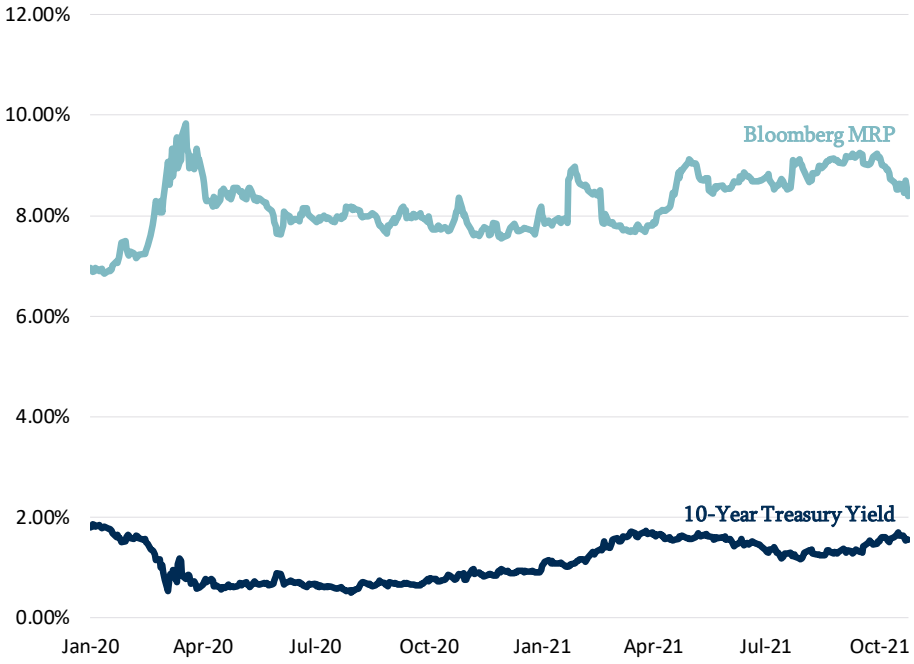
Q26. Please explain the current evidence related to the MRP.

A26. The heightened volatility in the market has increased the premium that investors require to hold risky assets, especially when measured utilizing forward-looking methodologies that estimate expected market returns with reference to current dividend yields. Bloomberg's forward-looking estimate of the MRP for the U.S. increased to as high as 9.84 percent in March 2020 and remained high at 8.39 percent as of October 2021.[38] Current forward market risk premium investors require to hold risky assets remains substantially elevated compared to both the long-term historical premium and premiums required during pre-pandemic years since capital markets' slow recovery following the financial crisis. Academic research has shown that market disruptions lead to a prolonged MRP impact as discussed below.

[37] In finance theory, the "market portfolio" describes a value-weighted combination of all risky investment assets (e.g., stocks, bonds, real estate) that can be purchased in markets. In practice, academics and financial analysts nearly always use a broad-based stock market index, such as the S&P 500, to represent the overall market.

[38] Bloomberg, as of October 31, 2021. Measured over a 10-year U.S. Treasury bond.

Figure 6: Bloomberg's Daily Market Risk Premium and Risk-Free Rate (Nov. 2019 – October 2021).



Q27. Are higher risk premiums relevant given that treasuries are near historic lows?

A27. Yes—this is highly relevant for cost of equity estimation as current risk-free rates are extremely low. As shown in Figure 6 above, the MRP has increased as the risk-free rate declined. Both academic and industry analyses have found that the allowed risk premium over the risk-free rate is inversely related to the risk-free rate. For example, Villadsen et al. (2017) found that the allowed risk premium increases by approximately 0.44 percent for each 1 percent decline in the risk-free rate for the period 1990 to 2015.[39] Morin finds that the risk premium increases by 0.52 percent for each 1 percent decline in the risk-free rate.[40] This is consistent with Figure 6 above, which focus on the risk premium for the forward-looking market risk premium calculated by Bloomberg. According to Bloomberg, the MRP is currently 7.89 percent over the 20-

[39] Bente Villadsen, Michael J. Vilbert, Dan Harris, and A. Lawrence Kolbe, "*Risk and Return for Regulated Industries*," Academic Press, 2017, pp. 118-119.

[40] Roger A. Morin, "*New Regulatory Finance*," Public Utilities Reports, Inc., 2006, pp. 123-125.

year Treasury bond,[41] which is higher than the historical average MRP of about 7.25 percent. It is also an increase over the forward-looking MRPs measured at the end of 2019 (pre-COVID) of 6.48 percent, the July 2019 of 7.05 percent (date of most recent filing) and the average for 2019 at 7.15 percent.[42]

Q28. Is there evidence that the MRP will remain elevated going forward?

A28. Yes. In 2015, Duarte and Rose of the Federal Reserve of New York performed a study that aggregated the results of many models of the required MRP in the United States and tracked them over time.[43] This analysis found a very high MRP after the financial crisis, relative to time periods prior the crisis.

The authors estimated the MRP that resulted from a range of models each year from 1960 through the time of their study. The authors then reported the average as well as the first principal component of the results.[44] The authors found that the models used to determine the risk premium were converging to provide comparable estimates and that the average annual estimate of the MRP had reached an all-time high in 2012-2013. (Figure 7 below is a copy of the summary chart from Duarte and Rosa's 2015 paper). These directional trends identified by Duarte and Rosa are reasonably consistent with those observed from Bloomberg and they further support the proposition that the elevation of the MRP over its historical pre-crisis levels was a persistent feature of capital markets in the time following the financial crisis. Specifically, the financial crisis saw high volatility and a flight to quality – similar to conditions seen in 2020 in

[41] Bloomberg, as of October 31, 2021. The 7.89% MRP is relative to the contemporaneous yield over a 20-Yr treasury bond. Relative to the contemporaneous yield over a 10-Yr treasury bond, the Bloomberg reported MRP is 8.39%, which is what Bloomberg reports.

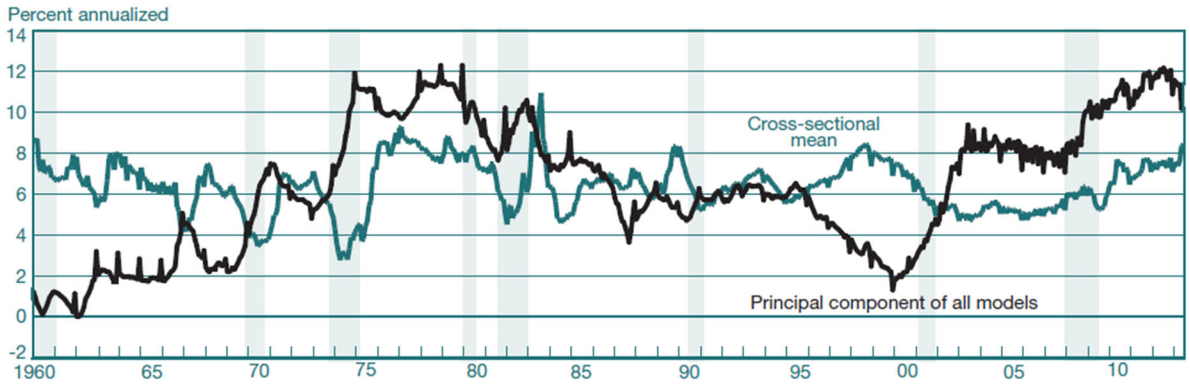
[42] *Id*.

[43] Fernando Durate and Carlo Rosa, "The Equity Risk Premium: A Review of Models," *Federal Reserve Bank of New York*, December 2015 ("Duarte and Rosa, 2015")
https://www.newyorkfed.org/research/staff_reports/sr714.html.

[44] Duarte and Rosa emphasize the "first principal component" of the 20 models. This means that the authors used statistics to compute the weighted average combination of the models that captures the variability among the 20 models over time.

response to the COVID-19 pandemic. Therefore, it is reasonable to expect that the current MRP will remain elevated compared to historical levels, especially given the uncertainty related to the extent of economic and financial impacts from COVID-19 and the historically low interest rates.

Figure 7: Duarte and Rosa's Chart 3
One-Year Ahead MRP and Cross-Sectional Mean of Models



Q29. Please summarize how the economic developments discussed above have affected the return on equity and debt that investors require.

A29. Utilities rely on investors in capital markets to provide funding to support their capital expenditure programs and efficient business operations. Investors consider the risk-return tradeoff in choosing how to allocate their capital among different investment opportunities. It is therefore important to consider how investors view the current economic conditions, including the plausible developments in the risk-free rate and the growth in the U.S. GDP.

These investors have been affected by the recent market volatility, so there are reasons to believe that their risk aversion remains elevated relative to pre-COVID-19 levels. As DTE Electric is expected to be compensated as a utility on the equity component of its rate base, the same factors would affect DTE Electric's equity.

C. UTILITIES SYSTEMATIC RISK

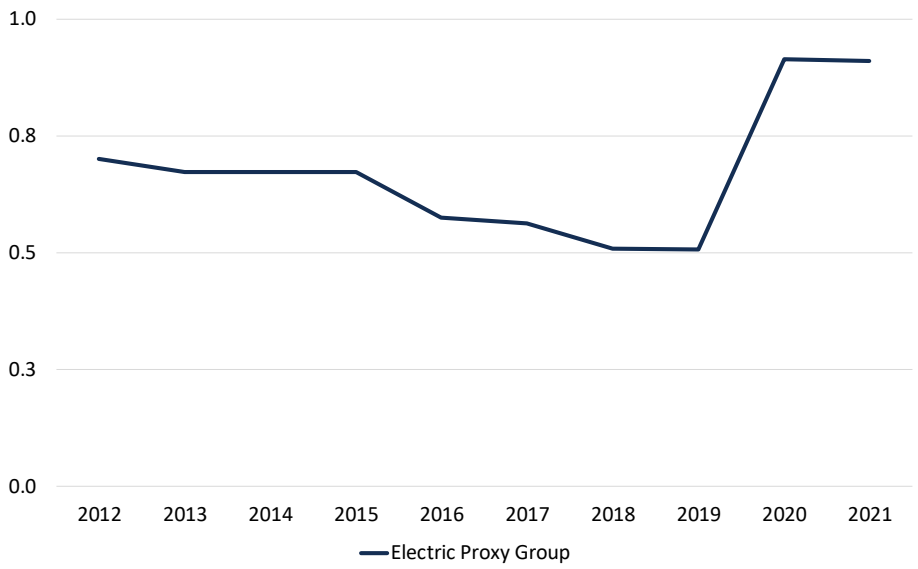
Q30. Are there indications that electric utilities systematic (non-diversifiable) risk has changed?

A30. Yes. The relative risk of electric utilities such as DTE Electric has increased as demonstrated by the substantial increase in the systematic (non-diversifiable) risk (measured by beta) with electric utilities moving closer to exhibiting risks similar to the market in general as shown in Figure 8 and Figure 9 below. Specifically, the figures below depict the development in Value Line betas since 2013 (Figure 8) and estimated 2-year weekly betas (Figure 9).[45] Whether I use the Value Line reported beta or estimate betas, the result is clear – the systematic risk of electric utilities has increased. Today's beta of approximately 0.91 for electric utilities is higher than in the past.[46] At the time of the last cost of capital proceeding for DTE Electric, I found an average Value Line beta of 0.59 and my estimated 2-year beta as of July 2019 was below 0.60. This difference is material because a higher beta, all else equal, will lead to a higher cost of equity regardless of the yield on government bonds. Specifically, the risk premium investors require to hold electric utility stock today is higher than at the time of the last cost of capital proceeding. The change in the risk-free rate therefore cannot in and of itself be used to assess the level of or the directional change in the cost of equity. Simply put, other factors that influence the cost of equity (*e.g.*, beta and market risk premia) and these factors have moved in a direction that increases the cost of equity.

[45] 2-year weekly betas were estimated using weekly total returns for the electric utilities in my peer group and combining the returns in proportion to the market capitalization. A standard least square regression against the S&P 500 was used.

[46] Value Line as of June 30, 2021.

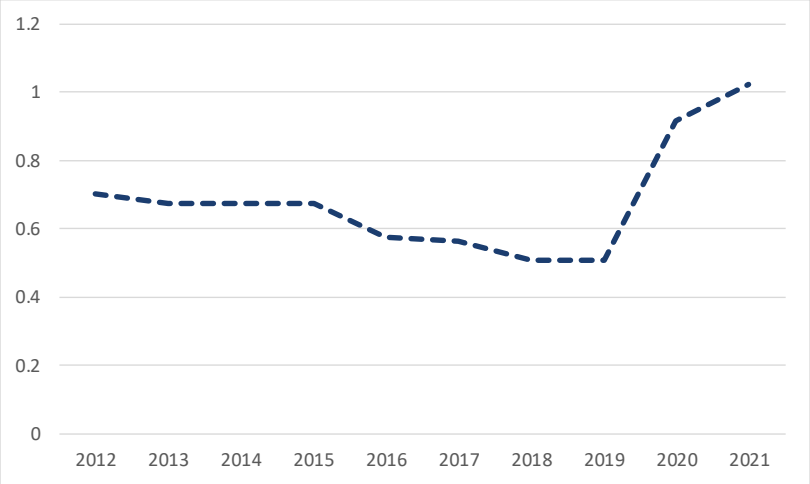
Figure 8
Average Value Line Beta for the Electric Utility Proxy Group over Time



Looking to a more recent measure of systematic risk, Figure 9 shows rolling two-year average betas for the sample of proxy group of electric utilities used to estimate the cost of equity.[47] The most recent measure is 0.90. Figure 8 and Figure 9 are clear indications that the systematic risk of the industry has increased.

[47] Each beta in Figure 9 is calculated as the using weekly data from the prior 104 weeks. The estimate as of year-end 2020 thus uses data for 2019 and 2020 to calculate the beta estimate. The estimate for 2021 uses the most recent 104 weeks of data.

Figure 9
Rolling Two Year Betas[48] over Time



Q31. What conclusions do you draw from the discussion above regarding beta?

A31. Because the utility-specific risk premium is the multiple of the market risk premium and the utility beta, the dramatic increase in beta combined with an increase in the market risk premium has resulted in a substantially higher utility-specific risk premium. Put simply, the return over and above the risk-free rate that utility investors require has increased and it has increased by more than the risk-free rate has declined since the last cost of capital proceeding DTE Electric.

D. Inflation Expectations and Impact

Q32. Why is inflation relevant to the return on DTE Electric's equity?

A32. The return on equity that is being determined now is expected to be applicable in future years (e.g., 2022 and beyond), so DTE Electric will be exposed to economic developments over the period for which rates are set. Because the allowed return on equity is a nominal return, it includes today's inflation, but going forward the inflation

[48] Rolling 2-year weekly betas calculated per the Value Line method.

could readily change. Historically, inflation has impacted not only product prices but also the cost of capital.[49]

Q33. What are recent indicators of the growth and inflation for the US economy?

A33. Recent surveys by economists, such as the BCEI survey, indicate that U.S. real GDP will increase by 5.7% in 2021, 4.1% in 2022 and 2.5% in 2023 for a nominal GDP at about 8%, 6%, and a bit below 5%, respectively.[50] In August 2020, the U.S. Federal Reserve announced a policy change whereby they would target inflation of 2% on average, noting that the Federal Reserve would hold overnight borrowing interest rates lower for longer.[51] The Federal Reserve has remained cautious about the pace and extent of the ongoing recovery. In the April 2021 Federal Open Market Committee ("FOMC") Press Conference, Federal Reserve Chair Powell noted that economic indicators have improved recently but reiterated that "economic recovery remains uneven and far from complete."[52] In the July 2021 meeting of the FOMC, the FOMC concluded[53]

> *The sectors most adversely affected by the pandemic have shown improvement but have not fully recovered. Inflation has risen, largely reflecting transitory factors.*

And

> *The path of the economy continues to depend on the course of the virus.*

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[49] For example, the correlation between the allowed ROE and the CPI inflation the prior period since 1992 has been about 34%.

[50] Wolters Kluwer Blue Chip Economic Indicators, October 2021, pp. 2-3, 14.

[51] U.S. Federal Reserve, "Federal Open Market Committee announces approval of updates to its Statement on Longer-Run Goals and Monetary Policy Strategy," August 27, 2020, accessed March 2, 2021, https://www.federalreserve.gov/newsevents/pressreleases/monetary20200827a.htm.

[52] Board of Governors of the Federal Reserve System, "Transcript of Chair Powell's Press Conference," April 28, 2021, https://www.federalreserve.gov/mediacenter/files/FOMCpresconf20210428.pdf.

[53] Federal Reserve Press Release, July 28, 2021.

