OCC EXHIBIT NO. _____

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Columbia Gas of Ohio, Inc. for Authority to Amend its Filed Tariffs to Increase the Rates and Charges for Gas Services and Related Matters.	)))))	Case No. 21-637-GA-AIR
In the Matter of the Application of Columbia Gas of Ohio, Inc. for Approval of an Alternative Form of Regulation.	)))	Case No. 21-638-GA-ALT
In the Matter of the Application of Columbia Gas of Ohio, Inc. for Approval of a Demand Side Management Program for its Residential and Commercial Customers.	)))))	Case No. 21-639-GA-UNC
In the Matter of the Application of Columbia Gas of Ohio, Inc. for Approval to Change Accounting Methods.	)))	Case No. 21-640-GA-AAM

DIRECT TESTIMONY
OF
ZHEN ZHU, Ph.D.

On Behalf of
Office of the Ohio Consumers' Counsel
And
Northeast Ohio Public Energy Council
65 East State Street, Suite 700
Columbus, Ohio 43215

May 13, 2022

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Mr. Zhu Sponsors the Following Exhibits:

I. INTRODUCTION

Q1. PLEASE STATE YOUR NAME, POSITION, AND BUSINESS ADDRESS.

A1. My name is Zhen Zhu. I am a Managing Consultant. My business address is 5555 North Grand Blvd., Oklahoma City, Oklahoma 73112.

Q2. BY WHOM ARE YOU EMPLOYED?

A2. I am employed by C. H. Guernsey & Company. I am also the Dr. Michael Metzger Chair Professor of Economics at the University of Central Oklahoma.

Q3. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A3. I have a B.A. in Business Administration from Renmin University in China, an M.A. in Economics from Bowling Green State University, and a Ph.D. in Economics from the University of Michigan.

Q4. PLEASE DESCRIBE YOUR PROFESSIONAL BACKGROUND.

A4. From 2000 to present, I have been an Economist, Consultant, Senior Consultant and Managing Consultant with C.H. Guernsey & Company. From 1994 to 2000, I was an Assistant Professor of Economics at the University of Oklahoma. From 2000 to present, I have been an Assistant Professor, Associate Professor, Department Chairperson, and the Dr. Michael Metzger Chair Professor of Economics at the University of Central Oklahoma. I have performed many

academic and applied studies of the energy market and of regulatory policy, along with studies of international financial markets and commodity markets. Please refer to Exhibit ZZ-1 for a list of my more recent publications and studies.

Q5. WHAT IS YOUR EXPERIENCE REGARDING UTILITY REGULATION?

A5. As a consultant, I have performed a variety of research studies and provided direct testimony, support, and engagement in many projects related to gas and electric utility regulatory matters. I have provided analysis and testimony in gas and electric utility cost of capital cases. I have also provided testimonies on issues related to Integrated Resource Planning, natural gas prices, and load forecasts before several regulatory agencies.

Q6. BEFORE WHAT REGULATORY COMMISSIONS HAVE YOU TESTIFIED AS AN EXPERT WITNESS?

A6. I have testified before the Michigan Public Service Commission, Georgia Public Service Commission, Oklahoma Corporation Commission, South Carolina Public Service Commission and Vermont Public Utility Commission.

Q7. HAVE YOU TESTIFIED BEFORE THE PUBLIC UTILITIES COMMISSION OF OHIO ("PUCO")?

A7. No, I have not.

Q8. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A8. I am testifying on behalf of the Office of the Ohio Consumers' Counsel ("OCC") and the Northeast Ohio Public Energy Council ("NOPEC").

Q9. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A9. I was asked by OCC and NOPEC to provide a recommendation regarding a just and reasonable rate of return (or cost of capital) for Columbia Gas of Ohio ("Columbia" or "Columbia Gas") in this proceeding. My focus will be on setting a reasonable cost of equity or return on equity ("ROE") for Columbia. In addition, I will provide an independent evaluation of the PUCO Staff's recommendations regarding the cost of capital issues included in the Staff Report.[1] I will explain and support OCC/NOPEC Objections 17-22. Additionally, I will assess the ROE determination supported by Mr. Paul Moul in his direct testimony on behalf of Columbia.[2]

[1] *In the Matter of the Application of Columbia Gas of Ohio, Inc. for Authority to Amend its filed Tariffs to Increase the rates and Charges for Gas Services and Related Matters,* Case No. 21-637-GA-AIR et al., (Application), Staff Report (April 6, 2022), (Staff Report).

[2] Prefiled Direct Testimony of Paul Moul (July 14, 2021).

II. SUMMARY AND RECOMMENDATIONS

Q10. WHAT IS YOUR UNDERSTANDING OF THE RATE OF RETURN ISSUE IN THIS PROCEEDING?

A10. Columbia Gas of Ohio ("Columbia" or "Utility") is a local distribution gas utility in the State of Ohio that is subject to the regulatory and rate setting authority of the PUCO. Columbia serves more than 1.4 million consumers in 60 of 88 counties in Ohio. Columbia is a subsidiary of NiSource Inc. Columbia filed an application to increase its rates and for approval of an alternative rate plan, as well as to change accounting methods on June 30, 2021.

My analysis of a just and reasonable ROE for Columbia, based on sound economic and regulatory principles, indicate that Columbia's required ROE or cost of equity should be no higher than 8.65%.

Columbia has an embedded cost of debt of 4.49%[3], which I accept. Columbia also requested a capital structure of 50.60% equity and 49.40% debt based on the actual equity-debt structure, which I do not oppose. Therefore, given the capital structure, cost of debts, and cost of equity, my recommended overall cost of capital is 6.59%. In my opinion, this is a just and reasonable rate of return for

[3] Columbia's cost of debt was 4.67% at the time of filing. The cost of debt has been lowered to 4.49% due to the refinancing of debt on 11/2021. *See* COH 20211 Rate Case - Schedule A-E actual update.xlsx SchD-2B.

Columbia under current market condition and Columbia's current business and financial risk.

This rate of return is lower than that proposed by Columbia (7.76%),[4] and also lower than the Staff proposed range of 6.88% to 7.39%.[5] Adopting this rate of return will protect Columbia's consumers from paying more than reasonable rates for gas distribution service.

Columbia provided a prefiled direct testimony by its cost of capital witness Mr. Paul Moul. Mr. Moul provided the analyses of return on equity (ROE) under the current market conditions and suggested that the Company should be afforded an opportunity to earn a ROE of 10.95% with the weighted average cost of 7.85%.[6]

The PUCO Staff ("Staff") also presented its analysis of Columbia's rate of return (cost of capital) and made recommendations concerning the cost of the capital issues. The Staff accepted the cost of debt and capital structure as requested by Columbia and recommended an ROE in a range of 9.04% to 10.05%, with an

[4] Columbia's originally proposed cost of capital was 7.85% at the time of the filing, before the refinancing of a debt in November 2021.

[5] The Staff Report of Investigation in the Cases No(s). 21-0637-GA-AIR, 21-0638-GA-ALT, 21-0639-GA-UNC, 21-0640-GAAAM, April 6, 2022, page 26.

[6] Prepared Direct Testimony of Paul Moul, page 1, lines 28-30. 7.78% was before the adjustment of the cost of debt to 4.49% by Columbia.

average ROE value of 9.54%. The Staff proposed a range of 6.88% to 7.39% for Columbia's rate of return.

Q11. PLEASE DESCRIBE THE ORGANIZATION OF YOUR TESTIMONY?

A11. First, I provide a summary of my analysis and recommendation regarding a just and reasonable rate of return for Columbia in this proceeding. Second, I describe the regulatory standard in setting the cost of capital and the general principles in estimating the cost of capital. Third, I examine the current state of the economy and capital markets because economic and capital market conditions set up the environment for firms (including regulated utilities) to operate, thus influencing the cost of capital.

Fourth, I present my analysis and recommendation of a just and reasonable rate of return for Columbia. I describe the capital structure and cost of debt of Columbia and provide evidence to support my recommendations regarding capital structure and cost of debt. Next, I detail the calculation of the cost of equity by using several generally accepted methodologies. Specifically, I calculate the Company's cost of equity by applying a two-step Constant Growth Discounted Cash Flow ("DCF") model and Capital Asset Pricing Model ("CAPM") to a group of proxy companies. I also provide a form of risk premium ("RP") analysis using the past authorized ROE and interest rate. After carrying out these calculations, I provide

my summary evaluations regarding the Company's cost of capital and comment on the 10.95% ROE as requested by the Company.

Fifth, I explain and support the OCC and NOPEC Objections to the rate of return recommendations included in the Staff Report. Finally, I discuss my assessment of the rate of return proposed by Columbia and the methodology and data used by its witness, Mr. Paul Moul to support Columbia's requested rate of return.

Q12. PLEASE SUMMARIZE YOUR METHODOLOGY IN ANALYZING A REASONABLE RATE OF RETURN FOR COLUMBIA.

A12. In making my recommendation of a reasonable rate of return for Columbia, I reviewed Columbia's financial conditions including the cost of debt and capital structure. I calculated the cost of equity for a group of comparable companies based on several different models. The models I used include a Constant Growth Discounted Cash Flow ("DCF") model. I used a two-step methodology that considers a long-term Earnings Per Share ("EPS") growth rate as represented by Gross Domestic Product ("GDP") growth rate.

In addition, I calculated the required cost of capital based on the Capital Asset Pricing Model ("CAPM") model. In applying the CAPM model, I used a measure of market risk premium obtained by applying a two-step forward-looking DCF model to companies in the S&P 500 market index to generate an expected market

return, and then subtracting interest rate from the expected market return. Then I obtained the ROE by adding a long-term interest rate to the adjusted risk premium which is the product of beta and market risk premium. Finally, I used a form of bond yield plus market risk premium model to calculate another measurement of ROE to support my cost of capital recommendation.

Q13. PLEASE DESCRIBE THE STAFF REPORT'S COST OF EQUITY ANALYSIS.

A13. The Staff used only two models: a non-constant DCF model and a CAPM model. While I am in a general agreement with the Staff's methodology, some specific aspects of the model assumptions and data used in the Staff's applications are questionable and invalid, which will lead to upward biased ROE estimates and increase the financial burden of Columbia's consumers without any justification.

Q14. PLEASE DESCRIBE THE METHODOLOGIES AND RESULTS OF COLUMBIA'S COST OF EQUITY ANALYSIS.

A14. Columbia's witness, Mr. Paul Moul, employed several models including a constant DCF models, CAPM models with historical and forward-looking market RPs, a RP model based on the historical relationship between RP (as measured by the difference between large company stock returns and corporate bond yield) and the interest rate, and a comparable earnings (CE) model to support his cost of equity recommendation.

Mr. Moul made many questionable and unreasonable assumptions about various models and applied questionable adjustments to the ROE models and estimates including the Hamada beta adjustment, leverage adjustment and flotation costs. I will point out the major differences in his and my methodologies and provide arguments why many of Mr. Moul's assumptions are invalid and erroneous thus leading to upward-biased ROE estimates.

Q15. PLEASE SUMMARIZE YOUR RATE OF RETURN AND COST OF EQUITY RECOMMENDATIONS.

A15. Table 1 below shows that the range of cost of equity (or ROE) generated from my three models (DCF, CAPM and RP) is from 8.36% to 9.08% (based on average), with an average mean value of 8.63%, an average median of 8.59%, and an average midpoint of 8.69% from three models. In my opinion, under the current market condition, an ROE of 8.65% is just and reasonable and I recommend the PUCO adopt the 8.65% ROE for Columbia.

Table 1: Summary of ROE

Model	DCF	CAPM	Average of DCF and CAPM	RP	Average of DCF, CAPM
Lower End	6.57%	7.87%	7.22%		
Upper End	9.72%	9.80%	9.76%		
Median	8.60%	8.09%	8.34%	9.08%	**8.59%**
Average	8.36%	8.45%	8.41%	9.08%	**8.63%**
Midpoint	8.14%	8.83%	8.49%	9.08%	**8.69%**

Columbia has an embedded cost of debt of 4.49%, which I accept. Columbia also requested a capital structure of 50.60% equity and 49.40% debt based on the actual equity-debt structure. Based on my analysis of capital structure of comparable companies, I recommend accepting Columbia's proposed capital structure. Therefore, given the capital structure, cost of debts, and cost of equity, my recommended overall cost of capital is 6.59%. Table 2 below shows the summary of recommended overall cost of capital.

Table 2: Overall Cost of Capital

	Ratio	Cost	Weighted Average Cost of Capital
Debt	49.40%	4.49%	2.22%
Equity	50.60%	8.65%	4.38%
Total	100%		6.59%

Q16. ARE YOU SPONSORING ANY EXHIBITS?

A16. Yes, I am sponsoring the following exhibits:

Exhibit ZZ-1: Dr. Zhen Zhu's resume

Exhibit ZZ-2: Long-term and short-term interest rates

Exhibit ZZ-3: Capital structure

Exhibit ZZ-4: IBES earnings growth estimate

Exhibit ZZ-5: Nominal GDP growth

Exhibit ZZ-6: DCF model

Exhibit ZZ-7: Market risk premium

Exhibit ZZ-8: CAPM model

Exhibit ZZ-9: Risk premium model

Exhibit ZZ-10: Moul's Risk Premium and interest rate

Exhibit ZZ-11: The Hamada Beta adjustment and the cost of capital for the regulated utilities

Q17. DID YOU OR SOMEONE UNDER YOUR DIRECT SUPERVISION PREPARE THESE EXHIBITS?

A17. Yes.

III. REGULATORY STANDARD IN SETTING A JUST AND REASONABLE RATE OF RETURN

Q18. WHAT IS THE PURPOSE OF ESTABLISHING A RATE OF RETURN WHEN SETTING A UTILITY'S RATES?

A18. The purpose of a rate of return, also commonly called "cost of capital" or "opportunity cost of capital," is to compensate investors who have committed capital to finance the plant and equipment necessary for utility service to customers. Investors commit these funds in anticipation of earning a return on their investment that is consistent with that of other investment alternatives with comparable risks.

This regulatory standard is well-recognized and was addressed by the U.S. Supreme Court in the cases of *Bluefield Water Works & Improvement Co.* (1923) and *Hope Natural Gas Co.* (1944). It provides the utility an opportunity to earn a rate of return sufficient to: (1) fairly compensate capital currently invested in the utility; (2) enable the utility to attract new capital on reasonable terms; and (3) maintain the utility's financial integrity.

Q19. DOES THE REGULATORY STANDARD INCLUDE GUIDELINES ON SETTING A COMPANY'S RATES?

A19. Yes. Utilities are a natural monopoly. If left unregulated, companies in the utility industry have every incentive to charge consumers prices that maximize the company's profit. The amount of product that a utility would provide to the consumers would be at a level that is lower than socially optimum, and the price will be higher than the price level of a perfectly competitive industry. Thus, utility firms are typically regulated by jurisdictional authorities.

The jurisdictional authorities set rules to make sure that consumers will be able to obtain services at reasonable rates and consumers will not be charged too high a price. In the meantime, utilities would still earn a fair return for their investors, and they can make investments for the long-term benefit of the consumers. Standards have been set from these guidelines:

1. The most important factor in determining the required rate of return of cost of equity ("ROE") of a utility is risk. Utilities face smaller degrees of risk compared to most other businesses; a utility's return, therefore, should be lower than other riskier businesses.
2. Utilities should earn returns comparable to other businesses with similar degrees of risk in order to maintain their financial soundness, including maintaining their credit standing, and attracting capital for investment.

These guidelines ensure that utility consumers receive adequate and reliable utility service at a reasonable price and companies make reasonable returns on their investment. In any setting, investors should receive the minimum, not excessive, level of required return as consumers' welfare needs to be considered as well.

Q20. IS YOUR RECOMMENDATION OF THE REQUIRED RATE OF RETURN BASED ON THESE REGULATORY STANDARDS?

A20. Yes, my estimation of the required rate of return and ROE is based on these standards. I recommend the PUCO authorize a rate of return and ROE based on the required market return so a regulated utility can maintain its financial

integrity. In the meantime, utility consumers can obtain the service at a reasonable cost.

Q21. WHAT ANALYTICAL METHODOLOGY DO YOU EMPLOY IN THIS CASE TO ANALYZE COLUMBIA GAS' COST OF CAPITAL?

A21. Columbia Gas is not an independent, publicly traded company. It is a subsidiary of NiSource, Inc. which means that Columbia Gas' financial condition is not regularly reported and reflected in the financial markets. However, the standard cost of capital analysis still applies – potential investors will consider the expected financial returns on an investment in comparison to the market returns on other available alternatives.

Columbia operates in the general economic and industry environment in the U.S.; thus its financial performances are also related to the overall economic and industry performances. For this reason, my analysis was broad in scope. I studied the underlying economic environment, Federal Reserve policy, the investors' likely expectation of future returns, and the utility industry's expected returns in the current market.

Q22. HOW DID YOU TAKE MARKET RISKS INTO ACCOUNT WHEN PERFORMING THE COST OF CAPITAL ANALYSIS FOR COLUMBIA GAS?

A22. I utilized standard DCF, CAPM, and RP methodologies to evaluate the risks and returns of a group of comparable companies. In particular, the CAPM model and the RP model take the market risk explicitly into consideration. Financial theory suggests that investors are compensated for bearing systematic market risks, but not individual company risks. Even though it can be argued that Columbia Gas may face some unique risks, as every company does, it is the systematic market risk (such as risks associated with market-wide environmental policies, regulations, general capital market, economic conditions, etc.) Columbia faces that should be taken into consideration.

This risk-reward principle is the basis for the analysis of required cost of capital for the company, as in other industries. In addition, the RP methodology recognizes an empirical relationship between interest rate and a RP based on the utilities' authorized ROE and market interest rate. I will go over the detailed methodologies in later sections.

Q23. DO YOU BELIEVE ANY OF THE MODELS YOU USED ARE BETTER THAN THE OTHERS?

A23. Economic models are theories describing the real world. The models have their underlying assumptions and focus more on specific aspects of the markets than others. As market conditions are complicated, it is difficult for any single economic/financial model to capture all aspects of the expected returns of the investors. In this sense, a combination of models gives a better measurement of the expected returns of the investors.

The recent Federal Energy Regulatory Commission ("FERC") Opinion No. 569-A clearly recognizes this need to incorporate more than one model to determine the expected ROE: "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."[7] I agree with this FERC's policy statement regarding the setting of a just and reasonable cost of equity.

Q24. DID YOU SELECT A PROXY GROUP FOR THE ESTIMATION OF THE COMPANY'S RETURN ON EQUITY?

A24. Yes, Columbia is a subsidiary of NiSource and it is not publicly traded. A conventional approach for companies like Columbia is to select a proxy group of comparable companies, which would enable a reliable analysis for companies of

[7] FERC Opinion N0. 569-A Order on Rehearing (Issued May 21, 2020), par 43.

comparable risk. Therefore, I have selected a group of gas utility companies that are similar to the target company, Columbia, that are engaged in gas distribution business.

Q25. WHAT CRITERIA DID YOU RELY ON TO SELECT THE GROUP OF COMPARABLE COMPANIES WHEN YOU PERFORMED THE ANALYSIS OF THE COST OF CAPITAL FOR COLUMBIA GAS?

A25. I selected gas distribution utilities that are representative of the risk characteristics of Columbia Gas. I selected companies that are publicly traded and whose main business is gas distribution and selling to end-users. The starting list is comprised of the gas utility companies by *Value Line*. I avoided companies that were involved in merger and acquisition activities during the study period as the stocks of those companies might be evaluated by investors differently than under market conditions in the absence of the mergers and acquisitions. Analysts typically would exclude companies that had reduced or halted dividend payment and companies that have negative dividend growth projections for the DCF analysis; I used the same set of the companies for both the DCF and CAPM analysis.

Q26. WHY DID YOU USE VALUE LINE-LISTED COMPANIES AS A STARTING POINT FOR THE SELECTION OF THE COMPARABLE COMPANIES?

A26. *Value Line* represents a respected, broadly available, and specialized source of financial information. In addition, *Value Line* provides an independent source of

information for the investment community because it does not have any financial interest in the companies it covers.

Q27. PLEASE LIST THE GROUP OF GAS DISTRIBUTION UTILITIES THAT YOU INCLUDED FOR THE PROXY GROUP.

A27. I selected 7 regulated gas utilities – *see* Table 3 below. For the convenience of comparison, I have also listed the proxy group by Mr. Moul. Mr. Moul included a total of 8 companies in the group. As I will show later, the difference in the selection of the proxy group company does not lead to significant differences in the ROE estimates. The difference in my ROE results and Mr. Moul's is mainly due to differences in other model methodologies and assumptions.

Table 3: Proxy Group

Zhu Sample	Moul Sample
Atmos Energy Corp	Atmos Energy Corp
New Jersey Resources	New Jersey Resources
NiSource	Chesapeake Utilities
N.W. Natural	N.W. Natural
One Gas Inc	One Gas Inc
South Jersey Industries	South Jersey Industries
Spire Inc	Spire Inc
	Southwest Gas

IV. THE ECONOMIC CONDITION AND COST OF CAPITAL

Q28. COULD YOU EXPLAIN HOW ECONOMIC CONDITIONS CAN AFFECT THE COST OF CAPITAL OF COLUMBIA GAS AT THE PRESENT TIME?

A28. The most relevant economic variables to the cost of capital are interest rate and expected inflation, as both are critical factors considered by investors to set their expected returns when making investment decisions. As in standard economic theory, what matters to investors is the real return. Both the interest rate and expected inflation influence the real return on investment directly.

In the current economic environment, both interest rate (especially the short-term interest rate) and expected inflation are influenced by Federal Reserve economic policies and its accompanying actions in the financial market to achieve its set objectives, even though economic variables can be influenced by monetary policy to different degrees.

Q29. WHAT ARE THE FEDERAL RESERVE'S OBJECTIVES AND ACTIONS IN AN ECONOMIC CYCLE?

A29. In the past, at the onset of and during the recession, the Federal Reserve provided mostly short-term credit to add liquidity to the market to counteract the effect of recession. In the early period of the recovery from the 2008-2009 recession, the Federal Reserve continued its accommodative monetary policy as the

unemployment level was still higher than the objective set by the Federal Reserve. For example, the Federal Reserve stated in its July 2013 Monetary Policy Report:[8]

> *With unemployment still well above normal levels and inflation below its longer-run objective, the Federal Open Market Committee ("FOMC") has continued its highly accommodative monetary policy this year by maintaining its forward guidance with regard to the target for the federal funds rate and continuing its program of large-scale asset purchases.*

The Federal Reserve's monetary easing has injected a large amount of liquidity to the financial market.

The Federal Reserve started to scale back its quantitative easing ("QE"), or accommodative monetary policy, due to improvement in labor market conditions in 2014. As the U.S. economy continued to cruise through expansion, the Federal Reserve has changed its policy stance from being accommodative to tightening. In 2019 however, the Federal Reserve cut interest rates three times to fend off possible slowdowns in the U.S. economy brought on by the trade wars between China and the United States.

Q30. WHAT ARE SOME OF THE MAJOR CONSEQUENCES OF THE FEDERAL RESERVE'S RECENT POLICIES SINCE 2019?

A30. The injection of a large amount of liquidity into the financial market since 2019 has caused short-term interest rates to fall to a historically low level as during the

[8] http://www.federalreserve.gov/monetarypolicy/mpr_20130717_part2.htm.

period between 2008 and 2015. In addition, the short-term interest rates are cyclical as they respond to the Federal Reserve's monetary policy manipulations, but the long-term interest rate is significantly less so.

I illustrate the changes in interest rates in Exhibit ZZ-2.

Exhibit ZZ-2 shows that the short-term interest rate, in this case the 3-month T-bill yield, fluctuated in response to business cycle and the monetary policy change. For example, at the onset of the last recession, when the Federal Reserve adopted quantitative ease, the short-term interest rate dropped precipitously to a level that was almost zero; however, the long-term interest rate, in this case the 30-year T-Bond yield, continued its downward trend. One can hardly see the cyclical behavior in the long-term interest rate as in the short-term interest rate. However, through all its movement, a downward trend in the long-term interest rate is clearly observable. Up until 2019, the Federal Reserve started to relax its QE policy, the short-term interest rate responded by going up from almost 0.0% to over 2% before declining again as the Federal Reserve started to cut interest rates to offset the impact of Covid-19 on the U.S. economy.

However, the long-term interest rate shows no obvious sign of responding to the Federal Reserve's monetary policy changes. As we can observe from Exhibit ZZ-2, the short-term interest rate dropped again to almost 0% in the beginning of

2021 while the long-term interest rate inched up and moved in the opposite direction of the short-term interest rate change.

Q31. WHAT IS THE CONSEQUENCE OF THE FEDERAL RESERVE MONETARY POLICY ON INFLATION RATE AND WHAT IS THE FEDERAL RESERVE'S POSITION ON INFLATION RATE?

A31. Another possible consequence of the Federal Reserve's monetary accommodation policy is inflation. If the monetary policy does not tighten in a timely fashion in response to economic expansion, then it creates an upward pressure on inflation; however, there is no evidence of expected inflation rate change, and the market expectation of inflation is quite stable during the recovery period of last recession. For example, the Federal Reserve September 20, 2017 Statement[9] reported:

> On a 12-month basis, overall inflation and the measure excluding food and energy prices have declined this year and are running below 2 percent. Market-based measures of inflation compensation remain low; survey-based measures of longer-term inflation expectations are little changed, on balance.

The Federal Reserve continued to pursue the same set of policies towards employment and inflation. In its November 5, 2020 Press Release, the Federal Reserve Board stated[10]:

> The Committee seeks to achieve maximum employment and inflation at the rate of 2 percent over the longer run. With inflation running persistently below this longer-run goal, the

[9] https://www.federalreserve.gov/newsevents/pressreleases/monetary20170920a.htm.

