BEFORE THE
MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of the application of **DTE GAS COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of natural gas, and for miscellaneous accounting authority	))))))	Case No. U-20940

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) and 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 educational 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 regulatory finance at conferences and webinars. I have testified or filed expert reports on cost of capital in Alaska, Arizona, California,

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

Illinois, Michigan,[2] New Mexico, New York, Oregon, and Washington, as well as before the Bonneville Power Administration, Federal Energy Regulatory Commission ("FERC"), the Surface Transportation Board, the Alberta Utilities Commission, and the Ontario Energy Board. 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 FERC, the Regulatory Commission of Alaska, the Michigan Public Service Commission ("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 a 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 Gas Company ("DTE Gas" or the "Company") has asked me to estimate the cost of equity that the Commission should allow DTE Gas an opportunity to earn on the equity-financed portion of its regulated utility rate base. I also consider the relative risk of the Company and its proposed regulatory capital structure ratio to arrive at my recommendation for the allowed Return on Equity ("ROE").

Q5. Are you sponsoring any exhibits?

A5. Yes. I am sponsoring Exhibit D5.1 – D5.18, which contains the details of my analysis and supporting tables

Schedule	**Description**
D5.1	Table of Contents
D5.2	Classification of Companies by Assets

[2] Previously I filed testimony on cost of equity before the Michigan Public Service Commission ("Commission") in U-20561.

D5.3	Market Value of the Sample Companies
D5.4	Capital Structure Summary of the Samples
D5.5	Estimated Growth Rates of the Samples
D5.6	DCF Cost of Equity of the Samples
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D5.16	Risk Premiums Determined by Relationship Between Authorized ROEs and Long-term Treasury Bond Rates
D5.17	Estimation of S&P 500 Cost of Equity Using FERC Methodology
D5.18	DTE and Proxy Group's Capital Intensity

Q6. Was this material prepared by you or under your supervision?

A6. Yes. It was.

II. SUMMARY OF CONCLUSIONS

Q7. Please summarize your recommendation for DTE Gas' ROE.

A7. I recommend that DTE Gas be allowed to earn a 10.25 percent rate of return on the equity portion of its regulated rate base including the requested 51.9 percent equity. This recommendation is based on 1) my implementations of standard cost of capital estimation models including two versions each of the Discounted Cash Flow ("DCF") model and Capital Asset Pricing Model ("CAPM"), as well as an implied risk premium analysis, and 2) an analysis of DTE Gas' risks.

First, my analysis of standard cost capital estimation models results using the requested 51.9 percent equity are summarized below in Figure 1. In the current environment, where there has been considerable consolidation in the natural gas industry and considerations of switching from gas to other fuels, I find it beneficial to add a sample of highly regulated water utilities, which similar to natural gas utilities serve a mix of residential, commercial, and industrial customers through a regulated set of pipelines. The full sample consists of the natural gas and water utility sample.

The gas sample results range from 8.6 to 11.1 percent with the average of the methods ranging from 9.2 to 10.2 percent. The range for the full sample is wider at 8.4 to 11.8 percent with the average of the methods ranging from about 9 to 10.6 percent. For completeness, the water sample range is even wider at about 8.4 to 12.8 percent.

Looking to the Commission Staff's recent reliance on the historical and forward-looking CAPM, constant-growth DCF and risk premium, the high end of the sample is most comparable. For that reason and because DTE Gas as discussed below face higher risk than the average gas LDC, the most comparable figure prior to any DTE Gas specific adders is 10.2 percent for the natural gas utility sample and 10.6 percent for the full sample.

Based on my consideration of the model results in the context of Michigan and DTE Gas' specific risk, I believe it is appropriate to place DTE Gas' allowed return at or near the upper end of the range that is reasonable. Using DTE Gas' requested 51.9 percent equity, I find a range of cost of equity of 9.25 to 10.25 percent for a gas utility proxy group (and a wider range of about 9 to 10.5 percent for the full sample). The corresponding reasonable ranges are further discussed in Section V below.

Figure 1
Summary of Reasonable Ranges of Estimates at 51.9% Equity[3]

	Gas Sample		Full Sample	
	Low	High	Low	High
CAPM	9.4%	9.9%	9.2%	9.8%
ECAPM	9.4%	10.1%	9.3%	10.2%
Multi-Stage DCF	8.6%		8.4%	
Single-Stage DCF		11.1%		11.8%
Risk Premium	9.4%	9.6%	na	na
Range	8.6 - 9.4%	9.6 - 11.1%	8.4- 9.3%	9.8 - 11.8%
Average, all methods	9.2%	10.2%	9.0%	10.6%

Second and looking to DTE Gas' specific risks as well as risks associated with its service territory, I find an appropriate ROE for DTE to be higher than that of the average gas utility and recommend DTE Gas be allowed a ROE of 10.25 percent. As discussed in Section VI below, the Company face higher than average risk as DTE Gas

- has high level of capital expenditure,
- has a high capital intensity meaning revenue to Property Plant & Equipment is low, and
- operate in a service territory with challenging economic conditions.

Because of the high level of company-specific risks, I recommend that DTE Gas be allowed a ROE of 10.25 percent, which is at the high end of the gas sample but well below the high end of the full sample

Q8. What impact do the current economic and financial conditions due to the ongoing COVID-19 pandemic have on the determination of DTE Gas' allowed ROE?

A8. The current determination of DTE Gas' allowed ROE takes place during uncertain economic and financial conditions due to the ongoing impacts of the COVID-19

[3] My analysis was conducted as of November 30, 2020.

pandemic, which has led to unprecedented low U.S. Treasury bond yields, substantial volatility in stock prices, and uncertainty on how long the recovery period will be.[4] Measures of the premium that investors require over and above the risk-free rate to invest in equities and bonds have increased as well. Going forward, the length and extent of the impacts of the pandemic are unknown and will depend on how measures impacting commerce stay in place and when a vaccine becomes widely available.[5]

In light of this uncertainty, it is important to assure investors that the allowed ROE and capital structure is such that DTE Gas can continue to raise the needed capital to continue to provide safe, adequate and reliable service to its customers while also providing a return that is comparable to those that investors expect.

In November 2019, DTE Gas filed its most recent rate case in U-20642 and in August 2020, the Commission approved a settlement, which authorized a 9.9% ROE on 52 percent common equity.[6] Since the filing of U-20642, economic and financial markets have been dramatically impacted by COVID-19 resulting in substantial increases in the level of volatility and premiums required by investors to hold risky assets as compared to the pre-COVID-19 time frame. Specifically, in November 2019, the Chicago Board of Options Exchange's CBOE Volatility Index ("VIX") averaged 12.5.[7] During November 2020 and similarly during January 2021, the VIX has ranged from a low of 20.7 to a high of 37.1. This level followed an all-time high of 82.69 in March 2020. Throughout 2020, the VIX has averaged approximately 30, compared to its long term average of 19.4.[8] Similarly, Bloomberg's estimation of the market risk premium ("MRP") was 6.7% in November 2019, then reached a high of 9.8% in March 2020, stood

[4] I acknowledge that all of society has been impacted to a degree not seen in decades, but I focus my discussion on the financial and economic impacts in this report.

[5] The U.S. started COVID-19 vaccinations on December 14, 2020.

[6] Michigan Public Service Commission, "Order Approving Settlement Agreement," Case No. U-20642, Appendix A, August 20, 2020, Appendix p. 2. ("Commission U-20642 Order")

[7] Villadsen Direct Testimony on behalf of DTE Gas in U-20642 relied on August 2019 data for the VIX (18.8).

[8] Bloomberg as of November 25, 2020. As of January 25, 2021, the VIX was 23.2 according to the CBOE before increasing to 36.33 on January 29, 2021. (https://www.cboe.com/tradable_products/vix/)

at 7.85% at the time of estimation (11/30/2020), but was up to 8.89 percent as of 1/29/2021.[9] Lastly, flight-to-quality and monetary policy has put downward pressure on U.S. Treasury bond yields – whereby10 Year U.S. Treasury yields were at 1.8% in November 2019 before reaching record lows in July 2020 (0.53%). While the government bond yield has since increased, it remains unusually low, but is forecasted to increase in 2021, 2022, 2023 and subsequent years.[10] Simply put, the financial markets are in turmoil, which has had negative impacts for investors with regard to volatility and risk. As a result, utilities systematic risk as measured by beta has increased. Therefore, it is important to look to stability in investors' allowed returns and recognize that the currently low Treasury yields are not reflective of a low cost of equity. Specifically, the data points to a return on equity that reflects a higher premium above the risk-free rate (systematic risk and market risk premium) today than at the time of DTE Gas' last rate case.[11] Thus, if we assume that a ROE of 9.9% and an equity percentage of 52% was appropriate in U-20642, then the appropriate ROE and capital structure today is higher. I provide more discussion of the current capital market conditions and their impact on the ROE for DTE Gas in Section IV below.

Q9. Please explain why a ROE of 10.25% in conjunction with 51.9% equity is appropriate today when DTE Gas' most recent order determined a ROE of 9.9% on 52% equity.[12]

A9. As I explain below, financial markets have become substantially more uncertain than they were when DTE Gas had its last rate case. Specifically, uncertainty in the market has led investors to require a higher return on assets that are not risk free. Specifically, the risk premium investors require to invest in equity instead of risk-free government

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9 Id. as of February 2.

10 Blue Chip Economic Indicators expect the 10-year government bond yield to be 1.4% in 2022 and 1.7% in 2023.

11 For example, I found an average Value Line beta for natural gas utilities of 0.66 for U-20642, but as of today, I find that the average Value Line beta for natural gas utilities is 0.84 for a non-trivial increase in the premium investors require to hold natural gas utilities' stock.

12 Commission U-20642 Order.

bonds has increased. I explain this further in section III below. Additionally, the relative risk of natural gas utilities has increased,[13] so that the return investors require to invest in natural gas utilities has increased relative to that required in other industries. I elaborate on this point in Section V below. Lastly, DTE Gas is requesting an equity percentage of 51.9%, which is lower than the 52% equity granted in the U-20642 Order. As the cost of equity increases when the equity percentage is reduced, the lower equity percentage gives rise to an, all else equal, higher return on equity.[14] Put differently, the return on equity (10.25 percent) goes hand in hand with the equity percentage (51.9 percent).

Q10. Do you have any other preliminary comments?

A10. Yes. Several equity and credit analysts have noted the constructive regulatory environment in Michigan as a reason that utilities in Michigan have solid access to capital. The analysts emphasize the stability of the regulatory regime as being beneficial to both customers and the utility.[15] I concur.

Q11. How is the remainder of your testimony organized?

A11. Section III formally defines the cost of capital and explains the techniques for estimating it in the context of utility rate regulation. Section IV discusses conditions and trends in capital markets and their impact on the cost of capital. Section V explains my analyses and presents the results. Finally, Section VI discusses DTE Gas' business risk characteristics, unique risks facing Michigan-based gas utilities, and other company-specific circumstances relevant to my recommended allowed ROE. Finally, Section VII concludes with a summary of my recommendations.

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[13] As measured by the systematic risk, beta.

[14] This is discussed further in the Direct Testimony of Company witness, Mr. Edward Solomon.

[15] Goldman Sachs, "Americas Utilities: A focus on stability and incentives – a conversation with the MI PSC," September 22, 2020, p. 1; Scotiabank, "DTE Energy Company," September 24, 2020, p. 1; Moody's Investor Service, "DTE Gas Company," July 23, 2020, p. 2.

III. COST OF CAPITAL PRINCIPLES AND APPROACH

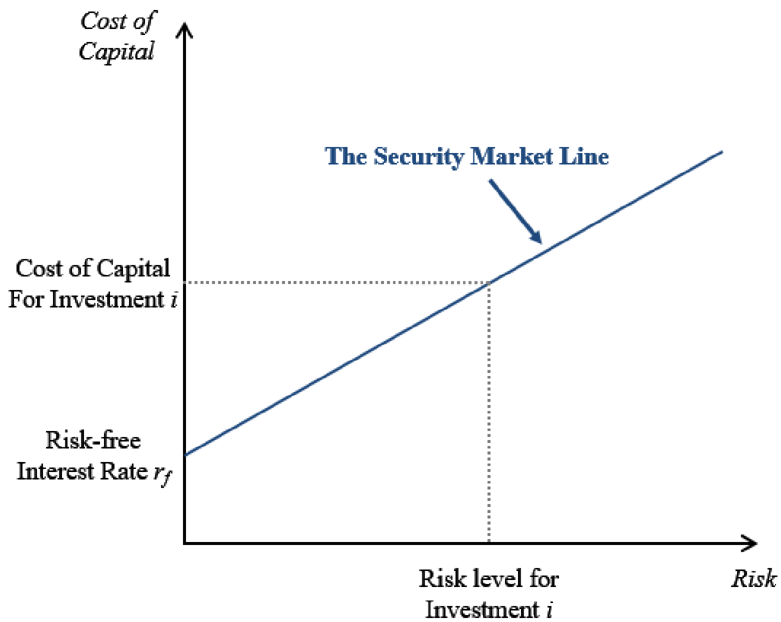
A. RISK AND THE COST OF CAPITAL

Q12. How is the "Cost of Capital" defined?

A12. The cost of capital is defined as the expected rate of return in capital markets on alternative investments of equivalent risk. Put differently, it is the rate of return investors require based on the risk-return alternatives available in competitive capital markets. The cost of capital is a type of opportunity cost: it represents the rate of return that investors could expect to earn elsewhere without bearing more risk. "Expected" is used in the statistical sense: the mean of the distribution of possible outcomes. The terms "expect" and "expected," as in the definition of the cost of capital itself, refer to the probability-weighted average over all possible outcomes.

The definition of the cost of capital recognizes a tradeoff between risk and return that can be represented by the "security market risk-return line" or "Security Market Line" for short. This line is depicted in Figure 2 below. The higher the risk, the higher the cost of capital required.

Figure 2
The Security Market Line



Q13. What factors contribute to systematic risk for an equity investment?

A13. 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.

Q14. What are the guiding standards that define a just and reasonable allowed rate of return on rate-regulated utility investments?

A14. The seminal guidance on this topic was provided by the U.S. Supreme Court in the *Hope* and *Bluefield* cases,[16] which found that:

- The return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks;[17]
- 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.[18]

Q15. How does the standard for just and reasonable rate of return relate to the cost of capital?

A15. 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.[19] The cost of capital is the rate of return investors can expect to earn in capital markets on alternative investments of equivalent risk.[20]

By investing in a regulated utility asset, investors are tying up some capital in that investment, thereby foregoing alternative investment opportunities. Hence, the investors

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[16] 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").

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

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

[19] 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).

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

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. Otherwise 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 Gas.

Q16. Please summarize how you considered risk when estimating the cost of capital.