Mr. Powell's April speech noted that the Federal Reserve has continued to keep interest rates near zero (0 to 0.25 percent) and that it would maintain its sizable asset purchases,[54] adding that these market support measures are necessary to ensure that the monetary policy continues to deliver "powerful support to the economy until the recovery is complete."[55] Projections from the FOMC continue to indicate that policy rates will remain at current levels through at least 2023.[56] These policy rates will likely continue to exert downward pressure on interest rates over the near to medium term.

At the same time, the Federal Government has engaged in substantial fiscal stimulus. For example, since January 2021, several government assistance programs were passed to stimulate the U.S. economy. In early March, the Government passed a $1.9 trillion American Rescue Plan, which provided direct economic impact payments and extended unemployment benefits.[57] More recently, the President signed the $1.2 trillion infrastructure bill into law. The bill allocates funds for infrastructure (including energy) and other items.[58] Other programs, such as the Paycheck Protection Program, continued to disburse aid to businesses. This infusion of cash into the economy has created concerns about inflation, albeit the Federal Reserve expects the inflation to be transitory.[59]

Following these initiatives, the CPI, a common measure of inflation, increased by 6.2% from October 2020 to October 2021, which is the largest 12-month increase since

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54 *Ibid.* The July 2021 meeting of the FOCM maintained this target. Source: Federal Reserve Press Release, July 28, 2021.

55 *Ibid.*

56 U.S. Federal Reserve, "March 17, 2021: FOMC Projections materials, accessible version," March 17, 2021, https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20210317.htm. See also, Federal Reserve Press Release, July 28, 2021.

57 Alan Fram, "Congress Oks $1.9T virus relief bill in win for Biden, Dems," *Associated Press*, March 11, 2021, accessed May 24, 2021, https://apnews.com/article/joe-biden-bills-legislation-coronavirus-pandemic-7eb383e58c8fcf50f6f586b6d5cfc523.

58 See, for example, Massive Bipartisan Infrastructure Bill Includes Billions in Funding and Process Improvements for Energy and Infrastructure | Publications | Kirkland & Ellis LLP

59 Federal Reserve Press Release, July 28, 2021.

September 1990.[60] Similarly, September's CPI increase was 5.4%.[61] These figures have caused Larry Summers,[62] to warn that "inflation is here" and that a soft landing from inflation is unprecedented.[63] [64] More recently Lawrence Summers has warned that

> *I don't think we're anywhere close to the kind of Carter-era double-digit inflation, but I do think we're in very serious danger of repeating almost all the mistakes of the 1960s and early 1970s.*[65]

At the same time the Federal Reserve Board in its July meeting stated that "the Committee will aim to achieve inflation moderately above 2 percent for some time so that inflation averages 2 percent over time …"[66] but more recently acknowledged that inflation is higher than expected, although Chairman Powell argues that the upward pressure will abate over time.[67] Thus, there is some disagreement as to the magnitude and persistence of the price increases currently experienced.

Regardless, rising inflation has introduced new uncertainties to the financial markets and points to an increase in the return required by investors to hold risky assets. With the risk of inflation increasing, there is an increased risk that the authorized as well as any currently calculated ROE will be downward biased over the upcoming period.

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60 U.S. Bureau of Labor Statistics, "Economic News Release: Consumer Price Index Summary," November 10, 2021.
Consumer Price Index Summary - 2021 M10 Results (bls.gov)

61 U.S. Bureau of Labor Statistics, "Consumer Price Index – September 2021," October 13, 2021.

62 Larry Summers is an economist and a former Secretary of the Treasury (Clinton), Chair of the National Economic Counsel (Obama), Chief Economist at the World Bank, and President of Harvard,

63 Former Treasury Secretary On Consumer Prices, Inflation, U.S. Role In Global Pandemic Efforts | Here & Now (wbur.org)

64 WBUR, "Former Treasury Secretary On Consumer Prices, Inflation, U.S. Role in Global Pandemic Efforts," August 11, 2021, https://www.wbur.org/hereandnow/2021/08/11/larry-summers-inflation-prices

65 Bloomberg Economics, "Summers Sees Dangerous Policy Parallels With High-Inflation Era," September 10, 2021; Summers Sees Dangerous Policy Parallels With High-Inflation Era - Bloomberg
More recently, Larry Summers urged stronger action by the Federal Reserve.
Economist Larry Summers says White House misread inflation | TheHill

66 Federal Reserve Press Release, July 28, 2021.

67 NPR, "The Fed Says Inflation Is Hotter Than Expected – But It Should Cool Next Year," September **22, 2021; The Fed Says Inflation Is Hotter Than Expected But It Should Cool : NPR**

Finally, although substantial progress has been made on distributing the COVID-19 vaccine, the length and extent of the economic impacts from the COVID-19 pandemic are unknown, and the impacts are expected to persist for some time even as expanded vaccination reduces the risk of spread of COVID-19 and social distancing measures in the US are reduced. In addition, substantial risk remains due to the emergence of the so-called Delta variant, which, as the Federal Reserve pointed out, means that "[t]he path of the economy continues to depend on the course of the virus."[68]

Q34. How do these events impact the cost of equity estimation for DTE Electric?

A34. The expected interest rate, market risk premium and GDP growth rate directly impact the cost of equity as determined by the CAPM and DCF model. Additionally, inflation expectations and the broader economic conditions affect investors' return and growth expectations. Thus, the factors discussed above impact the cost of equity, which inherently is a forward-looking concept.

V. ESTIMATING THE COST OF EQUITY

A. APPROACH TO COST OF EQUITY ESTIMATION

Q35. Can you explain your approach to estimating the cost of equity for DTE Electric?

A35. As discussed in Section IV, the financial and economic conditions are impacted by the ongoing COVID-19 pandemic, inflation pressures as well as government initiatives to stimulate the economy.

In the remainder of Section V, I present the inputs, assumptions, and results from my cost of equity estimation methods.

B. PROXY GROUP SELECTION

Q36. How do you identify sample companies of comparable business risk to DTE Electric?

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[68] *Ibid.*

A36. DTE Electric is a regulated electric utility. The business risk associated with these business activities depend on several factors, including the specific characteristics of the service territory and regulatory environment in which the utility operates. Consequently, it is not possible to identify publicly traded companies that replicate every aspect of DTE Electric's business risk profile. However, an appropriate starting point to create proxy groups of comparable business risk to DTE Electric is to select other companies whose primary business operations are concentrated in regulated industries or companies that have similar lines of business and/or business environments. As a second step, I must evaluate DTE Electric or Michigan-specific risks to ensure that the Company's ROE is appropriately placed relative to the proxy samples.

To that end, I have selected two proxy groups composed of regulated utility companies that focus on (i) the provision of electricity to end-users ("Electric Utility Proxy Group") and (ii) the provision of other highly-regulated utility services (*i.e.*, natural gas or water) to end customers. These proxy groups are similar to DTE Electric in that they are rate regulated by state utility commissions, serve customers through a network of assets, and rely on substantial capital to provide service—that is, they are capital intensive like DTE Electric.

It is important that the proxy groups used to assess the cost of equity for DTE Electric (absent any unique Michigan or Company specific characteristics) are comprised of regulated entities, because regulation tends to place substantial requirements and protections on the companies. I also believe the physical characteristics of the industry—*e.g.*, network, capital intensive, serving many different customers—are characteristics of DTE Electric and of other highly regulated utilities. The network characteristic implies that assets cannot readily be employed in a different capacity; the capital-intensive characteristic affects the operating risks through the split between fixed and variable costs; and the customer composition affects the demand risk.

Q37. How do you identify suitable utilities for inclusion in your proxy groups?

A37. First, I start with the universe of publicly traded electric, natural gas distribution, or water utilities reported by Value Line Investment Analyzer ("Value Line"). It is necessary to focus on publicly traded companies because non-traded entities do not have the necessary stock price data to utilize the financial models relied upon to estimate the cost of equity. Second, I narrow down this universe of electric, natural gas distribution, or water utilities identified by Value Line using the following screening criteria:

- Must be an investment grade utility,
- Must have a market capitalization greater than $300 million (to avoid micro caps),
- Must pay dividends with no dividend cuts for three years,
- Cannot have engaged in substantial merger, acquisition, or divesture activity for three years,

and

- Must have sufficient data for estimation.

Third, I review business descriptions and financial reports of these companies and eliminate those that have less than 50% of their assets dedicated to regulated utility activities. Within this group of companies, I apply further screening criteria to eliminate companies with recent significant events (*i.e.*, litigation) that could affect the market data necessary to perform cost of capital estimation.

To the degree that a subset or subsets of these utilities have risk characteristics that match those of DTE Electric to a larger degree, subset(s) will be created and analyzed. For example, DTE Electric has a larger capital expenditure than the average company does in the electric sample, so I consider a subset of that sample that has capital expenditures that are at the same level as those of DTE Electric.

Q38. What are the results of your sample selection process?

A38. The selection process produced a proxy group of 27 regulated electric utilities, 8 natural gas distribution utilities, and 8 water utilities. Figure 10 and Figure 11 below list these utilities and selected financial characteristics.

Q39. What are the characteristics of your Electric Utility Proxy Group?

A39. The Electric Utility Proxy group is comprised of electric utilities, whose primary source of revenues and the majority of its assets are subject to regulation. The final proxy group consists of 27 electric utilities listed in Figure 10 below. These companies own regulated electric utility subsidiaries and are classified by EEI as either "regulated" (having at least 80% of their assets dedicated to regulated utility operations) or "mostly regulated" having less than 80% regulated assets.[69] (These EEI categories are designated with an "R" or "M" in the Figure below). Therefore, the Electric Utility Proxy Group is broadly representative of the regulated electric industry from a business risk perspective.

Figure 11 reports the natural gas and water utilities' annual revenues for the most recent four quarters as of Q3 2021, the companies' market capitalization, credit rating, beta, and growth rates. The annual revenue as well as the market capitalization was obtained from Bloomberg. The credit rating is reported by Bloomberg. The growth rate estimate is a weighted average between estimates from Thomas Reuters and *Value Line*. The betas were obtained from *Value Line* as of October 31, 2021. The categorization was based on the companies' most recent 10-K.

69 Edison Electric Institute (EEI), Financial Report, 2019. Note: I eliminate any companies with less than 50% of regulated assets. See Appendix B for further detail.

Figure 10: Electric Utility Sample

Company	Annual Revenue (Q3 2021) ($MM)	Regulated Assets	Market Cap. (Q3 2021) ($MM)	Value Line Beta	S&P Credit Rating	Long-Term Growth Estimate
	[1]	[2]	[3]	[4]	[5]	[6]
ALLETE	$1,341	MR	$3,200	0.90	BBB	6.6%
Alliant Energy	$3,559	R	$14,457	0.85	A-	5.8%
Amer. Elec. Power	$16,341	R	$42,359	0.75	A-	5.8%
Ameren Corp.	$6,177	R	$21,583	0.85	BBB+	7.3%
Avista Corp.	$1,388	R	$2,817	0.95	BBB	6.9%
Black Hills	$1,873	R	$4,138	1.00	BBB+	4.9%
CMS Energy Corp.	$7,164	R	$17,788	0.80	BBB+	6.1%
CenterPoint Energy	$8,092	R	$15,792	1.15	BBB+	4.2%
Dominion Energy	$13,605	R	$60,572	0.85	BBB+	6.2%
Duke Energy	$24,636	R	$76,655	0.90	BBB+	5.6%
Edison Int'l	$14,731	R	$21,921	1.00	BBB	5.7%
Entergy Corp.	$11,391	R	$21,467	0.95	BBB+	5.7%
Evergy Inc.	$5,559	R	$14,690	0.95	A-	5.0%
Exelon Corp.	$34,833	MR	$48,431	0.95	BBB+	4.4%
Hawaiian Elec.	$2,732	MR	$4,504	0.85	BBB-	1.5%
IDACORP Inc.	$1,439	R	$5,249	0.85	BBB	3.6%
MGE Energy	$581	R	$2,762	0.75	AA-	5.6%
NextEra Energy	$16,418	MR	$160,201	0.95	A-	10.1%
NorthWestern Corp.	$1,339	R	$3,368	0.95	BBB	3.4%
OGE Energy	$3,558	R	$6,780	1.05	BBB+	4.5%
Otter Tail Corp.	$1,090	R	$2,324	0.90	BBB	3.1%
Pinnacle West Capital	$3,746	R	$8,263	0.95	A-	-1.5%
Public Serv. Enterprise	$9,068	MR	$31,055	0.95	BBB+	3.9%
Sempra Energy	$12,184	R	$37,693	1.00	BBB+	16.2%
Southern Co.	$22,463	R	$67,909	0.95	A-	6.9%
WEC Energy Group	$8,048	R	$28,674	0.80	A-	6.7%
Xcel Energy Inc.	$13,023	R	$34,475	0.80	A-	6.7%
Electric Sample	$9,125		$28,116	0.91	BBB+	5.6%

Q40. What are the characteristics of the Natural Gas and Water Utility Proxy Group?

A40. The Natural Gas and Water Utility sample consists of eight companies that have the majority of their revenue generating assets dedicated to regulated distribution of natural gas in the U.S. and eight water utilities, whose revenues originate from regulated water distribution (or wastewater services) and whose assets are predominantly devoted to regulated water services.[70]

[70] I note that Essential Utilities (formerly Aqua America) owns and operates what was formerly Peoples Gas in Pennsylvania, which has approximately 740,000 gas customers. Similarly, Northwest Natural owns and operates water utilities.

Figure 11 reports the sample companies' annual revenues for the most recent four quarters ended Q3 2021 and the percentage of their assets devoted to regulated activities. It also displays each company's market capitalization and S&P credit rating as well as betas from *Value Line* and Bloomberg and the weighted average long-term (3 to 5 year) earnings growth estimate for the company from Thomson Reuters and *Value Line.*[71]

The average Natural Gas and Water Utility sample company devotes over 80% of its assets to regulated activities.[72] Therefore, these sample companies are nearly pure-plays in the natural gas or water distribution industry. Moreover, the regulatory framework in the jurisdictions in which the Natural Gas and Water Utility sample companies operate is substantially similar to that for electric utilities in that most are regulated by the state regulatory commission in the state they operate. Therefore, I believe that although they do not engage in electric distribution or generation, the companies provide a good benchmark for DTE Electric's regulated assets. Like electric utilities, they operate a network that cannot be moved or repurposed. Both Gas LDCs and Water utilities provide services to a mixture of residential, commercial and industrial customers. Because of the comparable regulatory environment and both industries being based on a large network of fixed assets, I believe their overall business risk is comparable.[73]

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[71] In some cases, a proxy company does not have a credit rating from any of the major rating agencies. However, if they were to be rated, they would receive an investment grade rating. In these instances, I assign the company the average credit rating of the rest of the proxy group.

[72] While some of the companies in the Natural Gas sample own gas transmission assets, the majority of those assets are state regulated and not FERC regulated, indicating they are not long-haul transmission lines.

[73] I also note that a number of utilities operate both electric and gas operations (e.g., NiSource).

Figure 11: Natural Gas and Water Utility Sample

Company	Annual Revenue (Q3 2021) ($MM)	Regulated Assets	Market Cap. (Q3 2021) ($MM)	Value Line Beta	S&P Credit Rating	Long-Term Growth Estimate
	[1]	[2]	[3]	[4]	[5]	[6]
Amer. States Water	$506	R	$3,233	0.65	A+	6.5%
Amer. Water Works	$3,902	R	$32,247	0.90	A	7.6%
Artesian Res Corp	$90	R	$357	0.75	A	4.0%
Atmos Energy	$3,407	R	$11,824	0.80	A-	7.1%
California Water	$807	R	$3,139	0.70	A+	7.6%
Chesapeake Utilities	$547	R	$2,170	0.80	BBB+	6.1%
Essential Utilities	$1,816	MR	$11,897	1.00	A	5.3%
Global Water Resources In	$41	R	$426	0.80	A	15.0%
Middlesex Water	$144	R	$1,859	0.70	A	3.6%
New Jersey Resources	$1,992	MR	$3,407	1.00	BBB+	4.9%
NiSource Inc.	$4,702	R	$9,477	0.85	BBB+	8.6%
Northwest Natural	$827	R	$1,455	0.85	BBB+	5.1%
ONE Gas Inc.	$1,699	R	$3,479	0.80	BBB+	4.2%
SJW Group	$570	R	$1,971	0.80	A-	9.6%
South Jersey Inds.	$1,838	R	$2,529	1.05	BBB	9.2%
Spire Inc.	$2,273	R	$3,206	0.85	A-	5.7%
Gas Sample	$2,161		$4,693	0.88	BBB+	6.4%
Water Sample	$985		$6,891	0.79	A	7.4%
Combined Sample	$1,573		$5,792	0.83	A-	6.9%

Q41. How do the two proxy groups compare to DTE Electric in terms of financial metrics?