[10] https://www.federalreserve.gov/newsevents/pressreleases/monetary20201105a.htm.

> Committee will aim to achieve inflation moderately above 2 percent for some time so that inflation averages 2 percent over time and longer-term inflation expectations remain well anchored at 2 percent. The Committee expects to maintain an accommodative stance of monetary policy until these outcomes are achieved.

In its April 28, 2021 Statement[11], the Federal Reserve Board reiterated the same language exactly, signaling that the policy stance of the Federal Reserve will not change and the inflation target is maintained at exactly the same level. Despite the fact that inflation rate has increased significantly due to supply constraints and Russian invasion of Ukraine more recently, I believe the Federal Reserve will continue to focus on maintaining employment and price level stability.

Q32. HOW WILL THE CONSEQUENCES OF THE FEDERAL RESERVE'S POLICY CONCERN INVESTORS?

A32. Investors are concerned about their investment returns. The Federal Reserve increased the money supply to add liquidity to the financial market, but it will need to decrease the money supply in order to drain the liquidity and reduce inflation pressure. A reduction in the money supply will cause short-term interest rates to increase, as is the case for the period of late 2015 until late 2019. It is also shown in Exhibit OCC-2. However, investors focus on long-term interest rate as investments in the utility industry are long term.

[11] https://www.federalreserve.gov/newsevents/pressreleases/monetary20210428a.htm.

Q33. WHEN THE FEDERAL RESERVE TIGHTENS MONEY SUPPLY AND SHORT-TERM INTEREST RATE INCREASES, DO THE REQUIRED RETURNS FOR INVESTORS INCREASE?

A33. Not necessarily. There are two kinds of interest rates in the marketplace: short-term interest rates and long-term interest rates. In the case of determining required returns for investors, it is the long-term interest rates that matter. Investors in the utility industry face long-term investment decisions rather than short-term investment decisions. In this consideration, how the short-term interest rates fare is less relevant to them.

As the Federal Reserve tightens the money supply, interest rates generally will increase; however, the Federal Reserve policies that were used to counteract business cycles are generally considered short-term policies and they mainly influence short-term interest rates. As I discussed above, the short-term interest rates are very responsive to the Federal Reserve policy, while the long-term interest rates (such as 30-year T-Bond yield) are not responsive to the QE policy or tightening monetary policy. The opposite movements in the short-term interest rate and long-term interest rate since mid-2021 in Exhibit OCC-2 demonstrate just that. For this reason, it is not expected that the countercyclical monetary policy will have much effect on the long-term interest rates, and thus, the required return on capital.

It is critically important to note that the long-term interest rates have been declining, irrespective of the monetary policy during the business cycles. And, again, it is the long-term interest rates that matter to investors. Therefore, the current monetary policy, or the future monetary policy that targets short-term economic fluctuations, has little effect on the required return on equity. It is erroneous to argue that an interest rate increase leads to higher required cost of capital without distinguishing between short-term interest rates and long-term interest rates.

Q34. ARE THERE ANY REASONS FOR THE STEADY DECLINE IN THE LONG-TERM INTEREST RATES IN THE LAST 40 YEARS?

A34. Yes, many economic factors have contributed to the long-term decline of long-term interest rates. Professors and Economists Obstfeld and Tesar, in an article they wrote when they were serving on the Council of Economic Advisers under President Obama, have summarized these factors succinctly. They named the following factors whose effects on interest rates are likely to be transitory:

- Fiscal, monetary, and exchange rate policies;
- Inflation risk and the term premium; and
- Private-sector deleveraging.

They also named some factors that are likely longer-lived:

- Lower long-run growth in output and productivity;
- Shifting demographics;

- The global saving glut;
- Shortage of safe assets; and
- Tail risks and "unknown unknowns."

In conclusion, they suggest "there is no definitive answer to how long current long-term interest rates will persist and whether they will settle at levels below those previously expected. Most factors, however, suggest that long-term interest rates will be lower in the long run compared with their levels before the financial crisis."[12]

Q35. HOW HAS THE FEDERAL RESERVE RESPONDED TO COVID-19?

A35. Since its outbreak in Wuhan, China on December 31, 2019 and subsequent identification as the Covid-19 virus, commonly referred to as the Coronavirus, hundreds of millions of people worldwide have been infected and millions of people have died unfortunately. The economic impact of the virus has been staggering as well to say the least.

The impact of Covid-19 on the U.S. financial markets has been severe. Since all-time highs in February 2020, the Dow Jones Industrial Average, NASDAQ Composite, and S&P 500 Index have declined approximately 27%, 25%, and

[12] Maurice Obstfeld and Linda Tesar, "The decline in long-term interest rate," whitehouse.gov, 2015. https://obamawhitehouse.archives.gov/blog/2015/07/14/decline-long-term-interest-rates.

30%, respectively. As a result, the U.S. equity markets have lost $11.5 trillion in capitalization since peaking in February 2020. In April 2020, the U.S. unemployment rate reached 14.7%, followed by gradual declines in subsequent months (*see* Figure 1 below). As of March 2022, the unemployment rate has declined to roughly the pre-pandemic levels, however.

As a result of the Covid pandemic, the U.S. economy suffered significantly with steep GDP declines. The GDP declined in the second quarter of 2020 at an annual rate of 32.9% as restaurants and retailers closed their doors in a desperate effort to slow the spread of the virus. This decline was more than three times as sharp as the previous record — 10% in 1958 — and nearly four times more than the worst quarter during the Great Recession.

On March 15, 2020, and in response to the Covid-19 virus risk, the Federal Reserve Open Market Committee decided to lower the target range for the federal funds rate to 0% to 0.25%. The Committee expects to maintain this target range until it is confident that the economy has weathered recent events and is on track to achieve its maximum employment and price stability goals.

The supply chain problems caused the shortage of supplies in many sectors of the economy. Along with the quantitative ease, the U.S. inflation rate started to increase to a 40-year high. Annual inflation rate in the U.S. increased to 7.9% in February of 2022, the highest since January of 1982. As the market was expecting

the inflation to be peaking, Russian invasion of Ukraine pushed up energy prices to the highest level in several years. The geopolitical event, along with the continued supply constraint, strong demand and labor shortages are likely to continue to put upward pressure on general price level.

In faces of the higher inflation rate, the Federal Reserve has switched to monetary tightening with the first increase in short term rate target announced on March 16, 2022:

> The Committee seeks to achieve maximum employment and inflation at the rate of 2 percent over the longer run. With appropriate firming in the stance of monetary policy, the Committee expects inflation to return to its 2 percent objective and the labor market to remain strong. In support of these goals, the Committee decided to raise the target range for the federal funds rate to 1/4 to 1/2 percent and anticipates that ongoing increases in the target range will be appropriate. In addition, the Committee expects to begin reducing its holdings of Treasury securities and agency debt and agency mortgage-backed securities at a coming meeting.[13]

The above message suggests that the Federal Reserve still maintains its long-term objective of employment and price stability. The long-term inflation rate is still targeted at 2%. To achieve this objective, a series of increases in federal funds rate target will be needed. Even though the timing of achieving these objectives is not certain, I believe that the long-term inflation rate will be returning to a more normal level despite the short-term pressure for higher inflation.

[13] https://www.federalreserve.gov/newsevents/pressreleases/monetary20220316a.htm.

Q36. HOW HAS COVID-19 IMPACTED THE CAPITAL MARKET AND THE REQUIRED RETURNS ON EQUITY OF UTILITY COMPANIES?

A36. The utility industry and the capital market in general have been affected significantly by the Covid-19 pandemic. There are at least several changes that have impacted the required returns on capital.

The utility bond yield and spread increased noticeably at the breakout of the pandemic. The following chart shows that both the yields and the spread increased significantly in March of 2020; however, the bond market has stabilized since as both the utility bond yield and spread have declined to the pre-pandemic levels up to the end of 2021 followed by the increase in the bond yield in more recent months (*see* Figure 2 below). As a matter of fact, the spread, the measure of relative risks between the bonds of different grade, has declined to a level that is slightly lower than the spread before the onset of the pandemic, signaling the recognition of a more stable market by the investors.

In addition, utility stock prices have declined and rebounded since March 2020. Figure 3 below shows the Dow Jones utility index for the last year. There was a sharp decline in utility stock prices in March of 2020, followed by volatilities in the stock prices with the index hovering around 800. This has implications concerning the dividend yield as dividend yield is a part of return on equity in the DCF model. As stock prices decline with no changes in the dividend payout,

utility companies' dividend yields would increase; however, the stock prices of the utility stocks have surpassed the pre-pandemic levels as recent as March 2022. This would lead to lower dividend yields, causing the expected return to utilities equity to be lower holding everything else constant. However, as dividend yield decreases, utility stocks' earnings growth prospect usually improves. Therefore, it is premature to conclude that the investors flocking to utility stocks would lower the required ROE.

Q37. DO YOU THINK THE MARKET RISKS FACED BY THE UTILITY INDUSTRY HAVE INCREASED AS WELL?

A37. One measure of the utility company stock price risk is the association of its stock price fluctuation with market price movement; this is measured by the so-called beta. Figure 4 shows the beta value change for each gas utility company in *Value Line* group before and during the pandemic. The average value of beta before the pandemic was 0.61 as of February 2020 while the average value in early October 2020 was 0.88, a substantial increase in the risk of the utility stocks. The average beta value continued to stay high, and it was 0.88 as of March 2022. In my opinion, the substantial increase in these beta values is only temporary and the measured beta values will return to a more normal level after the effect of the pandemic rolls out of the five-year regression period that is used to obtain the beta values.

Q38. WHAT IS THE IMPLICATION OF THE INCREASE IN BETA VALUE IN DETERMINING THE UTILITIES' ROE?

A38. Financial theory suggests that investors are compensated for bearing risks. Beta is an accepted measurement of risk. When beta values are higher during the pandemic, the ROE estimated by the CAPM model will be higher. I argue that the currently high beta values are temporary and will show that there is evidence that beta values will decline in a longer term. In other words, we would expect beta values to return to the more normal levels when the initial effect of the pandemic dissipates.

Q39. WHY DO YOU SUGGEST THAT THE HIGHER BETA VALUES ARE TEMPORARY?

A39. The Covid-19 pandemic is an unprecedented episode in many ways. As I have shown earlier, the pandemic has increased the risks of the gas utilities as shown by the increased yield spread, and decreased stock prices of the utility firms as well as other companies in general. We also have shown, since then, that the utility yield spread has returned to pre-pandemic levels (Figure 2) and the utility stock index has returned and surpassed the pre-pandemic level as well (Figure 3). This suggests that the increased riskiness of the utility stocks should have declined. However, the average beta value of gas utility stocks today still remain elevated at about the same level in October 2020.

In Figure 5, I show that the average gas utility stock beta sometimes increases in anticipation and/or at the onset of the changing economic conditions, and it would decline afterwards. For example, around the time of the 2007-2008 economic recession, gas utility beta value increased to a new high level. However, the beta value declined during the economic recovery and when the economy returned to the more normal levels. In comparison, this time the Covid pandemic was largely an unexpected event that carried a tremendously negative impact never seen before, which caused the beta value to increase substantially in a very short time period.

Q40. HOW DID YOU ESTIMATE THE GAS UTILITY BETA SHOWN IN FIGURE 5?

A40. I followed the method adopted by *Value Line* to produce the beta values for each of the companies in my proxy group. Due to the fact that several companies do not have stock prices going back to 1973, I have only included 5 gas utilities in my estimation (NiSource, Northwest Natural, Southwest Gas, Spire and UGI). However, as every gas utility experienced the same pattern of change in beta, these companies are representative enough to show the changes in beta value for the whole industry.

Value Line "derive(s) the Beta coefficient from a regression analysis of the relationship between weekly percentage changes in the price of a stock and

weekly percentage changes in the NYSE Composite Index over a period of five years."[14] To replicate the *Value Line* estimation of beta, I downloaded stock price data for the gas utilities and the NYSE Composite Index for the period of January 1, 1973 to the end of December 2021. I then calculated the weekly percentage changes of the stock prices (returns) and ran a regression of the stock returns on the composite index return. I ran the regression for a five-year period with the period ending on December 31 of each year, and I ran the regression once a year for the period of 1978 to 2021 for each company. Therefore, in my notation, the beta for 2021 is the beta value at the beginning of 2022 or at the end of 2021, obtained from the regression using the sample data for the period of January 1, 2017 to December 31, 2021. The rest of the beta values were obtained the same way.

There was a gradual increase in the beta value before 2007 followed by declines for more than 10 years during the period of economic recovery and growth. The gradual increase in the beta value before 2007 reflected the market's perception of risk increase over time. The large spike in the beta value for 2020 (covering the period of 2016 through the end of 2020) captured the sudden increase in the volatility or the risk of utility stocks as the pandemic was not anticipated. Figure 5 also shows that the gas utility beta value fluctuated around an unobservable mean value. This is what is called mean reversion. The average

[14] https://www.valueline.com/tools/educational_articles/stocks/using_beta.aspx#.YKXTlqhKhPZ.

value of beta for the 44-year period including the high beta years of 2020 and 2021 is 0.69.

The high beta values for 2020 (five years data including 2016 through end of 2020) and 2021 (five-year data covering the period of 2017 to 2021) are not normal and do not represent the risks faced by the utility industry correctly. Using the current beta values will bias ROE upward, rendering the ROE estimates unreliable and excessive.

Q41. DO YOU HAVE ANY DIRECT EVIDENCE OF CURRENT BETA VALUES BEING ABNORMAL? MAYBE THE RISKS OF THE GAS UTILITIES ARE PERMANENTLY HIGHER DUE TO THE PANDEMIC?

A41. The currently elevated beta value is 0.88, higher than the 44-year historical average value of 0.69. However, I do not believe the risks of the gas utilities are permanently higher. I will show next that the currently high beta is the artifact of the beta regression by *Value Line* or any other financial services that generate and report beta values using the same approach in performing beta regressions. As I have stated earlier, the *Value Line* regression coefficient is obtained by running a 5-year regression. The inclusion of the highly volatile period of 2020 pandemic year in the regression has influenced the beta estimate significantly. However, the risk of the gas utility has declined from the initial high level right upon the impact

of the pandemic in 2020, but the beta values still remain high. The high beta value was the result of the regression including the 2020 time period,

Q42. HOW WOULD THE DATA FROM A SPECIFIC TIME PERIOD AFFECT THE REGRESSION COEFFICIENT?

A42. Regression is a statistical method that estimates an *average* relationship between/among variables, in this case, the relationship between the stock return of a utility company and the stock return of a market index. Just like calculating the average value, a large value in a dataset can influence the average value significantly. The large value will have a smaller influence on the average value if the number of observations in the dataset is large. To dilute the impact of a large value (or an abnormal time period), beta regressions are done on a longer time period such as five years. However, the impact of the large value on the average value will not disappear unless the large value is no longer included in the dataset.

Similarly, the pandemic in 2020 is a special event that lasted longer than just a few days. It has influenced the beta estimate very significantly in the same way as described above about a large value. Including a period of 5-years in the regression is expected to damp the impact of any particular year better than a regression with a shorter period. However, unless the abnormal period of pandemic 2022 rolls out the regression period, estimated beta value will be high even if the risk of the utility stocks has returned to a more normal level. In this

sense, the currently high beta values do not reflect the true risk of the utility stocks.

Q43. DO YOU HAVE EVIDENCE THAT THE RISKS OF THE UTILITY COMPANIES HAVE RETURNED TO A MORE NORMAL LEVEL?

A43. Yes, I do. I have performed regressions with different lengths of the sample period to show the impact of pandemic 2020 on the beta estimate. Figure 6 above shows the impact of inclusion of the 2020 data in each regression. The first three numbers show the beta values obtained from a five-year regression (2015-2019, 2016 – 2020, and 2017-2021). Without the 2020 pandemic data, the beta value from the regression for period ending December 2019 is only 0.60. The beta values for years ending 2020 and 2021 increased to 0.87 and 0.89, respectively when the time period included year 2020. When I ran the two-year regressions, these three numbers became 0.72, 0.956, and 0.952. The beta values from the last two-year regressions increased significantly. The reason for that is the second set of regressions only covered a shorter period of two years, and the 2020 pandemic year data had a much larger impact (having a weight of ½) on the regression results compared to the five-year regression where year 2020 only carried a 1/5 weight. When I ran the one-year regression, the three numbers became 0.63, 0.98 and 0.69, respectively. The beta value for year ending 2021 dropped significantly to 0.69 when the 2020 pandemic period was not included in the regression anymore.

This suggests that the unsettling market condition of year 2020 right after the breakout of the Covid virus was extremely abnormal and it distorted the normal relationship between utility stocks and the overall market. It shows that the market risk of the utility stocks increased substantially as the estimated beta value increased significantly. However, the increase in risk is only transitory with the impact occurring only for 2020. Now the market has started to return to a more normal condition,[15] but the five-year regression by *Value Line* still has the 2020 data "contaminating" the regression relationship. The five-year regression instead of a shorter period regression by *Value Line* was intended to lessen the influence of some anomalies in the data during the sample period. However, in this case, it has created a very undesirable adverse effect in the presence of an extreme abnormality.

The decline in the measured one-year beta value to the level close to the pre-pandemic level is proof that the utility stock risks have declined to the pre-pandemic levels. It also reflects the market's perception of utility's ability to deal with the impact of the pandemic. Utilities can manage the risk associated with the pandemic through existing recovery mechanisms. Rate cases and the creation of deferred regulatory assets can be expected by the utilities to collect the lost cash flows.

[15] Mr. Moul, the Company's cost of capital witness, also agreed that the market fundamentals have begun to return to more normal levels. *See* Prepared Direct Testimony of Paul Moul, page 2, lines 16-18.

Q44. WHAT ADJUSTMENT IS NEEDED TO CORRECTLY REFLECT THE RISK OF THE GAS UTILITY INDUSTRY AFTER THE PANDEMIC?

A44. I believe it is very important to mitigate the impact of the incorrect indication of the riskiness of the utilities by the current beta values. As the current values of the beta reported by information providers including *Value Line* are biased upward in measuring the utility risks at this time, I correct the bias by averaging the beta value before the pandemic and the beta value as reported now. The average beta value calculated this way is 0.74 (*see* Exhibit ZZ-8), which is still slightly higher than the historical average of 0.69. I believe the beta value of 0.74 reflects the true state of the utility stock riskiness with respect to the overall market movement much better than the unadjusted average beta value of 0.88.

V. OCC/NOPEC'S RECOMMENDATION OF A JUST AND REASONABLE RATE OF RETURN FOR COLUMBIA

CAPITAL STRUCTURE AND COST OF DEBT

Q45. WHAT IS COLUMBIA GAS' PROPOSED CAPITAL STRUCTURE?

A45. The Company proposed a capital structure of 49.40% debt and 50.60% equity is based on the actual capital structure of the company.

Q46. DO YOU AGREE WITH THE COMPANY'S PROPOSED CAPITAL STRUCTURE?

A46. I have studied the capital structure of the comparable companies. Exhibit ZZ-3 presents the equity ratio of the companies for the past 10 years as well as the expected equity ratio by *Value Line*. The equity ratio of 50.60% is slightly higher than the average value of the equity ratio but is within a reasonable range of the values for the proxy group. I consider 50.60% equity to be consistent with the industry norm, so I accept the Company's proposed capital structure.

Q47. WHAT IS COLUMBIA'S COST OF DEBT?

A47. Columbia Gas' cost of debt is 4.49%. As this is the cost of the debt of the Company at the filing date, I accept this embedded cost.

Q48. WHAT MEASURES OF COST OF COMMON STOCK EQUITY HAVE YOU USED TO CALCULATE THE COMPANY'S COST OF CAPITAL?

A48. I used three common methods of cost of equity calculations, namely, the DCF method, the CAPM model, and the RP model. The first two methods examine an individual company's financial information. I also use the RP method to obtain the equity premium for the whole gas utility capital market. All three methods are market based and they are recognized methods used in cost of capital proceedings.

The DCF method is based on anticipation of a company's future earnings and growth opportunities, so one requirement for the selection of the company is that company needs to pay dividends to equity owners. The CAPM model is based on the risk premium concept. Both the DCF and CAPM models take into account the investors' understanding and expectation of the economic environment, at present and in the future, and the current industry and company-specific information. The RP model utilizes the negative empirical relationship between interest rate and the expected risk premium which is the difference between the expected return (one representation is the utility's authorized ROE) and interest rate.

THE DISCOUNTED CASH FLOW MODEL

Q49. PLEASE DEFINE AND EXPLAIN THE DCF METHODOLOGY FOR MEASURING THE COST OF COMMON EQUITY.

A49. The DCF method calculates the required return for an investor as follows:

$$K = \frac{D}{P} + g$$

where:
K = cost of common equity
D = expected next-period dividend per share
P = price per share and
g = growth rate of dividends, or alternatively, common stock earnings.

In the equation, "K" is the required rate of return on investment by investors. It is also the discount rate that is used to convert the future cash flows from the investment into the present value. "D" is the expected next-period amount of

dividend paid to equity holders. "P" is the current market price of the common stock, representing the current valuation of the company by the market. So "D/P" is the expected next-period dividend yield on the company's common stock. And "g" is the expected growth rate of the dividend or earnings.

Q50. WHAT DOES THE COST OF EQUITY CALCULATED FROM DCF REPRESENT?

A50. The DCF method, as cited in the most common form, generates an estimate of the return required for an investor to measure against alternative investment opportunities. This represents the minimal return in order for a company to attract and maintain investment in the company's common equity. It represents the investor's expectation based on available current market information.

Q51. WHAT FORMS OF THE DCF MODEL HAVE YOU USED IN CALCULATING THE COST OF EQUITY?

A51. When the DCF model is used to calculate required return on equity, the appropriate EPS growth rate must be used because the model looks at the perpetual EPS growth rate. The constant growth DCF model is a standard DCF model used in practically all cost of capital proceedings. The correct use of the growth rate is essential to the correct valuation of the required return using the constant growth DCF model. I used a two-step DCF model to estimate ROE which I will explain more in the next section.

Q52. WHAT STOCK PRICE DID YOU USE IN YOUR CONSTANT GROWTH DCF MODEL?

A52. I have reviewed and used the six-month average of stock prices. Stock prices vary on a daily basis. The use of a six-month average reduces the impact of price volatility and reasonably represents the normal market condition concerning the value of the stock. As the market price can be volatile on a daily basis, I first calculated the average of monthly highs and lows as the monthly price. A six-month average limits the impact of abnormal stock price fluctuations. This method of calculating the average stock price is also the method adopted by FERC. The sample period I used for the stock prices runs from October 1, 2021 through March 31, 2022.

Q53. HOW DID YOU CALCULATE DIVIDEND YIELD?

A53. The dividend yield is calculated as the ratio of expected dividend at the end of the first period to the stock price at the beginning of the period. I collected the quarterly dividend for the same six-month period with the ending date matching the ending date of the stock price. I annualized the quarterly dividend by multiplying the quarterly dividend by 4. Then for each month, I calculated the dividend yield by dividing the annual dividend by the monthly stock price. The dividend yield for the six-month period is the average of the monthly dividend yield during the period. In the DCF model, dividend yield is the expected next-

period dividend. I multiplied the dividend yield by one half of the expected dividend growth rate to reflect the fact that the dividend is paid quarterly.

Q54. WHAT GROWTH RATE INFORMATION DID YOU USE IN THE CALCULATION OF THE ROE?

A54. The stock price and dividend information are known to the investors; however, the expected dividend growth rate is not directly observable and needs to be estimated. Investors project the dividend growth rate based on all available information; therefore, I have chosen the projected 3-5-year EPS growth rate by Institutional Brokers Estimate System ("IBES"). The IBES provides some of the most comprehensive financial information in business investment. IBES projected growth rates represent a consensus of multiple analysts, including some of the analysts included in First Call and Zacks. The IBES source of projected earnings is widely used by the market and is publicly available. The IBES growth rates are reported in Exhibit ZZ-4.

Q55. DID YOU USE IBES PROJECTED EPS GROWTH RATE AS THE FINAL FORM OF EARNINGS GROWTH RATE?

A55. No, I did not adopt the IBES earnings forecast as the final estimate of the earnings growth rate, and I have only used the IBES projected earnings growth rate in projecting the expected dividend yield at the end of the first period. As IBES earnings forecast is typically not of very long term – 3 to 5 years maximum - I

also used the long-term growth rate to correctly calculate the earnings growth rate in the long term. To obtain a more reliable measure of EPS growth in the long term, I have used a weighting scheme known as the two-step DCF method.

Q56. WHAT IS THE TWO-STEP DCF METHOD?

A56. In the two-step method, relatively short-term earnings growth forecasts, such as IBES projections, are obtained first. In the second step, the constant growth rate (g) is augmented by a measure of the long-term growth, and then the overall earnings growth rate is the weighted average of relatively short-term growth rate projection and the long-term growth projection. In this sense, the two-step constant growth DCF model is equivalent to a multi-stage DCF model that assumes different growth rates for different stages of a utility's life.

Q57. WHAT IS THE LONG-TERM GROWTH RATE YOU USED AND HOW DID YOU DETERMINE THE WEIGHTS?

A57. I used the GDP growth rate as the measure of the long-term growth rate. In perpetuity, the value of the stock market should grow at the same rate as the economy grows. The two sources of the expected growth I used are: [1] Energy Information Administration, Annual Energy Outlook ("AEO") 2022 and [2] Social Security Administration, 2022 OASDI Trustees Report. These two sources are frequently cited in cost of capital proceedings. For example, FERC requires the calculation of the EPS growth rate incorporating these two sources of long-term economic projections in addition to the projections by IHS Global Insight.

When calculating the expected future earnings growth rate, I used the weights of 2/3 and 1/3 for the IBES growth rate and the GDP growth rate respectively. The detailed calculation of the long-term growth rate is shown in Exhibit ZZ-5. My assessment of the long-term economic growth, based on most recent available information from these sources, is 4.27%.