A16. To evaluate comparable business risk, I looked to a proxy group of regulated natural gas and water utilities. The natural gas and water utilities I consider have a high proportion of regulated assets and revenue with the majority having more than 80% of assets subject to regulation. Additionally, they all 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). 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 and between the capital structures of the proxy companies and the regulatory capital structure that will be applied to DTE Gas for ratemaking purposes. To determine where in the estimated range DTE Gas' ROE reasonably falls, I compared the business risk of DTE Gas to that of the proxy group companies.

B. Financial Risk and the Cost of Equity

Q17. How does capital structure affect the cost of equity?

A17. Debtholders in a company have a fixed claim on the assets of the company and are paid prior to the company's owners (equity holders) who hold the inherently variable residual claim on the company's operating cash flows. Because equity holders only receive the profit that is left over after the fixed debt payments are made, higher degrees of debt in the capital structure amplify the variability in the expected rate of return earned by equity-holders. This phenomenon of debt resulting in financial leverage for equity holders means that, all else equal, a greater proportion of debt in the capital structure increases risk for equity holders, causing them to require a higher rate of return on their equity investment, even for an equivalent level of underlying business risk.

Q18. How do differences in financial leverage affect the estimation of the cost of equity?

A18. The CAPM and DCF models rely on market data to estimate the cost of equity for the proxy companies, so the results reflect the value of the capital that investors hold during the estimation period (market values).

The authorized ROE is applied to the regulatory equity portion of DTE Gas' rate base. Because the cost of equity is measured using a group of proxy companies, it may well be the case that these companies finance their operations with a different debt and equity proportion than the proportion the Commission allows in DTE Gas' rate base. Specifically, the CAPM and DCF models measure the cost of equity using market data and consequently are measures of the cost of equity using the proportion of debt and equity that is inherent in that data. Therefore, I consider the impact of any difference between the financial risk inherent in those cost of equity estimates and the capital structure used to determine DTE Gas' required return on equity.

Differences in financial risk due to the different degree of financial leverage in DTE Gas' regulatory capital structure compared to the capital structures of the proxy companies mean that the equity betas measured for the proxy companies must be adjusted before they can be applied in determining DTE Gas' CAPM return on equity. Similarly, the cost of equity measured by applying the DCF models to the proxy companies' market data requires adjustment if it is to serve as an estimate of the appropriate allowed ROE for DTE Gas at the regulatory capital structure the Commission grants.

Importantly, taking differences in financial leverage into account does not change the value of the rate base. Rather, it acknowledges the fact that a higher degree of financial leverage in the regulatory capital structure imposes a higher degree of financial risk for an equity investment in DTE Gas' rate base than is experienced by equity investors in the market-traded stock of the less leveraged proxy companies.

Q19. How specifically do you consider financial risk in your analysis of the cost of equity using market data for the proxy group companies?

A19. The impact of financial risk is taken into account in an analysis of cost of equity using market-based models such as the DCF and CAPM in several manners.[21] One way is to determine the after-tax weighted-average cost of capital ("WACC") for the proxy group using the equity and debt percentages as the weight assigned to the cost of equity and debt. Financial theory holds that for a given level of business risk, the WACC is constant over a broad set of capital structures, i.e., the WACC is the same at, for example, 55% and 45% equity, as the cost of equity increases as the percentage of equity decreases. I estimate the WACC for each utility in the proxy group based on that utility's capital structure. I then evaluate the average WACC across the proxy group. Once the weighted cost of capital is determined for the proxy group, I can determine the cost of equity that is required at DTE Gas' capital structure. This approach assumes that the after-tax WACC is constant for a range that spans the capital structures used to estimate the cost of equity and the regulatory capital structure.

A second approach was developed by Professor Hamada[22] who estimated the cost of equity using the CAPM and made comparisons between companies with different capital structure using beta. Specifically, under the Hamada approach, I use the estimated beta to calculate what beta would be associated with a 100 percent equity financed firm to obtain a so-called all-equity or assets beta and then re-lever the beta to determine the beta associated with the regulatory capital structure. This requires an estimate of the systematic risk associated with debt (*i.e.*, the debt beta), which is usually quite small. In

[21] The impact of financial leverage on the risk premium model needs to be considered separately as it uses regulatory data rather than market data, meaning that differences in regulatory capital structures are relevant for this model.

[22] Distinguished professor emeritus of finance and former dean of the University of Chicago's Booth School of Business. Professor Hamada is credited for developing a method to determine the cost of equity for a company with a different capital structure than that of the comparable companies. His research allows us to compare the cost of equity for companies that have different amounts of equity on an apples-to-apples basis.

Appendix B, I set forth additional technical details regarding the methods that can be used to account for financial risk when estimating the cost of capital.

Q20. Can you provide a numerical illustration of how the cost of equity changes, all else being equal, when the degree of leverage changes?

A20. Yes. I constructed a simple example below where only the leverage of a company varies. I assumed the return on equity is 11.00 percent at a 50 percent equity capital structure and determine the return on equity that would result in the same overall return if the percentage of equity in the capital structure were reduced to 45 percent.

Figure 3
Illustration of Impact of Financial Risk on ROE

		Company A (50% Equity)	Company B (45% Equity)
Rate Base	[a]	$1,000	$1,000
Equity	[b]	$500	$450
Debt	[c]	$500	$550
Total Cost of Capital (8%)	[d] = [a] × 8%	$80.0	$80.0
Cost of Debt (5%)	[e] = [c] × 5%	$25.0	$27.5
Equity Return	[f] = [d] - [e]	$55.0	$52.5
Rate of Return on Equity (ROE)	**[g] = [f] / [b]**	**11.00%**	**11.67%**

Figure 3, above, illustrates how financial risk[23] affects returns and the ROE. The overall return remains the same for Company A and B at $80. However, Company B with the lower equity share and higher financial leverage must earn a higher percentage ROE in order to maintain the same overall return. This higher percentage allowed ROE represents the increased risk to equity investors caused by the higher degree of leverage.

The principle illustrated in Figure 3 is an example of the adjustments I performed to account for differences in financial risk when conducting estimates of the cost of equity applicable to DTE Gas. This is important because it implies that if an equity percentage

[23] Financial risk is risk that a company has due to its capital structure; specifically the higher a company's debt, the larger the financial risk.

lower than the relied upon 51.9 percent is allowed, then DTE Gas' cost of equity is higher than what I estimate here.

C. APPROACH TO ESTIMATING THE COST OF EQUITY

Q21. Please describe your approach for determining the cost of equity for DTE Gas.

A21. As stated above, the standard for establishing an appropriate rate of return on equity requires that a regulated utility be allowed to earn a return equivalent to what an investor could expect to earn on an alternative investment of equivalent risk. Therefore, my approach to estimating the cost of equity for DTE Gas focuses on measuring the expected returns required by investors to invest in companies that face business and financial risks comparable to those faced by DTE Gas. Because certain of the models require market data, my consideration of comparable companies is restricted to those that have publicly traded stock. To this end, I have selected two proxy groups consisting of publicly traded companies. The first proxy group consists of companies providing primarily regulated natural gas distribution services and the second proxy group consists of highly regulated companies in the water utility industry.[24] I consider both the natural gas distribution sample and the full sample, which consist of the natural gas utilities **and** the water utilities, when deriving estimates of the representative cost of equity according to standard financial models including two versions of the CAPM—the traditional version and a version that takes into account the empirical observation that the security market line in Figure 2 is too steep relative to what is observed using market data. I also implement a single-stage and a multi-stage version of the DCF.

[24] I consider both a natural gas distribution utility sample (because DTE Gas is a natural gas distribution utility) and a sample including water utilities. The latter sample has the advantage of being highly regulated and, like natural gas distribution utilities, engaged in distributing a commodity through an extensive network of pipes. Further, in most state investor-owned water utilities are regulated by the same entity that regulates natural gas distribution utilities. Lastly, the number of companies in the natural gas distribution industry is limited due to mergers and acquisitions, so the water utility industry serves to increase the number of available, fully regulated utilities that serve customers through a network of pipes.

Lastly, I perform an analysis of historical allowed ROEs for natural gas LDCs in relation to prevailing risk-free interest rates at the time the ROE was authorized and use the implied allowed risk-premium relationship to estimate a utility cost of equity consistent with current economic conditions. The results of this implied risk premium analysis (sometimes referred to herein as the "Risk Premium" model) are an additional consideration that informs my recommendation and serves as a check on the reasonableness of my market-based results.

Q22. How does your approach and the models you employ compare to what the Commission has considered in prior DTE Gas proceedings?

A22. The Commission has in past decisions considered the DCF, CAPM, and Risk Premium models, as do I. Additionally, the Commission has in the past recognized that "some consideration should be given to current market volatility and uncertainty."[25] The Commission also stated that it will "monitor a variety of market factors in future applications to gauge whether volatility and uncertainty continue to be prevalent issues that merit more consideration in setting the ROE."[26] In its recent order regarding Consumer Energy, the Commission maintained its position stating that

> *It is also important to consider how extreme market reactions to global events, as have occurred in the recent past, may impact how easily capital will be able to be accessed during the future test period should an unforeseen market shock occur. The Commission will continue to monitor a variety of market factors in future rate cases to gauge whether volatility and uncertainty continue to be prevalent issues that merit more consideration in setting the ROE.* [27]

Given the level of uncertainty in the US economy, it is important that the Commission continues to consider the impact on ROE and capital structure.

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[25] Michigan Public Service Commission, Order for Case No. U-18999, September 13, 2018, p. 53.

[26] Michigan Public Service Commission, Order for Case No. U-20162, May 2, 2019, pp. 67-68.

[27] Commission Order in U-20697, pp. 165-166.

Q23. Have other utility regulatory bodies acknowledged the importance of relying upon multiple models?

A23. Yes. Notably FERC, which regulates electric transmission operations, recently issued an order proposing to rely explicitly on multiple models in its determination of just and reasonable ROEs for transmission owners.[28] In FERC's most recent (Order 569-A), the FERC relies on versions of the DCF and CAPM as well as the implied Risk Premium method. These recent FERC ROE Orders represents a substantial change of FERC's historical practice of relying on only a single model—the DCF—to set allowed ROEs. In it, FERC explicitly recognizes that different models offer complementary views of investor requirements and market expectations and that it is necessary to evaluate and consider all such evidence.

Q24. What reasons did FERC give for revising its approach to consider multiple models rather than only the DCF?

A24. In the FERC Coakley Order (October 2018), FERC stated its concern that compared to when it originally adopted the DCF model as its only focus of consideration for determining utility ROEs, "the DCF methodology may no longer singularly reflect how investors make their decisions," since "investors have increasingly used a diverse set of data sources and models to inform their investment decisions." The FERC Coakley Order also lays out other "difficulties with sole reliance on the DCF methodology," including that the single model's results appear at times to diverge from its underlying principles and the real world experience of capital market participants, and that the results sometimes move differently from the results of other models on which those market participants may rely to inform their investment decisions. Ultimately, FERC views its

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[28] See Coakley v. Bangor Hydro-Electric Co., 165 FERC ¶ 61,030 (October 2018)("Coakley Order") wherein FERC switched from relying on the DCF to relying on four cost of equity estimation methodologies (DCF, CAPM, Implied Risk Premium, and Expected Earnings). See also FERC Order 569-A, Docket No. EL14-12-004, May 21, 2020 and FERC Order 569-B, Docket No. EL14-12-004, November 19, 2020, which confirmed Order 569-A.

proposal to rely on multiple models as a way to avoid this "model risk" and summarizes its rationale as follows.

> In relying on a broader range of record evidence to estimate [New England Transmission Owners'] cost of equity, we ensure that our chosen ROE is based on substantial evidence and bring our methodology into closer alignment with how investors inform their investment decisions.[29]

In FERC's most recent Order 569-A, the Commission affirmed this view stating, "We continue to find that ROE determinations should consider multiple models, both to capture the variety of models used by investors and to mitigate model risk."[30] FERC's assessment and reasoning in this regard is very much in line with the principles that guide my own decision to inform my analysis based on the results of multiple complementary analyses.

IV. CAPITAL MARKET CONDITIONS AND THE COST OF CAPITAL

Q25. What do you cover in this section?

A25. In this section, I address recent changes in capital market conditions, the increased volatility in equity and debt markets, and how these factors affect the cost of equity and its estimation. Specifically, I address (i) interest rate developments; (ii) recent changes in utility credit spreads; and (iii) investors perception of the market risk premium.

Q26. Why do you discuss capital market conditions in a testimony aimed at determining DTE Gas' ROE?

A26. 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

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29 FERC Coakley Order, p. 15.

30 FERC Order 569-A, p. 25.

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. Similarly, the Market Risk Premium ("MRP") is an input to the CAPM, so factors that affect the MRP (e.g. volatility and changes in investors' risk perceptions) are vital for accurate determination of the ROE.

Q27. Can you provide a summary of recent events, which have impacted capital market conditions?

A27. Capital markets have seen historic changes since DTE Gas filed its last rate case. Starting in January 2020, long-standing trade tensions that were weighing on the economy began to ease. The U.S. signed Phase 1 of the U.S.-China Trade Agreement and also the United States-Mexico-Canada Agreement ("USMCA"). However, around the same time, a novel virus was beginning to spread in China and Europe. By March 2020, the World Health Organization declared that the COVID-19 outbreak was a pandemic. Many governments around the world, including in the U.S., sought measures to limit the health and economic impacts from the pandemic. By mid-March, local and state governments began issuing stay-at-home orders and major portions of the U.S. economy were shut down. As a result, over 65 million people in the U.S. have filed initial unemployment claims since March 21, 2020.[31] To help mitigate the economic impacts, the U.S. Federal Government passed the $2.1 trillion CARES Act on March 27, 2020.[32] The U.S. Federal Reserve also cut its policy rate to 0 to 0.25 percent and announced "unlimited"

[31] U.S. Department of Labor, "Unemployment Insurance Weekly Claims," New Release, November 26, 2020.

[32] The White House, "Statement by the President," March 27, 2020, accessed April 16, 2020, https://www.whitehouse.gov/briefings-statements/statement-by-the-president-38/.

quantitative easing and emergency liquidity programs to support financial markets.[33] As a result the Federal Reserve's balance sheet has climbed to over $7.2 trillion in assets as of December 2020.[34] This compares to about $4 trillion as of year-end 2019. Despite the monetary and fiscal policies intended to support the economy, the U.S. economy contracted substantially in the first half of 2020. According to the Bureau of Economic Analysis ("BEA") first and second quarter 2020, GDP decreased by annualized rate of 5.0% and 31.4%, respectively.[35] By June 2020, the National Bureau of Economic Research declared the U.S. was in a recession. As of December 2020, the U.S. had 10.7 million unemployed for an unemployment rate of 6.7%, which is twice the pre-pandemic level.[36] However, the Detroit area unemployment was higher at 8.9 percent in November 2020.[37]

Q28. What are the expectations going forward?