A41. DTE Electric's regulated electric operations generated an annual revenue of $5.5 billion in 2020,[74] which is lower than the average annual revenues for the Electric Utility proxy groups, but higher than the average for natural gas and water utilities. DTE Electric's S&P credit rating is A-, which is slightly above the average for the Electric Utility proxy group average but similar to the average for the combined Natural Gas and Water utility proxy groups. DTE Electric is a regulated entity as are all of my proxy companies, but I note that the Natural Gas and Water utility proxy groups have a higher average of regulated assets compared to the Electric Utility Sample, so that the sample's regulatory asset percentage may resemble that of DTE Electric, which is

[74] DTE 2020 10-K, p. 34.

regulated. The proxy groups, like DTE Electric, operate a capital-intensive network of assets, which are subject to state regulation.

C. FINANCIAL RISK ADJUSTMENT

Q42. Can you explain the difference between the data relied upon to estimate the cost of equity and the regulatory rate base to which the cost of equity is applied?

A42. Both the CAPM and the DCF models rely on market data to estimate the cost of equity for the sample companies, so the results reflect the value of the capital that investors hold during the estimation period (market values). The allowed return on equity is applied to rate base, which is determined using historical cost and hence reflect the (net) book values of assets.

Q43. Why is this difference important to the estimation of the cost of equity?

A43. Taking the level of financial risk or leverage into account is necessary to reflect the fact that different capital structure ratios have different levels of financial risk. Specifically, all else equal, higher levels of debt financing increase the risk faced by equity investors. Therefore, investors require higher ROEs from companies with more debt than from comparable business risk companies with less debt. To reflect the effect of capital structure on the cost of equity, I adjust the cost of equity estimates I obtain from applying the models to the market data of the proxy companies. I do so using two different approaches: (1) the overall cost of capital approach and (2) the Hamada approach. I provide further details of these two approaches in Appendix B.[75]

[75] In recognition of the Commission's past decision to not rely on the overall cost of capital approach, my CAPM / ECAPM recommended range is based on the Hamada approach. This approach cannot be applied to the DCF model.

D. CAPM/ ECAPM Approach and Cost of equity Estimates

1. CAPM Approach

Q44. Can you briefly explain the CAPM?

A44. The CAPM is a "risk-positioning model" that models the direct relationship between risk and return illustrated in the Security Market Line. More precisely, the CAPM states that the cost of capital for an investment, S (*e.g.*, a particular common stock), is determined by the risk-free rate plus the stock's systematic risk multiplied by the market risk premium (MRP). Mathematically, the relationship is shown by the following formula:

Formula 1

$$r_s = r_f + \beta_s \times MRP$$

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 equity risk premium.

2. ECAPM Approach

Q45. Can you briefly explain the ECAPM?

A45. Another risk-positioning model is the Empirical CAPM (ECAPM), which builds upon the CAPM. Empirical research has found 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. The ECAPM corrects for this by adjusting the CAPM using the formula below:

Formula 2

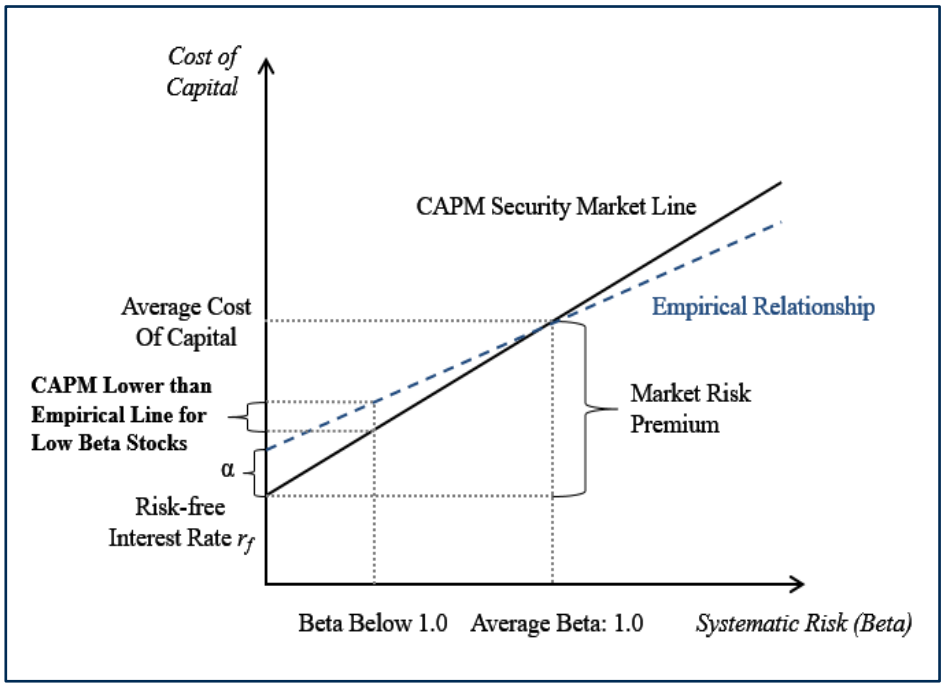
$$r_S = r_f + \alpha + \beta_S \times (MRP - \alpha)$$

where α is the "alpha" adjustment of the risk-return line, a constant; and

r_S, r_f, β_S, and MRP are defined in Formula 1 above.

The alpha adjustment has the effect of increasing the intercept but reducing the slope of the Security Market Line in Figure 12, which results in a Security Market Line that more closely matches the results of empirical tests. The impact on the Security Market Line is illustrated in Figure 12 below. In the ECAPM implementation, I use an alpha of 1.5 based on academic research documenting the magnitude of alpha.[76]

Figure 12
The Empirical Security Market Line



3. CAPM/ ECAPM Cost of Equity Estimates

Q46. Can you summarize the parameters of the scenarios you considered when conducting your CAPM and ECAPM analyses?

76 See Black, Fisher. 1993. Beta and Return. *The Journal of Portfolio Management* 20 (Fall): 8-18; Black, Fisher, Michael C. Jensen, and Myron Scholes. 1972. The Capital Asset Pricing Model: Some Empirical Tests. *Studies in the Theory of Capital Markets*, edited by Michael C. Jensen, pp. 79-121. New York: Praeger; Fama, Eugene F. and James D. MacBeth. 1972. Risk, Returns and Equilibrium: Empirical Tests. *Journal of Political Economy* 81 (3): pp. 607-636; Fama, Eugene F. and Kenneth R. French. 1992. The Cross-Section of Expected Stock Returns. *Journal of Finance* 47 (June): pp. 427-465; Fama, Eugene F. and Kenneth R. French. 2004. The Capital Asset Pricing Model: Theory and Evidence. *Journal of Economic Perspectives* 18 (3): pp. 25-46.

A46. I performed each CAPM/ ECAPM analysis using two scenarios to obtain a range of cost of equity estimates. Specifically, I rely on a forecasted risk-free rate and (i) a historical MRP or (ii) a forecasted MRP.

In Scenario I, I use the average forecasted risk-free rate for 2022-2024, which I determined as the 10-year forecast by Blue Chip Economic Indicators plus 50 basis points, which is the average maturity premium of a 20-year government bond yield over the 10-year government bond yield.[77] This gives me a risk-free rate of 2.73 percent. In Scenario I, I combine this risk-free rate with the historical average MRP as provided by Duff & Phelps.[78] In Scenario II, I use Bloomberg's forecasted MRP (over the 20-year Treasury bond yield) for a MRP of 7.89 percent.[79,80]

Figure 13
Scenarios in CAPM/ ECAPM Analysis

	Scenario I	Scenario II
Risk-Free Rate	2.73%	2.73%
MRP	7.25%	7.89%

Q47. Can you summarize the results from your CAPM and ECAPM analyses?

A47. The results from the CAPM and ECAPM models are presented in Figure 14 and Figure 15 below.

[77] Blue Chip Economic Indicators, October 2021. I use the 20-year government bond yield because the historical MRP is calculated over an approximately 20-year government bond yield.

[78] The MRP of 7.25% is sourced from Duff & Phelps, *Ibbotson SBBI 2021 Valuation Yearbook* 10-21.

[79] Bloomberg as of October 31, 2021.

[80] In past testimony I have used a yield spread adjustment to the risk-free rate in Scenario I, but because the yield spread (deviation of the spread between utility and government bond yields over or below the long-run average) is close to its long-run average, I do not make such an adjustment.

Figure 14: CAPM/ ECAPM Cost of Equity Estimates
Electric Sample

Estimated Return on Equity	Scenario 1 [1]	Scenario 2 [2]
Electric Sample		
Financial Risk Adjusted Method		
CAPM	10.8%	11.5%
ECAPM (α = 1.5%)	11.0%	11.7%
Hamada Adjustment Without Taxes		
CAPM	10.7%	11.4%
ECAPM (α = 1.5%)	10.6%	11.3%
Hamada Adjustment With Taxes		
CAPM	10.4%	11.1%
ECAPM (α = 1.5%)	10.3%	11.0%

Sources and Notes:
[1]: Long-Term Risk Free Rate of 2.73%, Long-Term Market Risk Premium of 7.25%.
[2]: Long-Term Risk Free Rate of 2.73%, Long-Term Market Risk Premium of 7.89%.

Figure 15: CAPM/ ECAPM Cost of Equity Estimates
Natural Gas and Water Utility Sample

Estimated Return on Equity	Scenario 1 [1]	Scenario 2 [2]
Gas and Water Sample		
Financial Risk Adjusted Method		
CAPM	10.9%	11.6%
ECAPM (α = 1.5%)	11.2%	11.9%
Hamada Adjustment Without Taxes		
CAPM	10.6%	11.3%
ECAPM (α = 1.5%)	10.5%	11.2%
Hamada Adjustment With Taxes		
CAPM	10.2%	10.9%
ECAPM (α = 1.5%)	10.2%	10.9%

Q48. How do you interpret the result of your CAPM and ECAPM analyses?

A48. The Electric Utility Sample's results are consistent with a cost of equity in the range of 10.3 percent to 11.4 percent if I ignore the financial risk adjustment method that the Commission has been critical of in the past. The results for the Natural Gas and Water

Utility Sample are comparable to slightly higher (again ignoring the results from the financial risk adjustment method). Rounding to the nearest ¼ percent (as is my practice), the CAPM / ECAPM indicates a range of 10.25 to 11.50 percent for the Electric Sample before any DTE Electric risks are considered. The range for the Natural Gas and Water Utility Sample is similar at 10.25 to 11.25 percent.

E. DCF Approach and Cost of Equity Estimates

Q49. Can you describe the discounted cash flow approach to estimating the cost of equity?

A49. The DCF model estimates the cost of capital for a given company directly, rather than based on its risk relative to the market as the CAPM does. There are two variations of the DCF model, the single-stage DCF and multi-stage DCF, as explained below.

1. Single-Stage DCF Approach

Q50. Can you please briefly describe the single-stage DCF and the inputs used to determine the cost of equity?

A50. Yes. The single-stage DCF model assumes that the current market price of a stock is equal to the present value of the dividends that its owners expect to receive. The expected stream of future dividends is discounted at a risk-appropriate rate to arrive at the present value of the dividends, represented by the current stock price. In this application of the DCF, the risk-appropriate rate is the cost of equity. Mathematically, the DCF model is shown in the formula below:

Formula 3

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

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

Formula 3 implies that if one knows the current market price of a stock and its expected stream of future dividends, then it is possible to solve for the cost of equity r. The single-stage DCF model assumes that the stream of future dividends will grow at a constant rate into perpetuity. This assumption allows Formula 3 to be algebraically rearranged into the formula below to directly estimate the cost of equity:

Formula 4

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

where $\boldsymbol{D_0}$ is the current dividend; and

$\boldsymbol{g}$ is the constant growth rate of the current dividend.

Another variation of the DCF model relaxes the restrictive constant growth rate assumption and instead, allows the dividend to grow at different rates at different points in time. This variation is known as the multi-stage DCF model and is further explained below.

2. Multi-Stage DCF Approach

Q51. Can you briefly describe the multi-stage DCF and the inputs used to determine the cost of equity?

A51. The multi-stage DCF accommodates different dividend growth rates at different points in time. Specifically, in the implementation of the multi-stage DCF, I assume three different growth rate phases. In the first phase, companies grow their dividend for five years at the forecasted company-specific rate of earnings growth. In the second phase, the company-specific growth rate incrementally steps down (or steps up) to the overall growth rate of the economy, represented by the long-term GDP growth rate. Finally, in the third phase, companies grow their dividend at the long-term GDP growth rate into perpetuity.

I calculate both the single- and multi-stage DCF using growth rates from *Value Line* and *IBES* as well as GDP forecasts from Blue Chip Economic Indicators in the case of

the multi-stage DCF. The growth rates utilized in the DCF implementations are shown in Figure 10 and Figure 11 above.

3. DCF Cost of Equity Estimates

Q52. What are the results from your DCF based cost of equity estimates for your samples?

A52. The financial risk adjusted single- and multi-stage DCF cost of equity estimates are presented in Figure 16 below.

Figure 16: DCF Cost of Equity Estimate

	Simple	Multi-stage
	[1]	[2]
Electric Sample	10.4%	8.7%
Gas and Water Sample	11.1%	8.0%

Q53. How do you interpret the results from your DCF analyses?

A53. The range of estimates obtained from the DCF methods is wide ranging from 8.7 to 10.4 percent for the Electric Utility Sample and from 8.0 to 11.1 percent for the Natural Gas and Water Sample. However, I view the multi-stage results as unrepresentative because they fail to include the very high near-term GDP growth and are out of line with other results. Consequently, I consider the range determined by the upper half of the estimation results representative; i.e., 9.50 to 10.50 percent for the Electric Sample and 9.50 to 11.00 percent for the Natural Gas and Water Sample before any DTE Electric risks are considered (again, I round to the nearest ¼ percent).

F. Risk Premium Approach and Cost of Equity Estimate

Q54. Can you briefly describe the Risk Premium approach to estimating the cost of equity?

A54. The Risk Premium approach adds a "risk premium" to the current risk-free rate to estimate the current cost of equity, as shown in Formula 5 below.

Formula 5

$$\boldsymbol{Cost\ of\ Equity = r_f + Risk\ Premium}$$

The risk premium component of Formula 5 is estimated using the allowed ROEs and prevailing risk-free rates from past utility rate cases. In our implementation, I calculate the risk premium as the difference between allowed ROEs and the prevailing quarterly 20-year Treasury bond yield over the period 1990 - Q2 2021.[81] This difference represents the compensation for risk allowed by regulators. I use the statistical technique of ordinary least squares (OLS) regression to estimate the parameters of the linear equation:

Formula 6

$$\boldsymbol{Risk\ Premium\ =\ A_0\ +\ A_1\ \times\ (r_f)}$$

where $\boldsymbol{A_0}$ and $\boldsymbol{A_1}$ are parameters to be estimated by the regression technique; and

$\boldsymbol{r_f}$ is the risk-free rate as measured by the 20-year Treasury bond yield.

Q55. How are the parameters to the Risk Premium approach estimated?

A55. The parameters estimated by regression analysis (*i.e.*, OLS) are shown in Figure 17 below. Additionally, the regression analysis finds that the risk-free rate has a high degree of statistical explanatory power in capturing changes in the risk premium. The negative coefficient $\boldsymbol{A_1}$ reflects the empirical fact that regulators grant lower risk premiums–and by extension, lower allowed ROEs–when the risk-free rate is higher. This is consistent with the observation that investors require a higher risk premium to hold equities over government bonds as bond yields decline. I then use the parameters from the regression analysis, $\boldsymbol{A_0}$ and $\boldsymbol{A_1}$, to estimate the cost of equity using the Scenario 1 and Scenario 2 risk-free rates (shown in Figure 13 above).

Q56. Can you describe the results from your Risk Premium model?

81 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.

A56. Applying the calculated risk premium and a risk-free rate of 2.73% to Formula 5 above results in an estimated cost of equity of 9.8% for all electric utilities and 9.9% for integrated electric utilities. These results are depicted in Figure 17 below.

Figure 17: Implied Risk Premium Model Estimate: All Electric Utilities

	R Squared	Estimate of Intercept (A0)	Estimate of Slope (A1)	Implied Cost of Equity Range
	[1]	[2]	[3]	[4]
Electric Utility	86.3%	8.5%	-55.2%	9.8%
Integrated Electric Utility	87.2%	8.7%	-56.9%	9.9%

Q57. How do you interpret the results from your Risk Premium model?