Q58. PLEASE SUMMARIZE YOUR ROE RESULT BASED ON THE CONSTANT GROWTH DCF MODELS.

A58. After adding the expected dividend yield to expected earnings growth rate for the two-step DCF model, I obtained a ROE of 8.60% based on the median and 8.36% based on the average value. Exhibit ZZ-6 shows the calculation of the ROE by the DCF model, and the table below (Table 4) summarizes the result of the DCF model. I also presented the ROE result based on the Moul sample. The results are similar based on the two samples. This suggests that the proxy group selection is not the major source of the difference between the ROE result I obtained and the result Mr. Moul obtained. I will address the methodological issues of Mr. Moul in later sections.

Table 4: DCF ROE results

	Zhu Sample		Moul Sample
	DCF		DCF
Min	6.57%		6.57%
Max	9.72%		9.72%
Median	8.60%		8.60%
Average	8.36%		8.42%
Midpoint	8.14%		8.14%

THE CAPITAL ASSET PRICING MODEL

Q59. PLEASE DESCRIBE THE CAPM METHOD IN THE CALCULATION OF THE COST OF COMMON EQUITY.

A59. The CAPM method is based on the analysis of risks. There are two types of risks to consider; one is the kind of risk that investors can diversify away or reduce by combining different investments into a portfolio, the other is the market risk an investor cannot reduce by diversification. Therefore, the CAPM method is a risk premium model based on the calculation of the risk differential between investments on the market portfolio and the individual stock. The calculation of the required rate of return on the company's stock is as follows:

$$K = R_F + \beta (R_M - R_F)$$

Where:
- K = the required return.
- R_F = the risk-free rate.
- R_M = the required overall market return; and
- β = beta, a measure of a given security's risk relative to that of the overall market.

The idea of calculating the required return on the individual investment from CAPM is to find the equivalent return for an investor based on the relative risk of the investment as compared to the alternative investment opportunities. Here, the alternative investment opportunity is usually assumed to be the market portfolio.

This is a model that suggests investors should be compensated for bearing risks. Typically, the risk-free rate is a benchmark investment on which investors can be

compensated for not bearing any risks. The benchmark risk-free rates are typically Treasury security yields. The market return is the return on all other available investment alternatives to the investor. This is typically a rate generated from a relevant market index. The risk of the firm's common stock is reflected in the beta of the company, which measures the relative stock price volatility of the company compared to the overall market.

Therefore, the CAPM model has two general components: one is the risk-free rate, and the other is the company RP, which is the product of the company's beta and market risk premium ("βxMRP"). The market risk premium ("MRP") is the difference between the expected market return and the risk-free rate ("R_M - R_F").

Q60. PLEASE EXPLAIN YOUR CAPM CALCULATIONS.

A60. I used the 30-year T-Bond yield as the benchmark risk-free rate. I obtained the base beta for the comparable companies from *Value Line*. Finally, I developed a measure of market risk premium based on the DCF model applied to S&P 500 dividend paying companies.

Q61. PLEASE DESCRIBE THE RISK-FREE RATE.

A61. I used the six-month average yield on 30-year T-Bonds. As utility investments are usually long term, and a longer-term Treasury bond would reflect the market condition better for the investments. The yield reflects all market information

known to investors at the time including the possibility of future interest rate increase. A 6-month average is used to mitigate the impact of T-bond yield volatility and it also matches the time period for the stock dividend yields. The 30-year T-Bond yield is a best measure of the required return on risk-free instrument.

Q62. PLEASE EXPLAIN THE BETA OF THE COMPARABLE COMPANIES.

A62. Betas measure the connection between the company's stock volatility and the overall market volatility. Many professional financial services, including *Value Line,* provide the estimate of the company beta. As it is generally known that a raw beta obtained from the regression of the company stock returns on market returns tends to move toward 1, *Value Line* has adjusted its estimated beta accordingly (the so-called Blume adjustment). The *Value Line* beta values are appropriately estimated to measure the company's stock price variations compared to the overall market index in normal economic conditions. Therefore, the product of the company's beta and market risk premium is supposedly to produce the company's RP.

Q63. YOU STATED EARLIER THAT THE MOST RECENT BETA VALUES FROM VALUE LINE ARE TOO HIGH AND MAY NOT REFLECT THE NORMAL RISK OF THE UTILITY STOCKS. HOW DID YOU CORRECT THIS PROBLEM?

A63. As I explained earlier, the current gas utility beta values from *Value Line* are too high, not reflecting the true risk of the gas utility stocks. The estimates of beta are heavily influenced by the transitory impact of the Covid pandemic mostly during year 2020. As the economy started to return to normal, beta values of the gas utilities should have declined from the abnormally high levels. As I explained in an earlier section, *Value Line* calculates the beta value based on data for a five-year period, thus it will take some time for the pandemic effect to be transitioned out in the time-series regression. I have also shown that the beta from a one-year regression (excluding the period of 2020) has already gone down to almost the pre-pandemic levels. Therefore, the elevated current betas from the five-year regressions as reported by *Value Line* and other professional services are an artifact of the regression estimation, so the beta as reported does not reflect the true risk of the utility stocks. For this reason, I have calculated the average value of beta for each company based on the beta value as of March 2022 and February 2020.

Q64. PLEASE DESCRIBE YOUR ANALYSIS OF MARKET RISK PREMIUM.

A64. As the CAPM model estimates the expected ROE, the market risk premium should be the expected equity market return over the risk-free rate. The estimate of the market equity risk premium is perhaps the most contentious issue for the financial market; however, there are generally accepted ways to estimate the equity risk premium. One method is to obtain the expected market return via DCF method. Many jurisdictional authorities, including FERC, accept the market return calculated using a DCF method. A very important feature of this methodology is that it generates a market risk premium that is forward looking. Some analysts including Mr. Moul use historical market risk premiums. However, historical risk premiums are backward looking.

Q65. PLEASE EXPLAIN WHAT MARKET INDEX YOU HAVE USED.

A65. I have used the S&P 500 index to represent the overall equity market. After obtaining the name of the companies included in the market index, I have excluded the companies that do not pay dividends and the companies that have negative projected earnings growth rates and growth rates higher than 20%. If a company has a negative earnings growth rate, it will not be sustainable in the long run. Similarly, it is not possible for a company to have an earnings growth rate of 20% forever; therefore, I have eliminated those companies from the list. The final sample included more than 300 companies, which is large enough to represent the broad spectrum of the businesses in the U.S. economy.

Q66. WHY DID YOU EXCLUDE NON-DIVIDEND PAYING COMPANIES FROM THE CALCULATIONS?

A66. The DCF model is based on the premise that a company's value is based on the stream of future dividends to the investors. The model breaks down if no dividend is issued to the investors. In other words, the DCF model cannot be applied to companies that do not issue dividends. The expected market return is then the weighted average of individual company returns (ROE derived from the DCF model) with the market capitalization being the weight.

Q67. DID YOU USE A ONE-STEP DCF MODEL OR A TWO-STEP DCF MODEL TO OBTAIN THE INDIVIDUAL COMPANY'S ROE?

A67. I used a two-step DCF model to calculate the ROE of an individual company. A weighted growth rate by the short-term and long-term growth rate can better capture the nature of the expected long-term dividend growth rate. I used the IBES projected earnings growth rate as the short-term expected earnings growth rate and the weighted value of IBES projected earnings growth and expected GDP growth rate as the long-term growth rate.

Q68. WHAT IS YOUR ESTIMATED MARKET RISK PREMIUM?

A68. My estimated market return is 10.65% and market risk premium is 8.64% by the two-step DCF method. These results are presented in Exhibit ZZ-7. Please note that the estimated market risk premium is likely on the high side compared to the

estimates from other sources.[16] One of the reasons could be that it ignores the returns of the companies in the S&P 500 index that do not issue dividends. However, it is a forward-looking measure that meets the requirement of the CAPM model.

Q69. WHAT IS YOUR ESTIMATED ROE BASED ON THE CAPM MODEL?

A69. I used the following method to obtain the estimates of the ROE: I applied the market risk premium obtained from the two-step DCF model to each comparable company's beta to obtain beta-adjusted company RP and then added to the risk-free rate. Then I calculated the average and median of the individual company's ROE based on the CAPM model. The final result of ROE in Exhibit OCC-ZZ-8 shows the application and the results of the method.

Table 5 below shows the summary of the CAPM model result.

Table 5: CAPM ROE results			
	Zhu Sample		Moul Sample
	CAPM		CAPM
Min	7.87%		7.87%
Max	9.80%		10.22%
Median	8.09%		8.62%
Average	8.45%		8.78%
Midpoint	8.83%		9.05%

[16] Aswath Damodaran, "Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2022 Edition", table 25. https://pages.stern.nyu.edu/~adamodar/.

The median from the calculation is 8.09%, and the mean value ROE estimate is 8.45%. The use of the current beta values without adjustment would have led to a much higher but incorrect ROE estimate. My use of average beta value mitigated the problem, leading to a much more reasonable estimate of required ROE. Again, table 5 shows the ROE results based on the Moul sample.

THE RISK PREMIUM MODEL

Q70. PLEASE DESCRIBE THE PRINCIPAL IDEA BEHIND THE RP MODEL.

A70. The RP model is based on the idea that equity owners or stockholders require higher returns than the bond holders who simply hold less risky bonds. Therefore, this risk-reward relationship reflects the basic principle in financial economics. The ROE is then equal to bond yield plus a form of expected RP which is the difference between expected returns of the stocks and bond yield.

Q71. HOW CAN THIS MODEL BE ESTIMATED TO GENERATE EXPECTED ROE?

A71. There are many versions of the RP models, depending on the stock returns and interest rates used. One typical form of the risk premium is measured by the difference between a utility's authorized ROE and a particular kind of long-term interest rate, frequently being the 30-year bond yield. The relationship between equity risk premium and bond yield is empirically obtained through regression of

risk premium on bond yield. Then, the estimated regression equation coefficients are used to obtain the expected ROE given the bond yield.

Q72. PLEASE EXPLAIN HOW YOU OBTAINED THE RP DATA AND HOW YOU EMPIRICALLY ESTIMATED THE RELATIONSHIP BETWEEN RISK PREMIUM AND INTEREST RATE.

A72. I used the authorized ROEs from past gas utility rate cases since 1980 to represent the expected returns and then subtracted the long-term interest rate, in this case, the 30-year Treasury bond yield, to generate the RP. I have included only past rate cases of fully integrated and distribution gas utilities in my sample. I have included both fully litigated and settled cases. The inclusion of the settled cases or not does not make any material difference as the obtained ROEs are essentially the same using either the fully litigated sample or litigated plus settled sample. Then I regressed the risk premium on interest rate to obtain the relationship between the RP and the interest rate. In order to capture the interest rate for the rate case as closely as possible, I have averaged the 30-year T-Bond yield for the period of each rate case, i.e., from the filing date to the decision date. This estimated relationship has been utilized to estimate the risk premium given the current interest rate. I have calculated the average length of a typical rate case and my result revealed that the average period is about 9 months. I then used the average T-Bond yield during the last 9 months (up to March 2022) as the interest

rate. The estimated RP then is added to the interest rate to yield the expected ROE.

Q73. USING THE CURRENT 30-YEAR BOND YIELD, WHAT IS YOUR ESTIMATE OF ROE PER RP METHOD?

A73. My estimated RP is 7.04%. *See* Exhibit OCC-ZZ-9. With the 9-month average 30-year T-Bond yield at 2.04%, my estimate of the ROE using the risk premium method is 9.08%.

VI. OCC/NOPEC OBJECTIONS TO THE STAFF REPORT REGARDING RATE OF RETURN

OCC/NOPEC Objection No. 17

Q74. WHAT IS THE STAFF REPORT'S RECOMMENDATIONS REGARDING THE RATE OF RETURN FOR COLUMBIA?

A74. The Staff recommended accepting the capital structure and cost of debt of Columbia Gas as filed. The Staff also recommended a cost of equity of 9.05% to 10.05%.

Q75. DO YOU AGREE WITH THE STAFF REPORT'S RECOMMENDATIONS?

A75. I agree with the recommendations regarding the cost of debt and capital structure. However, I do not agree with the Staff's assessment of the cost of equity for Columbia Gas.

Q76. WHY DO YOU DISAGREE WITH THE STAFF'S ANALYSIS AND RECOMMENDATION ON COST OF EQUITY?

A76. I believe the Staff utilized some questionable assumptions in modeling the cost of equity for Columbia Gas, which leads to higher than market required return on equity, thus increasing the financial burdens of the Columbia Gas' consumers.

Q77. PLEASE IDENTIFY THE ASSUMPTIONS THE STAFF USED THAT ARE QUESTIONABLE OR UNREASONABLE.

A77. The Staff first selected a proxy group for Columbia Gas. Then the Staff employed two models, a multi-stage DCF model and a CAPM model to estimate the market requirement ROE. In selecting a proxy group, the Staff used the S&P peer company selection tool, which includes all utilities in the U.S. based on the selection on several criteria including the beta, bond rating, dividend yield and earnings before interest, taxes, depreciation and amortization, and market capitalization.

In carrying out the DCF analysis, the Staff employed a multi-stage DCF model with short term growth rate modeled by the 3-5 years analyst projections by Yahoo Finance, Zack's and Value Line, and long-term earnings growth rate proxied by historical GNP growth rate. The Staff generated a ROE of 9.6% from the DCF model.

The Staff utilized the average of the Standard & Poor's betas of the comparable companies, which was 0.8 and an estimate of the market risk premium from Fairness Finance. The risk-free rate is the weighted average of 10-year and 30-year monthly T-bond yields for the period of September 1, 1991 to September 1, 2021. The interest rate was calculated to be 4.35%. The Staff's calculation of ROE is 9.32%.

Finally, the Staff adjusted the ROE estimate from the DCF model and CAPM model by a factor of 1.00871, which also reflects a 3.5% issuance cost, to allow for an issuance and other costs.

OCC/NOPEC Objection No. 18

Q78. DO YOU AGREE WITH THE SELECTION OF THE COMPARABLE GROUP BY THE STAFF?

A78. No, I do not. Columbia Gas is a gas distribution company and the companies in the proxy group should be gas utilities that reflect the same operational characteristics. The Staff's selection included seven companies such as CenterPoint Energy, Pinnacle West Capital Corporation, OGE Energy Corporation, CMS Energy Corporation, Ameren Corporation, Evergy and Atmos Energy Corporation. These companies are generally classified as electric utilities except for Atmos Energy. Even though all these companies are utilities in a broader sense, a proxy group based on gas utilities would be expected to generate more precise ROE estimates.

OCC/NOPEC Objection No. 21

Q79. WHAT ISSUES DO YOU HAVE WITH STAFF'S DCF MODELING?

A79. There are a couple of issues. One is the choice of the earnings projections. The Staff used three sources: Yahoo Finance, Zack's and *Value Line*. Yahoo Finance and Zack's include the estimates of some of the same analysts, and *Value Line*'s projections are updated less frequently (every 3 months). I believe Yahoo Finance

would be sufficient to represent the analyst projections with more updated information.

The more serious problem is with the Staff's choice of long-term earnings growth rate. The Staff is correct in assuming the economic growth rate to be the expected long-term dividend growth rate. However, the Staff used the historical economic growth rate represented by the GNP growth rate for the period of 1929 to 2020. The cost of capital is the market required return on capital for the future investment of the utilities in this case, therefore, it should be forward looking. Historical GNP or GDP growth rate only reflects what has happened in the past and the past does not necessarily reflect the current or future market and economic conditions. Therefore, it is inappropriate to use historical growth rate in this context.

The historical GNP growth rate during the sample period of the Staff is 6.41%, which is too high for the future given the expected economic condition in the U.S. In calculating the 6.41% annual growth rate, the Staff used the arithmetic growth formula – i.e., calculate the annual growth rate and then average over all the annual growth rate. However, this approach has a well-known problem of over-stating the growth rate when growth rate varies quite a bit during the sample period. The correct calculation is to obtain the geometric growth rate, which is

5.9%. However, even 5.9% is still not representative of the future GNP/GDP growth rate.

It is well-known that the U.S. economy experienced a slowdown in economic growth in the last several decades. As I have explained earlier in my testimony, the U.S. real GDP growth rate has been declining over the years. From 1970 to 2020, the U.S. real GDP grew at a rate of 2.66%, while that rate for the period of 1980-2020 and 1990 to 2020 has declined to 2.53% and 2.27% respectively. The growth rate for the period of 2000 to 2020 dipped to 1.69%. The historical GDP growth rate of 6.41% does not appear to be consistent with the more recent trend in GDP growth. The most recent expected GDP growth rate for the U.S. is around 4.25% (*see* Exhibit ZZ-5).

OCC/NOPEC Objections No. 19 and No. 20

Q80. WHAT ISSUES DO YOU HAVE WITH THE STAFF'S CAPM ANALYSIS?

A80. I have several issues with the Staff's analysis of ROE by the CAPM model. First, the Staff should have discounted the current value of the beta. Second, the Staff should not used the historical interest rate from 1991 to 2021, which is too different from the interest rate under the current capital market condition.

Regarding the first issue, as I have argued earlier in this testimony, the unadjusted beta values from professional services misrepresent the true risk of the utilities as the still elevated beta values are an artifact of including the abnormal 2020 pandemic in the 5-year beta regressions. The Staff should have used the historical average of betas or adjusted the beta values like I have done.

Regarding the interest rate issue, I believe the Staff should have just used the most recent market interest rate in the calculation of CAPM ROEs. The historical interest rate of 4.35% as used by the Staff is too high to reflect the current and expected capital market conditions. As I have shown in my Exhibit ZZ-2, the long-term interest rates have been declining in the last 30-40 years. The last time when we had a 4.5% long-term interest rate was about 15 years ago and the interest rate has been on the decline since then.

OCC/NOPEC Objection No. 22

Q81. DO YOU HAVE ISSUES WITH THE STAFF'S INCLUSION OF OTHER COSTS?

A81. Yes, I do. The Staff applied a factor of 1.00871 to accommodate issuance cost and other costs. The Staff did not justify the inclusion of these costs. Even if an adjustment for equity issuance and other costs were allowed, the Staff inappropriately increased the cost of common equity by using a hypothetical and

generic issuance cost factor of 3.5%. The Staff Report has not explained why this generic issuance cost factor is reasonable or why it should be applied in this proceeding. In addition, there is no demonstration in the Staff Report that Columbia is likely to incur these costs in the near future or the magnitude of these costs. The addition of arbitrary and unproven equity issuance and other costs will unnecessarily and unreasonably increase the cost of gas services to Columbia's consumers.

Q82. WHAT WOULD BE THE ROE NUMBERS FROM THE STAFF ANALYSIS IF THESE INCORRECT ASSUMPTIONS AND DATA WERE CORRECTED?

A82. If we used the current interest rate (6-month average 30-year T-bond yield) of 2.1%, along with the adjusted beta value of 0.74, and the Staff's 6.21% market risk premium, the Staff's ROE from the CAPM model would be about 6.7%, instead of 9.32%. The DCF model ROE should be lowered by about 70 to 100 basis points, leading to a ROE below 9% based on the Staff approach. Therefore, in my opinion, even though the Staff's recommended ROE is lower than what Columbia has requested, it is still too high and unjustified by the current economic and capital market conditions.

VII. A CRITICAL REVIEW OF COLUMBIA'S PROPOSED ROE AND RATE OF RETURN

Q83. WHAT IS THE ROE THAT COLUMBIA IS REQUESTING?

A83. Columbia is seeking an 10.95% ROE, which is based on its cost of capital witness Mr. Paul Moul's recommendations. The table below shows the ROE estimates from Mr. Moul's various models:

Table 6: Summary of Mr. Moul's ROE Estimates	
DCF:	11.37%
RP:	10.50%
CAPM:	12.51%
CE:	12.15%

The average ROE from these models is 11.63%, the median is 11.76%, and the midpoint is 11.51%.

Q84. DO YOU AGREE WITH MR. MOUL'S ROE RECOMMENDATION?

A84. No. I do not agree with Mr. Moul's ROE recommendation.

Mr. Moul, in arriving at the recommended ROE values, has made many questionable and unreasonable assumptions that bias the ROE estimate upward. To carry out the calculations using these models, he has made many assumptions that I believe are inappropriate, unreflective of the current market conditions. These calculated ROE values are simply too high. If the recommended ROE is

authorized, it will lead to a return for Columbia to exceed the market required return and lead to unjust and unreasonable charges to Columbia's costumers.

Q85. CAN YOU LIST THE MAJOR QUESTIONABLE AND ERRONEOUS ASSUMPTIONS THAT MR. MOUL MADE?

A85. There are many issues in Mr. Moul's analysis of the ROE for Columbia. Among some of the major problems are: (1) his inconsistent use of proxy groups for different methods, (2) the use of forecasted interest rate, (3) lack of long-term growth in the DCF model, (4) mixed use of historical values and forward-looking variables, (5) inclusion of size premium and flotation costs, (6) the application of the so-called Hamada adjustment, and (7) use of book value instead of market value returns, and so on.

Many of his assumptions and approaches are seriously flawed and thus lead to very much upward biased ROE results. For example, Mr. Moul's RP approach is based on a hypothetically negative relationship between risk premium and interest rate. It is normally observed that there is a valid empirical relationship between appropriately constructed risk premium and interest rate. However, due to the errors in his measurement of the risk premium and interest rate, there is no valid negative relationship between the risk premium and interest rate in his data. Without checking whether the empirical relationship is valid or not, Mr. Moul

built his ROE estimate based on the non-existent relationship and made a recommendation anyway.

Q86. WHAT COMPARABLE GROUP COMPANIES DO YOU THINK ARE APPROPRIATE IN MODELING THE ROE FOR COLUMBIA?

A86. Columbia is a gas distribution company. The comparable group should have similar operational and financial characteristics and similar degree of risks. The non-utility companies in Mr. Moul's sample for his CE method are not regulated and they operate in a different environment and are not comparable to gas utilities such as Columbia.

Mr. Moul has selected a group of 8 gas companies as his gas group: Atmos, Chesapeake Utilities, New Jersey Resources, Northwest Natural, ONE Gas, South Jersey Industries, Southwest Gas and Spire. He showed that Columbia has a degree of risk that is comparable to the gas group,[17] which I concur. I have selected a similar group of gas companies as Mr. Moul has selected.

My sample differs from Mr. Moul's sample by three companies: I have excluded Chesapeake Utilities and Southwest Gas due to M&A considerations. Mr. Moul excluded NiSource, the parent company of Columbia, due to the reason that "its capital structure is atypical for a gas distribution utility and is therefore

[17] Prepared Direct Testimony of Paul Moul, page 11, lines 15-23.

unreflective of the financial risk of the gas distribution utility industry".[18] NiSource's equity ratios in recent years are slightly above 30%. However, Mr. Moul did include another company South Jersey Industries that has a similar equity ratio in his gas group sample (*see* Exhibit ZZ-3 for equity ratios of the gas group companies).

Q87. CAN YOU DESCRIBE MR. MOUL'S APPROACH WITH THE DCF MODEL?

A87. Mr. Moul used the standard DCF approach based on the Gordon growth model. The ROE or expected market return on equity is the sum of the two parts: dividend yield and expected growth. Mr. Moul's dividend yield/adjusted dividend yield come very close to what I have estimated based on the current company dividend yield and expected dividend growth rate. However, Mr. Moul employed a relatively short-term dividend growth rate proxied by the projected 3-to-5-year earnings growth rate as the long-term sustainable growth rate. Mr. Moul further made a so-called leverage adjustment to his DCF model result, and finally added a flotation cost to arrive at the cost of equity of 11.54%, even though he did not adopt that number as the DCF ROE. Instead, Mr. Moul chose 11.37% (exclusive of the flotation cost as the estimated ROE from the DCF model). The table below summarizes Mr. Moul's ROE from the DCF model:

[18] Columbia Gas' response to the OCC's third set of interrogatories dated October 27, 2021, response to OCC set 3, no. 6.

Table 7: Mr. Moul's DCF Model Result	
Dividend yield:	3.69%
Expected growth rate:	6.75%
Leverage adjustment:	0.93%
Flotation cost factor:	1.015
Total ROE:	11.54%

Q88. DO YOU AGREE WITH MR. MOUL REGARDING THE PROJECTION OF THE 3-5 YEAR EARNINGS GROWTH RATE AS THE LONG-TERM SUSTAINABLE GROWTH RATE?

A88. I do not agree with the view that the projections of growth rate at an investment horizon of three to five years represent the long-term growth prospect of the equity market. As Mr. Moul explained in his testimony, there are several stages to the overall growth of the company's dividend streams: the initial "growth stage", the final stage that the firm's dividend is assumed to grow steadily "the steady-state stage", and a period between the initial growth stage and the final steady-state stage "transition stage).[19] The DCF model considers the infinite number of dividend streams for the future. Even though individual investors do not expect to hold an investment indefinitely,[20] ignoring long-term growth would bias the required return upward.

[19] Prepared direct testimony of Paul Moul, page 16.

[20] *Ibid*, page 17, lines 24-25.

When investors make investments of a relatively short-term span, they look at the return over the investment period. The return over a short-term investment period has two components – one is the dividend payment for the same short-term period (maybe three to five years), and the other component is the expected price change which involves the price of the asset at the end of the short-term investment period. The price of the asset at the end of the short-term investment involves the stream of the future dividend payments, which will ultimately be determined by the long-term growth rate of the dividend. In this sense, ignoring the long-term dividend growth is simply a mistake in applying the DCF model.