A28. The extent and length of the economic and financial impacts from COVID-19 are still unknown. The impacts on the economy and unemployment will depend on how long social-distancing measures are required and how long it takes to distribute a vaccine. Recent surveys by economists, such as in the Blue Chip Economic Indicators survey, indicate that the nominal U.S. GDP will decline by 3.0% in 2020 before recovering to 6% in 2021.[38] The Congressional Budget Office expects nominal GDP growth by 5.7%

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[33] U.S. Federal Reserve, "Federal Reserve Announces Extensive New Measures to Support the Economy," Press Release, March 23, 2020. The policy was largely continued in the Federal Reserve's most recent meeting; U.S. Federal Reserve, "Federal Reserve issues FOCM statement," December 16, 2020.

[34] S&P Global Market Intelligence, "Gray Swans: Blinded by Pandemic Investors May be Ignoring these Risks in 2021," December 16, 2020.

[35] Bureau of Economic Analysis, "Gross Domestic Product, 2nd Quarter 2020 (Third Estimate); Corporate Profits, (Revised), U.S. Department of Commerce, September 30, 2020. Accessed October 2, 2020, https://www.bea.gov/news/2020/gross-domestic-product-third-estimate-corporate-profits-revised-and-gdp-industry-annual.

[36] https://www.bls.gov/news.release/pdf/empsit.pdf

[37] www.bls.gov/regions/economic-summaries.htm, "Detroit Area Economic Summary," January, 2021.

[38] Wolters Kluwer Blue Chip Economic Indicators and PwC Analysis, October 2020, pp. 2-3.

in 2021.[39] However, the expectations of a 6% growth is the average of upward 40 financial and academic institutions' forecasts, which span a wide range from 3.7 to 8.1 percent in January 2021.[40] The nominal GDP growth rate is the figure that impacts the cost of equity estimate in the DCF model. In August 2020, the U.S. Federal Reserve announced a policy change whereby they would target inflation at 2% on average indicating the Federal Reserve may hold interest rates for longer.[41] After their September 2020 meeting, the Federal Reserve released economic projections indicating that policy rates would remain at current levels through 2023.[42] The policy was continued after the Feds December 2020 meeting[43] and will likely continue to exert downward pressure on interest rates over the near to medium term. While the length and extent of the economic impacts from COVID-19 are currently unknown, the impacts are expected to persist for some time until a vaccine is widely distributed or some other effective treatment is developed.[44]

Q29. How does this impact the cost of equity estimation for DTE Gas?

A29. It is important to remember that the cost of equity and capital structure established for DTE Gas in this proceeding is expected to be in effect beyond the current extraordinary

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[39] Wolters Kluwer Blue Chip Economic Indicators and PwC Analysis, October 2020, p. 14 shows a long-term nominal GDP growth of 4.1%. and Congressional Budget Office at https://www.cbo.gov/publication/56368#_idTextAnchor011

[40] Wolters Kluwer Blue Chip Economic Indicators, January 2021m pp. 2-3.

[41] 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 September 10, 2020, https://www.federalreserve.gov/newsevents/pressreleases/monetary20200827a.htm. See also, the December 16, 2020 Federal Reserve FOCM Statement.

[42] U.S. Federal Reserve, "Table 1. Economic Projections of Federal Reserve Board members and Federal Reserve Bank presidents under their individual assumptions of projected appropriate monetary policy, September 2020," September 15, 2020, accessed September 21, 2020,

https://www.federalreserve.gov/monetarypolicy/files/fomcprojtabl20200916.pdf.

[43] Federal Reserve December 16, 2020 FOCM Press Release;

https://www.federalreserve.gov/newsevents/pressreleases/monetary20201216a.htm

[44] The Federal Reserve in their September 16, 2020 FOMC statement said, "The ongoing public health crisis will continue to weight on economic activity, employment, and inflation in the near term, and poses considerable risks to the economic outlook over the medium term."

https://www.federalreserve.gov/newsevents/pressreleases/monetary20200916a.htm.

impacts of the COVID-19 pandemic. The analysis and recommendations should reflect expected market conditions that will prevail over the relevant rate period and not exclusively current market conditions. As discussed further below, many of the inputs to the cost of equity estimation methodologies are currently at unprecedented levels. Sole reliance on current economic and financial conditions to estimate DTE Gas' cost of equity would unfairly lock DTE Gas and their customers into the current economic and financial environment. Doing so would also not provide a fair return, especially when compared to other utilities that did not undergo a cost of capital proceeding during this period. However, the current conditions create an unusually large amount of uncertainty about the future and, if the financial crisis can be used as a guide, then investors' heightened perception of risk are likely to linger. As noted earlier, the Commission's Order in U-20697 acknowledge the need to consider market volatility and uncertainty.[45]

A. INTEREST RATES

Q30. How do interest rates affect the cost of equity?

A30. 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 (see Figure 2). 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, which will be in effect during the relevant regulatory period. Put another way, with current government bond yields downwardly biased due to flight-to-quality behavior by investors and "unlimited" quantitative easing programs by the U.S. Federal Reserve, using current yields in the CAPM will also downward bias the cost of equity estimate. At the same time, a low interest rate is associated with a high market risk premium, so that these two measures offset one another to a degree. To avoid

[45] Order in U-20697, pp. 165-166.

any bias in the cost of equity estimate, it is important to use a forecasted risk-free rate and consider whether the rate needs to be normalized (or the risk premium investors require needs to be adjusted) to ensure the resulting CAPM estimate reflects a non-biased estimate of DTE Gas cost of equity over the relevant regulatory period. As the economy begins to recover, as forecasted, in 2021 interest rates are expected to increase from current lows.[46] Therefore, the allowed fair return on equity for utilities should reflect the future interest rate environment.

Q31. What are the relevant developments regarding interest rates?

A31. Interest rates are currently near historic lows 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% at the end of 2019.[47] 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%.[48] Since then, long-term government bond yields have increased somewhat—10 year U.S. Government bonds as of January 26, 2021 was 1.05%.[49]

Most economists expect the economy to begin to recover in 2021.[50] This is expected to cause interest rates to rise from near-historic lows. Blue Chip Economic Indicators' ("BCEI") October 2020 edition forecasts that the yield on 10-year treasury bonds will

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[46] The 10-year treasury bond yield has increased more than 50 basis points from the summer of 2020; for example, the yield was 0.55% on August 6, 2020 but stood at 1.05% on January 26, 2021.

[47] Bloomberg accessed October 23, 2020 and Federal Reserve, FRED assessed December 3, 2020.

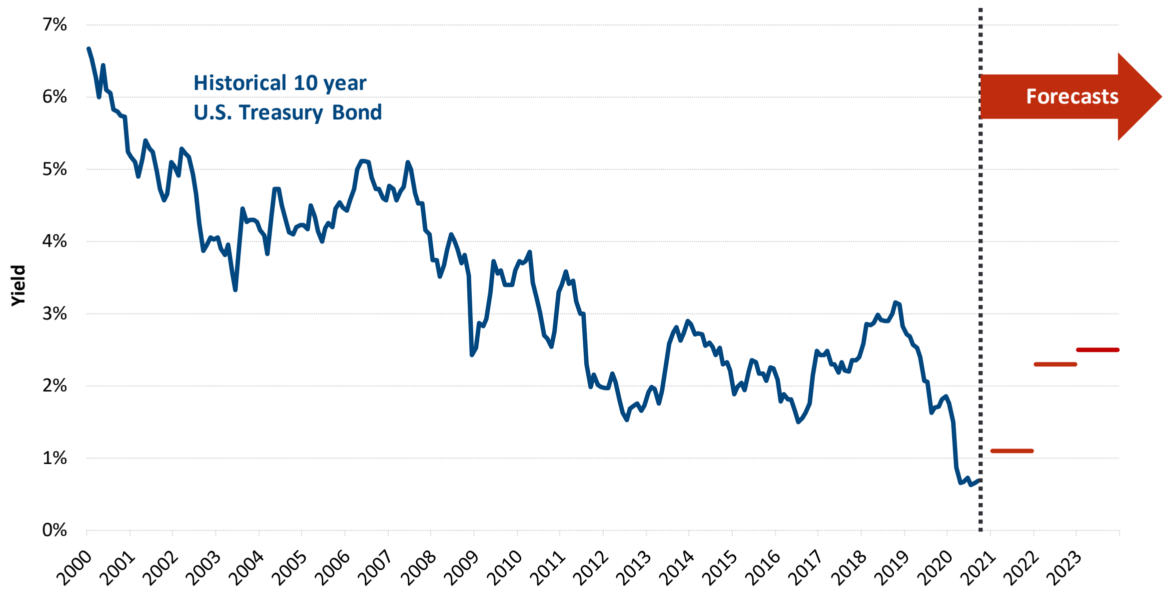
[48] Sunny Oh, "Treasury yield curve sinks below 1% after oil and coronavirus worries rout stocks," *Market Watch*, March 9, 2020, accessed March 31, 2020, https://www.marketwatch.com/story/30-year-treasury-yield-tumbles-below-1-after-oil-and-coronavirus-worries-rout-stocks-2020-03-09

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

[50] For example, Wolters Kluwer Blue Chip Economic Indicators and PwC Analysis, October 2020 collects GDP growth data from 40 financial institutions, academic institutions and other entities – all of whom predict a positive growth for 2021 with an average of 5.5 percent. The January 2021 issue of the publication forecast 2021 GDP growth at 6.0 percent.

increase.[51] Specifically, BCEI projects the 10-year government bond yield will be 1.4 and 1.7 percent in 2022 and 2023, respectively (Figure 4).[52] The expectations for 2022 and 2023 is what is relevant for this proceeding and consistent with Mr. Solomon development of the cost of long-term debt for year-end 2022..**[53]** Because the risk-free rates is an input to several cost of equity estimation models, the relationship between current and forecasted risk-free rates is an important consideration.

Figure 4: Historical and Projected Ten-Year Treasury Bond Yields[54]



Source: Historical data from Bloomberg. Forecasts from Blue Chip Economic Indicators October and December 2020 issue.

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[51] Wolters Kluwer Blue Chip Economic Indicators and PwC Analysis, December2020, p. 3. The historical maturity premium for a 20-year treasury bond over a 10-year treasury bond is approximately 50 basis points.

[52] Wolters Kluwer Blue Chip Economic Indicators and PwC Analysis, October 2020, p. 14.

[53] Direct Testimony of Mr. E.J. Solomon.

[54] Id.

B. YIELD SPREADS

Q32. Why are bond yield spreads relevant to your cost of equity analysis?

A32. Bond yield spreads (also called credit spreads) reflect the premium that investors demand to hold debt securities (specifically corporate or utility bonds) that are not risk free. Analogously, the MRP, which is a key input to the CAPM cost of equity estimation—represents the risk premium that investors require to hold equities rather than risk-free government bonds.

If bond yields are influenced to some extent by the same underlying market factors that drive the systematic risk premium for equities, then shifts in directly observable credit spreads can assist with inference about changes in the MRP, which itself must be estimated.[55] More specifically, if both credit spreads and equity premiums are determined in part by the general premium required by investors for bearing systematic risk, then an increase in credit spreads may indicate an increase in the forward-looking MRP.

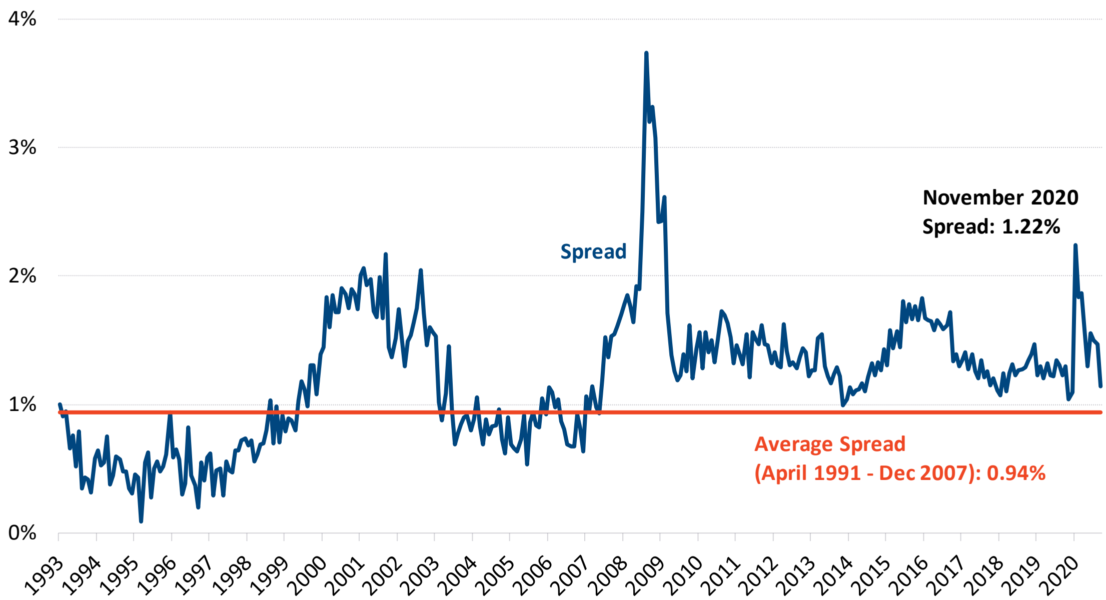
Q33. How does the current spread between utility and U.S. government bond yields compare to historical spreads?

A33. Utility bond yield spreads have increased substantially recently as investors require additional compensation to hold non-government debt due to the increased business risks and economic uncertainties. As shown in Figure 5 below, the spread between 20-year A-rated utility bond yields and 20-year U.S. government bond yields are currently at 1.15%, which is approximately 28 basis points above the pre-financial crisis average of 0.94%. At the same time the BBB utility bond spread is 36 basis points higher than the spread from 1991 to 2008 and 59 bps above the spread from 1991 to today (leaving out 2008-2011). Thus, regardless of the period over which I measure the increase in spread, it is higher today than historically and thus indicate a higher than historical premium over the

[55] This is the same issue as in cost of capital estimation more generally: the cost of debt can often be directly observed in the form of market bond yields, whereas the cost of equity must be estimated based on financial models.

risk-free rate to hold assets that are not risk free. I note that the spread increased dramatically in early 2020, but has since declined some.