A57. Based on the Risk Premium model using the forecasted interest rate indications, an average ROE for the average electric utility is in the range of 9.8 to 9.9 percent. This range is consistent with the estimates obtained from the lower end of the CAPM and middle range of the DCF model for the Electric Utility Sample.

G. SUMMARY RESULTS

Q58. Can you briefly summarize the results from the various models you employed to estimate the cost of equity for DTE Electric?

A58. Based on the discussions above, I obtain the following estimates for my proxy groups (rounding to the nearest ¼ percent).

Figure 18: ROE Estimates

	Electric		Gas & Water	
	Low	High	Low	High
CAPM / ECAPM	10.25%	11.50%	10.25%	11.25%
DCF	9.50%	10.50%	9.50%	11.00%
Risk Premium	9.80%	9.90%	n/a	n/a

I note that the average of the results for the Electric Sample is 9.9 to 10.6 percent, while the Natural Gas and Water Sample supports that slightly higher range for the CAPM / ECAPM and DCF methods.

VI. DTE ELECTRIC SPECIFIC CIRCUMSTANCES AND ROE RECOMMENDATION

A. REGULATORY ENVIRONMENT

Q59. Are there any differences in the regulatory environment in which the comparable companies and DTE Electric operates?

A59. Like many of the sample companies, DTE Electric benefits from certain regulatory policies that reduce regulatory lag, including a forward test year for rate cases, and an annual Power Supply Cost Recovery ("PSCR") clause for expenses such as fuel, capacity, energy, transmission, and purchased power.[82] Subject to Commission review, the Company is permitted to include construction work in progress ("CWIP") for pollution control measures and significant new infrastructure projects in rate base.[83] Cost-tracking mechanisms such as these are also in effect in states affecting several of the sample companies.[84] However, unlike some of the sample companies, DTE Electric does not currently have a revenue decoupling mechanism (since a 2012 Court of Appeals ruling reversed Michigan Public Service Commission approval for such a program that DTE Electric had implemented) or lost revenue adjustment mechanism ("LRAM") in place, as some sample companies do.[85]

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82 S&P Global Market Intelligence, Commission Details for the Michigan Public Service Commission, accessed April 8, 2020, https://platform.mi.spglobal.com/interactivex/CommissionDetails.aspx?Printable=1&id=4081574&Type=1&State=MI.

83 *Id*.

84 Lillian Federico, "Alternative ratemaking plans in the U.S.," S&P Global Market Intelligence, Regulatory Research Associates. April 16, 2020, accessed April 21, 2020, https://platform.marketintelligence.spglobal.com/web/client?auth=inherit#news/article?id=58062563&KeyProductLinkType=6. Checked for updates July 31, 2021.

85 *Edison Electric Institute*, "Alternative Regulation for Evolving Utility Challenges: An Updated Survey," January 2013. Many of the companies in my comparable sample have a decoupling mechanism in place. This means that these companies benefit from regulatory provisions allowing them to recover their fixed

Q60. How does the business risk of DTE Electric compare to that of the sample?

A60. Like the sample companies, DTE Electric's business is concentrated in regulated electric generation and distribution, and as mentioned above, DTE Electric does have some regulatory mechanisms in place that are comparable to those of the proxy group companies; however, if load is declining, the lack of a decoupling mechanism is a business risk. DTE Electric also has a credit rating of A- from Standard & Poor's, which is comparable to those of the proxy sample companies.

Regulatory policy plays a role in the business risk of the Company. In the current environment of market uncertainty, the fact that DTE Electric does not have a revenue decoupling mechanism or a fixed variable pricing policy in place puts it at an increased risk of under-recovering its cost of service relative to some companies in the sample group that benefit from such mechanisms. Because the Company recovers much of its fixed cost through per-kWh charges to their customers (i.e. does not benefit from full revenue decoupling or fixed variable pricing), it will be at risk for under-recovery during economic uncertainties. DTE Electric does not have a decoupling mechanism, which more than half of U.S. electric utilities do. This indicates that DTE Electric's business risk is higher than that of its peers.[86]

Michigan also allows competitive retail choice for electricity, which may erode sales volume, although state law caps the alternative supply in a utility's service territory at 10 percent of the preceding years' sales.

B. MICHIGAN ECONOMY

Q61. How do current economic uncertainties impact the business risk of DTE Electric?

costs independent of volumetric charges: if the utilities' customers use less electricity than was forecast, the decoupling mechanism ensures that the utilities can recover their cost despite the decrease in variable revenues.

[86] Regulatory Research Associates, "RRA Regulatory Focus: Adjustment Clauses," November 2019.

A61. The recent economic impacts from the COVID-19 pandemic has increased the business and systematic risk of utilities, including DTE Electric. As governments issued stay-at home orders in response to the pandemic, many parts of the economy shut down.

The Detroit area's economy has been hit particularly hard. As of June 2021, the Detroit metropolitan area's unemployment rate is 6.2 percent, while the national average is 5.9 percent.[87] At the same time the greater Detroit area continues to be economically challenged. However, Michigan currently is expected to see a very high growth in the general economy (GDP).[88]

C. NUCLEAR GENERATION

Q62. Does DTE Electric's ownership of the Fermi 2 Nuclear Generating Plant affect the Company's risk profile?

A62. Yes. Although empirical tests of the effects of the ownership of nuclear generating plants on the cost of capital have not shown a statistically significant increase in the cost of capital, ownership clearly increases the total risk of the Company. The cost of capital is affected by business risk which is the risk remaining after diversifiable risk is removed from total risk.

The additional risk of the Fermi 2 Nuclear Generation Plant is likely to be largely diversifiable, but it is also asymmetric. Asymmetric risk refers to a downside risk for which there is no corresponding upside to balance the risk.

Q63. If the risk of Fermi 2 does not affect the cost of capital, what do you recommend that the Commission do?

A63. First, the Commission should recognize that the risk of nuclear power plants is asymmetric. The Commission should remove the asymmetric risk if there is an event at the plant because the Company has not been previously compensated through its cost

[87] Bureau of Labor Statistics; Detroit-Livonia-Dearborn, MI Economy at a Glance (bls.gov) and United States Economy at a Glance (bls.gov).

[88] DTE Energy Presentation at EEI Financial Conference, November 7-9, 2021, p. 8.

of capital for potential loss. Second, the empirical tests of the effect of nuclear power plants on the cost of capital are likely too "weak" in the sense that is extremely difficult to develop a test likely to detect the effects of nuclear generating assets on the cost of capital for a company. That is because there are so many other factors that affect the cost of capital. For example, nuclear plants are generally owned by holding companies with many other types of assets and are affected by varying regulatory policies. It may well be that nuclear generating plants increase the cost of capital even though empirical tests have not been able to detect it. I regard ownership of Fermi 2 as one more factor indicating that the Company is riskier than the sample on average.

Q64. Can you summarize your assessment of DTE Electric's business risk relative to the sample companies?

A64. In consideration of the factors mentioned above, I believe DTE Electric is of higher than average business risk relative to the sample companies.

VII. COST OF CAPITAL RECOMMENDATION

Q65. What do you recommend for DTE Electric's cost of equity in this proceeding?

A65. The cost of equity estimates from my analyses range widely as summarized below in Figure 19.

Figure 19: Summary ROE Results

	Electric		Gas & Water	
	Low	High	Low	High
CAPM / ECAPM	10.25%	11.50%	10.25%	11.25%
DCF	9.50%	10.50%	9.50%	11.00%
Risk Premium	9.80%	9.90%	n/a	n/a

Based on the figures above, it is evident that the current cost of equity is higher than in DTE Electric's last rate case, when a ROE of 9.9 percent was allowed. The average of the low and high estimates results in a range of 9.9 to 10.6 percent, the midpoint (rounded to the nearest ¼ percent) is 10.25 percent. This is a conservative estimate

given DTE Electric's risk profile. The increase in the cost of equity is predominantly caused by higher systematic risk and equity risk premia – indicating that investors required return on equity has increased relative to the return available on, for example, government bond.

Based on the data above I recommend that DTE Electric be allowed a ROE of 10.25 percent on the 50 percent equity-financed rate base. The recommendation is based on my finding that DTE Electric has higher business risk than the electric sample group because (1) the presence of potential drop in demand from customer choice combined with no decoupling mechanism and (2) its ownership of nuclear generation, representing approximately 10% of its generation capacity.[89] Consequently, it is reasonable to place DTE Electric in the upper half of the estimates. I therefore conservatively recommend a ROE of 10.25 percent.

Q66. Does this conclude your testimony?

A66. Yes.

[89] DTE Energy, 2020 10-K, p. 9.

APPENDIX A: RESUME OF DR. BENTE VILLADSEN

Dr. Bente Villadsen's work concentrates in the areas of regulatory finance and accounting. Her recent work has focused on accounting issues, damages, cost of capital and regulatory finance. Dr. Villadsen has testified on cost of capital and accounting, analyzed credit issues in the utility industry, risk management practices as well the impact of regulatory initiatives such as energy efficiency and de-coupling on cost of capital and earnings. Among her recent advisory work is assisting entities in the acquisition of regulated utilities regarding issues such the return on equity, capital structure, recovery of costs and capital expenditures, growth opportunities, and regulatory environments as well as the precedence for regulatory approval in mergers or acquisitions. Dr. Villadsen's accounting work has pertained to disclosure issues and principles including impairment testing, fair value accounting, leases, accounting for hybrid securities, accounting for equity investments, cash flow estimation as well as overhead allocation. Dr. Villadsen has estimated damages in the U.S. as well as internationally for companies in the construction, telecommunications, energy, cement, and rail road industry. She has filed testimony and testified in federal and state court, in international and U.S. arbitrations and before state and federal regulatory commissions on accounting issues, damages, discount rates and cost of capital for regulated entities.

Dr. Villadsen holds a Ph.D. from Yale University's School of Management with a concentration in accounting. She has a joint degree in mathematics and economics (BS and MS) from University of Aarhus in Denmark. Prior to joining The Brattle Group, Dr. Villadsen was a faculty member at Washington University in St. Louis, University of Michigan, and University of Iowa.

She has taught financial and managerial accounting as well as econometrics, quantitative methods, and economics of information to undergraduate or graduate students. Dr. Villadsen served as the president of the Society of Utility Regulatory Financial Analysts for 2016-2018.

AREAS OF EXPERTISE

- Regulatory Finance
  - Cost of Capital
  - Cost of Service (including prudence)
  - Energy Efficiency, De-coupling and the Impact on Utilities Financials
  - Relationship between regulation and credit worthiness
  - Risk Management
  - Regulatory Advisory in Mergers & Acquisitions
- Accounting and Corporate Finance
  - Application of Accounting Standards
  - Disclosure Issues
  - Forensics
  - Credit Issues in the Utility Industry
- Damages and Valuation (incl. international arbitration)
  - Utility valuation

- Lost Profit for construction, oil&gas, utilities
- Valuation of construction contract
- Damages from the choice of inaccurate accounting methdology

EXPERIENCE

Regulatory Finance

- Dr. Villadsen has testified on cost of capital and capital structure for many regulated entities including electric and gas utilities, pipelines, railroads, water utilities and barges in many jurisdictions including at the FERC, the Surface Transportation Board, the states of Alaska, Arizona, California, Hawaii, Illinois, Iowa, Michigan, New Mexico, New York, Oregon, and Washington as well as in the provinces of Alberta, Ontario, and Quebec.
- On behalf of the Association of American Railroads, Dr. Villadsen appeared as an expert before the Surface Transportation Board (STB) and submitted expert reports on the determination of the cost of equity for U.S. freight railroads. The STB agreed to continue to use two estimation methods with the parameters suggested.
- On behalf of two taxpayers, Dr. Villadsen has testified on the methodology used to estimate the discount rate for the income approach to property valuation in Utah district court.
- For several electric, gas and transmission utilities as well as pipelines in Alberta, Canada, Dr. Villadsen filed evidence and appeared as an expert on the cost of equity and appropriate capital structure for 2015-17. Her evidence was heard by the Alberta Utilities Commission.
- For potential acquirers of electric, natural gas, and water utilities, Dr. Villadsen has conducted regulatory due diligence in the form of an assessment of the regulatory environment in the jurisdictions at issue including the ability to earn the allowed return and recover costs associated with operations or capital expenditures. Her evaluations also involved an assessment of needed capital expenditures and the recovery of such expenditure through rates or specific adjustment clauses. Her prior work includes more than 15 US states, the FERC, and several Canadian provinces.
- Dr. Villadsen has estimated the cost of capital and recommended an appropriate capital structure for natural gas and liquids pipelines in Canada, Mexico, and the US. using the jurisdictions' preferred estimation technique as well as other standard techniques. This work has been used in negotiations with shippers as well as before regulators.

- For the Ontario Energy Board Staff, Dr. Villadsen submitted evidence on the appropriate capital structure for a power generator that is engaged in a nuclear refurbishment program.
- Dr. Villadsen has advised many acquirers and potential acquirers of regulated utilities regarding the return on equity, capital structure, recovery of costs and capital expenditures, growth opportunities, and regulatory environments as well as the precedence for regulatory approval in mergers or acquisitions. Her work has pertained to many jurisdiction in the U.S. and Canada including more than 20 states and three provinces as well as the Federal Energy Regulatory Commission. She has worked on electric, natural gas, pipeline, transmission, and water utility acquisitions.
- She has estimated the cost of equity on behalf of entities such as Anchorage Municipal Light and Power, Arizona Public Service, Portland General Electric, Anchorage Water and Wastewater, NW Natural, Nicor, Consolidated Edison, Southern California Edison, American Water, California Water, and EPCOR in state regulatory proceedings. She has also submitted testimony before the FERC on behalf of electric transmission and natural gas pipelines as well as Bonneville Power Authority. Much of her testimony involves not only cost of capital estimation but also capital structure, the impact on credit metrics and various regulatory mechanisms such as revenue stabilization, riders and trackers.
- In Australia, she has submitted led and co-authored a report on cost of equity and debt estimation methods for the Australian Pipeline Industry Association. The equity report was filed with the Australian Energy Regulator as part of the APIA's response to the Australian Energy Regulator's development of rate of return guidelines and both reports were filed with the Economic Regulation Authority by the Dampier Bunbury Pipeline. She has also submitted a report on aspects of the WACC calculation for Aurizon Network to the Queensland Competition Authority.
- In Canada, Dr. Villadsen has co-authored reports for the British Columbia Utilities Commission and the Canadian Transportation Agency regarding cost of capital methodologies. Her work consisted partly of summarizing and evaluating the pros and cons of methods and partly of surveying Canadian and world-wide practices regarding cost of capital estimation.
- Dr. Villadsen worked with utilities to estimate the magnitude of the financial risk inherent in long-term gas contracts. In doing so, she relied on the rating agency of Standard & Poor's published methodology for determining the risk when measuring credit ratios.

- She has worked on behalf of infrastructure funds, pension funds, utilities and others on understanding and evaluating the regulatory environment in which electric, natural gas, or water utilities operate for the purpose of enhancing investors ability to understand potential investments. She has also provided advise and testimony in the approval phase of acquisitions.
- On behalf of utilities that are providers of last resort, she has provided estimates of the proper compensation for providing the state-mandated services to wholesale generators.
- In connection with the AWC Companies application to construct a backbone electric transmission project off the Mid-Atlantic Coast, Dr. Villadsen submitted testimony before the Federal Energy Regulatory Commission on the treatment the accounting and regulatory treatment of regulatory assets, pre-construction costs, construction work in progress, and capitalization issues.
- On behalf of ITC Holdings, she filed testimony with the Federal Energy Regulatory Commission regarding capital structure issues.
- For a FERC-regulated entity, Dr. Villadsen undertook an assessment of the company's classification of specific long-term commitments, leases, regulatory assets, asset retirement obligations, and contributions / distributions to owners in the company's FERC Form 1.
- Testimony on the impact of transaction specific changes to pension plans and other rate base issues on behalf of Balfour Beatty Infrastructure Partners before the Michigan Public Service Commission.
- On behalf of financial institutions, Dr. Villadsen has led several teams that provided regulatory guidance regarding state, provincial or federal regulatory issues for integrated electric utilities, transmission assets and generation facilities. The work was requested in connection with the institutions evaluation of potential investments.
- For a natural gas utility facing concerns over mark to market losses on long term gas hedges, Dr. Villadsen helped develop a program for basing a portion of hedge targets on trends in market volatility rather than on just price movements and volume goals. The approach was refined and approved in a series of workshops involving the utility, the state regulatory staff, and active intervener groups. These workshops evolved into a forum for quarterly updates on market trends and hedging positions.
- She has advised the private equity arm of three large financial institutions as well as two infrastructure companies, a sovereign fund and pension fund in connection with their acquisition of regulated transmission, distribution or integrated electric assets in the U.S. and Canada. For these clients, Dr. Villadsen evaluated the regulatory climate and the treatment of

acquisition specific changes affecting the regulated entity, capital expenditures, specific cost items and the impact of regulatory initiatives such as the FERC's incentive return or specific states' approaches to the recovery of capital expenditures riders and trackers. She has also reviewed the assumptions or worked directly with the acquirer's financial model.