Q89. MR. MOUL SUGGESTED THAT LONG-TERM GROWTH WAS NOT CONSIDERED BY INVESTORS WHEN MAKING INVESTMENT DECISIONS, BY STATING "INDEED, IF INVESTORS REQUIRED FORECASTS BEYOND FIVE-YEARS IN ORDER TO PROPERLY VALUE COMMON STOCKS, THEN IT WOULD BE REASONABLE TO EXPECT THAT SOME INVESTMENT ADVISORY SERVICE WOULD BEGIN PUBLISHING THAT INFORMATION FOR INDIVIDUAL STOCKS IN ORDER TO MEET THE DEMANDS OF THE MARKETPLACE." DO YOU AGREE WITH THIS STATEMENT?

A89. I do not agree with the statement in his testimony that "indeed, if investors required forecasts beyond five-years in order to properly value common stocks, then it would be reasonable to expect that some investment advisory service

would begin publishing that information for individual stocks in order to meet the demands of the marketplace."[21]

I believe this statement is simply false as lacking of long-term forecast of dividend growth, even if that is true, does not prove that investors are not considering long-term growth information. Investors may look at other information on long term-term growth when making their investment decisions. In the steady state, a business cannot growth faster than the rate at which the economy is growing. Therefore, long-term growth rate is often proxied by the GDP growth rate in rate setting proceedings. For example, FERC uses GDP growth rate as the proxy for long-term dividend growth rate. So did the Staff for this case. Investors could have been using the short-term growth projections such as the IBES growth rate projections as well as the GDP projections in making investment decisions.

There are many sources of GDP growth rate projections such as the two sources I have provided from EIA and SSA. Professional services such as Blue Chip Financial Forecast also provide long term economic growth projections. Using the logic Mr. Moul applied, the existence of long-term growth projections by government agencies and professional services provides the evidence that investors look at long-term growth rate when making investment decisions.

[21] *Ibid*, page 17, lines 38-page 18, line 2.

Therefore, excluding the long-term growth rate by Mr. Moul is simply erroneous. In addition, as the growth rate in the initial "growth stage" is usually higher than the growth rate in the "steady-state stage," ignoring the long-term growth in the DCF model biases the ROE estimate upward.

Q90. WHAT 3-5 YEAR EARNINGS GROWTH PROJECTION DID MR. MOUL UTILIZE?

A90. Mr. Moul used the 3-5 year earnings growth projections from three sources: IBES/First Call, Zack's and Value Line. The average growth rates from the three sources are 4.99%, 5.45% and 7.06%, respectively. [22] Mr. Moul then picked a number 6.75% as the projected earnings growth rate. There is no reason given as to why Mr. Moul picked a rate that is closer to the higher end of the numbers, rather than the average value.

Q91. DO YOU BELIEVE MR. MOUL'S SELECTION OF THE PROJECTED GROWTH RATE IS APPROPRIATE OR REASONABLE?

A91. No, I do not believe his selection method is appropriate. While these three sources appear to provide the projection of the earnings growth, there are some issues in utilizing them in the way Mr. Moul took. IBES and Zack's surveys cover the projection of some of the same analysts; *Value Line* projection is not from a

[22] *Ibid*, PRM-9.

survey, as it only reflects the opinion of one analyst (*Value Line* itself). In addition, it only updates once every 3 months.

Furthermore, the average projected values from IBES/First Call and Zack's are not directly comparable as Zack's average does not cover all the utilities covered by IBES/First Call. The Table below shows the projected 3-5 year earnings growth from Mr. Moul's sample. Note the average growth rate from Zack's is 5.45% based on five utilities, which is not directly comparable to the average from IBES which was based on all 7 companies. Projections on two companies in Zack's list are not available. The same two companies in the IBES sample have some of the lowest growth values. Assuming analysts projected the growth rate similarly, the two companies without the projected growth rate from the Zack's list should have lower than average projected growth rates. Therefore, the average value (5.45%) from Zack's may be lower than the average value Mr. Moul provided if these two companies had projected growth rates. For this reason, Zack's growth rate should not be included in the analysis.

Table 8: Projected EPS Growth - Moul Sample

Gas Group	I/B/E/S First Call	Zacks	Value Line Earnings Per Share
Atmos Energy Corp (ATO)	7.00%	7.30%	7.00%
Chesapeake Utilities Corp (CPK)	4.74%	N/A	8.50%
New Jersey Resources Corporation (NJR)	6.00%	6.00%	1.50%
Northwest Natural Holding Company (NWN)	3.10%	N/A	5.50%
ONE Gas Inc (OGS)	5.00%	5.00%	6.50%
South Jersey Industries Inc (SJI)	4.40%	4.40%	10.50%
Southwest Gas Holdings Inc (SWX)	4.00%	5.00%	8.00%
Spire Inc. (SR)	5.70%	5.00%	9.00%
Average	4.99%	5.45%	7.06%

Source: Prepared Direct Testimony of Paul Moul, PRM-9

The projections from *Value Line* is substantially higher than the projections from IBES and Zack's which are based on projections of multiple analysts. If the *Value Line*'s forecast is to be included, it should afford less weight. Even if we give the equal weight to IBES and *Value Line*, the average value of IBES's 4.99% and *Value Line*'s 7.06% would generate an average of 6.03%, which is more than 70 basis points lower than Mr. Moul's 6.75%, a number that is chosen arbitrarily and without any statistical or economic support by Mr. Moul. As the projected earnings growth rate goes into the ROE calculation in the DCF model directly, Mr. Moul's DCF analysis exaggerates the required return by at least 70 basis points from the projected growth rate alone.

Q92. DID MR. MOUL MAKE ANY OTHER ADJUSTMENTS TO HIS DCF MODEL RESULT?

A92. Yes, Mr. Moul made a so-called leverage adjustment to his "raw" DCF result. The leverage adjustment amounts to 0.93%. In addition, he also added a flotation cost on top of that. The flotation cost factor is 1.5%, adding 0.17% to the required return on equity for his proxy group companies.

Q93. WHY DID MR. MOUL ADD A LEVERAGE ADJUSTMENT?

A93. According to Mr. Moul, there are two related reasons for the adjustments. One is that the market value of the utilities' equity is higher than the book value equity, and the other is that the market required return on equity is applied to book value capital structure in this rate proceeding.

Q94. DO YOU AGREE WITH HIS LEVERAGE ADJUSTMENT?

A94. I do not agree with Mr. Moul's leverage adjustment for several reasons. First, there is no market value capital structure; and investors rely on book value capital structure for investment decisions. Financial services including *Value Line* only report book value capital structure. Only book value capital structure is filed with Security Exchange Commission. Second, there is only one leverage for each company, and any adjustment in the leverage is not justified. I also explained in a later section that the leverage adjustment by the Hamada equation by Mr. Moul is incorrect, as the Hamada formula Mr. Moul relied on to make the so-called

leverage adjustment is based only on market value capital structure. However, Mr. Moul was using book value capital structure in the unleveraging-releveraging process, which is theoretically incorrect, as Professor Scott Linn and I have pointed out in Exhibit ZZ-11.

Utilities' market value equity is higher than the book value equity precisely because utilities are earning more returns on book value equity than market required. This should be easy to understand: A utility's expected return on equity is higher than required, thus driving investors to buy the stocks of the utility. As the result, the market value is driven higher than the book value.

Perhaps it is due to these reasons, to my knowledge, there are no jurisdictional authorities that have adopted the leverage adjustment.

I believe there are sound practical reasons for the commissions not to accept the adjustment. Commissions would face a regulatory dilemma if the leverage adjustment is adopted: based on the leverage adjustment approach, a utility that has a higher market to book value will see a higher return to an already high return. On the flip side of it, a utility will see a decrease to its already low returns if the utility has a market value lower than the book value. In this sense, the leverage adjustment is illogical.

Q95. WHAT IS THE FUNDAMENTAL REASON BEHIND MR. MOUL'S LEVERAGE ADJUSTMENT?

A95. I believe Mr. Moul proposed the leverage adjustment because the current practice of rate setting for utilities is the application of the market required returns on book value capital structure.

Q96. IS THIS PRACTICE OF APPLYING BOOK VALUE CAPITAL STRUCTURE ACCEPTED BY UTILITY JURISDICTIONAL AUTHORITIES?

A96. Yes, it is generally accepted. As a matter of fact, the use of the book value capital structure for determining allowed return was firmly established by the U.S. Supreme Court in its seminal decision of *Federal Power Commission v. Hope Natural Gas Company*, 320 US 591 (1944).

Q97. DO YOU BELIEVE A FLOTATION COST ADJUSTMENT IS JUSTIFIED?

A97. I do not believe flotation cost adjustment to utility ROE is justified. Flotation costs are the costs related to the sale of new issues of company common stocks, including the preparation, filing, underwriting of the new issuance, and other related costs. There are several reasons why flotation costs should not be included to increase the return on equity. Columbia has not identified any stock issuance costs of its parent and it is not fair for the utility's consumers to pay for something that is not identifiable. Columbia's consumers should not bear the burden of its parent company's previous issuance of stocks if there is any. If the Company has

experienced flotation costs, it would already be included in the Company's expense schedule. As a matter of fact, the flotation cost is the difference between what the investors pay for a company's stock and what the company receives – there is no cost to be recovered. The capital market should have already factored in the transaction costs as the underwriting fees are known to the investors. Investors should have already considered this information when pricing the stocks they are purchasing, and they should not be compensated twice.

Q98. CAN YOU DESCRIBE THE RP METHOD THAT MR. MOUL USED TO ESTIMATE THE ROE FOR COLUMBIA GAS?

A98. Mr. Moul's ROE from the RP model has three components: an interest rate of 3.75% represented by the long-term A-rated public utility bond yield, a risk premium of 6.75% and a flotation cost of 0.17% for a total of 10.67% ROE. In the final recommendation of the ROE, the 0.17% flotation cost was not included, so the RP ROE is 10.5%. See below for a summary of the ROE from Mr. Moul's RP model:

Table 9: Mr. Moul's RP Model Result	
Interest rate:	3.75%
RP:	6.75%
Flotation cost:	0.17%
Total:	10.67%

Q99. DO YOU HAVE ANY MAJOR ISSUES WITH RESPECT TO MR. MOUL'S RP MODEL?

A99. I have two major issues with Mr. Moul's RP model, in addition to the more general issue of inclusion of the flotation cost which I addressed earlier.

Q100. CAN YOU EXPLAIN WHAT ISSUES YOU DO HAVE?

A100. The first issue is with Mr. Moul's method to obtain the interest rate, and the second has to do with the way to obtain the risk premium. Mr. Moul's long term A-rate utility bond yield was obtained by adding a 1% spread between the A-rated utility bond yield and 30-year T-bond yield to the forecasted interest rate (Blue Chip forecast of 30-year T-bond yield). Mr. Moul's risk premium was determined by a casual description of the relationship between risk premium and interest rate. The interest rate Mr. Moul used was the long-term government bond; however, the risk premium was the difference between large stock returns and long-term corporate bond. Therefore, there are at least three specific problems with Mr. Moul's way to the RP modeling.

1. The forecasted interest rate should not be used as the interest rate, in general. This issue also arises in Mr. Moul's application of CAPM model.
2. The equity risk premium was obtained from the difference between large stock returns and long-term corporate bond, but then the risk premium was added to the interest rate represented by the utility

bond yield, a different interest rate. This is a mismatch here. The estimate of the ROE my Mr. Moul's method is not a return of a utility, but a return of a large stock.

3. Mr. Moul chose a risk premium of 6.75 without giving convincing reasons why such a number was chosen. The risk premium-interest rate relationship was not established by a rigorous statistical method. As a matter of the fact, there is no statistically significant relationship between the risk premium and interest rate as defined by Mr. Moul, and thus it fails to be the basis for Mr. Moul to estimate the risk premium.

Q101. WHY DO YOU THINK THE FORECASTED INTEREST RATES SHOULD NOT BE THE INTEREST RATES USED IN THE MODEL?

A101. Even though the model requires the expected future interest rates, in my opinion, the best forecast of the future interest rates is the current interest rates. I believe the interest rates are extremely difficult to forecast and the interest rate forecasts from the past have been shown to perform poorly. The alternative to the interest rate forecast is to use the current market interest rate as what the market expects about the future interest rate.

There is serious doubt that these interest rate forecasts can outperform a simple forecast of interest rates by using the current market interest rate. The bond

markets are efficient; as the result, the best expected future interest rate is the current market interest rate.

Q102. PLEASE EXPLAIN WHY CURRENT INTEREST RATES ARE THE BEST FORECASTS OF THE EXPECTED INTEREST RATES.

A102. Financial information comes into marketplace randomly and the interest rate goes up or down with equal chances. Nobody can systematically get ahead by guessing what is going to happen in the marketplace. This leads to a phenomenon called "random walk." When a financial variable such as the interest rate follows a random walk, it implies that the best forecast of its future behavior is its immediate past. In this case, the immediately past available information is the latest interest rate or the current interest rate observable in the market.

Q103. WHAT SUPPORT DO YOU HAVE FOR THE CLAIM THAT THE BEST FORECAST OF INTEREST RATE IS THE CURRENT INTEREST RATE?

A103. There have been doubts about the predictability of long-term interest rates for a long time. As early as 1979, Professor Pesando provided reasons why it is not surprising for economic models to underperform the random walk forecast of interest rate.[23] The random walk forecast of interest rate is the current market interest rate.

[23] James. E. Pesando, "On the random walk characteristics of short- and long-term interest rates in an efficient market," Journal of Money, Credit and Banking, 1979, vol. 11, 457–66.

In a more recent study, Baghestani, Arzaghi, and Kaya (2015) documented evidence of model blue chip predictions being inferior to random walk models.[24] In a more extensive study of U.S. interest rate forecasts, Spiwoks, Bedke and Hein (2008), after a study of 136 forecasting series with 13,800 forecast data, showed empirical evidence that the random walk model dominated the forecasts series.[25] In the article, they stated: "Not one of the forecast time series proved to be unbiased. In the majority of cases, information from the past was not efficiently integrated into the forecasts. The sign accuracy is significantly better than random walk forecasts in only a very few of the forecast time series." What this passage suggests is that the professional forecast of interest rates systematically over- or under-projected the movement of the interest rate ("not unbiased"). The majority of the forecasts could not even predict the direction of movement correctly, not to mention the magnitude of the interest rate movement.

Q104. HOW HAS THE PAST FORECAST OF INTEREST RATE FARED?

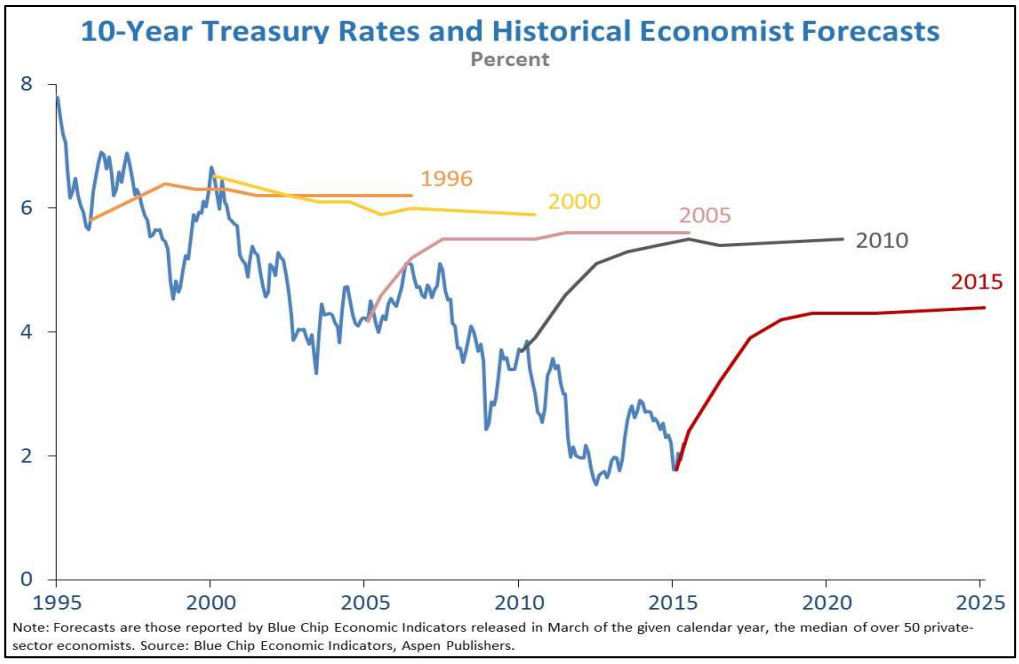
A104. The long-term interest rate has been declining, so many would project that the interest rate will eventually rise again. However, this kind of projection has not been doing well. In 2015, Obstfeld and Tesar[26] presented the chart below of 10-

[24] Hamid Baghestani, Mohammad Arzaghi and Ilker Kaya, "On the accuracy of Blue Chip forecasts of interest rates and country risk premiums," Applied Economics, 2015, Vol. 47, No. 2, 113–122, http://dx.doi.org/10.1080/00036846.2014.959656.

[25] Spiwoks, Markus; Bedke, Nils; Hein, Oliver, "Forecasting the Past: The Case of US Interest Rate Forecasts," Financial Markets and Portfolio Management Vol. 22, Iss. 4, (December 2008): 357-379.

[26] M. Obstfeld and L. Tesar, (2015)." The Decline in Long-Term Interest Rates." https://obamawhitehouse.archives.gov/blog/2015/07/14/decline-long-term-interest-rates.

year Treasury rates and historical forecasts which showed consistently high interest rate forecasts despite the fact that the interest rate was declining over time.



Q105. IS IT TRUE EVERYONE IS EXPECTING THE FEDERAL RESERVE TO TIGHTEN MONETARY POLICY TO FIGHT HIGH INFLATION RATE SO THE INTEREST RATE WILL BE HIGHER IN THE FUTURE?

A105. First, I need to point out again that Federal Reserve monetary policy targets short-term interest rate. It does not necessarily lead to changes in the long-term interest rate trend. Second, if everyone is expecting the Federal Reserve to increase the interest rate in the future, the market would have reacted to this expectation already. That is, the current interest rate should have already incorporated the future rate increase information. If it meant to increase upon the expected

monetary policy, it would have already increased. It is like when one expects a stock price to increase in the future, she/he would have bought the stock upon her/his expectation. The action of the buying would have caused the stock price to increase already. It is unimaginable that the investor would wait until later to buy the stock at the time of actual price increase. This is again essentially the concept of market efficiency.

It is generally regarded that the U.S. financial markets including the bond markets where interest rates are determined are very efficient. When bond markets are efficient, only unexpected information flow would lead the interest rate to change, let the information be that the Federal Reserve would increase interest rate more times than the market already expected due to the toughness of the high inflation to subside, or fewer times than market expected as the recessionary effect of the monetary tightening might be too fast and too large. Unfortunately, nobody can predict what is going to happen to the interest rate in the future.

Q106. DO YOU THINK THE RISK PREMIUM MR. MOUL CALCULATED REPRESENTS THE RISK PREMIUM OF THE GAS UTILITIES?

A106. No, I do not believe Mr. Moul estimated the gas utility risk premium correctly. His method of obtaining the risk premium is wrong.

Mr. Moul calculated the risk premium as the difference between the average returns from large company common stocks and the long-term corporate bonds. Then he guessed, not estimated, the relationship between the risk premium and interest rate, and then added a risk premium to a different interest rate – long-term government bond yield to obtain the expected returns. There are several problems with this approach. The first is he just simply picked a number without any statistical or empirical support. Secondly, a different interest rate is used in obtained the expected risk premium, which is a mismatch and incorrect. It is well-known that in estimating the risk premium relationship, the same interest rate should be used. The following example illustrates the idea. Risk premium is defined as the stock return minus the interest rate (rate 1), and then the anticipated interest rate (rate 1) is added back to the expected risk premium to obtain the anticipated stock return. The interest rate should be the same in this estimation. However, Mr. Moul used the corporate bond yield as the first interest rate (rate 1) and then government bond yield (rate 2) as the second interest rate. Therefore, it is not clear what we are obtaining as the result.

In addition, the task in this case is to estimate the required return on a utility's return, so we should use the equity risk premium of the utility stocks. However, Mr. Moul used the returns of the large common stocks, thus the risk premium he calculated (if correctly) would represent the risk premium of large companies, not the gas utilities.

Q107. WHY DO YOU BELIEVE MR. MOUL'S RISK PREMIUM AND INTEREST RATE RELATIONSHIP IS NON-EXISTENT AND THUS THERE IS NO BASIS FOR MR. MOUL'S RISK PREMIUM ESTIMATE?

A107. Even if Mr. Moul has defined the risk premium and the relationship between risk premium and interest rate correctly, his data shows that there is no empirical relationship between the risk premium he constructed and the interest rate he chose. Exhibit ZZ-10 shows that in the scatter plot of the risk premium and long-term government bond yield, the points are scattered all over the place, indicating no negative relationship, which is contrary to what Mr. Moul suggested in his testimony.[27] A formal test also indicates so. The R square from a regression of risk premium on the interest rate as Mr. Moul calculated shows the percentage of the variation in the dependent variable (risk premium) to be explained by the independent variable (interest rate).

If a variable explains the other variable perfectly, the R square would be equal to 1 or 100%. If a variable does not explain the other variable at all, then R square would be equal to 0. The R square from the regression of Mr. Moul's risk premium on his interest rate variable yielded a R square of 0.00275, virtually zero. This result confirms the impression one would get from the visual inspection of the scatter plot in Exhibit ZZ-10. Furthermore, the coefficient to the government bond yield variable is not statistically significant, meaning that the

[27] Prepared Direct Testimony of Paul Moul, page 25, lines 21-26.

interest rate variable – long-term government bond yield has nothing to do with the risk premium as measured by Mr. Moul. There it lacks a valid basis for Mr. Moul to calculate the ROE based on the RP model.

Q108. CAN YOU SUMMARIZE THE RESULT OF YOUR ANALYSIS OF MR. MOUL'S RISK PREMIUM MODEL?

A108. Mr. Moul's risk premium model employed an incorrect measure of interest rate, an incorrect measure of risk premium, and his data indicates no valid relationship between the risk premium and interest rate – a basis for him to build the expected return on equity. Thus, his RP model is fundamentally flawed, and his ROE result is totally invalid. I recommend the Commission to totally disregard his RP analysis.

Q109. CAN YOU DESCRIBE MR. MOUL'S CAPM APPROACH AND THE ROE RESULT?

A109. Mr. Moul employed the standard CAPM model with some twists of his own. The risk-free rate he employed is the forecasted interest rate. He obtained betas of the companies from *Value Line* but then he adjusted them by the Hamada formula to achieve the so-called Hamada Leverage Adjustment. The market risk premium was obtained as the average of the historical risk premium for the period of 1926-2021 and the forecasted risk premium based on Value Line returns and a return by applying the DCF model to the S&P 500 companies. Finally, he applied a size

premium of 1.02% to arrive at an ROE of 12.51% before adding a flotation cost of 0.17%. As for the DCF and RP models, he did not include the flotation cost in his final ROE recommendation. See below for a summary of Mr. Moul's CAPM model result:

Table 10: Mr. Moul's CAPM Model Result	
Risk free rate:	2.75%
Beta:	0.98
Market risk premium:	8.92%
Size premium:	1.02%
Flotation cost:	0.17%
Total ROE:	12.68%

Q110. WHAT PROBLEMS DO YOU SEE IN MR. MOUL'S CAPM ANALYSIS?

A110. There are several major problems in Mr. Moul's CAPM analysis, including the use of the forecasted interest rate, the use of pandemic affected raw *Value Line* beta, the application of the Hamada beta adjustment, the employment of the historical market risk premium, the inclusion of a size premium and flotation cost. My analysis of Mr. Moul's CAPM analysis will focus on the issues other than the forecast interest rate. I have already argued earlier that the correct use of the interest rate in any of the models should be the actual interest rate, not the forecasted interest rate. In addition, I have already argued that there is no justification for the inclusion of a flotation cost.

Q111. WHAT BETA SHOULD BE USED IN THE CAPM ANALYSIS?

A111. As I argued earlier in this testimony, the estimation of the raw beta from *Value Line* or any other professional services is affected by the inclusion of the

pandemic 2020 period and the high beta value is the artifact of the 5-year regression to obtain the beta estimate. The risks of the utility companies with respect to the market have returned to a more normal level, thus the use of the raw beta value inflates the estimates of market required ROE. The beta value should be adjusted as I did in my analysis.

Q112. CAN YOU EXPLAIN WHAT THE HAMADA LEVERAGE ADJUSTMENT IS?

A112. Professor Hamada, once the dean of the famed Booth College of Business at the University of Chicago, was the first to derive the relation between a company's stock's beta and the company's market value debt/equity ratio. Specifically he shows that beta increases as the market debt/equity ratio increases. Hamada defines two different betas for a company's stock. One beta is what we usually obtain from the investment services such as *Value Line*, and this beta is called the levered beta as it is derived from the market data reflecting the company's existing capital structure, that is, its market value debt/equity ratio. In contrast, suppose the same company used no debt financing, then the corresponding beta would be what we would observe for an unlevered (no debt financing) company, and is typically referred to as the unlevered beta. The levered beta exceeds the unlevered beta when the company uses debt financing.

Some cost of capital witnesses, especially the ones on behalf of utilities, advocate the use of the Hamada Leverage Adjustment. The Hamada equation is then used in rate proceedings to adjust the unlevered beta using the book value debt/equity ratio. If the book value of equity is less than the total market value of equity, which is typical nowadays, the Hamada adjustment will lead to a beta that is inflated more than it should be, and consequently a required return on equity computed using the CAPM that is larger than it should be.

I have provided an explanation of the Hamada adjustment and the reasons why the adjustment is not valid in an article (Exhibit ZZ-11) that I coauthored with Professor Scott Linn. The article is forthcoming in the next issue of *Energy Forum* by International Association for Energy Economists.

Q113. CAN YOU BRIEFLY EXPLAIN WHY THE HAMADA ADJUSTMENT AS APPLIED BY MR. MOUL IS NOT VALID?