Figure 5: Yield Spread Between Utility A-rated Bond Yields and 20 Year U.S. Treasury Bonds

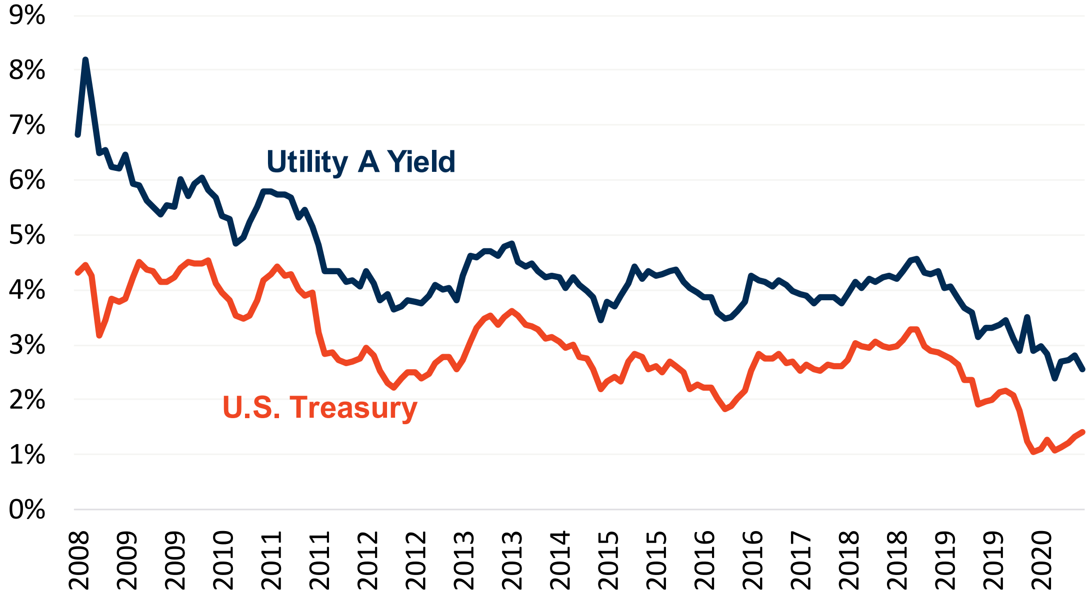


Source: Bloomberg as of 11/30/2020.

The yield spread is commonly thought to be explained by default risk, taxes, downward pressure on government bond yields due to monetary policy, or the equity risk premium. Hence, an increase in the spread could be caused by any or all of these components. As the default risk has not changed materially for highly rated utility bonds[56] and taxes are a very small portion of the spread, the remaining components: downward pressure and the equity risk premium must explain the majority of the spread increase. Figure 6 below illustrates that the increased spread is attributable both to lower yields on government bonds and also an increased premium required by investors to hold riskier assets.

[56] S&P Ratings reports Utility defaults are down slightly in 2020 versus 2019 year to date. S&P Global Ratings, "Corporate Defaults Slow In The Third Quarter While The Oil and Gas Total Remains High," October 2, 2020.

Figure 6: Utility A-rated Bond Yields and 20 Year U.S. Treasury Yields



Source: Bloomberg, data as of November 30, 2020.

While spreads have narrowed since the height of the COVID-19 pandemic in March and April, they remain elevated compared to the pre-COVID-19 period indicating lingering uncertainty and elevated risk. On April 2, 2020, S&P Global Ratings downgraded the outlook for North American utilities from "stable" to "negative" due to COVID-19 risks, citing concerns about the adequacy of utilities' financial cushions to weather the financial downturn.[57] As of January 25, 2025, S&P Global Ratings maintain the negative outlook on utilities noting that the "[c]redit quality for the North American regulated utility industry weakened in 2020" and that "[d]espite our negative 2021 industry outlook, [S&P] expect a modest improvement to credit quality over the next 12 months."[58] With heightened concern about utility credit, spreads and risk premiums are likely to remain elevated.

[57] *S&P Global Market Intelligence*, "S&P lowers North American utilities outlook to negative on coronavirus risk," April 2, 2020, Accessed April 3, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/s-p-lowers-north-american-utilities-outlook-to-negative-on-coronavirus-risk-57886477

[58] S&P Global Ratings, "North American Regulated Utilities: Negative Outlook Could See Modest Improvement," January 20, 2021.

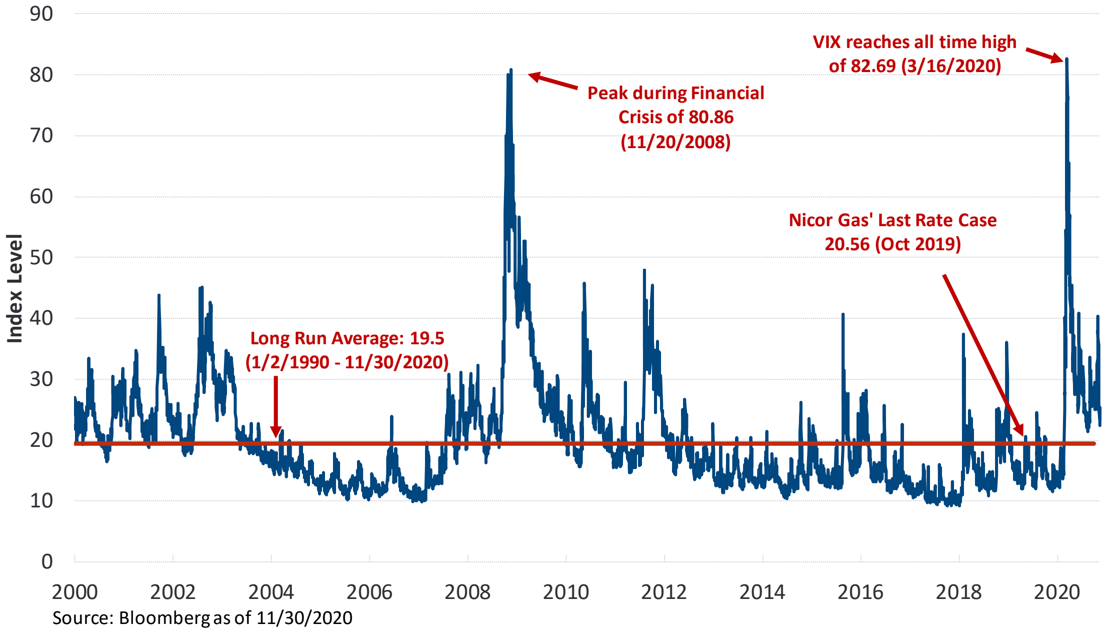
C. Risk Premiums

Q34. What is the current evidence regarding market volatility?

A34. Recently, financial markets have become 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. Although, the VIX has slowly retreated from recent highs to between 21.6 to 37.2 in January 2021 with thehighest level seen more recently on January 27, 2021.[59] Comparably, at the time of DTE Gas' last rate case in Michigan (filed in November 2019), the VIX stood at approximately 12.5. Clearly, investors are faced with substantially higher volatility today than when DTE Gas' last rate case was filed and higher volatility implies a higher risk premium.

[59] Bloomberg, as of October 23, 2020 and CBOE as of January 27, 2021 (https://www.google.com/search?q=VIX+cboe&sourceid=ie7&rls=com.microsoft:en-US:IE-Address&ie=&oe=#spf=1611799158418)

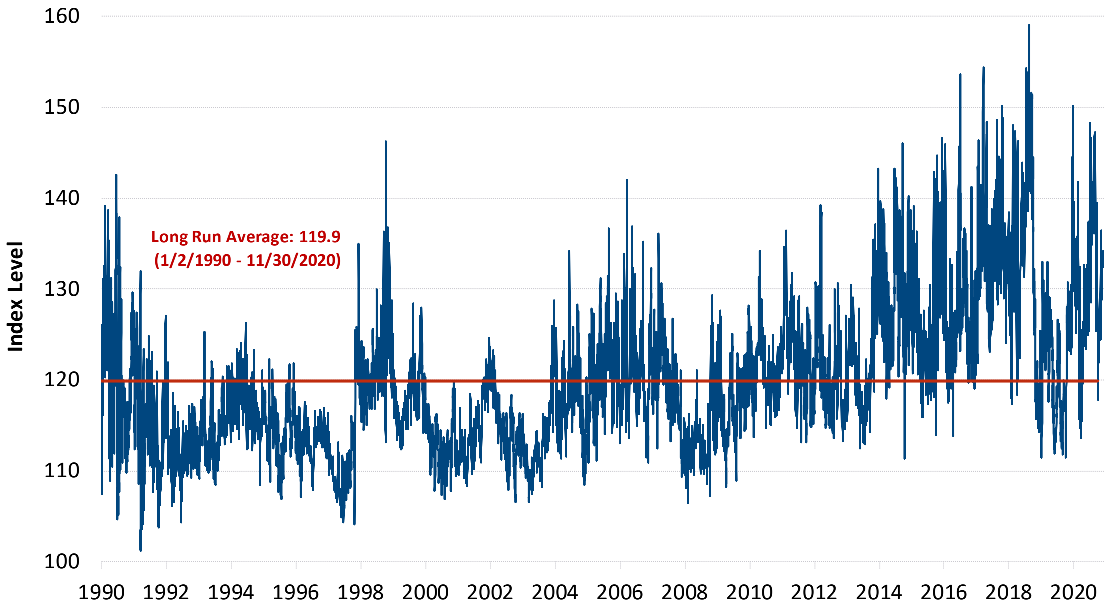
Figure 7: VIX



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),[60] 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 8 below shows the development in the SKEW since 1990 and that the index has recently increased following a period of declining SKEW. The index spiked over 148.3 on June 30, 2020 and stood at 137.9 on January 27, 2021, which is well above its long run average of 119.9. The recent spike in the SKEW shows that investors are willing to pay for protection against downside risks.

[60] For example, http://www.cboe.com/products/vix-index-volatility/volatility-indicators/skew.

Figure 8: SKEW



Source: Bloomberg as of 11/30/2020

The currently very high level of both the VIX and SKEW is consistent with day-to-day observations of volatile financial markets and shows that investors are cautious about investing in equity. Such circumstances lead investors to require a higher premium to invest in assets or financial instruments that are not risk-free.

Q35. What is the Market Risk Premium?

A35. 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,[61] the MRP is a highly relevant benchmark indicating the

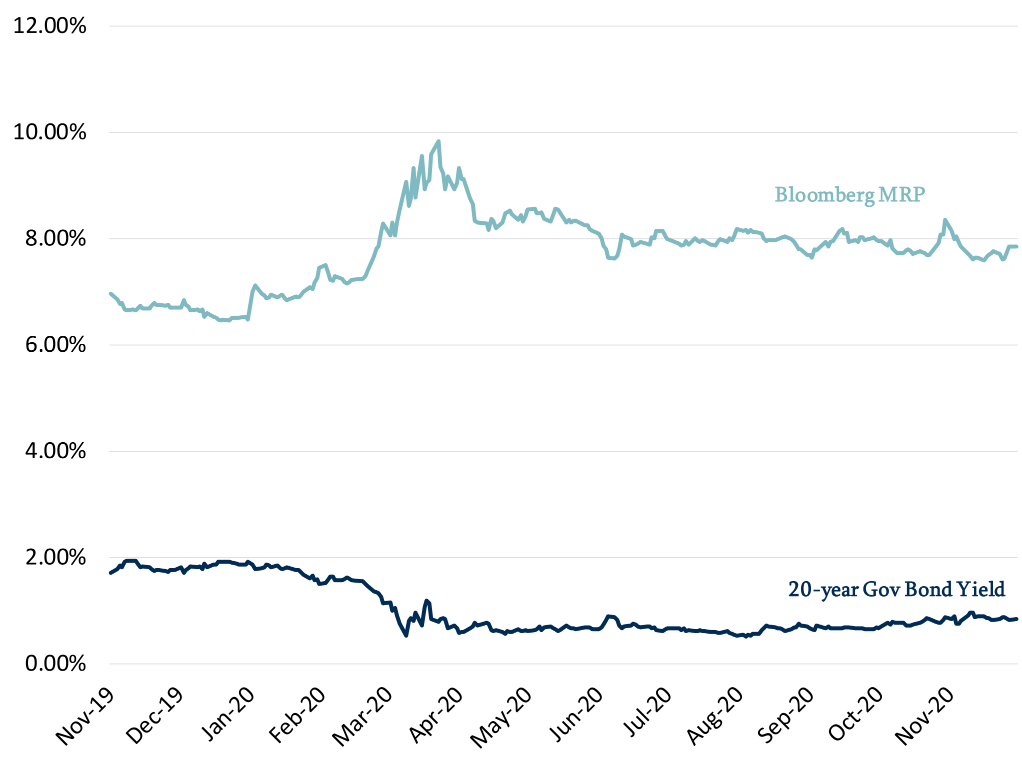
[61] In finance theory, the "market portfolio" describes a value-weighted combination of all risky investment assets (e.g., stocks, bonds, real estate) that can be purchased in markets. In practice, academics and financial analysts nearly always use a broad-based stock market index, such as the S&P 500,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

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.

Q36. Please explain the current evidence related to the MRP.

A36. The heightened volatility 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. This year, Bloomberg's forward looking estimate of the MRP for the U.S. increased to as high as 9.84% in March 2020 and was 8.39% as of January 2021.[62]

Figure 9: Bloomberg's Daily Market Risk Premium and Risk Free Rate; (Nov. 2019 to Nov. 2020).



[62] Bloomberg, as of February 2, 2021. Measured over a 10-year U.S. Treasury bond.

Q37. Are higher risk premiums relevant given that treasures are near historic lows?

A37. Yes—this is highly relevant for cost of equity estimation as current risk-free rates are extremely low. On March 9, 2020, the entire U.S. yield curve settled below 1.00% for the first time in history.[63] Since then, U.S. Government bond yields have increased somewhat with the 20-year and 30-year bond yields at or slightly above 1.00%. This decrease in bond yields has occurred as investors fled to safer assets due to the heightened market uncertainty.

As shown above in Figure 9, the MRP has also increased as the risk-free rate declined. Further, as shown in both academic and industry analyses, 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% for each 1% decline in the risk-free rate for the period 1990 to 2015.64 Morin finds that the risk premium increases by 0.52% for each 1% decline in the risk-free rate.65 Thus, the risk premium is likely to increase as the risk-free rate declines. As shown in Figure 9 above, this phenomenon is also documented in the forward-looking market risk premium calculated by Bloomberg. According to Bloomberg, the MRP is 7.85%,[66] which is higher than the historical average MRP of about 7.15 percent. It is also an increase over the forward-looking MRPs at the end of 2019 of 6.48%, which were much more in line with the historical average MRP.[67]

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[63] According to the Federal Reserve, the yield on the 10-year, 20-year, and 30-year Treasury bonds on March 9, 2020 was 0.54%, 0.87%, and 0.99% respectively. These yields have since increased. Source: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield

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

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

[66] Bloomberg, as of November 30, 2020.

[67] Id.

Q38. Is there evidence that the MRP will remain elevated going forward?