- On behalf of a provider of electric power to a larger industrial company, Dr. Villadsen assisted in the evaluation of the credit terms and regulatory provisions for the long-term power contract.
- For several large electric utility, Dr. Villadsen reviewed the hedging strategies for electricity and gas and modeled the risk mitigation of hedges entered into. She also studies the prevalence and merits of using swaps to hedge gas costs. This work was used in connection with prudence reviews of hedging costs in Colorado, Oregon, Utah, West Virginia, and Wyoming.
- She estimated the cost of capital for major U.S. and Canadian utilities, pipelines, and railroads. The work has been used in connection with the companies' rate hearings before the Federal Energy Regulatory Commission, the Canadian National Energy Board, the Surface Transportation Board, and state and provincial regulatory bodies. The work has been performed for pipelines, integrated electric utilities, non-integrated electric utilities, gas distribution companies, water utilities, railroads and other parties. For the owner of Heathrow and Gatwick Airport facilities, she has assisted in estimating the cost of capital of U.K. based airports. The resulting report was filed with the U.K. Competition Commission.
- For a Canadian pipeline, Dr. Villadsen co-authored an expert report regarding the cost of equity capital and the magnitude of asset retirement obligations. This work was used in arbitration between the pipeline owner and its shippers.
- In a matter pertaining to regulatory cost allocation, Dr. Villadsen assisted counsel in collecting necessary internal documents, reviewing internal accounting records and using this information to assess the reasonableness of the cost allocation.
- She has been engaged to estimate the cost of capital or appropriate discount rate to apply to segments of operations such as the power production segment for utilities.
- In connection with rate hearings for electric utilities, Dr. Villadsen has estimated the impact of power purchase agreements on the company's credit ratings and calculated appropriate compensation for utilities that sign such agreements to fulfill, for example, renewable energy requirements.
- Dr. Villadsen has been part of a team assessing the impact of conservation initiatives, energy efficiency, and decoupling of volumes and revenues on electric utilities financial performance.

Specifically, she has estimated the impact of specific regulatory proposals on the affected utilities earnings and cash flow.

- On behalf of Progress Energy, she evaluated the impact of a depreciation proposal on an electric utility's financial metric and also investigated the accounting and regulatory precedent for the proposal.
- For a large integrated utility in the U.S., Dr. Villadsen has for several years participated in a large range of issues regarding the company's rate filing, including the company's cost of capital, incentive based rates, fuel adjustment clauses, and regulatory accounting issues pertaining to depreciation, pensions, and compensation.
- Dr. Villadsen has been involved in several projects evaluating the impact of credit ratings on electric utilities. She was part of a team evaluating the impact of accounting fraud on an energy company's credit rating and assessing the company's credit rating but-for the accounting fraud.
- For a large electric utility, Dr. Villadsen modeled cash flows and analyzed its financing decisions to determine the degree to which the company was in financial distress as a consequence of long-term energy contracts.
- For a large electric utility without generation assets, Dr. Villadsen assisted in the assessment of the risk added from offering its customers a price protection plan and being the provider of last resort (POLR).
- For several infrastructure companies, Dr. Villadsen has provided advice regarding the regulatory issues such as the allowed return on equity, capital structure, the determination of rate base and revenue requirement, the recovery of pension, capital expenditure, fuel, and other costs as well as the ability to earn the allowed return on equity. Her work has spanned 14 U.S. states as well as Canada, Europe, and South America. She has been involved in the electric, natural gas, water, and toll road industry.
- For an electric utility, Dr. Villadsen provided guidance regarding the regulatory accounts needed as the utility was separated into separate generation, transmission, and distribution entities with each their accounting records.

Accounting and Corporate Finance

- For an electric utility subject to international arbitration, Dr. Villadsen submitted expert testimony on the application of IFRS as it pertains to receivables, the classification of liabilities and contingencies.

- In international arbitration, she submitted an expert report on IFRS' requirements regarding carve out financials, impairment, the allocation of costs to segments, and disclosure issues.
- On behalf of a construction company in arbitration with a sovereign, Dr. Villadsen filed an expert report report quantifying damages in the form of lost profit and consequential damages.
- In arbitration before the International Chamber of Commerce Dr. Villadsen testified regarding the true-up clauses in a sales and purchase agreement, she testified on the distinction between accruals and cash flow measures as well as on the measurement of specific expenses and cash flows.
- On behalf of a taxpayer, Dr. Villadsen recently testified in federal court on the impact of discount rates on the economic value of alternative scenarios in a lease transaction.
- On behalf of a taxpayer, Dr. Villaden has provided an expert report on the nature of the cost of equity used in regulatory proceedings as well as the interest rate regine in 2014.
- In an arbitration matter before the International Centre for Settlement of Investment Disputes, she provided expert reports and oral testimony on the allocation of corporate overhead costs and damages in the form of lost profit. Dr. Villadsen also reviewed internal book keeping records to assess how various inter-company transactions were handled.
- Dr. Villadsen provided expert reports and testimony in an international arbitration under the International Chamber of Commerce on the proper application of US GAAP in determining shareholders' equity. Among other accounting issues, she testified on impairment of long-lived assets, lease accounting, the equity method of accounting, and the measurement of investing activities.
- In a proceeding before the International Chamber of Commerce, she provided expert testimony on the interpretation of certain accounting terms related to the distinction of accruals and cash flow.
- In an arbitration before the American Arbitration Association, she provided expert reports on the equity method of accounting, the classification of debt versus equity and the distinction between categories of liabilities in a contract dispute between two major oil companies. For the purpose of determining whether the classification was appropriate, Dr. Villadsen had to review the company's internal book keeping records.

- In U.S. District Court, Dr. Villadsen filed testimony regarding the information required to determine accounting income losses associated with a breach of contract and cash flow modeling.
- Dr. Villadsen recently assisted counsel in a litigation matter regarding the determination of fair values of financial assets, where there was a limited market for comparable assets. She researched how the designation of these assets to levels under the FASB guidelines affect the value investors assign to these assets.
- She has worked extensively on litigation matters involving the proper application of mark-to-market and derivative accounting in the energy industry. The work relates to the proper valuation of energy contracts, the application of accounting principles, and disclosure requirements regarding derivatives.
- Dr. Villadsen evaluated the accounting practices of a mortgage lender and the mortgage industry to assess the information available to the market and ESOP plan administrators prior to the company's filing for bankruptcy. A large part of the work consisted of comparing the company's and the industry's implementation of gain-of-sale accounting.
- In a confidential retention matter, Dr. Villadsen assisted attorneys for the FDIC evaluate the books for a financial investment institution that had acquired substantial Mortgage Backed Securities. The dispute evolved around the degree to which the financial institution had impaired the assets due to possible put backs and the magnitude and estimation of the financial institution's contingencies at the time of it acquired the securities.
- In connection with a securities litigation matter she provided expert consulting support and litigation consulting on forensic accounting. Specifically, she reviewed internal documents, financial disclosure and audit workpapers to determine (1) how the balance's sheets trading assets had been valued, (2) whether the valuation was following GAAP, (3) was properly documented, (4) was recorded consistently internally and externally, and (5) whether the auditor had looked at and documented the valuation was in accordance with GAAP.
- In a securities fraud matter, Dr. Villadsen evaluated a company's revenue recognition methods and other accounting issues related to allegations of improper treatment of non-cash trades and round trip trades.
- For a multi-national corporation with divisions in several countries and industries, Dr. Villadsen estimated the appropriate discount rate to value the divisions. She also assisted the

company in determining the proper manner in which to allocate capital to the various divisions, when the company faced capital constraints.

- Dr. Villadsen evaluated the performance of segments of regulated entities. She also reviewed and evaluated the methods used for overhead allocation.
- She has worked on accounting issues in connection with several tax matters. The focus of her work has been the application of accounting principles to evaluate intra-company transactions, the accounting treatment of security sales, and the classification of debt and equity instruments.
- For a large integrated oil company, Dr. Villadsen estimated the company's cost of capital and assisted in the analysis of the company's accounting and market performance.
- In connection with a bankruptcy proceeding, Dr. Villadsen provided litigation support for attorneys and an expert regarding corporate governance.

Damages and Valuation

- For the Alaska Industrial Development and Export Authority, Dr. Villadsen co-authored a report that estimated the range of recent acquisition and trading multiples for natural gas utilities.
- On behalf of a taxpayer, Dr. Villadsen testified on the economic value of alternative scenarios in a lease transaction regarding infrastructure assets.
- For a foreign construction company involved in an international arbitration, she estimated the damages in the form of lost profit on the breach of a contract between a sovereign state and a construction company. As part of her analysis, Dr. Villadsen relied on statistical analyses of cost structures and assessed the impact of delays.
- In an international arbitration, Dr. Villadsen estimated the damages to a telecommunication equipment company from misrepresentation regarding the product quality and accounting performance of an acquired company. She also evaluated the IPO market during the period to assess the possibility of the merged company to undertake a successful IPO.

- On behalf of pension plan participants, Dr. Villadsen used an event study estimated the stock price drop of a company that had engaged in accounting fraud. Her testimony conducted an event study to assess the impact of news regarding the accounting misstatements.

- In connection with a FINRA arbitration matter, Dr. Villadsen estimated the value of a portfolio of warrants and options in the energy sector and provided support to counsel on finance and accounting issues.

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

- Dr. Villadsen was part of a team estimating the damages that may have been caused by a flawed assumption in the determination of the fair value of mortgage related instruments. She provided litigation support to the testifying expert and attorneys.

- For an electric utility, Dr. Villadsen estimated the loss in firm value from the breach of a power purchase contract during the height of the Western electric power crisis. As part of the assignment, Dr. Villadsen evaluated the creditworthiness of the utility before and after the breach of contract.

- Dr. Villadsen modeled the cash flows of several companies with and without specific power contract to estimate the impact on cash flow and ultimately the creditworthiness and value of the utilities in question.

BOOKS

"*Risk and Return for Regulated Industries*," (with Michael J. Vilbert, Dan Harris, and A. Lawrence Kolbe) Elsevier, May 2017.

PUBLICATIONS AND REPORTS

"A Review of International Approaches to Regulated Rates of Return," (with J. Anthony, T. Brown, L. Figurelli, D. Harris, and N. Nguyen) published by the *Australian Energy Regulator*, September 2020.

"Global Impacts and Implications of COVID-19 on Utility Finance," (with R. Mudge, F. Graves, J. Figueroa, T. Counts, L. Mwalenga, and S. Pant), *The Brattle Group*, July 2020.

"Impact of New Tax Law on Utilities' Deferred Taxes," (with Mike Tolleth and Elliott Metzler), *CRRI 37'th Annual Eastern Conference*, June, 2018.

"Implications of the New Tax Law for Regulated Utilities," The Brattle Group, January 2018.

"Using Electric and Gas Forwards to Manage Market Risks: When a power purchase agreement with a utility is not possible, standard forward contracts can act as viable hedging instruments*," North American Windpower*, May 2017, pp. 34-37.

"*Managing Price Risk for Merchant Renewable Investments: Role of Market Interactions and Dynamics on Effective Hedging Strategies*," (with Onur Aydin and Frank Graves), Brattle Whitepaper, January 2017.

"Aurizon Network 2016 Access Undertaking: Aspects of the WACC," (with Mike Tolleth), filed with the *Queensland Competition Authority*, Australia, November 2016.

"Report on Gas LDC multiples," with Michael J. Vilbert, *Alaska Industrial Development and Export Authority*, May 2015.

"Aurizon Network 2014 Draft Access Undertaking: Comments on Aspects of the WACC," prepared for Aurizon Network and submitted to the *Queensland Competition Authority*, December 2014

"Brattle Review of AE Planning Methods and Austin Task Force Report." (with Frank C. Graves) September 24, 2014.

Report on "Cost of Capital for Telecom Italia's Regulated Business" with Stewart C. Myers and Francesco Lo Passo before the *Communications Regulatory Authority of Italy* ("AGCOM"), March 2014. *Submitted in Italian.*

"Alternative Regulation and Ratemaking Approaches for Water Companies: Supporting the Capital Investment Needs of the 21st Century," (with J. Wharton and H. Bishop), prepared for the *National Association of Water Companies*, October 2013.

"Estimating the Cost of Debt," (with T. Brown), prepared for the Dampier Bunbury Pipeline and filed with the *Economic Regulation Authority*, Western Australia, March 2013.

"Estimating the Cost of Equity for Regulated Companies," (with P.R. Carpenter, M.J. Vilbert, T. Brown, and P. Kumar), prepared for the Australian Pipeline Industry Association and filed with the *Australian Energy Regulator* and the *Economic Regulation Authority*, Western Australia, February 2013.

"Calculating the Equity Risk Premium and the Risk Free Rate," (with Dan Harris and Francesco LoPasso), prepared for *NMa and Opta, the Netherlands*, November 2012.

"Shale Gas and Pipeline Risk: Earnings Erosion in a More Competitive World," (with Paul R. Carpenter, A. Lawrence Kolbe, and Steven H. Levine), *Public Utilities Fortnightly*, April 2012.

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

"Public Sector Discount Rates" (with rank Graves, Bin Zhou), *Brattle* white paper, September 2011

"FASB Accounting Rules and Implications for Natural Gas Purchase Agreements," (with Fiona Wang), *American Clean Skies Foundation*, February 2011.

"IFRS and You: How the New Standards Affect Utility Balance Sheets," (with Amit Koshal and Wyatt Toolson), *Public Utilities Fortnightly*, December 2010.

"Corporate Pension Plans: New Developments and Litigation," (with George Oldfield and Urvashi Malhotra), Finance Newsletter, Issue 01, *The Brattle Group*, November 2010.

"Review of Regulatory Cost of Capital Methodologies," (with Michael J. Vilbert and Matthew Aharonian), *Canadian Transportation Agency*, September 2010.

"Building Sustainable Efficiency Businesses: Evaluating Business Models," (with Joe Wharton and Peter Fox-Penner), *Edison Electric Institute*, August 2008.

"Understanding Debt Imputation Issues," (with Michael J. Vilbert and Joe Wharton and *The Brattle Group* listed as an author), *Edison Electric Institute*, June 2008.

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

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

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

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

SELECTED PRESENTATIONS

"Current Issues in Cost of Capital" presented to *EEI Members*, July, 2018-19, 2021.

"The Future of Gas: Options and Regulatory Strategies in a Carbon-Constrained Future," (with Ahmad Faruqui, Josh Figueroa, Long Lam), Presented to Executive Team at Gas Utility, June 2021.

"FERC's new ROE methodology for pipelines and electric transmission," (with Michael J. Vilbert) *UBS Fireside Chat*, June 24, 2020.

"Managing Price Risk for Merchant Renewable Investments," (with Onur Aydin) *EIA Electricity Pricing Workgroup* (webinar), April 30, 2019.

"Decoupling and its Impact on Cost of Capital" presented to *SURFA Members and Friends*, February 27, 2019.

"Introduction to Capital Structure & Liability Management", *the American Gas Association/Edison Electric Institute "Introduction and Advanced Public Utility Accounting Courses",* August 2018-2019.

"Lessons from the U.S. and Australia" presented at *Seminar on the Cost of Capital in Regulated Industries: Time for a Fresh Perspective?* Brussels, October 2017.

"Should Regulated Utilities Hedge Fuel Cost and if so, How?" presented at *SURFA's 49 Financial Forum*, April 20-21, 2017.

"Transmission: The Interplay Between FERC Rate Setting at the Wholesale Level and Allocation to Retail Customers," (with Mariko Geronimo Aydin) presented at *Law Seminars International: Electric Utility Rate Cases*, March 16-17, 2017.

"Capital Structure and Liability Management," *American Gas Association and Edison Electric Institute Public Utility Accounting Course*, August 2015-2017.

"Current Issues in Cost of Capital," *Edison Electric Institute Advanced Rate School*, July 2013-2017.

"Alternative Regulation and Rate Making Approaches for Water Companies," *Society of Depreciation Professionals Annual Conference*, September 2014.

"Capital Investments and Alternative Regulation," *National Association of Water Companies Annual Policy Forum*, December 2013.