A113. There are at least two problems associated with the Hamada adjustment as applied in the rate proceedings. Mr. Moul, like other proponents of the adjustment, argues that there are two financial risks associated with the company, one is reflected in the book value capital structure and another one is reflected in the market value capital structure. However, there is only one financial risk for any company, and that is reflected in the beta value based on the market information such as the

Value Line beta. Second, the process of unlevering and relevering as described by Mr. Moul is simply incorrect. Mr. Moul explains:[28]

> "To develop a CAPM cost rate applicable to a book-value capital structure, the Value Line (market value) betas have been unleveraged and re-leveraged for the book value common equity ratio using the Hamada formula."

However, as Professor Linn and I explained in the article, the Hamada formula was developed using the market value capital structure concept. Applying a book value capital structure in the adjustment process renders the whole adjustment invalid. There is simply no place for book value capital structure in the Hamada equation.

Furthermore, as we have explained in the article, the Hamada adjustment process assumes, even if we are using the correct market value debt/equity ratio, that the beta of the company's debt is zero. This assumption is simply not strictly met, although academic studies that present estimates of bond betas generally find that they are small but nevertheless positive. Thus the formula is invalid for any levering or unlevering operations in general if the company's debt beta is not zero or the risk is systematic. As the result, the so-called Hamada Leverage Adjustment is not valid at all.

[28] Prepared Direct Testimony of Paul Moul, page 27, lines 20-23.

Q114. MR. MOUL APPLIED A HISTORICAL MARKET RISK PREMIUM IN HIS CAPM ANALYSIS. DO YOU AGREE WITH HIS APPROACH?

A114. No, I do not agree with his historical approach. Using a historical relationship between the market return and bond yield is erroneous as the ROE is an ex-ante concept that represents investors expected required market return on investment. The market risk premium should be the expected market risk premium for the future, not the past market risk premium, as the past can be significantly different from the current and future market conditions. In a discussion of forecasted versus historical earnings growth, Mr. Moul said "while history cannot be ignored, it is already factored into the analysts' forecast of earnings growth,"[29] and "hence, there is no need to count historical growth rates a second time, because historical performance is already reflected in analysts' forecasts which reflect an assessment of how the future will diverge from historical performance."[30] Even though Mr. Moul was talking about historical and forecasted earnings growth, the same principle applies in the context of historical and forecasted market risk premium.

In addition, the historical market return in Mr. Moul's analysis utilized arithmetic growth instead of the geometric growth formula. It is well known that the arithmetic growth formula applied in a dataset that contains multiple years' data biases upward the growth rate or return significantly. A simple example could

[29] Prepared Direct Testimony of Paul R. Moul on behalf of Eastern Gas Transmission and Storage, Inc. before the Federal Energy Regulatory Commission, page 20, lines 17-18.

[30] *Ibid*, page 20, lines 20-23.

illustrate this idea. Suppose we have a stock price of $100 for the first year, and then it drops to $50 in the second year followed by a return to $100 in the third year. The arithmetic growth rate would be an annual average of 25% ((-50% + 100%)/2 = 0.25%). However, the correctly calculated annual growth rate should be 0%. Thus, Mr. Moul's calculation of returns exaggerates the historical returns.

Q115. MR. MOUL ALSO INCORPORATED A SIZE PREMIUM FOR THE CAPM ANALYSIS RESULT. WHY DO YOU THINK THE SIZE PREMIUM IS A NOT REASONABLE ADDITION TO THE ROE OF COLUMBIA GAS?

A115. Mr. Moul adopted the size premium from the SBBI yearbook. However, the size premium calculated in the SBBI yearbook relied on historical data and has many known errors. SBBI assumes a rebalanced portfolio which has a return that is biased upward. In addition, there is a survival bias in the SBBI dataset as only the successful companies are included in the dataset as performance-poor companies may not survive, which leads to exaggerated market returns.

Furthermore, there is no evidence that the size premium, if there is any, could be found in the utility industry. In a study of the utility size premium versus industrial firm size premium, Professor Annie Wong failed to find any significant size effect for utility stocks while she found some size effect for the industrial

companies.[31] She also explained the findings based on the characteristics of the utility and industrial firms. The utilities have similar information environment while industrials do not as utilities are heavily regulated and follow similar accounting procedures. In addition, a utility's earnings are predetermined to a certain degree. I believe her finding and explanation are very reasonable as the size premium of smaller companies usually hinges on the fact that investors often have less publicly available information on small firms than large firms. For the utility industry, the information environment is different from that of industrial companies. For this reason, I believe there is no justification for the size premium added to the ROE for Columbia Gas as the addition of a small firm premium biases the ROE upward so it should not be allowed.

Q116. CAN YOU EXPLAIN MR. MOUL'S COMPARABLE EARNINGS APPROACH?

A116. Mr. Moul chose a set of non-regulated companies as the proxy group and employed the *Value Line* data on earnings. He chose a historical value of 12.00% and an average forecasted rate of return of 12.3%. His ROE from the CE model is 12.15%.

[31] Annie Wong, "Utility stocks and the size effect: an empirical analysis," Journal of Midwest Finance Association, 1993, pp 95-101.

Q117. WHAT ARE YOUR MAIN OBJECTIONS TO MR. MOUL'S CE APPROACH?

A117. I have two issues. One is the use of the non-regulated proxy group. As regulated utilities have different operating characteristics and regulatory environment from the non-regulated industries, it is difficult to characterize the risks faced by these businesses. In a non-regulated, competitive industry, firms can enter and exit without any constraints. However, a utility does not have that degree of freedom. In a non-regulated industry, firms can set their own prices and choose the best pricing strategy. However, a regulated utility cannot set their rates at will.

On the other side, non-regulated businesses are responsible for the results of their investment decisions, while a regulated utility can have the rate of return on their investment largely set by the jurisdictional authorities, thus the risks associated with investment are a lot lower than faced by non-regulated industries. For this reason, in rate setting proceedings, the convention is to choose proxy groups based on the type of utility, i.e., gas utilities for a gas utility company and electric utilities for an electric utility company.

Q118. WHAT IS YOUR OTHER MAIN OBJECTION?

A118. My other main objection is that the ROE for a utility is a required return on capital determined in the marketplace. It is a market value concept. However, the rate of return as obtained by Mr. Moul in his CE approach is the rate of return on

book value, not market value, equity. This approach is problematic as investors require a fair return on market value of equity, not book value, because investors cannot buy stocks at book value. Precisely for this reason, FERC has rejected CE or Expected Earnings models as a method to estimate the market required return on equity. FERC stated:

> The Commission explained that the return on book value is not indicative of what return an investor requires to invest in the utility's equity or what return an investor receives on the equity investment, because those returns are determined with respect to the current market price that an investor must pay in order to invest in the equity. Specifically, the Commission found that the Expected Earnings model measures returns on book value, without consideration of what market price an investor would have to pay to invest in the relevant company, so it does not accurately measure the investor's expected returns on its investment, and, therefore, has been "thoroughly discredited"[32].

VIII. CONCLUSIONS

Q119. COULD YOU PLEASE STATE THE OVERALL CONCLUSION OF YOUR ANALYSIS?

A119. My analysis suggests that the Company's requested capital structure is consistent with the capital structure of the proxy group. The cost of debt is based on the Company's actual cost of debt. I recommend the Commission to accept the requested capital structure and cost of debt. In addition, my analysis suggests that Columbia is a company whose overall risk is about the same as the average risk of

[32] FERC Opinion No. 569-A, Order on Rehearing, (Issued May 21, 2020). Para 117, page 51.

the proxy group companies. Based on my analysis of the ROE based on three models, the DCF, the CAPM and RP models, I recommend to the Commission to authorize a ROE that is around 8.65%. I then provided an analysis of the Staff ROE estimation and provided evidence to suggest that the Staff has erred on several critical assumptions of the DCF and CAPM models, thus, the Staff's ROE recommendation is higher than the market required return for Columbia. In the last sections of my analysis, I showed that Mr. Moul's ROE analysis for Columbia is seriously flawed and leads to upward-biased ROE estimate, and thus his ROE results should be disregarded by the Commission.

Q120. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY AT THIS TIME?

A120. Yes, it does. However, I reserve the right to incorporate new information that may subsequently become available. I also reserve the right to supplement my testimony in the event Columbia, the PUCO Staff or other parties submit new or corrected information in connection with this proceeding.

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing *Direct Testimony of Zhen Zhu on behalf of Office of the Ohio Consumers' Counsel* and *Northeast Ohio Public Energy Council* has been served upon those persons listed below via electronic service this 13th day of May 2022.

/s/ Angela D. O'Brien
Angela D. O'Brien
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The PUCO's e-filing system will electronically serve notice of the filing of this document on the following parties:

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EDUCATION:

Ph.D., Economics, University of Michigan, 1994
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Dr. Zhu is an Economist specializing in the areas of cost of capital and cost of service analysis for electric and gas utilities. He has provided analyses and support in many public utility (both electric and gas) cost-of-capital cases and cost of service cases. He has been providing consulting services on behalf of the State Water Project of California (an Intervenor) in the Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric Transmission Formula rate cases. More recently, he has been involved with providing consulting services to the Duke Energy Progress rate case intervention for the US Army, among others. He has also presented cost of capital direct testimony and rebuttal testimony in the rate case of Dominion Energy South Carolina on behalf of the US Army, and cost of capital direct testimony in the Vermont Gas Systems rate case in 2021 on half of Vermont Department of Public Service.

Dr. Zhu also specialized in areas such as load forecasting, natural gas market analysis and modeling, gas price and underground storage forecasting, risk management and hedging strategy, financial analysis of merger potential, and other economic and statistical analyses. He has performed various studies regarding natural gas market risk management, price and volatility determination, market efficiency, and the analysis of gas pipelines. He has also performed numerous power price analyses, load analyses, weather normalization, and demand and energy forecasts for electric IOUs and cooperatives, evaluation of solar energy projects, corporate merger activities, stock market and foreign exchange market volatility, and financial market deregulation. Dr. Zhu has been instrumental in successfully modeling the storage injections and withdrawals from the U.S. natural gas reservoirs and the impact of these net supply changes on natural gas prices. Dr. Zhu and other Guernsey economists have received national recognition for successfully modeling the prices of natural gas in the physical market and at many trading hubs used in pricing natural gas in today's markets.

Dr. Zhu has testified in cases before several public service commissions regarding cost of capital, long-term demand and load forecasts, fuel price projections, and other issues.

Dr. Zhu is also Dr. Michael Metzger Endowed Chair and Professor of Economics at the University of Central Oklahoma.

Dr. Zhu teaches Master's level Energy Finance courses (Energy Valuation and Investment, Trading, and Risk Management) for the Mewbourne School of Petroleum and Geological Engineering and International Finance, Trade, and other courses for Advanced Programs at the University of Oklahoma.

SPECIFIC EXPERIENCE:

<u>Natural Gas</u>

Dr. Zhu has developed and maintains natural gas futures contract pricing models and natural gas storage models. He has also developed and maintained natural gas pricing models for multiple delivery points for a large Texas-based electric distribution cooperative and several other cooperatives. Dr. Zhu devised hedging strategies for several utilities and has done extensive study of natural gas price and natural gas markets.

Cost of Capital

Dr. Zhu has provided testimony and support in many gas and electric utility cost of capital cases.

Dr. Zhu provided cost of capital testimony in the rate case of Vermont Gas Systems on behalf of Vermont Department of Public Service in 2021.

Dr. Zhu provided cost of capital testimony in the rate case of Green Mountain Power on behalf of Vermont Department of Public Service in 2022.

Dr. Zhu was a ROE expert on a rate case of Columbia Gas Transmission LLC on behalf of Ohio Consumers Counsel before FERC in 2021

Dr. Zhu also serves as a cost of capital consultant for Ohio Consumers Counsel on the Columbia Gas of Ohio rate case in 2022.

Dr. Zhu also serves as a cost of capital consultant for Ohio Consumers Counsel on the Eastern Gas Transmission and Storage rate case before FERC in 2022.

Dr. Zhu served as a ROE expert in the rate case of Dominion Energy South Carolina, and submitted direct and rebuttal testimonies before the South Carolina Public Service Commission on behalf of the US Army and other Executive Agencies.

Dr. Zhu has assisted Department of Defense on Duke Energy Progress rate case in North Carolina on cost of capital and capital structure issues, DOCKET NO. E-2, SUB 1219, 2019-2020.

Dr. Zhu has assisted clients in Illinois on cases pending at FERC on ROE issues based on the new FERC ROE methodology.

Dr. Zhu has been providing consulting services, specifically related to capital structure and return on equity, to and on behalf of the State Water Project of California (an Intervenor) in the Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric Transmission Formula rate cases. Teaming with legal counsel, Dr. Zhu represents and negotiates on behalf of client at settlement conferences conducted at FERC in Washington DC.

Dr. Zhu testified on cost of capital on behalf of Michigan Attorney General's Office before Michigan Public Service Commission in the Matter of the Application of Indiana Michigan Power Company for authority to increase its rates in the sale of electricity energy and for approval of depreciation accrual rates and other related matters, Case No. U-18370, 2017.

In addition, Dr. Zhu has studied the connection of the U.S. economy and U.S. gas and electric utility return on equities, and the determination of the ROE. The studies have been published in trade, industrial, and academic journals.

Load Forecasting & Statistical Analysis, and other Financial and Economic Analysis

Dr. Zhu examined factors determining future fuel prices and loads, and then provided expert testimony services related to fuel prices and load forecasts for the following projects:

Dr. Zhu testified on energy and demand forecasts, and fuel price forecast issues before the Georgia Public Service Commission in Georgia Power Company's application for Approval of its 2007 Integrated Resource Plan, Docket No. 24505-U, 2007.

Dr. Zhu presented expert testimony before the Oklahoma Corporation Commission on fuel cost/pricing issues, providing rebuttal testimony before the Corporation Commission of the State of Oklahoma, in the Application of Blue Canyon Windpower II, LLC for establishment of purchased power rates and a purchase power contract with DUKE – Public Service Company of Oklahoma, pursuant to PURPA, Cause No. PUD 20030063, 2004.

Dr. Zhu presented expert testimony before the South Carolina Public Service Commission Docket No. 2008-196-E: "Combined Application of SCE&G for the Construction and Operation of a Nuclear Facility in Jenkinsville, S. Car." regarding load forecast and fuel forecast issues.

Dr. Zhu has performed numerous studies of financial markets and published extensively in financial economics, energy economics and other economics/finance fields.

Dr. Zhu studied the impact of government regulation on stock price volatilities using the event study methodology and the study was published in Journal of Financial Services Review and many other journals.

Dr. Zhu has used many time series models to study the financial prices including exchange rates, stock prices, and natural gas futures prices and so on. The studies have been published in many leading academic journals.

Other Consulting Experience

Dr. Zhu developed and maintained Guernsey's LDC, DisCo, and GenCo stock price indices, developed fuel cost and hedging strategies for utilities, and developed and maintains load forecast models.
Dr. Zhu has been involved in the inventory forecast system development, merger intervention projects for gas and electric utilities, integrated resource planning projects, survey design and statistical analysis, weather normalization studies and many others.

Previous Professional Experience:

Dr. Zhu has served as an Assistant Professor of Economics at The University of Oklahoma, a Research Fellow of Financial Research Institute at the University of Missouri, and as an Instructor and Teaching Assistant in the Department of Economics at the University of Michigan.

SELECTED RECENT PUBLICATIONS AND PROFESSIONAL PAPERS

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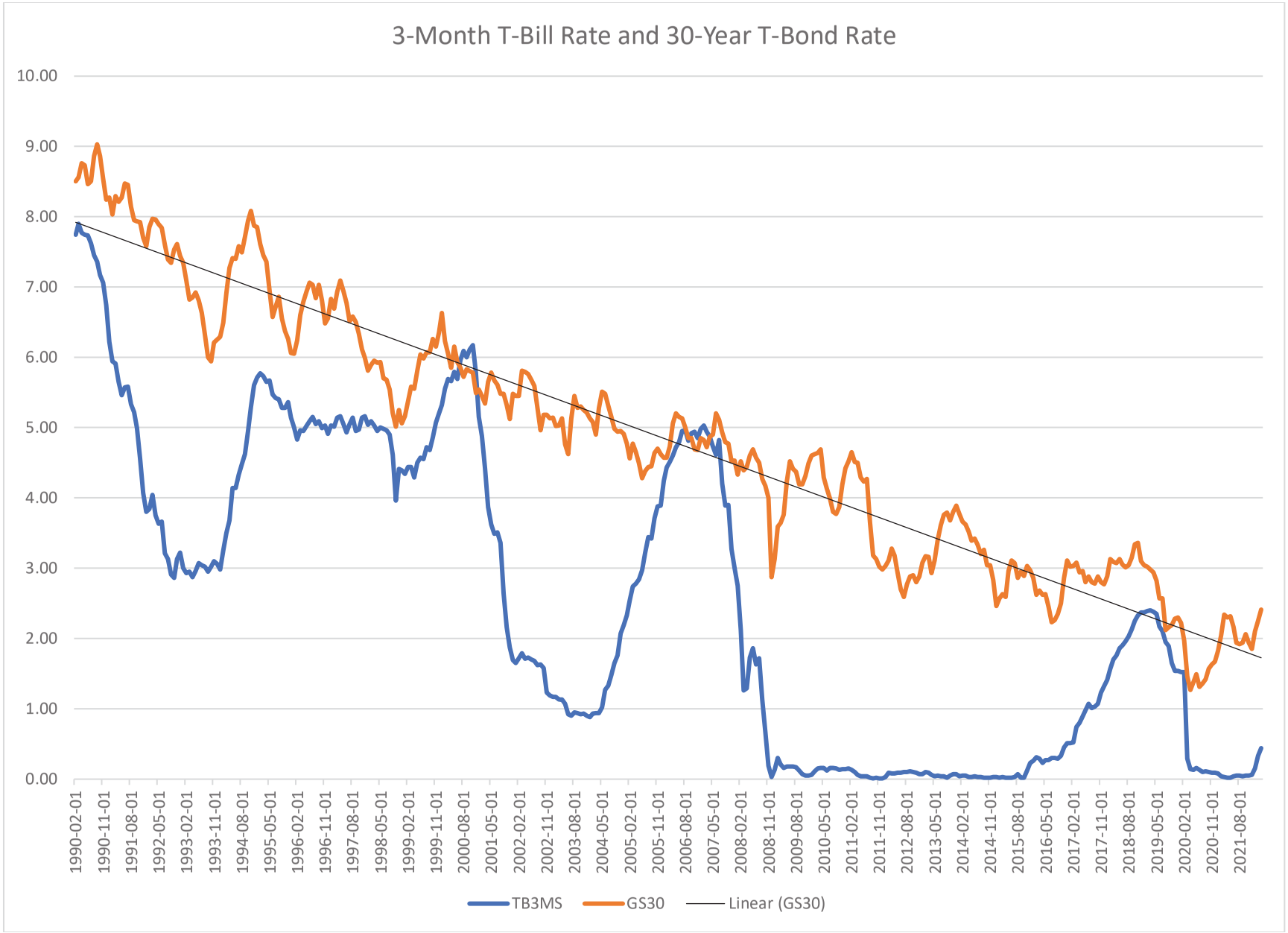
PROFESSIONAL ACTIVITIES / HONORS:

Barnabas Fellow, UCO, 2011-2012
Distinguished Paper Award, Association of Public and Business Administration, 2008
Faculty Research Merit Award, UCO, 2007, 2009, 2011
OSEHE-EPSCor Summer grant Writing Institute, UCO, 2008
Faulty Incentive Awards, Graduate College, UCO, 2007, 2008, 2009
McGraw-Hill Irwin Distinguished Paper Award, Southwestern Society of Economists, 2006.
Marquis' Who's Who in American Education, 2003.
Research Fellow, Financial Research Institute, University of Missouri, 2001, 2002.
Hauptman Fellow, University of Central Oklahoma, 2001.
Distinguished Researcher Award, College of Business, University of Central Oklahoma, 2002.
Marquis Who's Who in America: Finance and Industry, 1999
ODE Professor of the Year, 1997-1998, University of Oklahoma
Member, American Finance Association, International Association for Energy Economists


3-Month T-Bill Rate and 30-Year T-Bond Rate
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6.00
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3.00
2.00
1.00
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1990-11-01
1991-08-01
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1993-02-01
1993-11-01
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2021-08-01
TB3MS
GS30
Linear (GS30)

Common Equity Ratio

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Expected 2023	Expected 2025-2027
1	Atmos Energy Corp	ATO	54.6	50.6	54.7	51.2	55.7	56.5	61.3	56	65.7	62	60	61.6	60	60	60
2	New Jersey Resources	NJR	62.8	64.5	60.8	63.4	61.8	56.8	52.3	55.4	54.6	50.2	44.9	43	42.5	43	42.5
3	NiSource	NI	45.3	44.4	44.9	43.7	43.1	39.3	40.2	36.5	37.9	36.9	32.9	34	35	36	41.5
4	N.W. Natural	NWN	53.9	52.7	51.5	52.4	55.2	57.5	55.6	52.1	51.9	51.8	50.8	51	53.5	55.5	55.5
5	One Gas Inc	OGS	0	0	0	0	59.9	60.5	61.3	62.2	61.4	62.3	58.5	38.5	40	42	48
6	South Jersey Industries	SJI	62.6	59.5	55	54.9	52	50.8	61.5	51.5	37.6	40.8	37.4	36	36	37	39.5
7	Spire Inc	SR		61.1	63.9	53.4	44.9	47	49.1	50	54.3	49.7	46.1	43.2	43	44	45
	Average		46.53	47.54	47.26	45.57	53.23	52.63	54.47	51.96	51.91	50.53	47.23	43.90	44.29	45.36	47.43
	Median		54.25	52.7	54.7	52.4	55.2	56.5	55.6	52.1	54.3	50.2	46.1	43	42.5	43	45

	Company		Earning Growth Estimates
			IBES
1	Atmos Energy Corp	ATO	7.30%
2	New Jersey Resources	NJR	6.00%
3	NiSource	NI	3.52%
4	N.W. Natural	NWN	4.60%
5	One Gas Inc	OGS	2.90%
6	South Jersey Industries	SJI	5.20%
7	Spire Inc	SR	4.30%
	Average		4.83%

Projected earnings growth rates were obtained from Finance.yahoo.com as of April 11, 2022
List was based on the February 25, 2022 issue of Value Line

	Nominal GDP ($ Billion)		
	2023	2050	Compounded Annual Growth Rate
[1]. EIA			
Real GDP	20,862	36,652	
GDP Deflator	1.231	2.2730	
	25,681	83,310	4.45%
[2]. SSA Trustees Report	24,815	73,006	4.08%
Average Projected GDP Growth Rate			**4.27%**

[1]. Energy Information Administration, Annual Energy Outlook 2022 (Jan 2022)
[2]. Social Security Administration, 2022 OASDI Trustees Report, Table VI.G6-Selected Economic Variables

DCF Analysis

		[1]	[2]	[3]	[4]	[5]
	Company	Dividend Yield	Earnings Growth Rate	Adjusted Dividend Yield	Projected Earnings Growth Rate	ROE (Two-Step DCF)
1	Atmos Energy Corp	2.62%	7.30%	2.71%	6.29%	9.00%
2	New Jersey Resources	3.53%	6.00%	3.64%	5.42%	9.06%
3	NiSource	3.29%	3.52%	3.35%	3.77%	7.12%
4	N.W. Natural	4.02%	4.60%	4.11%	4.49%	8.60%
5	One Gas Inc	3.17%	2.90%	3.21%	3.36%	6.57%
6	South Jersey Industries	4.71%	5.20%	4.83%	4.89%	9.72%
7	Spire Inc	4.07%	4.30%	4.15%	4.29%	8.44%
	Min	2.62%	2.90%	2.71%	3.36%	6.57%
	Max	4.71%	7.30%	4.83%	6.29%	9.72%
	Median	3.53%	4.60%	3.64%	4.49%	8.60%
	Average	3.63%	4.83%	3.72%	4.64%	8.36%
	Midpoint	3.66%	5.10%	3.77%	4.82%	8.14%