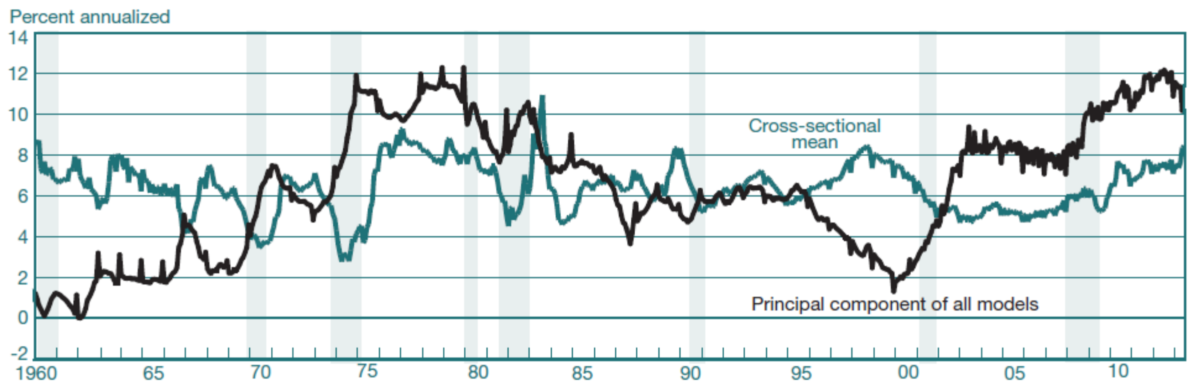
A38. Yes. In 2015, Duarte and Rose of the Federal Reserve of New York performed a study that aggregated the results of many models of the required MRP in the United States and tracked them over time.[68] This analysis found a very high MRP after the financial crisis, relative to time periods prior the 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.[69] 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 10 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 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.

[68] 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.

[69] 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.

Figure 10: Duarte and Rosa's Chart 3
One-Year Ahead MRP and Cross-Sectional Mean of Models



Q39. Please summarize how the economic developments discussed above have affected the return on equity and debt that investors require.

A39. 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 dramatically affected by the ongoing market uncertainty, so there are reasons to believe that their risk aversion remains elevated relative to pre-COVID-19 levels. As DTE Gas is expected to be compensated as a utility on the equity component of its rate base, the same factors would affect DTE Gas' equity.

V. ESTIMATING THE COST OF EQUITY

A. Proxy Group Selection

Q40. How do you identify proxy companies of comparable business risk to DTE Gas?

A40. DTE Gas is primarily engaged in the regulated natural gas distribution business. The business risk associated with these endeavors depends on many factors including the specific characteristics of the service territory and regulatory environment in which the provider of these services operates. Consequently, it is not possible to identify publicly traded proxy companies that replicate every aspect of DTE Gas' risk profile. However, selecting companies with business operations concentrated in regulated industries or having similar lines of business and/or business environments is an appropriate starting point for selecting one or more proxy groups of comparable risk to DTE Gas. As a second step, I must evaluate DTE Gas or Michigan-specific risks to ensure that the Company's ROE is placed appropriately relative to the sample companies.

To this end I have selected a sample of natural gas distribution utilities and highly regulated water utilities. Jointly these companies comprise the "Full Sample." I also report results for the natural gas distribution utilities that are included in the Full Sample and refer to that sample as the Gas Sample. The proxy companies are similar to DTE Gas in that they are rate regulated by state utility commissions, provide customers a product through a network of pipeline assets, and rely on substantial capital to provide service; i.e., they are capital intensive like DTE Gas.

It is important that a proxy group used to assess the cost of equity for DTE Gas (absent of any unique Michigan or Company characteristics) is regulated, because regulation tends to place substantial requirements and also protections on the companies. I also believe the physical characteristics of the industry – e.g., network, capital intensive, serving many different customers – is a characteristic of DTE Gas and of the selected natural gas distribution and water utilities. The network characteristic implies that assets cannot readily be employed in a different capacity, capital intensity affects the operating risks through the split between fixed and variable costs, and the customer composition affects the demand risk. For example, natural gas and water utilities all face declining per-customer demand due to conservation.

Q41. Why are you including water utilities when evaluating the cost of capital for a natural gas distribution utility?

A41. For several reasons. First, the natural gas distribution industry is expected to undergo substantial changes as customers, regulators and the legislature focus on carbon reductions. This means that initiatives in a specific state influences stock prices and analysts' evaluations along with more fundamental operating and market conditions.[70] I therefore select a group of water utilities where there are no carbon considerations to assess whether the estimates from the natural gas LDCs are reasonable. Second, investors make comparisons across regulated companies, so it becomes important to consider whether the returns awarded DTE Gas are comparable not only to other natural gas utilities, but also to other similar risk benchmarks – I consider a broader sample of natural gas and water utilities a reasonable such benchmark. Third, natural gas and water utilities generally share not only regulators but also the characteristics of being (a) capital-intensive,[71] (b) network industries, and (c) having an obligation to serve and interfacing with the local community.[72] I therefore believe these companies provide a useful benchmark when evaluating the cost of equity for DTE Gas.

Q42. Please summarize how you selected the members of the Full Sample and the Gas Sample.

A42. To identify companies suitable for inclusion in the Full Sample, I started with the universe of publicly traded companies in the natural gas and water utility industry as identified by *Value Line Investment Analyzer* (*"Value Line")*. I started with Value Line's list of publicly traded companies classified as natural gas LDCs or water utilities. Next, I reviewed business descriptions and financial reports of these companies and eliminated companies that had less than 50 percent of their assets dedicated to regulated utility activities in their industry; e.g., natural gas or water utility services.[73]

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70 In some jurisdictions, there has been initiatives to ban natural gas from new or existing housing and to enhance electrification of the residential sector.

71 As shown in Schedule D5.18, DTE Gas' capital intensity is between the average of the gas and water proxy groups.

72 I recognize that the Commission does not regulate water utilities. In contrast most state regulatory commissions do regulate (investor-owned) water utilities that operate in their jurisdiction.

73 I calculate the share of assets devoted to regulated activities using information from the companies' 10-Ks.

With this group of companies, I applied further screening criteria to eliminate companies that have had recent significant events that could affect the market data necessary to perform cost of capital estimation. Specifically, I identified companies that have cut their dividends or engaged in substantial merger and acquisition ("M&A") activities over the relevant estimation window.[74] I eliminated companies with such dividend cuts because the announcement of a cut may produce disturbances in the stock prices and growth rate expectations in addition to potentially being a signal of financial distress. I generally eliminated companies with significant M&A activities because such events typically affect a company's stock price in ways that are not representative of how investors perceive its business and financial risk characteristics. For example, a utility's stock price will commonly jump upon the announcement of an acquisition to match the acquirer's bid.

Further, I require companies have an investment grade credit rating[75] and a fundamental, requirement is that the proxy companies have the necessary data available for estimation.

Q43. What are the characteristics of the Gas and Water Utility Proxy Group?

A43. The Gas and Water Utility Proxy Group is comprised of natural gas and water utilities whose primary source of revenues and majority of assets are subject to regulation. The final proxy group consists of the nine natural gas and six water utilities listed in Figure 11 and Figure 12 below.

All companies are engaged in the distribution of a commodity to end customers through a network of pipes and mains. While the product differs across natural gas and water utilities, they are all focused on distribution, a mix of residential, commercial and industrial customers and all are regulated. Further, the proxy group companies have

74 As described in Sections V.B, the CAPM requires five years of historical data, while the DCF relies on current market data.

75 In a few 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.

credit ratings in the range of BBB to A+, which is consistent with DTE Gas' credit rating albeit the average for the proxy companies is slightly higher.[76]

Figure 11 reports the natural gas utility proxy companies' annual revenues for the most recent four quarters as of Q3, 2020 and also reports the market capitalization, credit rating, beta and growth rate. The annual revenue as well as the market cap was obtained from Bloomberg. The credit ratings are reported by Bloomberg. The growth rate estimate is a weighted average between estimates from Thomson Reuters and *Value Line*. Betas were obtained from *Value Line*. Similar data for the water utility proxy group are reported in Figure 12, below. Of note, while the average beta for the natural gas utility proxy group was approximately 0.66, when I undertook my analysis for U-20642, the average beta has now increased to 0.87. Similarly, the water utilities' beta has increased from approximately 0.65 on average to 0.76.[77] This indicate a substantial increase in systematic risk.

[76] DTE Energy's unsecured rating is BBB from S&P, while secured ratings for DTE Gas is higher at A. Source: DTE, "EEI Financial Conference," November 9-10, 2020.

[77] In each case Value Line betas were used. Source: Villadsen Direct in U-20642, Schedule D5.10.

Figure 11
Gas Proxy Group

Company	Annual Revenue (Q3 2020) ($MM)	Regulated Assets	Market Cap. (Q3 2020) ($MM)	Value Line Beta	S&P Credit Rating	Long-Term Growth Estimate
	[1]	[2]	[3]	[4]	[5]	[6]
Atmos Energy	$2,821	MR	$11,798	0.80	A	6.3%
Chesapeake Utilities	$483	R	$1,304	0.80	A-	8.0%
New Jersey Resources	$1,954	R	$2,627	0.95	A-	6.0%
NiSource Inc.	$4,868	R	$8,443	0.85	BBB+	6.9%
Northwest Natural	$761	MR	$1,379	0.80	BBB+	6.2%
ONE Gas Inc.	$1,499	R	$3,638	0.80	A	6.2%
South Jersey Inds.	$1,519	R	$1,957	1.05	BBB	10.7%
Southwest Gas	$3,233	MR	$3,511	0.95	BBB+	7.3%
Spire Inc.	$1,855	R	$2,725	0.85	A-	6.4%
Average	$2,110		$4,154	0.87	A-	7.1%

Sources and Notes:
[1]: Bloomberg as of November 30, 2020.
[2]: Key R - Regulated (80% or more of assets regulated).
MR - Mostly Regulated (less than 80% of assets regulated).
[3]: See Schedule No. BV-3 Panels A through I.
[4]: See Schedule No. BV-10
[5]: Bloomberg as of November 30, 2020.
[6]: See Schedule No. BV-5.

Figure 12
Water Proxy Group

Company	Annual Revenue (Q3 2020) ($MM)	Regulated Assets	Market Cap. (Q3 2020) ($MM)	Value Line Beta	S&P Credit Rating	Long-Term Growth Estimate
	[1]	[2]	[3]	[4]	[5]	[6]
Amer. States Water	$477	R	$2,699	0.65	A+	5.2%
Amer. Water Works	$3,756	R	$25,696	0.85	A	7.3%
California Water	$782	R	$2,143	0.65	A+	15.1%
Middlesex Water	$140	R	$1,089	0.75	A	3.8%
SJW Group	$555	R	$1,724	0.85	A-	14.6%
York Water Co. (The)	$53	R	$557	0.80	A-	5.3%
Average	$960		$5,651	0.76	A	8.6%

Sources and Notes:
[1]: Bloomberg as of November 30, 2020.
[2]: Key R - Regulated (80% or more of assets regulated).
MR - Mostly Regulated (less than 80% of assets regulated).
[3]: See Schedule No. BV-3 Panels A through I.
[4]: See Schedule No. BV-10
[5]: Bloomberg as of November 30, 2020.
[6]: See Schedule No. BV-5.

Q44. How do the proxy companies compare to DTE Gas in terms of financial metrics?

A44. DTE Gas regulated operations expects to generate income of $202-212 million in 2021 according to DTE's presentation at the EEI Financial Conference.[78] Compared to the annual revenues of the proxy companies, DTE Gas is smaller than all but two of the water utilities. DTE Energy's unsecured credit rating at BBB is towards the lower end of the comparable companies while DTE Gas' A rating is a secured bond rating and hence not fully comparable rating. Lastly, as noted above, DTE Gas is a regulated distribution company as is all the proxy companies.

Q45. What regulatory capital structure did you use for DTE Gas?

A45. As recommended by DTE Gas, I use a capital structure including 51.9 percent equity in my recommendation.

Q46. How does that capital structure compare to those of the comparable companies or industry?

A46. The average allowed equity percentage for natural gas LDC having a rate case decided in the first three quarters of 2020 was over 52 percent,.[79] Consequently, DTE Gas' requested capital structure is in line with what has been approved for other natural gas LDCs, but has a lower equity percentage than that relied upon in the estimation process (for CAPM and DCF based methods).[80]

B. THE CAPM BASED COST OF EQUITY ESTIMATES

Q47. Please briefly explain the CAPM.

A47. CAPM assumes 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

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[78] DTE, "EEI Financial Conference," November 9-10, 2020 p. 40.

[79] Direct Testimony of Edward J. Solomon..

[80] See Schedule D5.4.

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 2 in Section III), in which the required expected return on an asset (above the risk-free return) is proportional to that asset's relative risk as measured by that asset's beta.

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 (as measured by beta) multiplied by the market risk premium. Mathematically, the relationship is given by the following equation:

$$\boldsymbol{r_s = r_f + \beta_s \times MRP} \quad (1)$$

- $\boldsymbol{r_S}$ is the cost of capital for 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 a "risk-positioning model," which operates on the principle (corroborated by empirical data) that investors price risky securities to offer a higher expected rate of return than safe securities. It says that an investment, whose returns do not vary relative to market returns, should receive the risk-free interest rate (that is the return on a zero-risk security, the y-axis intercept in Figure 2), whereas investments of the same risk as the overall market (*i.e.*, those that by definition have average systematic market risk) are priced so as to expect to return the risk-free rate plus the MRP. Further, it says that the risk premium of a security over the risk-free rate equals the product of the beta of that security and the MRP.

1. Inputs to the CAPM

Q48. What inputs does your implementation of the CAPM require?

A48. As demonstrated by equation (1), estimating the cost of equity for a given company requires a measure of the risk-free rate of interest and the MRP as well as a measure of the stock's beta. There are several choices and sources of data that inform the selection of these inputs. I discuss these issues below. (Additional technical detail, along with a discussion of the finance theory underlying the CAPM is provided in Appendix B.)

Q49. What value did you use for the risk-free rate of interest?

A49. I use the yield on a 20-year U.S. Treasury bond as the risk-free asset for purposes of my analysis. I rely on a forecast of what Treasury bond yields will be in 2022-23 and use the average of the forecasts for these two years. Specifically, *Blue Chip Economic Indicators* projects that the yield on a ten-year Government Bond will be 1.4 percent by 2022 and 1.70 percent by 2023 for an average of 1.55 percent.[81] I adjust this value upward by 50 basis points ("bps"), which is my estimate of the representative historical maturity premium for the 20-year over the ten-year Government Bond. This produces a base risk-free rate of 2.05 percent for 2022.

I consider this a conservative estimate as the spread between the yield on A-rated (BBB-rated) utility bonds and the 20-year Treasury bond is elevated by about 28 (and 36) basis points relative to the spread's long-run average as shown in Appendix B, Figure B-1. Thus, an adjustment for yield spread might be warranted. I conservatively add 25 basis points to one of my scenarios for this reason.

Alternatively, the increase in yield spread can be viewed as an increase in the return investors require to hold assets that are not risk-free; i.e., an increase in the MRP. I consider this possibility in a second scenario, where I rely on a forecasted MRP and the base risk-free rate of 2.05 percent. Consequently, I implement two scenarios for the CAPM / ECAPM. In Scenario I, the forecasted risk-free rate including a 25 bps yield spread adjustment is combined with the historical average MRP. In scenario II, I rely on the base risk-free rate and combine that with the forecasted MRP.

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[81] Blue Chip Economic Indicators, October 2020. Blue Chip does not provide estimates for 2022 or further out years in its November or December issue, but I note that Blue Chip increased its 2021 forecast for the 10-year yield from 0.9% in the October issue to 1.1% in its December issue.