"Accounting for Power Plant," *SNL's Inside Utility Accounting Seminar*, Charlotte, NC, October 2012.

"GAAP / IFRS Convergence," *SNL's Inside Utility Accounting Seminar*, Charlotte, NC, October 2012.

"International Innovations in Rate of Return Determination," *Society of Utility Financial and Regulatory Analysts' Financial Forum*, April 2012.

"Utility Accounting and Financial Analysis: The Impact of Regulatory Initiatives on Accounting and Credit Metrics," 1.5 day seminar, EUCI, Atlanta, May 2012.

"Cost of Capital Working Group Eforum," *Edison Electric Institute webinar*, April 2012.

"Issues Facing the Global Water Utility Industry" Presented to Sensus' Executive Retreat, Raleigh, NC, July 2010.

"Regulatory Issues from GAAP to IFRS," NASUCA *2009 Annual Meeting*, Chicago, November 2009.

"Subprime Mortgage-Related Litigation: What to Look for and Where to Look," *Law Seminars International: Damages in Securities Litigation*, Boston, May 2008.

"Evaluating Alternative Business / Inventive Models," (with Joe Wharton). *EEI Workshop, Making a Business of Energy Efficiency: Sustainable Business Models for Utilities*, Washington DC, December 2007.

"Deferred Income Taxes and IRS's NOPR: Who should benefit?" *NASUCA Annual Meeting*, Anaheim, CA, November 2007.

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

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

TESTIMONY

Direct Testimony on Cost of Equity and Capital Structure on behalf of Énergir, Gazifère, and Intragaz before *Régie de l'énergie du Québec*, R-4156-2021, November 2021.

Direct Testimony on Cost of Equity for Advanced Ratemaking on behalf of Interstate Power and Light Company, *Iowa Utilities Board*, RPU-2021-0003, November 2021.

Expert Report on Cost of Equity and the Weighted Average Cost of Capital on behalf of Barbados Light and Power Company, *Barbados Fair Trading Commission*, September 2021.

Direct Testimony on California's Cost of Capital Mechanism and Cost of Equity on behalf of Southern California Edison, *California Public Utilities Commission*, Application A.21-08-013, August 2021.

Expert Report on Contingent Liabilities and Materiality under IFRS on behalf of of Norilsk Nickel Mauritius, *LCIA Arbitration* No. 163506, August 2021.

Deposition Testimony re. rate of return and bypass rates on behalf on Southwest Gas Corporation, *Superior Court for the state of Arizona, County of Maricopa*, CV2012-050939, August 2021.

Direct Testimony on Cost of Equity on behalf of Portand General Electric, *Oregon Public Utility Commission*, UE-324, July 2021.

Direct Testimony on Cost of Capital on behalf of California-American Water Company, *California Public Utilities Commission*, Application No. 21-05-, May 2021.

Prefiled Direct Testimony on cost of equity on behalf of Southern Star Central Gas Pipeline, *Federal Energy Regulatory Commission*, Docket RP21-778-000, April 2021.

Direct Testimony re. the prospective excessive earnings test on behalf of Cleveland Electric Illuminating Company and the Toledo Edison Company, *Public Utilities Commission of Ohio*, Case Nos. 20-1034-EL UNC and 20-1476-EL-UNC, March 2021.

Rebuttal Testimony re. the discount rate for property valuation in tax assessment on behalf of Union Pacific Railroad, *Utah District Court*, Case No. 2:18-cv-00630-DAK_DBP (Union Pacific Railroad v. Utah State Tax Commission et al), February 2021.

Direct Testimony and Rebuttal Testimony on cost of equity on behalf of DTE Gas submitted to the *Michigan Public Service Commission*, U-20940, February and June 2020.

Direct Testimony on the cost of equity on behalf of Orange & Rockland Utilities submitted to the *New York Department of Public Service*, Case No. 21-E-0074, January 2021.

Direct Testimony, Rebuttal Testimony, and Surrebuttal Testimony on the cost of equity on behalf of Nicor Gas submitted to the *Illinois Commerce Commission*, Docket No. 21-0098, January 2021, June 2021, July 2021.

Direct Testimony on the cost of equity and capital structure on behalf of Anchorage Water and Wastewater Utility submitted to the *Regulatory Commission of Alaska*, Matters TA168-122 and 168-126, December 2020.

Direct Testimony on the cost of equity on behalf of NW Natural submitted to the *Washington Transportation and Utilities Commission*, Docket No. UG-200994, December 2020.

Written Evidence in Review and Variance of Decision 22570-D01-2018 Stage 2 (AltaGas' capital structure) (joint with Paul R. Carpenter) on behalf of AltaGas Utilities Inc. Filed with the *Alberta Utilities Commission*, Proceeding 25031, January 2020.

Written Evidence on Cost of Equity and Capital Structure on behalf of ATCO, AltaGas and FortisAlberta in 2021-2022 Generic Cost of Capital Proceeding. Filed with the *Alberta Utilities Commission*, Proceeding No. 24110, January 2020.

Report on the Return Margin for the Alberta Bottle Depots on behalf of the Alberta Beverage Container Recycling Corporation, February 2020.

Verified Statement and Reply Verified Statement regarding Revisions to the Board's Methodology for Determining the Railroad Industry's Cost of Capital on behalf of the American Association of Railroads before the *Surface Transportation Board*, Docket No. EP 664 (Sub-No. 4), January, February 2020.

Affidavit regarding the creation of a regulatory asset for earthquake related costs on behalf of Anchorage Water and Wastewater submitted to the *Regulatory Commission of Alaska*, December 2019.

Expert Report and Hearing Appearance on Going Concern and Impairment, *American Arbitration Association*: International Engineering & Construction S.A., Greenville Oil & Gas Co. Ltd and GE Oil & Gas, Inc., November, December 2019.

Direct Testimony and Rebuttal Testimony on the cost of equity on behalf of DTE Gas submitted to the *Michigan Public Service Commission*, Docket No. U-20642, November 2019.

Expert Report on IFRS Issues and Forensics. *SIAC Arbitration* No. 44 of 2018, October 2019.

Expert Report, Reply Report and Hearing Appearance on IFRS issues. *ICC Arbitration* No. 23896/GSS, September 2019, September and November 2020.

Direct Testimony on the cost of debt and equity capital as well as capital structure on behalf of Young Brothers, LLC. submitted to the *Public Utilities Commission of the State of Hawaii*, Docket No. 2019-0117, September 2019.

Direct Testimony on Cost of Equity on behalf of DTE Gas submitted to the *Michigan Public Service Commission*, Docket No. U-20940, February 2021.

Expert Report on discount rates in property tax matter for Union Pacific Company in *Union Pacific Railroad Co. v. Utah State Tax Comm'n, et. al.*, Case No. 2:18-cv-00630-DAK-DBP, Utah August 2019.

Answering Testimony on the Cost of Equity on behalf of Northern Natural Gas Company submitted to the *Federal Energy Regulatory Commission*, Docket No. RP19-59-000, August 2019.

Direct Testimony, Rebuttal Testimony, and Hearing Appearance on Cost of Equity on behalf of DTE Electric Company submitted to the *Michigan Public Service Commission*, Docket No. U-20561, July, November, December 2019.

Prepared Direct Testimony on Cost of Capital for Northern Natural Gas Company submitted to the *Federal Energy Regulatory Commission*, Docket No. RP19-1353-000, July 2019.

Prepared Direct Testimony on Cost of Capital and Term Differentiated Rates for Paiute Pipeline Company submitted to the *Federal Energy Regulatory Commission*, Docket No. RP19-1291-000, May 2019.

Expert report, deposition, and oral trial testimony on behalf of PacifiCorp in the Matter of *PacifiCorp, Inc. v. Utah State Tax Comm'n*, Case No. 180903986 TX, *Utah District Court* April, May, September 2019.

Direct Testimony, Rebuttal Testimony, and hearing appearance on the cost of capital for Southern California Edison submitted to the *California Public Utilities Commission*, Docket No. A.19-04-014, April 2019, August 2019.

Prepared Direct Testimony on the cost of equity for Southern California Edison's transmission assets submitted to the *Federal Energy Regulatory Commission*, Docket No. ER19-1553, April 2019.

Direct and Rebuttal Testimony on cost of equity for Consolidated Edison of New York submitted to the *New York Public Service Commission*, Matter No. 19-00317, January, June 2019.

Direct Testimony on cost of capital and capital structure for Northwest Natural Gas Company submitted to the *Washington Utilities and Transportation Commission*, Docket No. 181053, December 2018.

Pre-filed Direct Testimony and Reply Testimony on cost of capital and capital structure for Anchorage Water Utility and Anchorage Wastewater Utility submitted to the *Regulatory Commission of Alaska*, TA163-122 and TA164-126, December 2018, October 2019.

Direct Testimony on cost of capital for Portland General Electric Company submitted to the *Oregon Public Utility Commission* on behalf of Portland General Electric Company (with Hager and Liddle), UE 335, February 2018.

Direct Testimony and Rebuttal Testimony on cost of capital for NW Natural submitted to the *Oregon Public Utility Commission* on behalf of NW Natural, UG 344, December 2017, May 2018.

Direct Pre-filed Testimony and Reply Pre-filed Testimony on cost of equity and capital structure for Anchorage Water and Wastewater Utilities before the *Regulatory Commission of Alaska*, TA161-122 and TA162-126, November 2017, September 2018.

Direct Testimony, Rebuttal Testimony, deposition, and hearing appearance on wholesale water rates for Petitioner Cities, *Texas Public Utility Commission*, PUC Docket 46662, SOAH Docket 473-17-4964.WS, November 2017, January, June, July, October 2018.

Affidavit on Lifting the Dividend Restriction for Anchorage Water Utility for AWWU, *Regulatory Commission of Alaska*, U-17-095, November 2017.

Written Evidence, Rebuttal Evidence and Hearing appearance on the Cost of Capital and Capital Structure for the ATCO Utilities and AUI, 2018-2020 Generic Cost of Capital Proceeding, *Alberta Utilities Commission*, October 2017, February – March 2018.

Written Evidence, Rebuttal Evidence, and Hearing Appearance on Regulatory Tax Treatment for the ATCO Utilities and AUI, 201802020 Generic Cost of Capital Proceeding, *Alberta Utilities Commission*, October 2017, February – March 2018.

Affidavit on the Creation of a Regulatory Assets for PRV Rebates for Anchorage Water Utility, submitted to the *Regulatory Commission of Alaska*, U-17-083, August 2017.

Direct and Rebuttal Testimony, Hearing Appearance on Cost of Capital for California-American Water Company for California-American Water submitted to the *California Public Utilities Commission*, Application 17-04-003, April, August, September 2017.

Direct, Rebuttal, Surrebuttal, Supplemental, Supplemental Rebuttal Testimony and Hearing Appearance on the Cost of Capital for Northern Illinois Gas Company submitted to the *Illinois Commerce Commission*, GRM #17-055, March, July, August, September, and November 2017.

Direct and Rebuttal Testimony on Cost of Capital for Portland General Electric Company submitted to the *Oregon Public Utility Commission* on behalf of Portland General Electric Company, Docket No. UE 319, February, July 2017.

Pre-filed Direct and Reply Testimony and Hearing Appearance on Cost of Equity and Capital Structure for Anchorage Municipal Light and Power, *Regulatory Commission of Alaska*, Docket No. TA357-121, December 2016, August and December 2017.

Expert report and Hearing Appearance regarding the Common Equity Ratio for OPG's Regulated Generation for OEB Staff, *Ontario Energy Board*, EB-2016-0152, November 2016, April 2017.

Pre-filed Direct Testimony on Cost of Equity and Capital Structure for Anchorage Municipal Wastewater Utility, *Regulatory Commission of Alaska*, Docket No. 158-126, November 2016.

Expert Report, Reply Expert Report and Hearing on damages (quantum) in exit arbitration (with Dan Harris), *International Center for the Settlement of Investment Disputes*, October 2016, October 2018, July 2019.

Direct Testimony on capital structure, embedded cost of debt, and income taxes for Detroit Thermal, Michigan Public Service Commission, Docket No. UE-18131, July 2016.

Direct Testimony on return on equity for Arizona Public Service Company, Arizona Corporation Commission, Docket E-01345A-16-0036, June 2016.

Written evidence, rebuttal evidence and hearing appearance regarding the cost of equity and capital structure for Alberta-based utilities, the *Alberta Utilities Commission*, Proceeding No. 20622 on behalf of AltaGas Utilities Inc., ENMAX Power Corporation, FortisAlberta Inc., and The ATCO Utilities, February, May and June 2016.

Verified Statement, Verified Reply Statement, and Hearing Appearance regarding the cost of capital methodology to be applied to freight railroads, the *Surface Transportation Board* on behalf of the Association of American Railroads, Docket No. EP 664 (Sub-No. 2), July 2015, September and November 2015.

Direct Testimony on cost of capital submitted to the Oregon Public Utility Commission on behalf of Portland General Electric, Docket No. UE 294, February 2015.

Supplemental Direct Testimony and Reply Testimony on cost of capital submitted to the *Regulatory Commission of Alaska* on behalf of Anchorage Water and Wastewater utilities, Docket U-13-202, September 2014, March 2015.

Expert Report and hearing appearance on specific accrual and cash flow items in a Sales and Purchase Agreement in international arbitration before the *International Chamber of Commerce*. Case No. 19651/TO, July and November 2014. (*Confidential*)

Rebuttal Testimony regarding Cost of Capital before the *Oregon Public Utility Commission* on behalf of Portland General Electric, Docket No. UE 283, July 2014.

Direct Testimony on the rate impact of the pension re-allocation and other items for Upper Peninsula Power Company in connection with the acquisition by BBIP before the *Michigan Public Service Commission* in Docket No. U-17564, March 2014.

Expert Report on cost of equity, non-recovery of operating cost and asset retirement obligations on behalf of oil pipeline in arbitration, April 2013. (with A. Lawrence Kolbe, Michael J. Vilbert, *Confidential*)

Direct Testimony on the treatment of goodwill before the *Federal Energy Regulatory Commission* on behalf of ITC Holdings Corp and ITC Midwest, LLC in Docket No. PA10-13-000, February 2012.

Direct and Rebuttal Testimony on cost of capital before the *Public Utilities Commission of the State of California* on behalf of California-American Water in Application No. 11-05, May 2011.

Direct Testimony, Rebuttal Testimony, and Hearing Appearance on cost of capital before the *New Mexico Public Regulation Commission* on behalf of New Mexico-American Water in Case No. 11-00196-UT, May 2011, November 2011, and December 2011.

Direct Testimony on regulatory assets and FERC accounting before the *Federal Energy Regulatory Commission* on behalf of AWC Companies, EL11-13-000, December 2010.

Expert Report and deposition in Civil Action No. 02-618 (GK/JMF) in the *United States District Court for the District of Columbia*, November 2010, January 2011. (*Confidential*)

Direct Testimony, Rebuttal Testimony, and Rejoinder Testimony on the cost of capital before the *Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-10-0448, November 2010, July 2011, and August 2011.

Direct Testimony on the cost of capital before *the New Mexico Public Regulation Commission* on behalf of New Mexico-American Water in Docket No. 09-00156-UT, August 2009.

Direct and Rebuttal Testimony and Hearing Appearance on the cost of capital before the *Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-09-0343, July 2009, March 2010 and April 2010.

Rebuttal Expert Report, Deposition and Oral Testimony re. the impact of alternative discount rate assumptions in tax litigation. *United States Court of Federal Claims*, Case No. 06-628 T, January, February, April 2009. (*Confidential*)

Direct Testimony, Rebuttal Testimony and Hearing Appearance on cost of capital before the *New Mexico Public Regulation Commission* on behalf of New Mexico-American Water in Docket No. 08-00134-UT, June 2008 and January 2009.

Direct Testimony on cost of capital and carrying charge on damages, U.S. Department of Energy, *Bonneville Power Administration*, BPA Docket No. WP-07, March 2008.

Direct Testimony, Rebuttal Testimony, Rejoinder Testimony and Hearing Appearance on cost of capital before the *Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-08-0227, April 2008, February 2009, March 2009.

Expert Report, Supplemental Expert Report, and Hearing Appearance on the allocation of corporate overhead and damages from lost profit. *The International Centre for the Settlement of Investment Disputes*, Case No. ARB/03/29, February, April, and June 2008 (*Confidential*).