[1]. 6-month average dividend yield Oct 1 to Mar 31 2022
[2] IBES projected earnings growth rate
[3] Dividend yield adjusted by growth rate, = [1]*(1+0.5*[2])
[4]. Long term earnings growth based on IBES Earnings growth projection*2/3+GDP growth rate*1/3
[5] [1]+[2]

symbol	Security	Market Capitalization (billion)	Forward Dividend Yield	Trailing Dividend Yield	Projected Next 5 Year Earnings Growth Rate by IBES (%)	Adjusted Dividend Yield	Adjusted EPS Growth	ROE by DCF	Weighted ROE	Check Sum
MMM	3M	84.34	4.04	3.95	7.15	4.091	6.190	10.281	0.04512	0.00439
AOS	A. O. Smith	10.26	1.65	1.56	8	1.622	6.757	8.379	0.00447	0.00053
ABT	Abbott	206.19	1.54	1.49	12.12	1.580	9.503	11.084	0.11891	0.01073
ABBV	AbbVie	279.81	3.52	3.32	2.57	3.363	3.137	6.499	0.09462	0.01456
ABMD	Abiomed	14.16	N/A	0	5.84					
ACN	Accenture	205.19	1.18	1.16	12.58	1.233	9.810	11.043	0.11790	0.01068
ATVI	Activision Blizzard	62.701	0.59	0.59	16.45	0.639	12.390	13.029	0.04250	0.00326
ADM	ADM	50.11	1.8	1.69	2.9	1.715	3.357	5.071	0.01322	0.00261
ADBE	Adobe	220.33	N/A	0	14.38					
ADP	ADP	89.29	1.96	1.78	13.71	1.902	10.563	12.465	0.05791	0.00465
AAP	Advance Auto Parts	13.03	2.81	1.55	15.25	1.668	11.590	13.258	0.00899	0.00068
AES	AES	15.62	2.66	2.54	7.35	2.633	6.323	8.957	0.00728	0.00081
AFL	Aflac	41.39	2.48	2.05	3.16	2.082	3.530	5.612	0.01209	0.00215
A	Agilent Technologies	40.27	0.6	0.57	13.6	0.609	10.490	11.099	0.02325	0.00210
AIG	AIG	50.39	2.07	2.04	30.69					
APD	Air Products	52.16	2.74	2.54	11.2	2.682	8.890	11.572	0.03141	0.00271
AKAM	Akamai	18.67	N/A	0	12					
ALK	Alaska Air Group	6.81	N/A	0	-23.4					
ALB	Albemarle	24.38	0.76	0.76	29.83					
ARE	Alexandria	30.43	2.42	2.32	0.1	2.321	1.490	3.811	0.00603	0.00158
ALGN	Align	34.44	N/A	0	43.25					
ALLE	Allegion	9.99	1.45	1.23	10.37	1.294	8.337	9.630	0.00501	0.00052
LNT	Alliant Energy	15.13	2.85	2.69	6.1	2.772	5.490	8.262	0.00650	0.00079
ALL	Allstate	38.15	2.48	2.36	-4					
GOOGL	Alphabet (Class A)	1.83	N/A	0	20					
GOOG	Alphabet (Class C)	1.83	N/A	0	20					
MO	Altria	96.71	6.75	6.6	5.36	6.777	4.997	11.774	0.05924	0.00503
AMZN	Amazon	1.66	N/A	0	34.8					
AMCR	Amcor	16.98	4.19	4.15	6.95	4.294	6.057	10.351	0.00914	0.00088
AMD	AMD	185.39	N/A	0	29.9					
AEE	Ameren	22.97	2.65	2.48	7.4	2.572	6.357	8.928	0.01067	0.00120
AAL	American Airlines Group	10.52	N/A	0	-105.1					
AEP	American Electric Power	48.44	3.25	3.15	6.1	3.246	5.490	8.736	0.02202	0.00252
AXP	American Express	127.5	1.09	0.9	23.13					
AMT	American Tower	106.68	2.39	2.17	16.01	2.344	12.097	14.440	0.08015	0.00555
AWK	American Water	28.28	1.54	1.51	8.3	1.573	6.957	8.529	0.01255	0.00147
AMP	Ameriprise Financial	33.52	1.49	1.44	26.39					
ABC	AmerisourceBergen	31.69	1.21	1.17	10.34	1.230	8.317	9.547	0.01574	0.00165
AME	Ametek	30.64	0.65	0.59	-1.2					
AMGN	Amgen	133.27	3.28	2.98	7.13	3.086	6.177	9.263	0.06423	0.00693
APH	Amphenol	44.46	1.06	0.86	10.5	0.905	8.423	9.328	0.02158	0.00231
ADI	Analog Devices	83.28	1.84	1.78	14.71	1.911	11.230	13.141	0.05694	0.00433
ANSS	Ansys	26.73	N/A	0	11.42					
ANTM	Anthem	117.51	1.11	0.98	12.88	1.043	10.010	11.053	0.06758	0.00611
AON	Aon	67.13	0.65	0.63	14.21	0.675	10.897	11.571	0.04042	0.00349
APA	APA Corporation	N/A	1.23	0.58	26.2					
AAPL	Apple	2.78	0.52	0.51	14.85	0.548	11.323	11.871	0.00172	0.00014
AMAT	Applied Materials	116.1	0.75	0.73	16.53	0.790	12.443	13.234	0.07994	0.00604
APTV	Aptiv	34.15	N/A	0	49.34					
ANET	Arista	40.98	N/A	0	17.66					

AIZ	Assurant	10.33	1.52	1.49	17.7	1.622	13.223	14.845	0.00798	0.00054
T	AT&T	166.25	8.96	8.96	3.66	9.124	3.863	12.987	0.11234	0.00865
ATO	Atmos Energy	15.48	2.38	2.24	7.6	2.325	6.490	8.815	0.00710	0.00081
ADSK	Autodesk	45.06	N/A	0	26.7					
AZO	AutoZone	39.15	N/A	0	14					
AVB	AvalonBay Communities	33.74	2.6	2.63	2.54	2.663	3.117	5.780	0.01015	0.00176
AVY	Avery Dennison	13.56	1.65	1.62	7.77	1.683	6.603	8.286	0.00585	0.00071
BKR	Baker Hughes	35.84	1.99	1.92	50.9					
BLL	Ball	29.36	0.88	0.77	14.78	0.827	11.277	12.104	0.01849	0.00153
BAC	Bank of America	347.51	1.95	1.81	23.89					
BBWI	Bath & Body Works	11.67	1.6	0.92	13.96	0.984	10.730	11.714	0.00711	0.00061
BAX	Baxter	38.78	1.45	1.41	11.38	1.490	9.010	10.500	0.02119	0.00202
BDX	Becton Dickinson	74.58	1.33	1.28	6	1.318	5.423	6.742	0.02616	0.00388
WRB	Berkley	17.32	0.53	0.52	9	0.543	7.423	7.967	0.00718	0.00090
BRK.B	Berkshire Hathaway	769.04	N/A	0	23.3					
BBY	Best Buy	22.37	3.64	3.09	7.9	3.212	6.690	9.902	0.01153	0.00116
BIO	Bio-Rad	16.96	N/A	0	17.8					
TECH	Bio-Techne	16.86	0.3	0.3	15	0.323	11.423	11.746	0.01030	0.00088
BIIB	Biogen	30.81	N/A	0	-9.2					
BLK	BlackRock	111.97	2.65	2.24	11.53	2.369	9.110	11.479	0.06688	0.00583
BK	BNY Mellon	41.75	2.63	2.51	14.92	2.697	11.370	14.067	0.03056	0.00217
BA	Boeing	109.84	N/A	0	20.17					
BKNG	Booking Holdings	88.31	N/A	0	43.16					
BWA	BorgWarner	8.98	1.82	1.82	20.07					
BXP	Boston Properties	19.32	3.18	3.18	7	3.291	6.090	9.381	0.00943	0.00101
BSX	Boston Scientific	60.35	N/A	0	15.06					
BMY	Bristol Myers Squibb	155.59	3.05	2.82	5	2.891	4.757	7.647	0.06191	0.00810
AVGO	Broadcom	249.6	2.74	2.57	14.74	2.759	11.250	14.009	0.18194	0.01299
BR	Broadridge	17.58	1.7	1.61	11.8	1.705	9.290	10.995	0.01006	0.00091
BRO	Brown & Brown	19.38	0.6	0.55	13.22	0.586	10.237	10.823	0.01091	0.00101
BF.B	Brown–Forman	31.05	1.16	1.12	7.01	1.159	6.097	7.256	0.01172	0.00162
CHRW	C.H. Robinson	13.25	2.1	1.99	12.3	2.112	9.623	11.736	0.00809	0.00069
CDNS	Cadence	43.79	N/A	0	15.4					
CZR	Caesars Entertainment	16.49	N/A	0	27.5					
CPB	Campbell's	12.97	3.44	3.44	1.78	3.471	2.610	6.081	0.00410	0.00067
COF	Capital One	54.36	1.79	1.49	45.9					
CAH	Cardinal Health	15.73	3.4	3.45	5.1	3.538	4.823	8.361	0.00684	0.00082
KMX	CarMax	16.04	N/A	0	16.4					
CCL	Carnival	22.17	N/A	0	9.95					
CARR	Carrier	39.68	1.26	1.1	12.01	1.166	9.430	10.596	0.02188	0.00206
CTLT	Catalent	18.8	N/A	0	15.8					
CAT	Caterpillar	119.06	2	1.96	20.48					
CBOE	Cboe	12.29	1.67	1.56	5.03	1.599	4.777	6.376	0.00408	0.00064
CBRE	CBRE	29.69	N/A	0	11					
CDW	CDW	23.55	1.15	0.97	13.1	1.034	10.157	11.190	0.01371	0.00123
CE	Celanese	15.29	1.92	1.92	-2.22					
CNC	Centene	48.06	N/A	0	10.69					
CNP	CenterPoint Energy	18.64	2.3	2.19	1.8	2.210	2.623	4.833	0.00469	0.00097
CDAY	Ceridian	10.33	N/A	0	12					
CERN	Cerner	27.45	1.15	0.99	13.52	1.057	10.437	11.494	0.01642	0.00143
CF	CF Industries	21.47	1.16	1.16	62.7					
CRL	Charles River	14.07	N/A	0	16.94					
SCHW	Charles Schwab	169.98	0.89	0.8	21.7					
CHTR	Charter Communications	107.23	N/A	0	32.03					
CVX	Chevron	323.02	3.42	3.2	8.45	3.335	7.057	10.392	0.17465	0.01681

CMG	Chipotle Mexican Grill	43.22	N/A	0	29.02					
CB	Chubb	89.78	1.5	1.51	28.48					
CHD	Church & Dwight	23.58	1.07	1.04	7.83	1.081	6.643	7.724	0.00948	0.00123
CI	Cigna	75.93	1.88	1.68	11.15	1.774	8.857	10.630	0.04200	0.00395
CINF	Cincinnati Financial	21.14	2.1	1.91	14.39	2.047	11.017	13.064	0.01437	0.00110
CTAS	Cintas	38.31	0.95	0.9	11	0.950	8.757	9.706	0.01935	0.00199
CSCO	Cisco	226.32	2.71	2.72	7.14	2.817	6.183	9.000	0.10598	0.01178
C	#REF!	111.15	3.62	3.62	-0.66					
CFG	Citizens	20.32	3.24	3.24	-2.76					
CTXS	Citrix	12.73	1.47	1.46	2.2	1.476	2.890	4.366	0.00289	0.00066
CLX	Clorox	16.71	3.42	3.38	-3.53					
CME	CME Group	88.7	1.62	1.46	8.34	1.521	6.983	8.504	0.03925	0.00462
CMS	CMS Energy	19.6	2.75	2.57	7.4	2.665	6.357	9.022	0.00920	0.00102
KO	Coca-Cola	261.83	2.91	2.78	7.24	2.881	6.250	9.131	0.12439	0.01362
CTSH	Cognizant	47.71	1.19	1.09	11.49	1.153	9.083	10.236	0.02541	0.00248
CL	Colgate-Palmolive	61.89	2.52	2.43	6.64	2.511	5.850	8.361	0.02692	0.00322
CMCSA	Comcast	210.89	2.29	2.15	14.31	2.304	10.963	13.267	0.14558	0.01097
CMA	Comerica	12.24	2.91	2.91	-10.7					
CAG	Conagra Brands	14.44	3.89	3.66	1.66	3.690	2.530	6.220	0.00467	0.00075
COP	ConocoPhillips	135.63	1.36	1.68	12.79	1.787	9.950	11.737	0.08283	0.00706
ED	Con Edison	31.85	3.51	3.45	2	3.485	2.757	6.241	0.01034	0.00166
STZ	Constellation Brands	39.94	1.33	1.35	9.6	1.415	7.823	9.238	0.01920	0.00208
CEG	Constellation Energy	16.66	1.15	0	N/A					
COO	CooperCompanies	20.64	0.01	0.01	10	0.011	8.090	8.101	0.00870	0.00107
CPRT	Copart	29.66	N/A	0	22.3					
GLW	Corning	31.75	2.88	2.56	22.14					
CTVA	Corteva	41.72	0.98	0.96	22.39					
COST	Costco	247.95	0.57	0.57	11.25	0.602	8.923	9.525	0.12289	0.01290
CTRA	Coterra	21.24	1.89	2.37	74.49					
CCI	Crown Castle	74.95	3.39	3.15	12.4	3.345	9.690	13.035	0.05083	0.00390
CSX	CSX	79.28	1.09	1.03	15.79	1.111	11.950	13.061	0.05388	0.00412
CMI	Cummins	29.63	2.79	2.69	10.72	2.834	8.570	11.404	0.01758	0.00154
CVS	CVS Health	139.39	2.07	1.88	5.97	1.936	5.403	7.339	0.05323	0.00725
DHI	D.R. Horton	27.83	1.14	1.05	10.95	1.107	8.723	9.831	0.01424	0.00145
DHR	Danaher	204.63	0.35	0.29	16.87	0.314	12.670	12.984	0.13825	0.01065
DRI	Darden	16.72	3.32	3.16	29.22					
DVA	DaVita	10.53	N/A	0	13.37					
DE	Deere & Co.	132.38	0.97	0.9	15.01	0.968	11.430	12.398	0.08539	0.00689
DAL	Delta Air Lines	23.18	N/A	0	-23.7					
XRAY	Dentsply Sirona	10.77	1.02	0.87	10.73	0.917	8.577	9.493	0.00532	0.00056
DVN	Devon	40.96	6.5	3.2	17.23	3.476	12.910	16.386	0.03492	0.00213
DXCM	DexCom	43.61	N/A	0	31.2					
FANG	Diamondback	25.31	1.68	1.36	11	1.435	8.757	10.191	0.01342	0.00132
DLR	Digital Realty	38.87	3.55	3.37	23.19					
DFS	Discover	31.52	1.79	1.68	56.42					
DISCA	Discovery (Series A)	13.56	N/A	0	5.95					
DISCK	Discovery (Series C)	13.56	N/A	0	20					
DISH	Dish	16.52	N/A	0	-26.57					
DIS	Disney	250.59	N/A	0	40.96					
DG	Dollar General	50.56	0.99	0.76	10.85	0.801	8.657	9.458	0.02488	0.00263
DLTR	Dollar Tree	34.93	N/A	0	17.87					
D	Dominion Energy	66.16	3.24	3.06	6.37	3.157	5.670	8.827	0.03039	0.00344
DPZ	Domino's	14.19	1.12	0.96	11.78	1.017	9.277	10.293	0.00760	0.00074
DOV	Dover	22.74	1.27	1.27	14.5	1.362	11.090	12.452	0.01473	0.00118
DOW	Dow	46.53	4.42	4.37	59.79					

DTE	DTE	24.6	2.77	3.04	6	3.131	5.423	8.555	0.01095	0.00128
DUK	Duke Energy	82.25	3.67	3.63	5.85	3.736	5.323	9.060	0.03877	0.00428
DRE	Duke Realty	21.44	2	1.91	6	1.967	5.423	7.391	0.00824	0.00112
DD	DuPont	38.95	1.71	1.57	13.73	1.678	10.577	12.254	0.02483	0.00203
DXC	DXC Technology	7.89	N/A	0	29.1					
EMN	Eastman	14.1	2.75	2.56	12.31	2.718	9.630	12.348	0.00906	0.00073
ETN	Eaton	60.91	2.02	1.97	18.61	2.153	13.830	15.983	0.05065	0.00317
EBAY	eBay	32.67	1.58	1.25	11.65	1.323	9.190	10.513	0.01787	0.00170
ECL	Ecolab	49.74	1.16	1.1	15.63	1.186	11.843	13.029	0.03372	0.00259
EIX	Edison International	25.36	4.18	3.91	5.35	4.015	4.990	9.005	0.01188	0.00132
EW	Edwards Lifesciences	66.61	N/A	0	15.19					
EA	Electronic Arts	35.05	0.54	0.53	23.16					
EMR	Emerson	57.79	2.11	2.06	10.46	2.168	8.397	10.564	0.03177	0.00301
ENPH	Enphase	25.47	N/A	0	15.6					
ETR	Entergy	22.51	3.58	3.36	5.9	3.459	5.357	8.816	0.01033	0.00117
EOG	EOG Resources	72.32	2.48	1.6	11.75	1.694	9.257	10.951	0.04121	0.00376
EPAM	EPAM	17.44	N/A	0	24.9					
EFX	Equifax	28.89	0.66	0.66	14.1	0.707	10.823	11.530	0.01733	0.00150
EQIX	Equinix	64.21	1.74	1.62	37					
EQR	Equity Residential	32.87	2.84	2.71	6.5	2.798	5.757	8.555	0.01463	0.00171
ESS	Essex	21.87	2.62	2.45	7.9	2.547	6.690	9.237	0.01051	0.00114
EL	Estée Lauder Companies	98.07	0.87	0.8	14.86	0.859	11.330	12.189	0.06220	0.00510
ETSY	Etsy	18.1	N/A	0	39.45					
RE	Everest	11.46	2.1	2.07	62.29					
EVRG	Evergy	14.94	3.5	3.26	5.12	3.343	4.837	8.180	0.00636	0.00078
ES	Eversource	29.17	2.99	2.78	7.1	2.879	6.157	9.035	0.01371	0.00152
EXC	Exelon	42.83	3.04	3.36	8.5	3.503	7.090	10.593	0.02361	0.00223
EXPE	Expedia Group	29.12	N/A	0	22.8					
EXPD	Expeditors	17.14	1.12	1.13	-15.4					
EXR	Extra Space Storage	25.97	2.57	2.28	6	2.348	5.423	7.772	0.01050	0.00135
XOM	ExxonMobil	351.94	4.13	4.1	12.54	4.357	9.783	14.140	0.25893	0.01831
FFIV	F5	12.44	N/A	0	8.7					
FDS	FactSet	15.85	0.78	0.79	10	0.830	8.090	8.920	0.00736	0.00082
FAST	Fastenal	32.85	2.16	1.95	6.33	2.012	5.643	7.655	0.01308	0.00171
FRT	Federal Realty	9.2	3.64	3.56	6.7	3.679	5.890	9.569	0.00458	0.00048
FDX	FedEx	58.35	1.33	1.32	19.33	1.448	14.310	15.758	0.04784	0.00304
FITB	Fifth Third Bank	31.32	2.62	2.44	-2.98					
FRC	First Republic	29.57	0.53	0.53	16.93	0.575	12.710	13.285	0.02044	0.00154
FE	FirstEnergy	24.82	3.55	3.48	-6.6					
FIS	FIS	58.17	1.95	1.6	13.67	1.709	10.537	12.246	0.03706	0.00303
FISV	Fiserv	64.42	N/A	0	15.54					
FLT	Fleetcor	18.71	N/A	0	16					
FMC	FMC	16.52	1.58	1.44	8	1.498	6.757	8.254	0.00709	0.00086
F	Ford	66.79	2.38	0.61	74.15					
FTNT	Fortinet	51.69	N/A	0	17.49					
FTV	Fortive	21.66	0.46	0.45	37.89					
FBHS	Fortune Brands	10.53	1.44	1.34	9.3	1.402	7.623	9.026	0.00494	0.00055
FOXA	Fox Corporation (Class A)	22	1.18	1.14	6	1.174	5.423	6.598	0.00755	0.00114
FOX	Fox Corporation (Class B)	22	1.29	1.24	9.2	1.297	7.557	8.854	0.01013	0.00114
BEN	Franklin Templeton	13.67	4.2	4.06	1.86	4.098	2.663	6.761	0.00481	0.00071
FCX	Freeport-McMoRan	72.46	1.17	0.58	28.9					
AJG	Gallagher	34.22	1.23	1.14	11.6	1.206	9.157	10.363	0.01845	0.00178
GRMN	Garmin	22.34	2.29	2.3	10.78	2.424	8.610	11.034	0.01283	0.00116
IT	Gartner	23.82	N/A	0	18.3					
GE	GE	103.23	0.34	0.34	47.3					

GNRC	Generac	20.25	N/A	0	8					
GD	General Dynamics	66.56	2.09	1.95	10.95	2.057	8.723	10.780	0.03733	0.00346
GIS	General Mills	38.74	3.07	3.03	5.03	3.106	4.777	7.883	0.01589	0.00202
GPC	Genuine Parts	18.1	2.79	2.54	4.6	2.598	4.490	7.088	0.00668	0.00094
GILD	Gilead	73.79	4.94	4.82	-0.68					
GL	Globe Life	9.88	0.83	0.77	10.31	0.810	8.297	9.106	0.00468	0.00051
GPN	Global Payments	37.81	0.74	0.69	18.18	0.753	13.543	14.296	0.02812	0.00197
GM	GM	63.61	N/A	0	14.7					
GS	Goldman Sachs	114.05	2.38	1.93	11.41	2.040	9.030	11.070	0.06569	0.00593
GWW	Grainger	25.8	1.29	1.26	15.38	1.357	11.677	13.034	0.01750	0.00134
HAL	Halliburton	34.21	1.27	0.46	62.7					
HIG	Hartford (The)	23.51	2.15	1.97	13	2.098	10.090	12.188	0.01491	0.00122
HAS	Hasbro	11.83	3.3	3.2	17.7	3.483	13.223	16.707	0.01028	0.00062
HCA	HCA Healthcare	78.71	0.86	0.74	14.42	0.793	11.037	11.830	0.04845	0.00410
PEAK	Healthpeak	17.98	3.55	3.5	2.9	3.551	3.357	6.907	0.00646	0.00094
HSIC	Henry Schein	12.05	N/A	0	18.56					
HSY	Hershey's	42.64	1.71	1.59	8.85	1.660	7.323	8.984	0.01993	0.00222
HES	Hess	32.9	1.41	0.92	55.36					
HPE	Hewlett Packard Enterprise	22.06	2.82	2.74	11.83	2.902	9.310	12.212	0.01402	0.00115
HLT	Hilton	41.43	N/A	0	272.53					
HOLX	Hologic	18.76	N/A	0	1.7					
HD	Home Depot	326.31	2.41	2.2	14.6	2.361	11.157	13.517	0.22950	0.01698
HON	Honeywell	131.85	2.01	1.91	10.54	2.011	8.450	10.461	0.07176	0.00686
HRL	Hormel	27.21	2.07	1.96	8.5	2.043	7.090	9.133	0.01293	0.00142
HST	Host Hotels & Resorts	13.11	0.16	0	28.4					
HWM	Howmet Aerospace	15.39	0.22	0.11	32.25					
HPQ	HP	39.74	2.6	2.09	10.07	2.195	8.137	10.332	0.02136	0.00207
HUM	Humana	54.58	0.66	0.64	14.26	0.686	10.930	11.616	0.03299	0.00284
HII	Huntington Ingalls Industries	8.14	2.32	2.23	13.6	2.382	10.490	12.872	0.00545	0.00042
HBAN	Huntington National Bank	21.66	4.1	3.94	-2.15					
IEX	IDEX	14.72	1.11	1.11	12	1.177	9.423	10.600	0.00812	0.00077
IDXX	Idexx Laboratories	45.16	N/A	0	24.2					
ITW	Illinois Tool Works	65.51	2.3	2.23	11.03	2.353	8.777	11.130	0.03794	0.00341
ILMN	Illumina	53.35	N/A	0	1					
INCY	Incyte	17.06	N/A	0	15					
IR	Ingersoll Rand	20.12	0.16	0.04	18.8	0.044	13.957	14.000	0.01466	0.00105
INTC	Intel	196.56	2.83	2.68	3.38	2.725	3.677	6.402	0.06547	0.01023
ICE	Intercontinental Exchange	75.79	1.13	0.98	9.97	1.029	8.070	9.099	0.03588	0.00394
IBM	IBM	115.38	5.08	4.99	16.5	5.402	12.423	17.825	0.10701	0.00600
IP	International Paper	16.8	4.09	4.32	19.2	4.735	14.223	18.958	0.01657	0.00087
IPG	Interpublic Group	13.84	3.22	2.96	5.6	3.043	5.157	8.200	0.00590	0.00072
IFF	International Flavors & Fragrances	32.12	2.47	2.41	4.62	2.466	4.503	6.969	0.01165	0.00167
INTU	Intuit	130.5	0.59	0.55	16.7	0.596	12.557	13.153	0.08931	0.00679
ISRG	Intuitive Surgical	98.85	N/A	0	19.11					
IVZ	Invesco	9.91	3.08	3.08	7.4	3.194	6.357	9.551	0.00492	0.00052
IPGP	IPG Photonics	5.98	N/A	0	25.4					
IQV	IQVIA	42.06	N/A	0	18.22					
IRM	Iron Mountain	15.11	4.71	4.64	6.44	4.789	5.717	10.506	0.00826	0.00079
JBHT	J.B. Hunt	22.04	0.76	0.56	28.04					
JKHY	Jack Henry & Associates	13.7	1.04	0.95	14	1.017	10.757	11.773	0.00839	0.00071
J	Jacobs	17.53	0.66	0.61	12.33	0.648	9.643	10.291	0.00939	0.00091
JNJ	Johnson & Johnson	458.45	2.42	2.37	6.05	2.442	5.457	7.898	0.18840	0.02385
JCI	Johnson Controls	45.49	2.11	1.74	19.54	1.910	14.450	16.360	0.03872	0.00237
JPM	JPMorgan Chase	419.06	2.82	2.68	7.21	2.777	6.230	9.007	0.19638	0.02180