Q50. What value did you use for the MRP?

A50. Like the cost of capital itself, the MRP 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. Rather, it 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 government bonds a long historical period.[82] The average market risk premium from 1926 to the present (March 2020) is 7.15 percent.[83] I use this value of the MRP along with a risk-free rate of 2.30 percent in one of my CAPM scenarios.

I also use a forward-looking MRP of 7.35 percent, which is Bloomberg's November30 forecasted MRP. I use that MRP in combination with the base risk-free rate of 2.05 percent. I note that this is a conservative estimate as the FERC-relied upon methodology to determine the MRP currently results in an MRP of 9.12% as shown in Schedule D5.17.

Of note, the increase in yield spread can be used to provide a quantitative benchmark for the implied increase in MRP based on a paper by Edwin J. Elton, et al., which documents that the yield spread on corporate bonds is normally a combination of a default premium, a tax premium, and a systematic risk premium.[84] Of these components, it is the systematic risk premium that likely explains the vast majority of the yield spread increase. In other words, unless the risk-free rate is underestimated as described above, the market equity risk premium has increased relative to its "normal" level.[85] For example, assuming a beta

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[82] The longest period for which Duff & Phelps reports data is 1926 to current. Based on financial textbooks such as Ross, Westerfield and Jaffe, "*Corporate Finance*," 10'th Edition, 2013, pp. 324-327, I use the longest period for which reliable estimates are available – in this case 1926 to 2018.

[83] Duff & Phelps, *Ibbotson SBBI 2020 Valuation Yearbook* 10-21.

[84] "Explaining the Rate Spread on Corporate Bonds," Edwin J. Elton, Martin J. Gruber, Deepak Agarwal, and Christopher Mann, *The Journal of Finance*, February 2001, pp. 247-277.

[85] In theory, some of the increase in yield spread for A rated debt may be due to an increase in default risk, but the increase in default risk for A rated debt is very small because utilities with A range rated debt have a low default risk – even following the COVID-19 impact on credit risk. This means that the vast majority—if not all—of the increase in A rated yield spreads is due to a combination of the increased systematic risk premium and the downward pressure on the yields of government debt. Although there

of 0.25 for A rated debt[86] means that an increase in the MRP of one percentage point translates into a ¼ percentage point increase in the risk premium on A rated debt (i.e., 0.25 (beta) times 1 percentage point (increase in MRP) = ¼ percentage point increase in yield spread). Thus, a 25 bps increase in the yield spread is therefore consistent with a 0.8 percentage point increase in the MRP ($\frac{0.25\%}{0.25} = 1.0\%$). Thus, there is evidence that the current MRP is higher than the historical MRP of 7.15 percent.

The fact that recent forward-looking estimates of the MRP exceeded the historical average level is consistent with the broader body of evidence that risk premiums have remained elevated relative to their pre-financial crisis levels. (See Section IV above.)

Therefore, I believe the 7.15 percent long-term historical average MRP value I rely on is a low-end estimate of what the market risk premium will be during the period at issue in this proceeding. I similarly believe that the 7.35 percent I rely on for my Scenario 2 is also conservative as the FERC approach would result in a substantially higher MRP.

Q51. Please summarize the parameters of the scenarios and variations you considered in your CAPM and ECAPM analyses.

A51. As discussed above, I consider two scenarios; in each case, the risk-free interest rate represents Blue Chip Economic Indicators projection for the ten-year Treasury Yield to prevail in 2022, adjusted to a 20-year maturity. However, I consider that the elevated spread between the yield on A rated utility bonds and 20-year Treasury bonds could either be reflected predominantly in the risk-free rate (Scenario 1) on in the MRP (Scenario 1). The MRP is the long-term historical arithmetic average of annual realized premiums of

is no increase in the tax premium discussed in the Elton et al. paper due to coupon payments, there may be some increase due to a small tax effect resulting from the probability of increased capital gains taxes when the debt matures.

[86] Elton, *et al*. estimates the average beta on BBB-rated corporate debt as 0.26 over the period of their study, and A-rated debt will have a slightly lower beta than BBB-rated debt. I note that 0.25 is a conservatively high estimate of the beta on A-rated utility debt. Most academic estimates, including those presented in *Berk & Demarzo* that I utilize for my Hamada adjustments are significantly lower: in the range of 0.0 – 0.1 percent. Using the lower debt betas would result in a substantially higher MRP estimate.

U.S. stock market returns over long-term (approximately 20-year maturity) Treasury bond income returns from 1926 to 2019 as reported by Duff and Phelps in Scenario 1. In Scenario 2, I look to the forecasted MRP from Bloomberg and validate the figure by increased yield spreads and also looking to the FERC MRP methodology consistent with Order 569-A was 9.12% as of November 30, 2020.[87]

Q52. What betas did you use for the companies in your proxy groups?

A52. I used *Value Line* betas, which are estimated using the most recent five years of weekly historical returns data.[88] The *Value Line* levered equity betas are reported in Figure 11 above. Importantly, natural gas LDCs' betas as reported by Value Line have increased substantially since DTE Gas' last rate case. For example, the average natural gas LDC beta (as measured by Value Line) was 0.66 in September 2019, whereas it today is 0.84. This indicate a large increase in the systematic risk of the natural gas LDC industry, which therefore has moved towards the overall market in terms of systematic risk. Consequently, the allowed return for natural gas LDCs need to approach that of the market when taking into account the higher leverage of DTE Gas.

Importantly, as explained in Section III.B above, these betas—which are measured (by *Value Line*) using the market stock return data of the proxy companies—reflect the level of financial risk inherent in the proxy companies' market value leverage ratios over the estimation period. Because DTE Gas regulatory capital structure includes a higher proportion of debt financing compared to some of the proxy companies, the financial risk associated with an equity investment in DTE Gas rate base is correspondingly greater than the financial risk borne by investors in the proxy companies' publicly traded stock.[89]

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[87] FERC Opinion No. 569-A, Docket No. EL14-12-004, EL15-45-013, May 21, 2021, FERC Order on Rehearing, see also Schedule D5.17.

[88] See Value Line Glossary, accessible at http://www.valueline.com/Glossary/Glossary.aspx

[89] A further detailed discussion is contained in Appendix B, Section III.

Consequently, standard textbook techniques are applied to unlever the *Value Line* betas reported in Figure 11 above and relever the resulting asset betas at DTE Gas' regulatory capital structure. See Schedules D5.14 and D5.15.[90]

2. The Empirical CAPM

Q53. What other equity risk premium model do you use?

A53. Empirical research has long shown that the CAPM tends to overstate the actual sensitivity of the cost of capital to beta: low-beta stocks tend to have higher risk premiums than predicted by the CAPM and high-beta stocks tend to have lower risk premiums than predicted.[91] 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 by using beta to measure relative risk by making a direct empirical adjustment to the CAPM.

The second variation on the CAPM that I employ makes use of these empirical findings. It estimates the cost of capital with the equation,

$$\boldsymbol{r_S = r_f + \alpha + \beta_S \times (MRP - \alpha)} \qquad (2)$$

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 (2) above).

I label this model the Empirical Capital Asset Pricing Model, or "ECAPM." The alpha adjustment has the effect of increasing the intercept, but reducing the slope of the Security Market Line in Figure 2, which results in a Security Market Line that more

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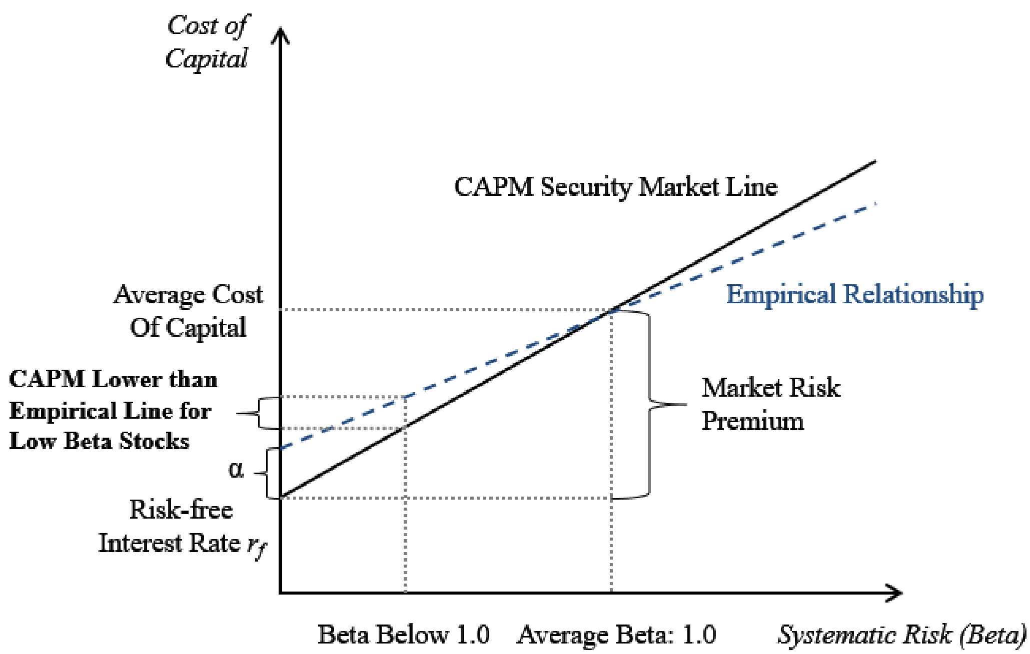
90 The Technical Appendix (Appendix B) to this testimony provides a detailed description of the standard textbook formulas used to implement the "Hamada" technique for unlevering measured equity betas based on the proxy companies' capital structures to calculate "asset betas" that measure the proxy companies' business risk independent of the financial risk impact of differing capital structures. The proxy group average asset betas are then relevered at the target capital structure (i.e., DTE Gas' regulatory capital structure), with the precise relevered beta depending on the specific version of the unlevering/relevering formula employed.

91 *See* Figure B-2 in Appendix B for references to relevant academic articles.

closely matches the results of empirical tests. This adjustment is portrayed in Figure 13 below. In other words, the ECAPM produces more accurate predictions of eventual realized risk premiums than does the CAPM.

Figure 13
The Empirical Security Market Line



Q54. Why do you use the ECAPM?

A54. Academic research finds that the CAPM has not generally performed well as an empirical model. One of its short-comings is directly addressed by the ECAPM, which recognizes the consistent empirical observation that the CAPM underestimates the cost of capital for low beta stocks. In other words, the ECAPM is based on recognizing that the actual observed risk-return line is flatter and has a higher intercept than that predicted by the CAPM. The alpha parameter (α) in the ECAPM adjusts for this fact, which has been established by repeated empirical tests of the CAPM. In summary, these studies estimate alpha parameters that range between 1%[92] and 7.32%.[93] I apply an alpha parameter of 1.5% in my application of the ECAPM. Appendix B Section II.C provides further discussion of the empirical findings that have tested the CAPM and also provides documentation for the magnitude of the adjustment, α.

3. Results from the CAPM Based Models

Q55. Please summarize the results of the CAPM-based models.

A55. The results of CAPM and ECAPM estimation for the two proxy groups are presented in Figure 14 below. The ranges of results for each model (CAPM and ECAPM) reflect the application of different specific versions of the textbook formulas used to account for the impact of different financial leverage on financial risk.

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[92] Black, Fischer. Beta and Return. *The Journal of Portfolio Management* 20 (Fall): 8-18.

[93] Fama, Eugene F. and Kenneth R. French. 1992. The Cross-Section of Expected Stock Returns. *Journal of Finance* 47 (June): 427-465.

Figure 14
CAPM / ECAPM Summary at 51.9% Equity

Estimated Return on Equity	Scenario 1 [1]	Scenario 2 [2]
Full Sample		
Financial Risk Adjusted Method		
CAPM	9.8%	9.7%
ECAPM (α = 1.5%)	10.2%	10.1%
Hamada Adjustment Without Taxes		
CAPM	9.6%	9.5%
ECAPM (α = 1.5%)	9.5%	9.5%
Hamada Adjustment With Taxes		
CAPM	9.3%	9.2%
ECAPM (α = 1.5%)	9.3%	9.3%
Gas Sample		
Financial Risk Adjusted Method		
CAPM	9.9%	9.8%
ECAPM (α = 1.5%)	10.1%	10.0%
Hamada Adjustment Without Taxes		
CAPM	9.6%	9.6%
ECAPM (α = 1.5%)	9.6%	9.6%
Hamada Adjustment With Taxes		
CAPM	9.4%	9.4%
ECAPM (α = 1.5%)	9.4%	9.4%

Sources and Notes:
[1]: Long-Term Risk Free Rate of 2.30%, Long-Term Market Risk Premium of 7.15%.
[2]: Long-Term Risk Free Rate of 2.05%, Long-Term Market Risk Premium of 7.35%.

Q56. How do you interpret the results of your CAPM and ECAPM Analyses?

A56. Looking to Figure 14 above, the results range from about 9.0 percent to a bit over 10.0 percent.[94] As discussed above, the established academic evidence indicates that the traditional CAPM tends to understate the cost of equity for lower-than-average risk

[94] I round to the nearest 0.25% when determining ranges of reasonable results. Clearly, there are numbers below 9% and numbers above 10% in the table, but if rounding to the nearest .25%, all results are within that range.

companies such as those in Figure 11 above, so the ECAPM may be more applicable. I acknowledge that the Commission in U-18999 agreed "in general, with the ALJ's analysis"[95] and that the ALJ found that "DTE Gas' CAPM results were calculated using the ATWACC and ECAPM methods and neither the Commission, nor any other state regulatory commission, have adopted these methods."[96] For the record, the New York Public Service Commission consistently implement an ECAPM version as does the Mississippi Public Service Commission.[97] Thus, the method has certainly been adopted. Similarly, the Surface Transportation Board calculates a weighted average cost of capital using market value and uses that figure to assess the freight railroads' earnings.[98]

C. DCF Based Estimates

Q57. Can you describe the DCF model's approach to estimating the cost of equity?

A57. The DCF model attempts to estimate the cost of capital for a given company directly, rather than based on its risk relative to the market as the CAPM does. The DCF method assumes that the market price of a stock is equal to the present value of the dividends that its owners expect to receive. The method also assumes that this present value can be calculated by the standard formula for the present value of a cash flow—literally a stream of expected "cash flows" discounted at a risk-appropriate discount rate. When the cash flows are dividends, that discount rate is the cost of equity capital:

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

Where,

$\boldsymbol{P_0}$ is the current market price of the stock;

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95 Order in U-18999, p. 53.

96 Order in U-18999, p. 48.

97 See, for example, State of New York Public Service Commission, "Staff Finance Panel Testimony", Case Nos. 18-E-0067, 18-G-0068, May 2018, p. 134 and Mississippi Public Service Commission, "PERFORMANCE EVALUATION PLAN RATE SCHEDULE "PEP-5A" 2015.