Expert Report on accounting information needed to assess income. *United States District Court* for the District of Maryland (Baltimore Division), Civil No. 1:06cv02046-JFM, June 2007 (*Confidential*)

Expert Report, Rebuttal Expert Report, and Hearing Appearance regarding investing activities, impairment of assets, leases, shareholder' equity under U.S. GAAP and valuation. *International Chamber of Commerce* (ICC), Case No. 14144/CCO, May 2007, August 2007, September 2007. (Joint with Carlos Lapuerta, *Confidential*)

Direct Testimony, Rebuttal Testimony, and Hearing Appearance on cost of capital before the *Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-06-0491, July 2006, July 2007.

Direct Testimony, Rebuttal Testimony, Rejoinder Testimony, Supplemental Rejoinder Testimony and Hearing Appearance on cost of capital before the *Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-06-0403, June 2006, April 2007, May 2007.

Direct Testimony, Rebuttal Testimony, Rejoinder Testimony, and Hearing Appearance on cost of capital before *the Arizona Corporation Commission* on behalf of Arizona-American Water in Docket No. W-01303A-06-0014, January 2006, October 2006, November 2006.

Expert report, rebuttal expert report, and deposition on behalf of a major oil company regarding the equity method of accounting and classification of debt and equity, *American Arbitration Association*, August 2004 and November 2004. (*Confidential*).

APPENDIX B; Technical Appendix to the Direct Testimony of Bente Villadsen

This technical appendix contains methodological details related to my implementations of the DCF and CAPM / ECAPM models. It also contains a discussion of both the basic finance principles and the specific standard formulations of the financial leverage adjustments employed to determine the cost of equity for a company with the level of financial risk inherent in DTE Electric's requested regulatory capital structure.

Table of Contents

I. DCF Models

A. DCF Estimation of Cost of Equity

The DCF method for estimating the cost of equity capital 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:

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

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; r is the cost of equity capital; and T is the last period in which a dividend cash flow is to be received. 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. Since the current market price is known, it is possible to infer the cost of equity that corresponds to that price and a forecasted pattern of expected future dividends. In terms of Equation (1), if P_0 is known and $D_1, D_2, \ldots D_T$ are estimated, an analyst can "solve for" the cost of equity capital r.

B. Details of the DCF Model

Perhaps the most widely known and used application of the DCF method assumes that the expected rate of dividend growth remains constant forever. In the so-called Gordon Growth Model, the relationship expressed in Equation (1) is such that the present value equation can be rearranged algebraically into a formula for estimating the cost of equity. 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

$$P_0 = \frac{D_1}{r-g} \tag{2}$$

where D_1 is the dividend expected at the end of the first period, g is the perpetual growth rate, and P_0 and r are the market price and the cost of capital, as before. Equation (2) is a simplified version of Equation (1) that can be solved algebraically to yield the well-known "DCF formula" for the cost of equity capital,

$$r = \frac{D_1}{P_0} + g = \frac{D_0 \times (1+g)}{P_0} + g \qquad (3)$$

There are other versions of the DCF model that relax this restrictive assumption and posit a more complex or nuanced pattern of expected future dividend payments. For example, if there is reason to believe that investors do *not* expect a company's dividends to grow at a steady rate forever, but rather have different growth rate expectations in the near term (e.g., over the next five or ten years), compared to the distant future (e.g., a period *starting* ten years from the present moment), a "multi-stage" growth pattern can be modeled in the present value formula (Equation (1)).

1. Dividends, Cash Flows, and Share Repurchases

In addition to the DCF model described above, there are many alternative formulations. Notable among these are versions of the model that use cash flows rather than dividends in the present value formula (Equation (1)).[1]

Because investors are interested in cash flow, it is technically important to capture *all* cash flows that are distributed to shareholders when estimating the cost of equity using the DCF method. In some circumstances, investors may expect to receive cash in forms other than dividends. An important example concerns the fact that many companies distribute cash to shareholders through share buybacks in addition to dividends. To the extent such repurchases are expected by investors, but not captured in the forecasted pattern of future dividends; a dividend-based implementation of the DCF model will underestimate the cost of equity.

Similarly, if investors have reason to suspect that a company's dividend payments will not reflect a full distribution of its available cash free cash flows in the period they were generated, it may be appropriate replace the forecasted dividends with estimated free cash flows to equity in the present value formula (Equation (1)). Focusing on *available* cash rather than that actually distributed in the form of dividends can help account for instances when near-term investing and financing activities (e.g., capital expenditures or asset sales, debt issuances or retirements, or share repurchases) may cause dividend growth patterns to diverge from growth in earnings.

[1] For an example in a regulatory context, the U.S. Surface Transportation Board uses a cash flow based model with three stages to estimate the cost of equity for the railroads. See Surface Transportation Board Decision, "STB Ex Parte No. 664 (Sub-No. 1)," Decided January 23, 2009. Confirmed in EP-664 (Sub-No. 2), October 31, 2016 and EP 664 (Sub-No. 4), June 23, 2020.

Many utility companies such as those included in my proxy group have long histories of paying a dividend. In fact, as mentioned in Section I of this Appendix, one of my standard requirements for inclusion in my proxy group is that a company pays dividends for 3-years without a gap or a dividend cut (on per share basis). Additionally, although some utility companies have engaged in share repurchase programs, the companies in my proxy group do not distribute substantial cash flows by means other than dividends.

C. DCF Model Inputs

1. Dividends and Prices

As described above, DCF models are forward-looking, comparing the *current* price of a stock to its expected *future* dividends to estimate the required expected return demanded by the market for that stock (i.e., the cost of equity). Therefore, the models demand the current market price and currently prevailing forecasts of future dividends as inputs.

The stock price input I employ for each proxy group company is the average of the closing stock prices for the 15 trading days ending on the date of my analysis. This guards against biases that may arise on a single trading day, yet is consistent with using current stock prices.

2. Company Specific Growth Rates

a. Analysts' Forecasted Growth Rates

Finding the right growth rate(s) is usually the "hard part" of applying the DCF model, which is sometimes criticized due to what has been called "optimism bias" in the earnings growth rate forecasts of security analysts. Optimism bias is defined as tendency for analysts to forecast earnings growth rates that are higher than are actually achieved. Any optimism bias might be related to incentives faced by analysts that provide rewards not strictly based upon the accuracy of the forecasts. To the extent optimism bias is present in the analysts' earnings forecasts the cost of capital estimates from the DCF model would be too high.

While academic researchers during the 1990s as well as in early 2000s found evidence of analysts' optimism bias, there is some evidence that regulatory reforms have eliminated the issue. A more recent paper by Hovakimina and Saenyasiri (2010) found that recent efforts to curb analysts' incentive to provide optimistic forecasts have worked, so that "the median forecast bias essentially

disappeared."[2] Thus, some recent research indicates that the analyst bias may be a problem of the past.

The findings of several academic studies[3] show that analyst earnings forecasts turn out to be too optimistic for stocks that are more difficult to value, for instance, stocks of smaller firms, firms with high volatility or turnover, younger firms, or firms whose prospects are uncertain. Coincidentally, stocks with greater analyst disagreement have higher analyst optimism bias—all of these describe companies that are more volatile and/or less transparent—none of which is applicable to the majority of utility companies with wide analyst coverage and information transparency. Consequently, optimism bias is not expected to be an issue for utilities.

b. Sources for Forecasted Growth Rates

For the reasons described above, I rely on analyst forecasts of earnings growth for the company-specific growth rate inputs to my implementations of the single- and multi-stage DCF models. Most companies in my proxy group have coverage from equity analysts reporting to Thomson Reuters IBES, so I use the consensus 3-5 year EPS growth rate provided by that service. I supplement these consensus values with growth rates based on EPS estimates from *Value Line*.[4]

II. CAPM and ECAPM

A. THE CAPITAL ASSET PRICING MODEL (CAPM)

The Capital Asset Pricing Model (CAPM) is a theoretical model stating that the collective investment decisions of investors in capital markets will result in equilibrium prices for all risky assets such that the returns investors expect to receive on their investments are commensurate with the risk of those assets relative to the market as a whole. The CAPM posits a risk-return relationship known as the Security Market Line (see Figure 3 in my Direct Testimony), in which

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2 A. Hovakimian and E. Saenyasiri, "Conflicts of Interest and Analyst Behavior: Evidence from Recent Changes in Regulation," *Financial Analysts Journal*, vol. 66, 2010.

3 These studies include the following: (i) Hribar, P, McInnis, J. "Investor Sentiment and Analysts' Earnings Forecast Errors," *Management Science* Vol. 58, No. 2 (February 2012): pp. 293-307; (ii) Scherbina, A. (2004), "Analyst Disagreement, Forecast Bias and Stock Returns," downloaded from Harvard Business School Working Knowledge: http://hbswk.hbs.edu/item/5418.html; and (iii) Michel, J-S., Pandes J.A. (2012), "Are Analysts Really Too Optimistic?" downloaded from http://www.efmaefm.org.

4 Specifically, I compute the growth rate implied by *Value Line*'s current year EPS estimate and its projected 3-5 year EPS estimate. I then average this in with the IBES consensus estimate as an additional independent estimate, giving it a weight of 1 and weighting the IBES consensus according to the number of analysts who contributed estimates.

the required expected return on an asset is proportional to that asset's risk relative to the market as measured by its "beta". More precisely, the CAPM states that the cost of capital for an investment S (e.g., a particular common stock), is given by the following equation:

$$\boldsymbol{r_s = r_f + \beta_s \times MRP} \tag{4}$$

where $\boldsymbol{r_S}$ is the required return on investment S;
$\boldsymbol{r_f}$ is the risk-free interest rate;
$\boldsymbol{\beta_S}$ is the beta risk measure for the investment S; and
$\boldsymbol{MRP}$ is the market equity risk premium.

The CAPM is based on portfolio theory, and recognizes two fundamental principles of finance: (1) investors seek to minimize the possible variance of their returns for a given level of expected returns (or alternatively, they demand higher *expected* returns when there is greater uncertainty about those returns), and (2) investors can reduce the variability of their returns by diversifying—constructing portfolios of many assets that do not all go up or down at the same time or to the same degree. Under the assumptions of the CAPM, the market participants will construct portfolios of risky investments that minimize risk for a given return so that the aggregate holdings of all investors represent the "market portfolio". The risk-return trade-off faced by investors then concerns their exposure to the risk inherent in the market portfolio, as they weight their investment capital between the portfolio of risky assets and the risk-free asset.

Because of the effects of diversification, the relevant measure of risk for an individual security is its *contribution* to the risk of the market portfolio. Therefore, beta (β) is defined to capture the sensitivity of the security's returns to the market's returns. Formally,

$$\boldsymbol{\beta_s} = \frac{covariance(\boldsymbol{r_s}, \boldsymbol{R_m})}{variance(\boldsymbol{R_m})} \tag{5}$$

where $\boldsymbol{R_m}$ is the return on the market portfolio.

Beta is usually calculated by statistically comparing (using regression analysis) the excess (positive or negative) of the return on the individual security over the government bond rate with the excess of the return on a market index such as the S&P 500 over a government bond rate.

The basic idea behind beta is the risk that cannot be diversified away in large portfolios is what matters to investors. Beta is a measure of the risks that *cannot* be eliminated by diversification. It is this non-diversifiable risk, or "systematic risk", for which investors require compensation in the

form of higher expected returns. By definition, a stock with a beta equal to 1.0 has average non-diversifiable risk; its returns vary to the same degree as those on the market as a whole. According to the CAPM, the required return demanded by investors (i.e., the cost of equity) for investing in that stock will match the expected return on the market as a whole. Similarly, stocks with betas above 1.0 have more than average risk, and so have a cost of equity greater than the expected market return; those with betas below 1.0 have less than average risk, and are expected to earn lower than market levels of return.

B. INPUTS TO THE CAPM

1. The Risk-free Interest Rate

The precise meaning of a "risk-free" asset according to the finance theory underlying the CAPM is an investment whose return is guaranteed, with no possibility that it will vary around its expected value in response to the movements of the broader market. (Equivalently, the CAPM beta of a risk-free asset is zero.) In developed economies like the U.S., government debt is generally considered have no default risk. In this sense they are "risk-free"; however, unless they are held to maturity, the rate of return on government bonds may in fact vary around their stated or expected yields.[5]

The theoretical CAPM is a single period model, meaning that it posits a relationship between risk and return over a single "holding period" of an investment. Because investors can rebalance their portfolios over short horizons, many academic studies and practical applications of the CAPM use the short-term government bond as the measure of the risk-free rate of return. However, regulators frequently use a version based on a measure of the long-term risk-free rate; e.g., a long-term government bond. I rely on the 20-year Treasury bond as a measure of the risk-free asset in this proceeding. [6] I use the term "risk-free rate" as describing the yield on the 20-year Treasury bond.

However, I do not believe the *current* yield on long-term Treasury bonds is a good estimate for the risk-free rate that will prevail over the time period relevant to this proceeding as currently prevailing bond yields are near historic lows for a variety of circumstances that should not be expected to persist for the reasons discussed in my direct testimony.

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[5] This is due to interest rate fluctuations that can change the market value of previously issued debt in relation to the yield on new issuances

[6] The use of a 20-year government bond is consistent with the measurement of the Ibbotson MRP and permits me to use a series that has been in consistent circulation since the 1990's (the 30-year government bond was not issued from 2002 to 2006).

For this reason I rely on Blue Chip's forecast of 2.23% for the yield on a 10-year Treasury bond for 2022-24[7] and adjust this value upward by 50 basis points,[8] which is my estimate of the maturity premium for the 20-year over the 10-year Treasury Bond.[9]

2. The Market Equity Risk Premium

a. Historical Average Market Risk Premium

Like the cost of capital itself, the market risk premium is a forward-looking concept. It is by definition the premium above the risk-free interest rate that investors can *expect* to earn by investing in a value-weighted portfolio of all risky investments in the market. The premium is not directly observable and must be inferred or forecasted based on known market information.

One commonly used method for estimating the MRP is to measure the historical average premium of market returns over the income returns on risk-free government bonds over some long historical period. When such a calculation is performed using the traditional industry standard Ibbotson data, the result is an arithmetic average of 7.25% for annual observed premiums of U.S. stock market returns over income returns on long-term (approximate average maturity of 20-years) U.S. Treasury bonds from 1926 to the present is 7.25%.[10]

b. Forward Looking Market Equity Risk Premium

An alternative approach to estimating the MRP eschews historical averages in favor of using current market information and forecasts to infer the expected return on the market as a whole, which can then be compared to prevailing government bond yields to estimate the equity risk premium. Bloomberg performs such estimates of country-specific MRPs by implementing the DCF model on the market as a whole—using forecast market-wide dividend yields and current level on market indexes; for the U.S. Bloomberg performs a multi-stage DCF using dividend-paying stocks in the S&P 500 to infer the expected market return.

When calculated relative to 20-year Treasury bond yields, Bloomberg's estimate of the forward-looking market-implied MRP as of October 2021 was 7.89%. These Bloomberg forward-looking

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7 Blue Chip Economic Indicators, October 2021.

8 The 50 basis points is the average maturity premium of a 20-year government bond over a 10-year government bond as measured from 1991 to today (September 2021).

9 In the past I have also considered a scenario that takes the spread between the yield on utility bond yields and government bond yields into account. As this spread currently is only slightly elevated, I do not consider such a scenario in this case.

10 Duff & Phelps, "2020 SBBI Yearbook," p. 10-21.

MRP estimates are above the historical long-term average. I also note that the forward-looking MRP recently calculated using FERC's methodology over the 30-year yield is even higher at 12.21% and 10.43% using IBES and Value Line growth, respectively.[11]

C. THE EMPIRICAL CAPM

1. Description of the ECAPM

Empirical research has 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.