JNPR	Juniper Networks	11.32	2.36	2.19	9.35	2.292	7.657	9.949	0.00586	0.00059
K	Kellogg's	20.9	3.75	3.68	2.42	3.725	3.037	6.761	0.00735	0.00109
KEY	KeyCorp	21.82	3.31	3.14	-1.55					
KEYS	Keysight	28.45	N/A	0	10.2					
KMB	Kimberly-Clark	40.64	3.86	3.79	8.22	3.946	6.903	10.849	0.02294	0.00211
KIM	Kimco Realty	14.84	3.15	2.79	4.6	2.854	4.490	7.344	0.00567	0.00077
KMI	Kinder Morgan	41.09	5.9	5.66	-3.62					
KLAC	KLA	52.56	1.15	1.06	20.7					
KHC	Kraft Heinz	46.84	4.14	4.07	-1.37					
KR	Kroger	40.98	1.47	1.42	5.53	1.459	5.110	6.569	0.01401	0.00213
LHX	L3Harris	49.28	1.74	1.58	41.8					
LH	LabCorp	25.38	N/A	0	-12.49					
LRCX	Lam Research	74.07	1.08	1.01	15.93	1.090	12.043	13.134	0.05062	0.00385
LW	Lamb Weston	7.96	1.71	1.64	10.75	1.728	8.590	10.318	0.00427	0.00041
LVS	Las Vegas Sands	29.16	N/A	0	265.7					
LDOS	Leidos	14.57	1.34	1.29	7.2	1.336	6.223	7.560	0.00573	0.00076
LEN	Lennar	24.47	1.81	1.36	23.7					
LLY	Lilly	270.65	1.36	1.18	6.37	1.218	5.670	6.888	0.09699	0.01408
LNC	Lincoln Financial	11.28	2.57	2.52	35.7					
LIN	Linde	156.03	1.47	1.33	N/A					
LYV	Live Nation Entertainment	25.89	N/A	0	80.3					
LKQ	LKQ Corporation	12.93	2.2	0.55	33.5					
LMT	Lockheed Martin	118.67	2.49	2.34	8.2	2.436	6.890	9.326	0.05758	0.00617
L	Loews Corporation	15.86	0.38	0.38	14.03	0.407	10.777	11.183	0.00923	0.00083
LOW	Lowe's	146.15	1.5	1.41	14.45	1.512	11.057	12.569	0.09557	0.00760
LUMN	Lumen	11.12	9.18	8.77	-19.7					
LYB	LyondellBasell	34.18	4.2	4.12	1.55	4.152	2.457	6.609	0.01175	0.00178
MTB	M&T Bank	23.09	2.67	2.45	5.69	2.520	5.217	7.736	0.00929	0.00120
MRO	Marathon Oil	18.69	1.08	0.84	10.63	0.885	8.510	9.395	0.00914	0.00097
MPC	Marathon Petroleum	44.94	2.82	2.82	24.05					
MKTX	MarketAxess	13.11	0.8	0.75	13.88	0.802	10.677	11.479	0.00783	0.00068
MAR	Marriott International	54.86	N/A	0	135.51					
MMC	Marsh & McLennan	81.72	1.29	1.25	7.6	1.298	6.490	7.788	0.03311	0.00425
MLM	Martin Marietta	23.44	0.64	0.6	17.97	0.654	13.403	14.057	0.01714	0.00122
MAS	Masco	12.8	2.14	1.88	15.4	2.025	11.690	13.715	0.00913	0.00067
MA	Mastercard	341.16	0.56	0.52	24.69					
MTCH	Match Group	29.22	N/A	0	16					
MKC	McCormick	25.72	1.51	1.39	7.2	1.440	6.223	7.663	0.01026	0.00134
MCD	McDonald's	175.58	2.3	2.17	12.97	2.311	10.070	12.381	0.11310	0.00914
MCK	McKesson	44.94	0.62	0.57	12.96	0.607	10.063	10.670	0.02495	0.00234
MDT	Medtronic	142.42	2.37	2.28	12.16	2.419	9.530	11.949	0.08854	0.00741
MRK	Merck	201.54	3.43	3.2	9.42	3.351	7.703	11.054	0.11592	0.01049
FB	Meta	581.03	N/A	0	18.5					
MET	MetLife	57.28	2.74	2.67	5.02	2.737	4.770	7.507	0.02237	0.00298
MTD	Mettler Toledo	30.9	N/A	0	17.8					
MGM	MGM Resorts	18.19	0.02	0.02	-383					
MCHP	Microchip	41.02	1.31	1.1	20.5					
MU	Micron	84.71	0.26	0.26	25.21					
MSFT	Microsoft	2.25	0.82	0.78	17.4	0.848	13.023	13.871	0.00162	0.00012
MAA	Mid-America Apartments	23.44	2.12	1.99	7	2.060	6.090	8.150	0.00994	0.00122
MRNA	Moderna	72.03	N/A	0	16.8					
MHK	Mohawk Industries	8.86	N/A	0	1.5					
MOH	Molina Healthcare	19.47	N/A	0	20.52					
TAP	Molson Coors	11.4	2.9	1.26	2.42	1.275	3.037	4.312	0.00256	0.00059
MDLZ	Mondelez International	84.38	2.28	2.16	8.25	2.249	6.923	9.172	0.04027	0.00439

MPWR	Monolithic Power Systems	21.57	0.61	0.49	25					
MNST	Monster Beverage	41.32	N/A	0	14.01					
MCO	Moody's	60.46	0.85	0.75	13.12	0.799	10.170	10.969	0.03451	0.00315
MS	Morgan Stanley	164.56	3.04	2.65	100.36					
MOS	Mosaic	25.02	0.66	0.39	-10.5					
MSI	Motorola Solutions	38.15	1.36	1.26	14.27	1.350	10.937	12.287	0.02439	0.00198
MSCI	MSCI	39.92	0.79	0.74	13.9	0.791	10.690	11.481	0.02385	0.00208
NDAQ	Nasdaq	28.63	1.24	1.2	9.52	1.257	7.770	9.027	0.01345	0.00149
NTAP	NetApp	19.41	2.33	2.31	8.8	2.412	7.290	9.702	0.00980	0.00101
NFLX	Netflix	166.26	N/A	0	16.86					
NWL	Newell Brands	9.36	4.2	4.12	5.37	4.231	5.003	9.234	0.00450	0.00049
NEM	Newmont	62.54	2.81	2.79	N/A					
NWSA	News Corp (Class A)	12.94	0.89	0.89	21.06					
NWS	News Corp (Class B)	12.94	0.87	0.87						
NEE	NextEra Energy	162.06	1.88	1.83	9.07	1.913	7.470	9.383	0.07912	0.00843
NLSN	Nielsen	8.35	1.07	1.08	5.3	1.109	4.957	6.065	0.00264	0.00043
NKE	Nike	210.31	0.88	0.87	15.34	0.937	11.650	12.587	0.13773	0.01094
NI	NiSource	12.26	3.02	2.87	3.52	2.921	3.770	6.691	0.00427	0.00064
NDSN	Nordson	13.27	0.9	0.79	13	0.841	10.090	10.931	0.00755	0.00069
NSC	Norfolk Southern	66.47	1.75	1.47	13.32	1.568	10.303	11.871	0.04106	0.00346
NTRS	Northern Trust	24.03	2.4	2.35	12.15	2.493	9.523	12.016	0.01502	0.00125
NOC	Northrop Grumman	69.77	1.38	1.34	4.8	1.372	4.623	5.995	0.02176	0.00363
NLOK	NortonLifeLock	15.97	1.78	1.77	12.4	1.880	9.690	11.570	0.00961	0.00083
NCLH	Norwegian Cruise Line Holdings	8.09	N/A	0	-24.13					
NRG	NRG Energy	8.79	3.78	3.58	37.9					
NUE	Nucor	39.6	1.27	1.09	37.75					
NVDA	Nvidia	706.57	0.06	0.06	30.74					
NVR	NVR	16.21	N/A	0	4.8					
NXPI	NXP	48.2	1.84	1.18	16.83	1.279	12.643	13.923	0.03492	0.00251
ORLY	O'Reilly Automotive	45.84	N/A	0	16.6					
OXY	Occidental Petroleum	55.89	0.89	0.07	23.64					
ODFL	Old Dominion	36.15	0.38	0.25	24.81					
OMC	Omnicom Group	17.25	3.33	3.27	10.6	3.443	8.490	11.933	0.01071	0.00090
OKE	Oneok	30.78	5.18	5.18	9.86	5.435	7.997	13.432	0.02151	0.00160
ORCL	Oracle	214.49	1.57	1.57	10.24	1.650	8.250	9.900	0.11049	0.01116
OGN	Organon	8.96	3.17	1.6	-5					
OTIS	Otis	32.48	1.24	1.19	11.68	1.259	9.210	10.469	0.01769	0.00169
PCAR	Paccar	30.57	1.53	1.51	23.17					
PKG	Packaging Corporation of America	14.29	2.56	2.56	16.4	2.770	12.357	15.127	0.01125	0.00074
PARA	Paramount	24.51	2.49	2.49	-4.31					
PH	Parker	36.84	1.42	1.37	11.4	1.448	9.023	10.471	0.02007	0.00192
PAYX	Paychex	45.23	2.05	2.02	12.37	2.145	9.670	11.815	0.02780	0.00235
PAYC	Paycom	20.73	N/A	0	25.4					
PYPL	PayPal	133.57	N/A	0	17.32					
PENN	Penn National Gaming	7.1	N/A	0	239.5					
PNR	Pentair	9.3	1.51	1.44	8.8	1.503	7.290	8.793	0.00425	0.00048
PBCT	People's United Financial	9.06	3.37	3.37	10.74	3.551	8.583	12.134	0.00572	0.00047
PEP	PepsiCo	226.17	2.6	2.57	7.72	2.669	6.570	9.239	0.10872	0.01177
PKI	PerkinElmer	22.29	0.16	0.16	44.8					
PFE	Pfizer	294.76	3.04	2.96	103.09					
PM	Philip Morris International	141.42	5.4	5.24	8.42	5.461	7.037	12.497	0.09196	0.00736
PSX	Phillips 66	44.9	4.54	4.32	13	4.601	10.090	14.691	0.03432	0.00234
PNW	Pinnacle West	8.32	4.47	4.4	0.1	4.402	1.490	5.892	0.00255	0.00043
PXD	Pioneer Natural Resources	61.89	2.15	0.9	15.75	0.971	11.923	12.894	0.04152	0.00322

PNC	PNC Financial Services	80.62	2.54	2.44	-3.8					
POOL	Pool Corporation	18.48	0.71	0.69	17	0.749	12.757	13.505	0.01299	0.00096
PPG	PPG Industries	30.4	1.82	1.75	16.6	1.895	12.490	14.385	0.02275	0.00158
PPL	PPL	19.77	2.93	6.02	-16.2					
PFG	Principal	18.49	3.56	3.32	14	3.552	10.757	14.309	0.01377	0.00096
PG	Procter & Gamble	361.53	2.3	2.22	6.84	2.296	5.983	8.279	0.15574	0.01881
PGR	Progressive	66.68	0.34	1.63	-10.1					
PLD	Prologis	116.35	2.03	1.6	-6.05					
PRU	Prudential	43.97	4.03	3.81	3.25	3.872	3.590	7.462	0.01707	0.00229
PEG	PSEG	33.54	3.23	2.99	2.5	3.027	3.090	6.117	0.01068	0.00175
PTC	PTC	12.53	N/A	0	11.35					
PSA	Public Storage	64.54	2.14	2.13	17	2.311	12.757	15.068	0.05060	0.00336
PHM	PulteGroup	10.78	1.35	1.28	9.2	1.339	7.557	8.896	0.00499	0.00056
PVH	PVH	5.61	0.18	0	-6.04					
QRVO	Qorvo	13.63	N/A	0	12.4					
PWR	Quanta	18.44	0.21	0.19	16.6	0.206	12.490	12.696	0.01218	0.00096
QCOM	Qualcomm	172.28	1.72	1.7	14.68	1.825	11.210	13.035	0.11684	0.00896
DGX	Quest Diagnostics	17.01	1.86	1.72	-13.82					
RL	Ralph Lauren	8.28	2.34	1.73	80.15					
RJF	Raymond James	21.94	1.24	1.01	8.54	1.053	7.117	8.170	0.00933	0.00114
RTX	Raytheon Technologies	150.86	2.01	1.97	16.2	2.130	12.223	14.353	0.11266	0.00785
O	Realty Income	39.56	4.31	4.14	14.1	4.432	10.823	15.255	0.03140	0.00206
REG	Regency Centers	11.63	3.61	3.48	9.1	3.638	7.490	11.128	0.00673	0.00061
REGN	Regeneron	72.64	N/A	0	-16					
RF	Regions	21.27	2.95	2.82	25.1					
RSG	Republic Services	40.97	1.4	1.33	8.59	1.387	7.150	8.537	0.01820	0.00213
RMD	ResMed	34.07	0.69	0.68	25.5					
RHI	Robert Half	12.89	1.47	1.3	11.6	1.375	9.157	10.532	0.00706	0.00067
ROK	Rockwell Automation	31.42	1.6	1.55	11.21	1.637	8.897	10.534	0.01722	0.00163
ROL	Rollins	16.46	1.18	0.99	8.2	1.031	6.890	7.921	0.00678	0.00086
ROP	Roper	48.79	0.53	0.49	7.5	0.508	6.423	6.932	0.01760	0.00254
ROST	Ross	31.71	1.35	1.25	35.8					
RCL	Royal Caribbean Group	19.24	N/A	0	58.7					
SPGI	S&P Global	140.79	0.82	0.74	14.2	0.793	10.890	11.683	0.08558	0.00733
CRM	Salesforce	209	N/A	0	15.13					
SBAC	SBA Communications	34.59	0.73	0.69	189.32					
SLB	Schlumberger	59.93	1.2	1.2	36.4					
STX	Seagate	20.01	3.03	2.93	25.02					
SEE	Sealed Air	10.01	1.15	1.1	12.07	1.166	9.470	10.636	0.00554	0.00052
SRE	Sempra Energy	50.32	2.82	2.7	4.3	2.758	4.290	7.048	0.01845	0.00262
NOW	ServiceNow	113.59	N/A	0	26.1					
SHW	Sherwin-Williams	64.52	0.92	0.88	14.65	0.944	11.190	12.134	0.04074	0.00336
SBNY	Signature Bank	18.82	0.74	0.74	6.32	0.763	5.637	6.400	0.00627	0.00098
SPG	Simon	42.72	5.01	4.44	8.6	4.631	7.157	11.788	0.02620	0.00222
SWKS	Skyworks	21.86	1.63	1.55	12.7	1.648	9.890	11.538	0.01312	0.00114
SJM	Smucker	14.12	2.96	2.89	1.61	2.913	2.497	5.410	0.00397	0.00073
SNA	Snap-on	11.07	2.72	2.48	5	2.542	4.757	7.299	0.00420	0.00058
SEDG	SolarEdge	18.04	N/A	0	30.86					
SO	Southern Company	72.93	3.72	3.69	6.47	3.809	5.737	9.546	0.03622	0.00379
LUV	Southwest Airlines	25.39	N/A	0	-21					
SWK	Stanley Black & Decker	23.09	2.18	2.11	10.77	2.224	8.603	10.827	0.01301	0.00120
SBUX	Starbucks	99.18	2.24	2.13	11.4	2.251	9.023	11.275	0.05818	0.00516
STT	State Street	32.02	2.53	2.42	13.39	2.582	10.350	12.932	0.02154	0.00167
STE	Steris	23.04	0.71	0.68	10	0.714	8.090	8.804	0.01055	0.00120
SYK	Stryker	96.45	1.05	0.96	11.2	1.014	8.890	9.904	0.04970	0.00502

SIVB	SVB Financial	33.48	N/A	0	8					
SYF	Synchrony	18.94	2.4	2.45	35.92					
SNPS	Synopsys	48.45	N/A	0	16.2					
SYY	Sysco	40.81	2.32	2.3	51.22					
TMUS	T-Mobile	155.95	N/A	0	70.07					
TROW	T. Rowe Price	33.4	3.19	2.87	12.6	3.051	9.823	12.874	0.02237	0.00174
TTWO	Take-Two Interactive	17.24	N/A	0	14.63					
TPR	Tapestry	9.91	1.95	1.3	16.5	1.407	12.423	13.831	0.00713	0.00052
TGT	Target	100.22	1.64	1.44	14.02	1.541	10.770	12.311	0.06420	0.00521
TEL	TE Connectivity	42.07	1.69	1.51	10.36	1.588	8.330	9.918	0.02171	0.00219
TDY	Teledyne	21.26	N/A	0	23.27					
TFX	Teleflex	15.42	0.39	0.39	11	0.411	8.757	9.168	0.00736	0.00080
TER	Teradyne	18.92	0.35	0.33	14.16	0.353	10.863	11.217	0.01104	0.00098
TSLA	Tesla	1.03	N/A	0	37.15					
TXN	Texas Instruments	165.27	2.49	2.27	10	2.384	8.090	10.474	0.09006	0.00860
TXT	Textron	15.92	0.11	0.11	23.57					
TMO	Thermo Fisher Scientific	223.49	0.21	0.18	10.87	0.190	8.670	8.860	0.10302	0.01163
TJX	TJX Companies	70.95	1.68	1.68	12	1.781	9.423	11.204	0.04136	0.00369
TSCO	Tractor Supply	26.18	1.58	0.9	13.6	0.961	10.490	11.451	0.01560	0.00136
TT	Trane Technologies	35.71	1.71	1.51	22.29					
TDG	TransDigm	36.65	N/A	0	24.3					
TRV	Travelers	43.86	1.88	1.87	8.94	1.954	7.383	9.337	0.02131	0.00228
TRMB	Trimble	17.45	N/A	0	10					
TFC	Truist	77.32	3.22	3.12	1.24	3.139	2.250	5.389	0.02168	0.00402
TWTR	Twitter	30.42	N/A	0	80					
TYL	Tyler Technologies	17.7	N/A	0	10					
TSN	Tyson	31.07	2.12	2.1	7.5	2.179	6.423	8.602	0.01391	0.00162
USB	U.S. Bank	82.94	3.22	3.1	10.26	3.259	8.263	11.522	0.04972	0.00432
UDR	UDR	17.75	2.65	2.51	-34.21					
ULTA	Ulta Beauty	21.1	N/A	0	43.63					
UAA	Under Armour (Class A)	7.65	N/A	0	55					
UA	Under Armour (Class C)	7.65	N/A	0	21.8					
UNP	Union Pacific	170.49	1.71	1.56	16.77	1.691	12.603	14.294	0.12680	0.00887
UAL	United Airlines	13.48	N/A	0	-129.1					
UNH	UnitedHealth Group	473.49	1.13	1.09	14.51	1.169	11.097	12.266	0.30218	0.02464
UPS	United Parcel Service	186.9	2.82	1.86	14.03	1.990	10.777	12.767	0.12415	0.00972
URI	United Rentals	25.59	N/A	0	20.22					
UHS	Universal Health Services	10.76	0.54	0.54	11.42	0.571	9.037	9.608	0.00538	0.00056
VLO	Valero	39.11	4.03	4.07	23					
VTR	Ventas	24.03	2.87	2.88	-19.7					
VRSN	Verisign	23.34	N/A	0	8					
VRSK	Verisk	33.49	0.6	0.55	10.07	0.578	8.137	8.714	0.01518	0.00174
VZ	Verizon	213.96	5	4.95	2.88	5.021	3.343	8.365	0.09312	0.01113
VRTX	Vertex	63.17	N/A	0	11.8					
VFC	VF Corporation	21.64	3.48	3.43	44.76					
VTRS	Viatris	13.16	4.41	4.13	-1.7					
V	Visa	464.9	0.69	0.63	17.95	0.687	13.390	14.077	0.34050	0.02419
VNO	Vornado Realty Trust	8.69	4.62	4.62	17.33	5.020	12.977	17.997	0.00814	0.00045
VMC	Vulcan Materials	23.55	0.87	0.79	24.25					
WAB	Wabtec	17.73	0.53	0.49	7.3	0.508	6.290	6.798	0.00627	0.00092
WMT	Walmart	390.62	1.53	1.51	8.35	1.573	6.990	8.563	0.17404	0.02032
WBA	Walgreens Boots Alliance	40.35	4.05	4.01	3.73	4.085	3.910	7.995	0.01678	0.00210
WM	Waste Management	63.66	1.64	1.45	12.25	1.539	9.590	11.129	0.03686	0.00331
WAT	Waters	19.6	N/A	0	10					
WEC	WEC Energy Group	30.12	2.97	2.75	6.1	2.834	5.490	8.324	0.01304	0.00157

WFC	Wells Fargo	194.34	1.93	1.16	118.9					
WELL	Welltower	41.53	2.53	2.53	13	2.694	10.090	12.784	0.02762	0.00216
WST	West Pharmaceutical Services	29.95	0.18	0.17	9.6	0.178	7.823	8.001	0.01247	0.00156
WDC	Western Digital	15.23	N/A	0	20					
WRK	WestRock	12.14	2.12	1.96	21.99					
WY	Weyerhaeuser	28.47	1.87	1.76	5	1.804	4.757	6.561	0.00972	0.00148
WHR	Whirlpool	10.69	3.86	2.99	6.2	3.083	5.557	8.639	0.00481	0.00056
WMB	Williams	39.82	5.11	4.92	5.1	5.045	4.823	9.869	0.02045	0.00207
WTW	Willis Towers Watson	27.31	1.36	1.3	6.36	1.341	5.663	7.005	0.00995	0.00142
WYNN	Wynn Resorts	9.11	N/A	0	-133.4					
XEL	Xcel Energy	37.71	2.76	2.57	6.9	2.659	6.023	8.682	0.01703	0.00196
XYL	Xylem	15.57	1.38	1.29	18.76	1.411	13.930	15.341	0.01243	0.00081
YUM	Yum! Brands	33.51	1.91	1.71	12.52	1.817	9.770	11.587	0.02020	0.00174
ZBRA	Zebra	22.29	N/A	0	10					
ZBH	Zimmer Biomet	25.26	0.77	0.76	9.82	0.797	7.970	8.767	0.01152	0.00131
ZION	Zions Bancorp	10.28	2.14	2.07	-32.4					
ZTS	Zoetis	90.25	0.69	0.53	12	0.562	9.423	9.985	0.04689	0.00470
									Market Return	
		Total Market Capitalization				2.07	8.24	10.32	10.65	
		30675								Total
		Total Market Cap - Adjusted								1.00000
		19220								

Average 30-year T-bond yield October 2021 -- March 2022.	2.10
Market Risk Premium	8.55

Notes:
Market Capitalization was obtained as of March 28, 2022
So were forward dividend yield, trailing dividend yield and projected next 5-year earnings growth.
From Finance.yahoo.com

Total Market Capitalization - Adjusted: exclude market capitalization of companies with negative or higher than 20% earnings growth rate

CAPM

	Company	[1] Beta	[2] Risk Free Rate	[3] Market Risk Premium	[4] Adjusted RP	[5] ROE
				Market Return based on IBES Expected Earnings Forecast		
1	Atmos Energy Corp	0.675	2.10%	8.55%	5.77%	7.87%
2	New Jersey Resources	0.825	2.10%	8.55%	7.05%	9.16%
3	NiSource	0.7	2.10%	8.55%	5.99%	8.09%
4	N.W. Natural	0.675	2.10%	8.55%	5.77%	7.87%
5	One Gas Inc	0.7	2.10%	8.55%	5.99%	8.09%
6	South Jersey Industries	0.9	2.10%	8.55%	7.70%	9.80%
7	Spire Inc	0.725	2.10%	8.55%	6.20%	8.30%
	Min	0.68	2.10%	8.55%	5.77%	7.87%
	Max	0.90	2.10%	8.55%	7.70%	9.80%
	Median	0.70	2.10%	8.55%	5.99%	8.09%
	Average	0.74	2.10%	8.55%	6.35%	8.45%
	Midpoint	0.79	2.10%	8.55%	6.73%	8.83%

[1] Beta is the average beta value of Feb 2020 and Feb 2022.

[2] 6-month Average 30- year U.S. Treasury bond yields are from October 2021 to March 2022.