98 See, for example, Surface Transportation Board, "Decision: Docket No. EP 558 (Sub-No. 23), Railroad Cost of Capital – 2019."

$\boldsymbol{D_t}$ is the dividend cash flow expected at the end of period $\boldsymbol{t}$;

$\boldsymbol{T}$ is the last period in which a dividend cash flow is to be received; and

$\boldsymbol{r}$ is the cost of equity capital.

Importantly, this formula implies that if the current market price and the pattern of expected dividends are known, it is possible to "solve for" the discount rate r that makes the equation true. In this sense, a DCF analysis can be used to estimate the cost of equity capital implied by the market price of a stock and market expectations for its future dividends.

Many DCF applications assume that the growth rate lasts into perpetuity, so the formula can be rearranged algebraically to directly estimate the cost of capital. Specifically, the implied DCF cost of equity can then be calculated using the well-known "DCF formula" for the cost of capital:

$$\boldsymbol{r = \frac{D_1}{P_0} + g = \frac{D_0}{P_0} \times (1 + g) + g} \quad (4)$$

where $\boldsymbol{D_0}$ is the current dividend, which investors expect to increase at rate $\boldsymbol{g}$ by the end of the next period, and over all subsequent periods into perpetuity.

Equation (4) says that if equation (3) holds, the cost of capital equals the expected dividend yield plus the (perpetual) expected future growth rate of dividends. I refer to this as the single-stage DCF model; it is also known as the Gordon Growth model, in honor of its originator, Professor Myron J Gordon.

Q58. Are there other versions of the DCF model?

A58. Yes. There are many alternative versions, notably (i) multi-stage models, (ii) models that use cash flow rather than dividends, or versions that combine aspects of (i) and (ii).[99]

99 The Surface Transportation Board uses a cash flow based model with three stages. See, for example, Surface Transportation Board Decision, "STB Ex Parte No. 664 (Sub-No. 1)," Decided January 23, 2009 and most recently re-affirmed in "STB Ex Parte No. 664 (Sub-No. 4)," issued June 23, 2020.

One such alternative expands the Gordon Growth model to three stages. In the multistage model, earnings and dividends can grow at different rates, but must grow at the same rate in the final, constant growth rate period. [100]

In my implementation of the multi-stage DCF, I assume that companies grow their dividend for five years at the forecasted company-specific rate of earnings growth, with that growth then tapering over the next five years toward the growth rate of the overall economy (*i.e*., the long-term GDP growth rate forecasted to be in effect ten years or more into the future). I note that the multi-stage DCF model likely understates the cost of equity as it is plausible the payout ratio changes and a company reaches steady-state growth. The model ignores that possibility.

1. DCF Inputs and Results

Q59. What growth rate information do you use?

A59. The first step in my DCF analysis (either constant growth or multi-stage formulations) is to examine a sample of investment analysts' forecasted earnings growth rates for companies in my proxy group. For the single-stage DCF and for the first stage of the multi-stage DCF, I use investment analyst forecasts of company-specific growth rates sourced from *Value Line* and Thomson Reuters *IBES*.

For the long-term growth rate for the final, constant-growth stage of the multistage DCF estimates, I use the long-term U.S. GDP growth forecast of 4.1 from Blue Chip Economic Indicators.[101] Thus, the long-run (or terminal) growth rate in the multi-stage model is nominal GDP growth.

Q60. What are the pros and cons of the input data?

A60. Both the Gordon Growth and single-stage DCF models require forecast growth rates that reflect investor expectations about the pattern of dividend growth for the companies over

100 See Appendix B, Section I for further discussion of the various versions of the DCF model, as well as the details of the specific versions I implement in this proceeding.

101 See Blue Chip Economic Indicators, October 2020, p. 14.

a sufficiently long horizon, but estimates are typically only available for three - five years. In the multi-stage version, I taper these growth rates toward a stable growth rate corresponding to a forecast of long-term GDP growth for all companies.

One issue with the data is that it includes solely dividend payments as cash distributions to shareholders, while some companies also use share repurchases to distribute cash to shareholders. To the extent that companies distribute cash to shareholders via share repurchases, a DCF model that uses dividends as the payment to shareholders will under-estimate the cost of equity capital.

Q61. Please summarize the DCF-based cost of equity estimates for the proxy groups.

A61. The results of the DCF based estimation for the proxy groups are displayed below in Figure 15.

Figure 15
DCF Model Results at 51.9% Equity

	Simple	Multi-stage
	[1]	[2]
Gas Sample	11.1%	8.6%
Full Sample	11.8%	8.4%

Q62. How do you interpret the results of your DCF analyses?

A62. The DCF models are estimated based on dividend yields that may be expected to increase as interest rates continue to rise in the coming months and years. It is also possible that the current growth forecasts are impacted by the financial impact of the COVID-19 pandemic, so that macro-economic forecasts may change as the pandemic moderates. Consequently, I believe that the multi-stage DCF underestimates the cost of equity at this point in time, so that emphasis should be put on the simple DCF (consistent with Staff's practice). I also note that because the results reported in Figure 15 above are relatively close to those obtained before considering financial risk – for example, the natural gas

LDC proxy group show an average DCF-based cost of equity of 10.7 percent prior to any consideration of financial risk.[102]

D. Risk Premium Model Estimates

Q63. Did you estimate the cost of equity that results from an analysis of risk premiums implied by allowed ROEs in past utility rate cases?

A63. Yes. In this type of analysis, sometimes called the "risk premium model," the cost of equity capital for utilities is estimated based on the historical relationship between allowed ROEs in utility rate cases and the risk-free rate of interest at the time the ROEs were granted. These estimates add a "risk premium" implied by this relationship to the relevant (prevailing or forecast) risk-free interest rate:

$$Cost\ of\ Equity = r_f + Risk\ Premium \quad (5)$$

Q64. What are the merits of this approach?

A64. First, it estimates the cost of equity from regulated entities as opposed to holding companies, so that the relied-upon figure is directly applicable to a rate base. Second, the allowed returns are readily observable to market participants, who will use this one data input in making investment decisions, so that the information is at the very least a good check on whether the return is comparable to that of other investments. Third, I analyze the spread between the allowed ROE at a given time and the then-prevailing interest rate to ensure that I properly consider the interest rate regime at the time the ROE was awarded. This implementation ensures that I can compare allowed ROE granted at different times and under different interest rate regimes.

[102] Schedule D5.7.

Q65. How did you use rate case data to estimate the risk premiums for your analysis?

A65. The rate case data from 1990 through November 2020 is derived from Regulatory Research Associates.[103] Using this data I compared (statistically) the average allowed rate of return on equity granted by U.S. state regulatory agencies in natural gas LDC cases to the average 20-year Treasury bond yield that prevailed in each quarter.[104] I calculated the allowed utility "risk premium" in each quarter as the difference between allowed returns and the Treasury bond yield, since this represents the compensation for risk allowed by regulators. Then I used the statistical technique of ordinary least squares ("OLS") regression to estimate the parameters of the linear equation:

$$Risk\ Premium = A_0 + A_1 \times (Treausury\ Bond\ Yield) \quad (6)$$

I derived my estimates of A_0 and A_1 using standard statistical methods (OLS regression) and found that the regression has a high degree of explanatory power in a statistical sense. I report my results for the respective classifications of rate cases below in Figure 16.[105] I note that the results displayed in Figure 16 below shows that the risk premium model fits the data well as the R-squared is above 80% for the more recent period of 2011 to today and above 70% for the full period. The R-squared is a measure of how well the data fits the model and these R-squared indicate solid results.

103 SNL Financial as of December 2020.

104 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.

105 Schedule D5.17 contains my risk premium analysis.

Figure 16
Implied Risk Premium Model Estimates

	R Squared	Estimate of Intercept (A0)	Estimate of Slope (A1)	Implied Cost of Equity Range	
	[1]	[2]	[3]	[4]	[5]
Q1 2011 - Q3 2020	0.883	9.41%	-0.900	9.6%	9.6%
Q1 1990 - Q4 2010	0.711	8.34%	-0.534	9.3%	9.4%

Sources and Notes:
[1]-[3]: Estimated Using S&P Market Intelligence, as of 11/30/2020.
[4]: Risk-free rate of 2.05%
[5]: Risk-free rate of 2.30% (includes utility yield spread adjustment of 0.25%)

The negative slope coefficient reflects the empirical fact that regulators grant smaller risk premiums when risk-free interest rates (as measured by Treasury bond yields) are higher. This is consistent with past observations that the premium investors require to hold equity over government bonds increases as government bond yields decline. In the regression described above, the risk premium declined by less than the increase in Treasury bond yields. Therefore, the allowed ROE on average declined by less than 100 bps when the government bond yield declined by 100 bps. Because I was concerned that the market has changed since the substantial drop in risk-free rates, I statistically tested whether the results for the full period and the results for the more recent period could be considered the same from a statistical perspective – and they could not.[106] Hence, the relationship has changed, so that the slope today is steeper meaning that a change in the risk-free rate has less of an impact on ROE than previously. The more recent regression is correspondingly more reliable today.

Q66. Please summarize your results before considering where to place DTE Gas.

A66. The results are summarized in Figure 17 below.

[106] Technically, I undertook a ML test to determine whether and where a structural break may have happened and a standard Chow test to investigate whether the difference between the two regressions could be explained by the statistical variation in the data. The test rejected that so from a statistical perspective the period from 2011 onward is different from the prior period.

Figure 17
Summary of Ranges

	Gas Sample		Full Sample	
	Low	High	Low	High
CAPM	9.4%	9.9%	9.2%	9.8%
ECAPM	9.4%	10.1%	9.3%	10.2%
Multi-Stage DCF	8.6%		8.4%	
Single-Stage DCF		11.1%		11.8%
Risk Premium	9.4%	9.6%	na	na
Range	8.6 - 9.4%	9.6 - 11.1%	8.4- 9.3%	9.8 - 11.8%
Average, all methods	9.2%	10.2%	9.0%	10.6%

VI. DTE GAS SPECIFIC CIRCUMSTANCES AND ROE RECOMMENDATION

A. BUSINESS RISK CHARACTERISTICS

Q67. Are there any differences in the regulatory environment in which the comparable companies and DTE Gas operates?

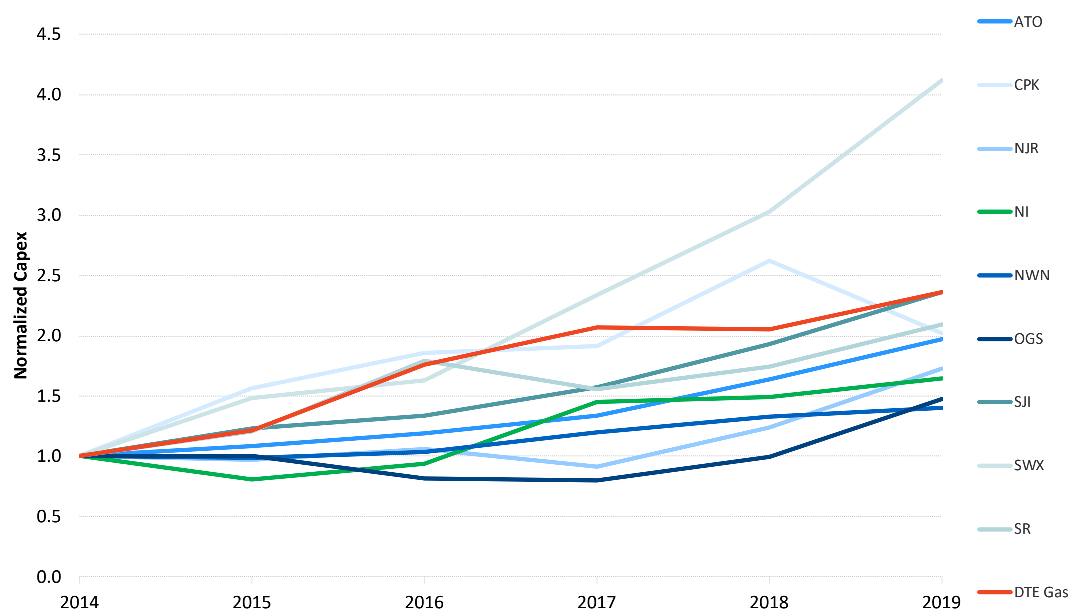
A67. Like many of the sample companies, DTE Gas benefits from certain regulatory policies that reduce regulatory lag, including a forward test year for rate cases, and an annual recovery mechanism for expenses such as fuel. DTE Gas also has a decoupling mechanism. However, many of these mechanisms are similar to those of the majority of the sample companies. For example, SNL reports that more than half of U.S. jurisdictions use decoupling mechanisms and all have a fuel recovery mechanism.[107]

Q68. Are there any specific area in which DTE Gas has higher risk than the sample?

A68. Yes, there are several. First, DTE Gas has higher capital expenditures than the average company in the Gas Sample as can be seen in the table below, which normalizes all natural gas LDCs capital expenditures to equal 1.0 in 2014. It is readily seen that DTE Gas have experienced higher capital expenditures than its peers.

[107] SNL, "RRA Regulatory Focus: Adjustment Clauses – A State-by-State Overview," November 12, 2019

Figure 18
Comparison of DTE Gas' and Gas Sample's Capital Expenditures



Source: DTE Gas and S&P Capital IQ.

As can be seen from the figure above, DTE Gas' capital expenditures has exceeded those of all sample gas utilities but Southwest Gas. Because a higher capital expenditure is associated with higher risk, DTE Gas is all else more risky. Higher capital expenditures also indicate a move towards becoming more capital intensive. Capital intensity is also associated with higher risks as capital cost are fixed costs that cannot be eliminated should economic conditions deteriorate. DTE Gas' high capital expenditure is also noted as a credit challenge Moody's Investor Service.[108]

Q69. Are there other measures of capital intensity?

A69. Yes. A common measure of capital intensity is the amount of revenue relative to fixed assets (property, plant, and equipment). The less revenue each dollar of fixed asset generates, the more capital intense is the company. A higher level of capital intensity

[108] Moody's Investor Service, "DTE Gas Company," July 23, 2020.

implies that a larger amount of fixed assets has to be supported by each dollar revenue, which results in less flexibility. Looking next to DTE Gas' capital intensity, I find that it is higher than the gas sample average meaning the amount of revenue per dollar invested in property, plant, and equipment ("PP&E") is lower than that of the proxy group.