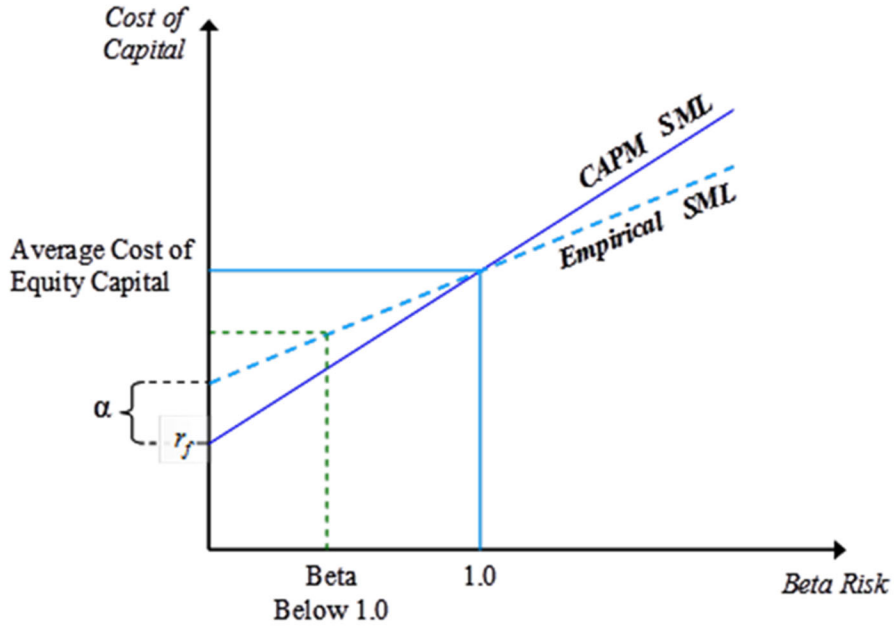
The Empirical CAPM (ECAPM) makes use of these empirical findings. It estimates the cost of capital with the equation,

$$\boldsymbol{r_S = r_f + \alpha + \beta_S \times (MRP - \alpha)} \qquad (6)$$

where $\boldsymbol{\alpha}$ is the "alpha" adjustment of the risk-return line, a constant, and the other symbols are defined as for the CAPM (see Equation (4)). The alpha adjustment has the effect of increasing the intercept but reducing the slope of the Security Market Line, 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.

[11] FERC Opinion No. 569-A, Docket No. EL14-12-004, May 21, 2020. Translating this to a MRP over the forecasted risk-free rate as of October 2021 result in a FERC MRP of approximately 11.7 and 9.9 percent using IBES and Value Line, respectively.

Figure B-1
The Empirical Security Market Line



2. Academic Evidence on the Alpha Term in the ECAPM

below summarizes the empirical results of tests of the CAPM, including their estimates of the "alpha" parameter necessary to improve the accuracy of the CAPM's predictions of realized returns.

Figure B-2

EMPIRICAL EVIDENCE ON THE ALPHA FACTOR IN ECAPM*

AUTHOR	RANGE OF ALPHA	PERIOD RELIED UPON
Black (1993)[1]	1% for betas 0 to 0.80	1931-1991
Black, Jensen and Scholes (1972)[2]	4.31%	1931-1965
Fama and McBeth (1972)	5.76%	1935-1968
Fama and French (1992)[3]	7.32%	1941-1990
Fama and French (2004)[4]	N/A	
Litzenberger and Ramaswamy (1979)[5]	5.32%	1936-1977
Litzenberger, Ramaswamy and Sosin (1980)	1.63% to 3.91%	1926-1978
Pettengill, Sundaram and Mathur (1995)[6]	4.6%	1936-1990

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

[1]Black estimates alpha in a one step procedure rather than in an un-biased two-step procedure.
[2]Estimate a negative alpha for the subperiod 1931-39 which contain the depression years 1931-33 and 1937-39.
[3]Calculated using Ibbotson's data for the 30-day treasury yield.
[4]The article does not provide a specific estimate of alpha; however, it supports the general finding that the CAPM underestimates returns for low-beta stocks and overestimates returns for high-beta stocks.
[5]Relies on Lizenberger and Ramaswamy's before-tax estimation results. Comparable after-tax alpha estimate is 4.4%.
[6]Pettengill, Sundaram and Mathur rely on total returns for the period 1936 through 1990 and use 90-day treasuries. The 4.6% figure is calculated using auction averages 90-day treasuries back to 1941 as no other series were found this far back.

Sources:
Black, Fischer. 1993. Beta and Return. *The Journal of Portfolio Management* 20 (Fall): 8-18.
Black, F., Michael C. Jensen, and Myron Scholes. 1972. The Capital Asset Pricing Model: Some Empirical Tests, from Studies in the theory of Capital Markets. In *Studies in the Theory of Capital Markets*, edited by Michael C. Jensen, 79-121. New York: Praeger.
Fama, Eugene F. and James D. MacBeth. 1972. Risk, Returns and Equilibrium: Empirical Tests. *Journal of Political Economy* 81 (3): 607-636.
Fama, Eugene F. and Kenneth R. French. 1992. The Cross-Section of Expected Stock Returns. *Journal of Finance* 47 (June): 427-465.
Fama, Eugene F. and Kenneth R. French. 2004. The Capital Asset Pricing Model: Theory and Evidence. *Journal of Economic Perspectives* 18 (3): 25-46.
Litzenberger, Robert H. and Krishna Ramaswamy. 1979. The Effect of Personal Taxes and Dividends on Capital Asset Prices, Theory and Empirical Evidence. *Journal of Financial Economics* XX (June): 163-195.
Litzenberger, Robert H. and Krishna Ramaswamy and Howard Sosin. 1980. On the CAPM Approach to Estimation of a Public Utility's Cost of Equity Capital. *The Journal of Finance* 35 (2): 369-387.

III. Financial Risk and the Cost of Equity

A common issue in regulatory proceedings is how to apply data from a benchmark set of comparable securities when estimating a fair return on equity for the target/regulated company.[12] It may be tempting to simply estimate the cost of equity capital for each of the proxy companies (using one of the above approaches) and average them. After-all, the companies were chosen to be comparable in their business risk characteristics, so why would an investor necessarily prefer equity in one to the other (on average)?

The problem with this argument is that it ignores the fact that underlying asset risk (i.e., the risk inherent in the lines of business in which the firm invests its assets) for each company is typically divided between debt and equity holders. The firm's debt and equity are therefore financial derivatives of the underlying asset return, each offering a differently structured claim on the cash flows generated by those assets. Even though the risk of the underlying assets may be comparable, a different capital structure splits that risk differently between debt and equity holders. The relative structures of debt and equity claims are such that higher degrees of debt financing increase the variability of returns on equity, *even when the variability of asset returns remains constant*. As a consequence, otherwise identical firms with different capital structures will impose different levels of risk on their equity holders. Stated differently, increased leverage adds financial risk to a company's equity.[13]

A. The Effect of Financial Leverage on the Cost of Equity

To develop an intuition for the manner in which financial leverage affects the risk of equity, it is helpful to consider a concrete example. Figure B-3 and Figure B-4 below demonstrate the impact of leverage on the risk and return for equity by comparing equity's risk when a company uses no debt to finance its assets, and when it uses a 50-50 capital structure (i.e., it finances 50 percent of its assets with equity, 50 percent with debt). For illustrative purposes, the figures assume that the cash flows will be either $5 or $15 and that these two possibilities have the same chance of occurring (e.g., the chance that either occurs is ½).

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[12] This is also a common valuation problem in general business contexts.

[13] I refer to this effect in terms of *financial risk* because the additional risk to equity holders stems from how the company chooses to finance its assets. In this context financial risk is distinct from and independent of the *business risk* associated with the manner in which the firm deploys its cash flow generating assets. The impact of leverage on risk is conceptually no different than that faced by a homeowner who takes out a mortgage. The equity of a homeowner who finances his home with 90% debt is much riskier than the equity of one who only finances with 50% debt.

Figure B-3: All Equity Capital Structure

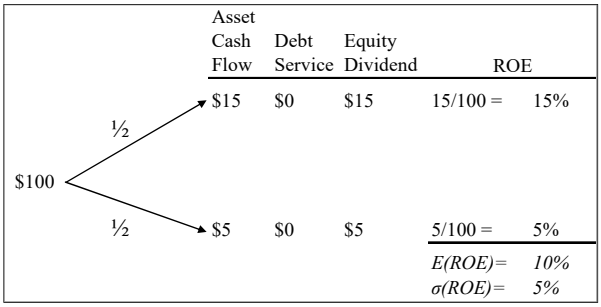
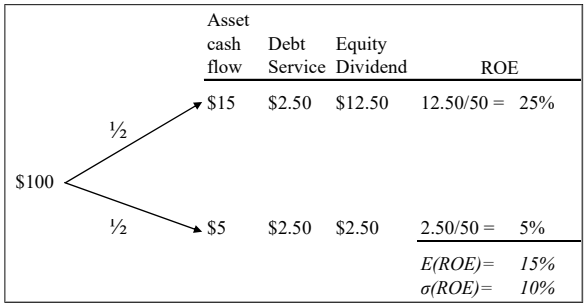


Figure B-4: 50/50 Capital Structure



In the figures, E(ROE) indicates the mean return and σ(ROE) represents the standard deviation. This simple example illustrates that the introduction of debt increases both the mean (expected) return to equity holders and the variance of that return, even though the firm's expected cash flows—which are a property of the line of business in which its assets are invested—are unaffected by the firm's financing choices. The "magic" of financial leverage is not magic at all—leveraged equity investors can only earn a higher return because they take on greater risk.

B. Methods to Account for Financial Risk

1. Cost of Equity Implied by the Overall Cost of Capital

If the companies in a proxy group are truly comparable in terms of the systematic risks of the underlying assets, then the overall cost of capital of each company should be about the same across companies (except for sampling error), so long as they do not use extreme leverage or no leverage. The intuition here is as follows. A firm's asset value (and return) is allocated between equity and debt holders.[14] The expected return to the underlying asset is therefore equal to the value weighted

[14] Other claimants can be added to the weighted average if they exist. For example, when a firm's capital structure contains preferred equity, the term $\frac{P}{V} \times r_p$ is added to the expression for the overall cost of capital shown in Equation (7)**Error! Reference source not found.**, where P refers to the market value of preferred e quity, r_P is the cost of preferred equity and $V = E + D + P$. In my analysis, I attribute the same implied yield to the cost of preferred equity as to the cost of debt.

average of the expected returns to equity and debt holders – which is the overall cost of capital ($\boldsymbol{r}^*$), or the expected return on the assets of the firm as a whole.[15]

$$\boldsymbol{r}^* = \frac{E}{V} \times r_E + \frac{D}{V} \times r_D(1 - \tau_c) \tag{7}$$

where r_D is the market cost of debt,
r_E is the market cost of equity,
τ_c is the corporate income tax rate,
D is the market value of the firm's debt,
E is the market value of the firm's equity, and
$V = E + D$ is the total market value of the firm.

Since the overall cost of capital is the cost of capital for the underlying asset risk, and this is comparable across companies, it is reasonable to believe that the overall cost of capital of the underlying companies should also be comparable, so long as capital structures do not involve unusual leverage ratios compared to other companies in the industry.[16]

The notion that the overall cost of capital is constant across a broad middle range of capital structures is based upon the Modigliani-Miller theorem that choice of financing does not affect the firm's value. Franco Modigliani and Merton Miller eventually won Nobel Prizes in part for their work on the effects of debt.[17] Their 1958 paper made what is in retrospect a very simple point: if there are no taxes and no risk to the use of excessive debt, use of debt will have no effect on a company's operating cash flows (i.e., the cash flows to investors as a group, debt and equity combined). If the operating cash flows are the same regardless of whether the company finances mostly with debt or mostly with equity, then the value of the firm cannot be affected at all by the

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[15] As this is on an after-tax basis, the cost of debt reflects the tax value of interest deductibility. Note that the precise formulation of the weighted average formula representing the required return on the firm's *assets* independent of financing (sometimes called the *unlevered* cost of capital) depends on specific assumptions made regarding the value of tax shields from tax-deductible corporate debt, the role of personal income tax, and the cost of financial distress. See Taggart, Robert A., "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management*, 1991; 20(3) for a detailed discussion of these assumptions and formulations. Equation (7**Error! Reference source not found.**) r epresents the overall weighted average cost of capital to the firm, which can be assumed to be constant across a relatively broad range of capital structures.

[16] Empirically, companies within the same industry tend to have similar capital structures, while typical capital structures may vary between industries, so whether a leverage ratio is "unusual" depends upon the company's line of business.

[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.

debt ratio. In cost of capital terms, this means the overall cost of capital is constant regardless of the debt ratio, too.

Obviously, the simple and elegant Modigliani-Miller theorem makes some counterfactual assumptions: no taxes and no cost of financial distress from excessive debt. However, subsequent research, including some by Modigliani and Miller,[18] showed that while taxes and costs to financial distress affect a firm's incentives when choosing its capital structure as well as its overall cost of capital,[19] the latter can still be shown to be constant across a broad range of capital structures.[20]

This reasoning suggests that one could compute the overall cost of capital for each of the proxy companies and then average to produce an estimate of the overall cost of capital associated with the underlying asset risk. Assuming that the overall cost of capital is constant, one can then re-arrange the overall cost of capital formula to estimate what the implied cost of equity is at the target company's capital structure on a book value basis.[21]

2. Unlevering and Relevering Betas in the CAPM (Hamada Adjustment)

An alternative approach to account for the impact of financial risk is to examine the impact of leverage on beta. Notice that this means working within the CAPM framework as the methodology cannot be applied directly to the DCF models.

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

[19] When a company uses a high level of debt financing, for example, there is significant risk of bankruptcy and all the costs associated with it. The so called costs of financial distress that occurs when a company is over-leveraged can increase its cost of capital. In contrast a company can generally decrease its cost of capital by taking on reasonable levels of debt, owing in part to the deductibility of interest from corporate taxes.

[20] This is a simplified treatment of what is generally a complex and on-going area of academic investigation. The roles of taxes, market imperfections and constraints, etc. are areas of on-going research and differing assumptions can yield subtly different formulations for how to formulate the weighted average cost of capital that is constant over all (or most) capital structures.

[21] Market value capital structures are used in estimating the overall cost of capital for the proxy companies.

Recognizing that under general conditions, the value of a firm can be decomposed into its value with and without a tax shield, I obtain:[22]

$$V = V_U + PV(ITS) \tag{8}$$

where $V = E + D$ is the total value of the firm as in Equation (7)),
V_U is the "unlevered" value of the firm—its value if financed entirely by equity
$PV(ITS)$ represents the present value of the interest tax shields associated with debt

For a company with a fixed book-value capital structure and no additional costs to leverage, it can be shown that the formula above implies:

$$r_E = r_U + \frac{D}{E}(1 - \tau_c)(r_U - r_D) \tag{9}$$

where r_U is the "unlevered cost of capital"—the required return on assets if the firm's assets were financed with 100% equity and zero debt—and the other parameters are defined as in Equation (7).

Replacing each of these returns by their CAPM representation and simplifying them gives the following relationship between the "levered" equity beta β_L for a firm (i.e., the one observed in market data as a consequence of the firm's actual market value capital structure) and the "unlevered" beta β_U that would be measured for the same firm if it had no debt in its capital structure:

$$\beta_L = \beta_U + \frac{D}{E}(1 - \tau_c)(\beta_U - \beta_D) \tag{10}$$

where β_D is the beta on the firm's debt. The unlevered beta is assumed to be constant with respect to capital structure, reflecting as it does the systematic risk of the firm's assets. Since the beta on

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[22] This follows development in Fernandez (2003). Other standard papers in this area include Hamada (1972), Miles and Ezzell (1985), Harris and Pringle (1985), Fernandez (2006). (See Fernandez, P., "Levered and Unlevered Beta," IESE Business School Working Paper WP-488, University of Navarra, Jan 2003 (rev. May 2006); Hamada, R.S., "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stock," *Journal of Finance*, 27, May 1972, pp. 435-452; Miles, J.A. and J.R. Ezzell, "Reformulating Tax Shield Valuation: A Note," *Journal of Finance*, XL5, Dec 1985, pp. 1485-1492; Harris, R.S. and J.J. Pringle, "Risk-Adjusted Discount Rates Extensions form the Average-Risk Case," *Journal of Financial Research*, Fall 1985, pp. 237-244; Fernandez, P., "The Value of Tax Shields Depends Only on the Net Increases of Debt," IESE Business School Working Paper WP-613, University of Navarra, 2006.) Additional discussion can be found in Brealey, Myers, and Allen (2014).

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 that holds when the market value capital structures (rather than book value) are assumed to be held constant:

$$\beta_L = \beta_U + \frac{D}{E}(\beta_U - \beta_D) \tag{11}$$

Unlike Equation (10), Equation (11) 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. And both equations allow an analyst to adjust for differences in financial risk by translating back and forth between β_L and β_U. In principal, Equation (10) 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 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 (10), or Equation (11). Rather than estimating debt betas, I rely on the standard financial textbook of Professors Berk & DeMarzo, who report a debt beta of 0.05 for A rated debt and a beta of 0.10 for BBB rated debt.[23]

Once a decision on debt betas is made, the levered equity beta of each proxy 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 proxy companies are comparable on an "apples to apples" basis, since they reflect the systematic risk inherent in the assets of the proxy 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

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

company's capital structure, and CAPM reapplied with this levered beta, which reflects both the business and financial risk of the target company.

Hamada adjustment procedures—so-named for Professor Robert S. Hamada who contributed to their development[24]—are ubiquitous among finance practitioners when using the CAPM to estimate discount rates.

[24] 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.