Figure 19
Comparison of DTE Gas' and Gas Sample Capital Intensity

	2012	2013	2014	2015	2016	2017	2018	2019	Average
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	
Atmos Energy	0.47	0.52	0.57	0.37	0.24	0.25	0.24	0.19	0.36
Chesapeake Utilities	0.56	0.55	0.56	0.43	0.40	0.32	0.30	0.26	0.42
New Jersey Resources	1.20	1.58	1.52	0.87	0.66	0.74	0.89	0.55	1.00
NiSource Inc.	0.23	0.20	0.30	0.24	0.22	0.23	0.22	0.21	0.23
Northwest Natural	0.26	0.26	0.25	0.23	0.21	0.24	0.21	0.21	0.23
ONE Gas Inc.	0.32	0.37	0.38	0.30	0.26	0.27	0.27	0.26	0.30
South Jersey Inds.	0.36	0.32	0.34	0.32	0.32	0.37	0.37	0.33	0.34
Southwest Gas	0.36	0.34	0.35	0.38	0.36	0.35	0.35	0.35	0.36
Spire Inc.	0.67	0.51	0.44	0.41	0.33	0.33	0.33	0.28	0.41
Gas SampleAverage	0.49	0.52	0.52	0.40	0.33	0.34	0.35	0.29	0.41
DTE Gas	0.32	0.35	0.38	0.30	0.27	0.26	0.25	0.24	0.30

In each year, DTE Gas saw lower revenue per dollar PP&E and hence is more capital intensive. Looking to Schedule D5.18, DTE Gas' capital intensity in between that of the gas sample and water sample average.

Q70. What do you conclude from this analysis?

A70. Because DTE Gas is more capital intensive and has relatively higher capital expenditures, it has relatively less flexibility regarding the use of the revenue; (i.e.., they face a higher degree of risk from fluctuations in revenue and is all else equal more risky).

Q71. Are there other factors that may impact DTE Gas' relative risk?

A71. Yes. DTE Gas operates in the state of Michigan, where the Detroit area is predominant in its service territory. Michigan's economy is heavily dependent upon the auto industry, and Detroit's economy in relatively weaker than the Michigan economy. The City of Detroit ("City"), which was in bankruptcy until December 10, 2014, was recovering until the COVID-19 pandemic hit. Currently, the unemployment in the Detroit area is about 8.9 percent while that of the U.S is about 6.7%.[109]

Further, according to recent census data, Detroit is among the poorest cities in the country[110] and the City has experienced falling population year-over-year since 2005.

The weak local economic conditions and declining population and industrial activity in the Company's service territory contribute to and exacerbate the effect of declining sales, which—in conjunction with a rate structure that relies on volumetric charges to recover fixed costs—increases the downside risk that DTE Gas may not be able to earn its authorized return.

The risk of under-recovery of DTE Gas' fixed costs due to its reliance on volumetric charges to recover fixed costs is magnified by DTE Gas' relatively higher capital intensity and capital spending.

Q72. Are there other factors that impact DTE Gas' risk?

A72. Yes. As discussed in the direct testimony of Mr. Solomon, DTE Gas was downgraded by Moody's in July 2019 due to the high level of capital expenditure, the effect of the federal tax reform and pressure on its financial metrics. Combined with the higher than average capital spending and capital intensity, it is evidence that DTE Gas is riskier than the average natural gas sample company.

Q73. Can you please summarize your assessment of DTE Gas' business risk relative to the sample?

A73. Compared to the sample, DTE Gas is engaged in the same line of business, has a comparable credit rating and access to similar regulatory mechanisms. However, DTE

[109] www.bls.gov/regions/economic-summaries.htm, "Detroit Area Economic Summary," January, 2021 and https://www.bls.gov/news.release/pdf/empsit.pdf

[110] https://www.mlive.com/news/2019/09/flint-and-detroit-among-nations-top-5-poorest-cities-new-census-data-shows.html

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Gas has relatively higher capital intensity, higher capital expenditure in recent years and operates in a distressed locality. As a result, DTE Gas is riskier than the sample profile.

VII. COST OF CAPITAL RECOMMENDATION

Q74. Please summarize your conclusions regarding DTE Gas' risk and the necessary return.

A74. I find that DTE Gas to be of higher than average risk relative to the sample companies and merits placement in the upper end of the reasonable range that I summarized in Figure 17 above. I therefore recommend that DTE Gas be placed at the upper end of the reasonable range.

Q75. What do you recommend for DTE Gas' cost of equity in this proceeding?

A75. I find a range of about 9¼ to 10¼ percent for the gas sample and wider range of about 9 to 10½ percent for the full sample. As DTE Gas is of higher risk, the Company can reasonably be placed at the upper end of this range and I recommend 10.25 percent along with the 51.9% percent equity. This recommendation is at the upper end of the reasonable range I obtained from the DCF, CAPM and Risk Premium models, considering the natural Gas Sample and the full sample.111 Lastly, I note that if a lower than 51.9% equity is allowed DTE Gas, then its cost of equity is higher than the 10.25 percent I recommend at 51.9 percent equity.

Q76. Does this conclude your direct testimony?

A76. Yes, it does.

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[111] I emphasize the gas LDC sample as the Commission in the past has found that sample more compelling.

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 the review of regulatory practices regarding the return on equity, capital structure, recovery of costs and capital expenditures 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 serves 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, Michigan, New Mexico, New York, Oregon, and Washington as well as in the provinces of Alberta and Ontario.

- 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.

- 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.

- 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.

- She has estimated the cost of equity on behalf of Anchorage Municipal Light and Power, Arizona Public Service, Portland General Electric, Anchorage Water and Wastewater, American Water, California Water, and EPCOR in state regulatory proceedings. She has also submitted testimony before the 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 12 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.

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.

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

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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 Gas' 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:

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

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

$$P_0 = \frac{D_1}{r-g} \qquad (2)$$

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,

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

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 5-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:

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

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. For this reason I rely on the average of Blue Chip's forecast of 1.4% for the yield on a 10-year Treasury bond for 2022 and

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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).

1.7% for 2023.[7] This provides me with a forecasted 10-year Treasury bond yield of 1.55%. I adjust this value upward by 50 basis points, which is my estimate of the maturity premium for the 20-year over the 10-year Treasury Bond. This provides me with an estimate of the 20-year Treasury bond for 2022 of 2.05%.

Additionally, it is important to recognize the implications of the elevated level of spread between yields on U.S. utility bonds and U.S. Treasury bonds of the same horizon. As shown in Figure B-1 below, the current spread between utility bond yields and the 20-year U.S. Treasury bond yield is elevated by about 30 basis points.[8] One way to account for this observation is if the prevailing and near-term expected government bond yields are artificially depressed relative to longer-term market expectations. Therefore, I rely on risk-free rate (conservatively) 25 basis points higher at 2.30% when performing my CAPM-based analyses using the historical MRP. The reason I include only a portion of the elevation in yield spread is that as interest rates increase the yield spread may decline. Thus, I choose 25 basis points.

Figure B-1: Yield Spreads

Spreads between U.S. Utility Bond (20 year maturity) and U.S. Government Bond (20 year maturity) - bps			
Periods	A-Rated Utility and Treasury	BBB-Rated Utility and Treasury	Notes
Period 1 - Average Dec-1991 - 2007	94	124	[1]
Period 2 - Average Aug-2008 - Nov-2020	147	193	[2]
Period 3 - Average Nov-2020	115	150	[3]
Period 4 - Average 15-Day (Nov 06, 2020 to Nov 30, 2020)	122	160	[4]
Spread Increase between Period 2 and Period 1	54	69	[5] = [2] - [1]
Spread Increase between Period 3 and Period 1	21	26	[6] = [3] - [1]
Spread Increase between Period 4 and Period 1	28	36	[7] = [4] - [1]

Sources and Notes:
Spreads for the periods are calculated from Bloomberg's yield data.
Average monthly yields for the indices were retrieved from Bloomberg as of November 30, 2020.

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

[7] Blue Chip Economic Indicators, October 2020.

[8] This maturity premium is estimated by comparing the average excess yield on 20-year versus 10-year Treasury Bonds over the period January 1990 – November 2020, using data from Bloomberg.

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 use 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 the 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 7.15%.[9]

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 over the month leading up to my analysis was 7.35% This Bloomberg forward-looking MRP estimate is above the historical long-term average. I also calculated the forward-looking MRP using the methodology from the FERC Order 569-A and found a forward-looking MRP of 9.12% over my 2.05% forecasted risk-free rate.[10]

c. Yield Spreads and the Market Equity Risk Premium

As shown in Figure B-1 above the yield spreads for 20-year A rated utility debt over 20-year Treasury bonds is elevated relative to its historical norm by about 50 bps relative to its long-term average leading up to the 2008 financial crisis. This means that investors require a higher return on investment grade utility debt relative to the return on T-bonds than they did before the crisis and ensuing economic turmoil.

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9 Duff & Phelps, Cost of Capital Navigator, U.S. Cost of Capital Module 2020.

10 Schedule D5.19.

This information can be used to provide a quantitative benchmark for the implied increase in MRP based on a paper by Edwin J. Elton, et al., which documents that the yield spread on corporate bonds is normally a combination of a default premium, a tax premium, and a systematic risk premium.[11] Of these components, it is the systematic risk premium that likely explains the vast majority of the yield spread increase. In other words, unless the risk-free rate is underestimated as described above, the market equity risk premium has increased relative to its "normal" level.[12] For example, assuming a beta of 0.25 for A rated debt[13] means that an increase in the MRP of one percentage point translates into a ¼ percentage point increase in the risk premium on A rated debt (i.e., 0.25 (beta) times 1 percentage point (increase in MRP) = ¼ percentage point increase in yield spread). Thus, a 25 bps increase in the yield spread is therefore consistent with a 1.0 percentage point increase in the MRP ($\frac{0.25\%}{0.25} = 1.0\%$). Thus, there is evidence that the current MRP is elevated relative to the historical MRP of 7.15%. While the increase in yield spread as well as an implementation of the DCF model on the S&P 500 could justify an MRP of 8.35%,[14] I conservatively use the historical average of 7.15% and a forecasted MRP of 7.35%.

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.

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11 "Explaining the Rate Spread on Corporate Bonds," Edwin J. Elton, Martin J. Gruber, Deepak Agarwal, and Christopher Mann, *The Journal of Finance*, February 2001, pp. 247-277.

12 In theory, some of the increase in yield spread for A rated debt may be due to an increase in default risk, but the increase in default risk for A rated debt is undoubtedly very small because utilities with A range rated debt have a low default risk. This means that the vast majority—if not all—of the increase in A rated yield spreads is due to a combination of the increased systematic risk premium and the downward pressure on the yields of government debt. Although there is no increase in the tax premium discussed in the Elton et al. paper due to coupon payments, there may be some increase due to a small tax effect resulting from the probability of increased capital gains taxes when the debt matures.

13 Elton, *et al*. estimates the average beta on BBB-rated corporate debt as 0.26 over the period of their study, and A-rated debt will have a slightly lower beta than BBB-rated debt. I note that 0.25 is a conservatively high estimate of the beta on A-rated utility debt. Most academic estimates, including those presented in *Berk & Demarzo* that I utilize for my Hamada adjustments are significantly lower: in the range of 0.0 – 0.1 percent and would result in a substantially higher MRP estimate.

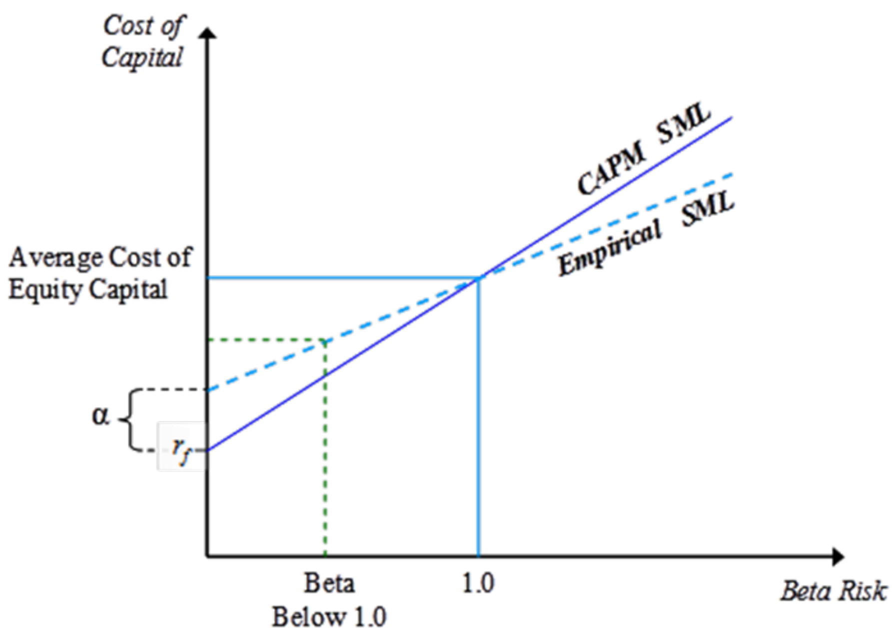
14 Using the yield spread as estimated, the increase in the MRP is 0.30% / 0.25% = 1.20%, while Schedule D5.19 shows a forecast of approximately 9 percent.

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

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

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

Figure B-2
The Empirical Security Market Line



2. Academic Evidence on the Alpha Term in the ECAPM

Figure B- 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-3

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.[15] 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.[16]

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-4 and Figure B-5 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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15 This is also a common valuation problem in general business contexts.

16 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-4: All Equity Capital Structure

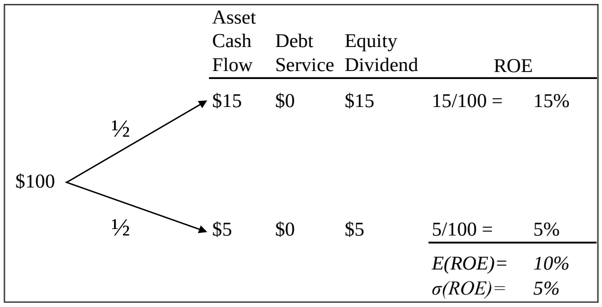
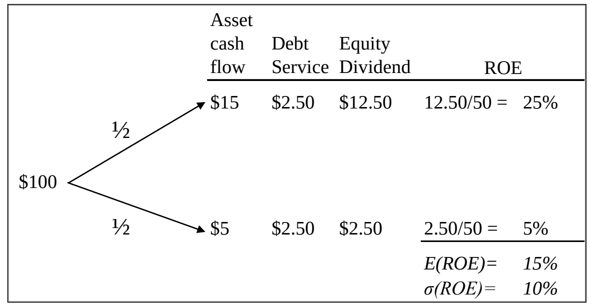


Figure B-5: 50/50 Capital Structure



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.[17] The expected return to the underlying asset is therefore equal to the value weighted

[17] 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), where P refers to the market value of preferred equity, 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.[18]

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

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.[19]

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.[20] 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

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[18] 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) represents 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.

[19] 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.

[20] 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.

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,[21] 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,[22] the latter can still be shown to be constant across a broad range of capital structures.[23]

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.[24]

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

22 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.

23 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.

24 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:[25]

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

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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25 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:

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

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.[26]

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

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

Hamada adjustment procedures—so-named for Professor Robert S. Hamada who contributed to their development[27]—are ubiquitous among finance practitioners when using the CAPM to estimate discount rates.

27 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.