[3] MRP - See Exhibit___(ZZ-7)

[4] [1]x[3]

[5] [2]+[4]

Filing Date	**Decision Date**	**Authorized ROE**	**Rate Case Duration (months)**	***Interest Rate***	***Risk Premium***
12/3/1980	7/2/1981	14.00	7	12.83	1.17
4/28/1995	11/27/1995	13.60	7	6.63	6.97
5/25/1990	12/21/1990	13.60	7	8.65	4.95
1/4/1985	3/28/1985	14.80	2	11.58	3.22
11/30/1982	6/30/1983	14.80	7	10.66	4.14
10/15/2013	7/25/2014	9.30	9	3.61	5.69
3/8/2007	11/20/2007	9.90	8	4.90	5.00
2/1/2005	12/9/2005	9.70	10	4.54	5.16
12/15/2017	10/5/2018	9.61	9	3.05	6.56
4/1/2015	1/28/2016	9.40	10	2.93	6.47
9/9/2013	7/7/2014	9.30	10	3.64	5.66
9/25/2006	7/13/2007	9.50	9	4.86	4.64
12/29/2004	11/2/2005	9.70	10	4.55	5.15
11/8/2002	9/17/2003	9.90	10	5.07	4.83
1/30/1996	11/27/1996	11.30	10	6.78	4.52
11/24/1980	7/21/1981	15.78	7	12.86	2.92
11/10/2015	9/2/2016	9.50	9	2.61	6.89
1/16/2007	10/25/2007	9.65	9	4.91	4.74
11/24/2004	9/19/2005	9.45	9	4.58	4.87
4/9/1993	2/9/1994	10.70	10	6.41	4.29
3/21/1985	12/6/1985	12.00	8	10.68	1.32
8/27/1982	9/30/1983	16.15	13	11.04	5.11
11/18/1980	10/29/1981	16.50	11	13.31	3.19
11/2/1979	5/29/1980	16.00	6	11.04	4.96
5/1/2019	12/9/2020	9.10	19	1.89	7.21
5/2/2016	4/11/2017	9.50	11	2.69	6.81
11/12/2010	12/13/2011	9.50	13	4.01	5.49
8/31/2007	12/24/2008	10.00	16	4.39	5.61
12/9/2004	2/15/2006	9.50	14	4.58	4.92
5/5/2000	10/24/2001	11.00	17	5.66	5.34
11/7/1990	2/27/1992	11.75	15	8.11	3.64
7/2/1990	8/12/1993	10.75	37	7.83	2.92
4/20/1989	8/31/1990	12.50	16	8.38	4.12
4/20/1989	8/31/1990	12.50	16	8.38	4.12
9/23/1983	6/13/1984	15.50	8	12.23	3.27
3/2/1982	9/30/1982	16.50	7	13.21	3.29
6/12/1981	11/30/1981	16.75	5	13.98	2.77
6/2/1980	4/30/1981	15.00	11	11.75	3.25
4/8/2011	4/24/2012	9.75	12	3.52	6.23

11/7/2008	4/1/2010	9.50	17	4.09	5.41
7/13/2006	11/27/2007	10.00	16	4.86	5.14
8/6/2002	7/1/2003	11.00	10	5.03	5.97
5/3/1993	6/16/1994	10.50	13	6.60	3.90
4/20/2012	12/20/2012	10.40	8	2.82	7.58
11/8/2002	6/2/2004	11.22	19	5.13	6.09
4/22/2019	12/19/2019	10.20	8	2.40	7.80
9/29/2017	10/26/2017	10.20	0	2.87	7.33
4/20/2012	12/20/2012	10.30	8	2.82	7.48
7/1/1980	12/30/1980	14.50	6	11.45	3.05
4/22/2019	12/19/2019	10.05	8	2.40	7.65
9/29/2017	10/30/2017	10.05	1	2.88	7.17
4/20/2012	12/20/2012	10.10	8	2.82	7.28
8/30/2019	3/25/2021	10.00	19	1.77	8.23
8/30/2019	3/25/2021	10.00	19	1.77	8.23
8/30/2019	3/25/2021	10.00	19	1.77	8.23
2/13/2002	3/16/2004	10.90	25	5.25	5.65
2/13/2002	3/16/2004	10.90	25	5.25	5.65
7/2/1982	11/17/1982	16.00	4	12.18	3.82
6/1/2021	12/13/2021	9.20	6	1.98	7.22
2/1/2019	5/19/2020	9.20	15	2.28	6.92
6/24/2010	12/1/2010	10.00	5	3.93	6.07
3/4/2008	8/27/2008	10.25	5	4.54	5.71
2/5/2020	10/12/2020	9.20	8	1.45	7.75
12/17/2010	9/1/2011	10.10	8	4.32	5.78
12/1/2006	7/3/2007	10.25	7	4.87	5.38
5/27/2005	2/3/2006	10.50	8	4.51	5.99
5/31/2002	6/26/2003	11.00	13	5.14	5.86
7/17/2000	3/15/2001	11.25	8	5.65	5.60
11/2/1998	6/8/1999	11.25	7	5.42	5.83
6/5/1996	1/31/1997	11.25	8	6.83	4.42
1/20/1993	11/26/1993	11.00	10	6.59	4.41
5/18/1981	12/1/1981	15.70	6	13.86	1.84
5/7/1980	12/12/1980	15.45	7	11.04	4.41
3/26/1980	5/27/1980	14.60	2	11.07	3.53
7/8/2013	1/22/2014	9.18	6	3.76	5.42
1/16/2009	6/30/2009	9.31	5	3.89	5.42
9/29/2006	3/14/2007	10.10	5	4.77	5.33
11/9/1999	5/25/2000	10.80	6	6.21	4.59
4/10/1995	10/13/1995	10.76	6	6.78	3.98
6/17/1993	12/16/1993	11.20	6	6.26	4.94

3/13/1989	8/23/1989	12.90	5	8.56	4.34
1/8/1987	6/30/1987	12.60	5	8.04	4.56
4/16/1984	9/12/1984	15.90	4	13.06	2.84
1/24/1983	6/30/1983	15.90	5	10.70	5.20
12/18/1981	5/25/1982	16.25	5	13.71	2.54
1/17/1980	6/25/1980	14.25	5	11.19	3.06
7/1/1988	12/21/1988	12.90	5	9.08	3.82
8/8/1987	2/4/1988	12.60	6	9.17	3.43
11/25/1985	6/11/1986	14.00	6	8.45	5.55
7/15/1983	12/8/1983	15.90	4	11.68	4.22
7/30/1982	12/14/1982	16.40	4	11.58	4.82
7/2/1981	11/25/1981	16.10	4	14.14	1.96
7/2/1981	11/25/1981	16.10	4	14.14	1.96
5/5/1980	10/9/1980	14.50	5	10.60	3.90
5/5/1980	10/9/1980	14.50	5	10.60	3.90
1/20/2009	7/17/2009	9.26	5	3.95	5.31
4/29/2005	12/28/2005	10.00	8	4.50	5.50
7/15/1999	1/28/2000	10.71	6	6.23	4.48
4/23/1993	12/1/1993	11.45	7	6.42	5.03
10/13/1989	3/28/1990	13.00	5	8.19	4.81
3/6/1987	10/20/1987	12.60	7	8.75	3.85
7/24/1984	1/2/1985	16.00	5	12.05	3.95
6/21/1982	11/2/1982	16.25	4	12.54	3.71
5/28/1981	8/25/1981	15.45	2	13.48	1.97
6/6/1980	11/6/1980	14.35	5	10.86	3.49
12/29/2006	6/29/2007	10.10	6	4.89	5.21
7/2/2004	12/8/2004	9.90	5	5.06	4.84
7/24/2001	1/30/2002	11.00	6	5.35	5.65
3/30/1992	8/26/1992	12.43	4	7.75	4.68
6/22/1990	11/19/1990	13.00	5	8.77	4.23
1/13/2020	2/24/2021	9.25	13	1.58	7.67
2/26/2016	3/1/2017	9.25	12	2.64	6.61
2/29/2012	5/10/2013	9.25	14	2.95	6.30
2/7/2003	11/10/2003	10.60	9	5.09	5.51
6/19/2001	10/30/2002	10.60	16	5.46	5.14
12/18/1992	10/8/1993	11.50	9	6.75	4.75
9/22/1989	5/31/1990	12.40	8	8.33	4.07
1/22/1988	10/27/1988	12.95	9	8.95	4.00
10/23/1985	9/5/1986	13.30	10	8.32	4.98
4/14/1982	2/25/1983	15.70	10	12.04	3.66
4/24/1981	2/9/1982	14.95	9	13.87	1.08

8/3/1984	2/22/1985	14.86	6	11.84	3.02
5/8/1981	12/15/1981	15.81	7	13.82	1.99
6/8/2020	11/19/2020	9.90	5	1.45	8.45
6/3/2019	12/19/2019	10.25	6	2.31	7.94
12/1/2016	2/21/2017	10.55	2	3.06	7.49
5/3/2010	11/3/2010	10.75	6	3.98	6.77
5/25/2004	6/10/2005	10.90	12	4.90	6.00
8/24/2001	4/29/2002	11.00	8	5.45	5.55
11/26/1997	6/30/1998	11.00	7	5.89	5.11
3/31/1993	9/29/1993	11.00	6	6.59	4.41
3/31/1992	9/30/1992	11.60	6	7.67	3.93
5/31/1991	11/26/1991	12.00	5	8.15	3.85
3/30/1990	9/18/1990	12.75	5	8.69	4.06
3/31/1989	7/31/1989	13.00	4	8.56	4.44
5/27/1987	11/29/1988	12.75	18	9.00	3.75
3/27/1986	9/23/1986	12.75	6	7.44	5.31
3/29/1985	9/23/1985	15.30	5	10.79	4.51
4/2/1984	9/25/1984	16.25	5	12.95	3.30
3/31/1983	9/30/1983	16.25	6	11.14	5.11
3/31/1982	9/30/1982	16.70	6	13.16	3.54
7/2/1981	12/22/1981	16.00	5	14.01	1.99
7/20/1979	1/18/1980	14.00	6	9.70	4.31
10/1/2009	3/31/2010	10.70	6	4.48	6.22
3/20/2008	9/19/2008	10.70	6	4.51	6.19
5/20/2005	12/20/2005	10.13	7	4.49	5.64
7/28/1981	9/3/1982	15.50	13	13.76	1.74
5/24/1992	11/25/1992	12.00	6	7.56	4.44
3/1/2019	12/18/2019	9.60	9	2.50	7.10
11/9/1992	9/1/1993	11.25	9	6.95	4.30
8/24/1990	4/30/1991	12.45	8	8.45	4.00
6/30/1989	4/30/1990	12.45	10	8.22	4.23
10/1/1981	7/2/1982	15.10	9	13.78	1.32
9/15/1980	4/30/1981	13.60	7	12.37	1.23
5/11/1984	8/21/1984	14.64	3	13.22	1.42
8/30/1982	2/10/1983	15.00	5	11.02	3.98
12/30/1980	3/3/1982	15.00	14	13.54	1.46
8/1/1980	7/31/1981	14.20	12	12.47	1.73
5/1/1980	11/6/1981	15.17	18	12.43	2.74
8/1/1978	7/31/1981	13.50	36	10.90	2.60
6/22/1978	8/1/1980	12.50	25	9.91	2.59
3/29/1978	4/29/1980	12.50	25	9.86	2.64

6/1/2015	12/18/2015	9.50	6	2.98	6.52
1/23/2009	7/17/2009	10.50	5	3.97	6.53
4/3/2008	9/30/2008	10.20	6	4.51	5.69
2/6/2004	9/9/2004	10.40	7	5.23	5.17
3/17/1982	9/17/1982	15.25	6	13.28	1.97
3/20/1981	10/20/1981	15.25	7	13.72	1.53
3/17/1980	8/11/1980	14.85	4	10.68	4.17
8/12/2016	4/28/2017	9.50	8	2.82	6.68
4/30/1982	11/4/1982	15.75	6	12.76	2.99
9/3/1981	2/9/1982	15.75	5	14.11	1.64
5/14/1980	10/31/1980	14.50	5	10.75	3.75
2/21/2020	1/13/2021	9.67	10	1.47	8.20
1/31/2018	11/1/2018	9.87	9	3.11	6.76
1/23/2015	12/9/2015	9.60	10	2.85	6.75
1/25/2013	12/18/2013	9.08	10	3.46	5.62
2/18/2011	1/10/2012	9.06	10	3.79	5.27
6/5/2009	4/29/2010	9.40	10	4.46	4.94
6/5/2009	4/29/2010	9.19	10	4.46	4.73
6/5/2009	4/29/2010	9.40	10	4.46	4.94
11/2/2007	9/24/2008	10.68	10	4.49	6.19
11/2/2007	9/24/2008	10.68	10	4.49	6.19
11/2/2007	9/24/2008	10.68	10	4.49	6.19
6/25/2004	5/17/2005	10.00	10	4.89	5.11
11/27/2002	10/22/2003	10.46	10	5.09	5.37
11/27/2002	10/22/2003	10.71	10	5.09	5.62
11/22/2002	10/17/2003	10.54	10	5.08	5.46
6/29/1998	3/1/1999	10.65	8	5.29	5.36
6/29/1998	3/1/1999	10.65	8	5.29	5.36
1/14/1994	12/12/1994	11.82	11	7.39	4.43
5/14/1993	4/6/1994	11.24	10	6.43	4.81
4/24/1991	3/18/1992	12.50	10	8.03	4.47
2/22/1990	1/16/1991	13.25	10	8.64	4.61
1/16/1990	11/28/1990	12.75	10	8.67	4.08
2/19/1982	1/12/1983	15.50	10	12.46	3.04
1/4/1982	11/23/1982	15.50	10	13.02	2.48
5/6/1981	7/1/1982	16.00	14	13.78	2.22
5/1/1980	3/25/1981	15.30	10	11.47	3.83
2/15/1980	1/7/1981	14.30	10	11.33	2.97
6/2/2009	3/24/2010	10.13	9	4.43	5.70
10/19/2001	9/11/2002	11.20	10	5.49	5.71
9/1/1999	7/17/2000	11.06	10	6.15	4.91

9/1/1992	7/21/1993	11.78	10	7.13	4.65
11/23/1982	10/13/1983	15.52	10	10.96	4.56
10/2/1981	8/25/1982	16.00	10	13.67	2.33
7/11/1980	6/3/1981	14.67	10	12.17	2.50
10/15/2020	9/8/2021	9.67	10	2.00	7.67
2/26/2014	1/21/2015	9.05	10	3.23	5.82
7/31/2012	6/18/2013	9.28	10	2.98	6.30
2/15/2011	1/10/2012	9.45	10	3.80	5.65
2/13/2009	1/21/2010	10.33	11	4.21	6.12
3/9/2007	2/5/2008	9.99	11	4.79	5.20
12/16/1994	11/8/1995	11.30	10	7.04	4.26
12/14/1990	11/8/1991	12.75	10	8.20	4.55
11/2/1983	9/12/1984	15.60	10	12.51	3.09
3/18/1982	12/28/1982	15.25	9	12.46	2.79
1/21/1980	12/17/1980	14.40	11	11.30	3.11
1/14/2021	11/18/2021	9.75	10	2.09	7.66
11/9/2018	10/2/2019	9.73	10	2.76	6.97
3/10/2017	1/31/2018	9.80	10	2.86	6.94
4/29/2008	3/25/2009	10.17	11	4.02	6.15
11/4/2004	9/30/2005	10.51	11	4.60	5.91
5/8/1995	4/3/1996	11.13	11	6.47	4.66
1/27/1987	1/20/1988	12.75	11	8.69	4.06
8/6/1981	7/1/1982	15.55	10	13.89	1.66
2/9/1979	1/3/1980	12.55	10	9.34	3.21
2/26/2014	1/21/2015	9.05	10	3.23	5.82
7/31/2012	6/18/2013	9.28	10	2.98	6.30
2/15/2011	1/10/2012	9.45	10	3.80	5.65
2/13/2009	1/21/2010	10.23	11	4.21	6.02
3/9/2007	2/5/2008	10.19	11	4.79	5.40
12/16/1994	11/8/1995	11.10	10	7.04	4.06
11/15/1991	10/6/1992	12.25	10	7.72	4.53
12/15/1989	11/9/1990	13.25	10	8.62	4.63
10/17/1983	8/30/1984	15.60	10	12.47	3.13
2/3/1982	12/28/1982	15.25	10	12.65	2.60
1/21/1980	12/17/1980	14.20	11	11.30	2.90
5/18/2007	2/13/2008	10.20	9	4.77	5.43
3/19/2004	11/30/2004	10.60	8	5.18	5.42
1/8/1992	10/28/1992	12.25	9	7.70	4.55
5/1/1990	10/31/1990	12.95	6	8.74	4.21
2/6/1987	9/18/1987	13.00	7	8.46	4.54
7/8/1983	1/18/1984	15.53	6	11.70	3.83

3/25/1982	10/27/1982	17.00	7	12.94	4.06
6/11/1980	12/8/1980	16.40	6	11.14	5.26
11/12/1987	10/26/1988	13.50	11	8.97	4.53
11/16/1981	8/11/1982	17.11	8	13.63	3.48
9/1/2006	8/1/2007	10.15	11	4.87	5.28
3/12/2004	6/30/2004	10.50	3	5.32	5.18
12/15/1995	7/3/1996	11.25	6	6.58	4.67
6/28/2019	2/24/2020	9.10	8	2.24	6.86
1/9/2014	9/4/2014	9.10	7	3.47	5.63
5/15/1992	1/12/1993	12.00	8	7.55	4.45
10/28/1999	6/22/2000	11.25	7	6.17	5.08
8/17/1995	4/15/1996	10.50	8	6.37	4.13
11/25/1987	9/26/1988	12.40	10	8.97	3.43
2/25/1987	10/20/1987	12.98	7	8.70	4.28
10/18/1985	6/13/1986	13.55	7	8.71	4.84
12/16/1983	8/9/1984	15.33	7	12.65	2.68
4/7/1982	12/3/1982	15.33	8	12.55	2.78
5/29/1981	1/25/1982	16.25	8	13.88	2.37
3/10/1981	11/4/1981	15.33	7	13.72	1.61
11/16/1979	7/23/1980	14.19	8	10.84	3.35
6/20/1979	3/5/1980	14.00	8	9.97	4.03
9/28/2018	5/7/2019	9.65	7	3.11	6.54
9/28/2017	5/3/2018	9.70	7	2.95	6.75
2/13/1990	9/13/1990	12.50	7	8.65	3.85
5/9/1986	10/31/1986	13.75	5	7.50	6.25
6/10/1983	12/1/1983	14.50	5	11.55	2.95
5/28/2021	12/28/2021	9.35	7	1.97	7.38
2/1/2007	8/29/2007	10.50	6	4.94	5.56
1/30/1989	10/6/1989	13.00	8	8.57	4.43
1/21/1988	10/21/1988	12.80	9	8.95	3.85
4/30/1984	10/18/1984	15.00	5	12.90	2.10
1/14/1983	7/5/1983	15.00	5	10.70	4.30
5/28/2021	1/3/2022	9.25	7	1.97	7.28
4/23/2010	10/21/2010	10.40	6	4.00	6.40
4/20/2007	10/19/2007	10.50	6	4.96	5.54
6/1/2021	12/28/2021	9.38	7	1.97	7.41
8/31/2018	3/27/2019	9.70	6	3.15	6.55
7/1/2009	12/29/2009	10.38	6	4.32	6.06
3/29/2001	1/31/2002	11.00	10	5.48	5.52
9/16/1992	7/23/1993	11.50	10	7.12	4.38
4/2/1990	10/2/1990	13.00	6	8.72	4.28

5/4/1984	10/24/1984	15.50	5	12.86	2.64
11/25/2020	6/30/2021	9.43	7	2.09	7.34
9/28/2018	4/30/2019	9.73	7	3.11	6.62
11/23/2016	6/22/2017	9.70	7	3.00	6.70
6/29/2012	12/20/2012	10.25	5	2.80	7.45
2/22/2000	9/27/2000	11.25	7	5.92	5.33
6/29/1990	12/21/1990	12.50	5	8.69	3.81
11/20/1987	7/1/1988	12.75	7	8.89	3.86
11/23/1983	5/16/1984	15.00	5	12.21	2.79
9/10/1982	3/2/1983	15.25	5	10.90	4.35
7/1/1981	1/4/1982	15.50	6	13.99	1.51
3/31/1980	9/24/1980	15.00	5	10.67	4.33
6/14/1995	4/17/1996	10.77	10	6.45	4.32
1/14/1988	11/15/1988	12.00	10	8.95	3.05
3/27/1986	2/24/1987	12.00	11	7.47	4.53
3/1/1985	9/25/1985	14.50	6	10.93	3.57
5/11/1984	10/2/1984	14.80	4	12.97	1.83
9/28/1982	6/27/1983	14.50	9	10.71	3.79
11/4/1981	5/20/1982	15.82	6	13.63	2.19
5/14/1980	10/28/1980	12.00	5	10.71	1.29
11/14/2003	7/22/2004	10.25	8	5.23	5.02
3/28/1991	12/10/1991	11.75	8	8.16	3.59
8/19/1987	7/8/1988	12.00	10	9.04	2.96
3/30/1987	11/24/1987	12.50	7	8.90	3.60
6/11/1985	5/28/1986	14.00	11	9.44	4.56
5/6/1983	9/26/1983	14.50	4	11.30	3.20
5/15/1981	10/26/1981	13.50	5	13.91	(0.41)
7/2/2004	7/6/2005	10.50	12	4.81	5.69
12/10/1982	12/12/1983	14.50	12	11.10	3.40
11/9/1979	11/17/1980	15.50	12	11.00	4.50
9/21/2018	11/7/2019	9.35	13	2.78	6.57
7/31/2008	4/2/2009	10.75	8	3.77	6.98
4/18/1980	4/9/1981	15.00	11	11.52	3.48
11/15/2017	9/28/2018	9.50	10	3.02	6.48
4/16/2010	11/2/2010	9.75	6	4.03	5.72
4/16/2003	10/31/2003	10.20	6	5.09	5.11
4/16/1993	10/29/1993	11.25	6	6.47	4.78
6/24/1988	9/30/1988	13.25	3	9.16	4.09
3/16/1982	9/30/1982	15.50	6	13.19	2.31
11/15/2017	9/28/2018	9.50	10	3.02	6.48
4/16/2010	11/2/2010	9.75	6	4.03	5.72

5/17/1982	11/30/1982	16.10	6	12.46	3.64
4/16/2013	2/28/2014	9.55	10	3.60	5.95
4/13/2012	11/1/2012	9.45	6	2.82	6.63
4/16/2009	10/30/2009	9.95	6	4.28	5.67
4/27/2005	11/30/2005	10.00	7	4.48	5.52
4/16/1992	10/30/1992	11.40	6	7.63	3.77
5/17/1983	8/31/1983	15.25	3	11.30	3.95
5/17/1982	11/30/1982	15.50	6	12.46	3.04
7/17/1981	1/31/1982	14.00	6	14.08	(0.08)
6/16/2015	4/29/2016	9.80	10	2.87	6.93
1/14/2011	8/1/2011	9.20	6	4.42	4.78
9/16/2010	3/31/2011	9.45	6	4.31	5.14
7/17/2008	2/2/2009	10.05	6	3.88	6.17
12/17/2014	10/30/2015	9.80	10	2.81	6.99
6/16/1987	12/31/1987	13.25	6	9.09	4.16
5/17/1982	11/30/1982	15.50	6	12.46	3.04
7/17/1979	1/31/1980	12.61	6	9.76	2.85
5/17/2018	1/18/2019	9.70	8	3.14	6.56
5/24/2019	12/17/2019	9.75	6	2.32	7.43
6/8/2018	1/4/2019	9.80	7	3.15	6.65
11/6/2015	6/3/2016	9.65	7	2.76	6.89
5/17/2013	12/13/2013	9.60	7	3.65	5.95
7/27/2012	2/22/2013	9.60	7	2.91	6.69
5/7/2010	12/6/2010	9.56	7	4.00	5.56
4/29/2005	12/21/2005	11.00	7	4.50	6.50
11/7/1999	6/19/2000	11.05	7	6.18	4.87
4/21/1995	11/20/1995	11.40	7	6.67	4.73
9/25/1992	4/23/1993	11.75	7	7.25	4.50
11/10/1986	5/5/1987	12.85	5	7.63	5.22
12/6/1982	7/1/1983	14.80	6	10.66	4.14
7/10/1981	2/8/1982	15.50	7	14.07	1.43
11/13/1979	6/10/1980	13.78	7	11.01	2.77
5/1/2006	9/26/2006	10.75	4	5.08	5.67
5/14/2021	12/3/2021	9.65	6	2.01	7.64
5/15/2020	11/7/2020	9.60	5	1.44	8.16
5/22/2019	12/18/2019	9.60	7	2.33	7.27
4/14/2017	9/19/2017	9.70	5	2.85	6.85
2/28/2013	9/23/2013	9.60	6	3.38	6.22
8/28/2020	4/9/2021	9.70	7	1.81	7.89
4/22/2019	10/15/2019	9.70	5	2.45	7.25
5/15/2018	12/11/2018	9.70	7	3.15	6.55

4/26/2013	11/22/2013	9.50	7	3.57	5.93
4/15/2011	11/14/2011	9.60	7	3.80	5.80
4/20/2007	11/15/2007	10.00	6	4.92	5.08
3/13/2003	10/31/2003	10.75	7	5.10	5.65
6/1/1994	10/18/1994	11.50	4	7.58	3.92
3/31/1993	7/29/1993	11.50	4	6.80	4.70
3/31/1989	8/22/1989	12.80	4	8.48	4.32
2/23/1988	9/20/1988	12.90	7	9.02	3.88
3/31/1983	8/29/1983	16.00	5	11.03	4.97
4/29/1982	11/24/1982	16.02	6	12.56	3.46
7/31/1981	3/1/1982	15.96	7	14.11	1.85
7/11/1980	12/31/1980	14.56	5	11.54	3.02
10/17/1979	1/14/1980	13.20	2	10.21	2.99
6/28/2019	3/26/2020	9.48	9	2.15	7.33
5/31/2017	2/28/2018	9.50	9	2.85	6.65
12/16/2019	9/10/2020	9.90	8	1.59	8.31
11/30/2018	9/26/2019	9.90	10	2.73	7.17
10/31/2017	8/28/2018	10.00	10	3.00	7.00
8/13/2010	5/26/2011	10.50	9	4.26	6.24
12/29/1994	3/11/1996	11.60	14	6.78	4.82
11/13/1987	12/7/1989	13.25	25	8.75	4.50
2/12/2021	12/9/2021	9.90	10	2.10	7.80
11/25/2019	8/20/2020	9.90	8	1.65	8.25
11/22/2017	9/13/2018	10.00	9	3.02	6.98
9/1/1992	10/28/1993	11.50	14	6.90	4.60
9/11/1989	4/12/1990	13.25	7	8.21	5.04
8/14/1987	12/22/1988	13.50	16	9.05	4.45
2/10/1984	6/26/1985	14.82	16	12.07	2.75
3/22/2021	9/9/2021	9.85	5	2.13	7.72
6/22/2015	12/11/2015	9.90	5	2.97	6.93
6/7/2013	11/14/2013	10.25	5	3.67	6.58
7/1/2009	12/16/2009	10.75	5	4.31	6.44
5/16/2008	1/13/2009	10.45	8	4.12	6.33
10/31/1995	3/27/1997	10.75	17	6.66	4.09
6/29/1984	3/11/1986	14.00	20	11.01	2.99
7/25/1983	2/14/1984	14.25	6	11.74	2.51
5/31/2019	12/6/2019	9.87	6	2.31	7.56
5/26/2006	1/9/2007	11.00	7	4.91	6.09
12/1/2004	3/29/2005	11.00	3	4.76	6.24
11/21/2002	5/2/2003	11.40	5	5.10	6.30
12/10/1996	10/29/1997	10.75	10	6.71	4.04

4/14/1989	6/29/1990	13.25	14	8.35	4.90
4/29/1988	10/25/1988	13.25	5	9.12	4.13
9/29/2017	6/6/2018	9.80	8	2.97	6.83
2/6/2014	12/3/2014	10.00	10	3.34	6.66
4/11/2017	2/21/2018	9.80	10	2.86	6.94
4/2/2009	2/10/2010	10.00	10	4.32	5.68
5/2/2006	3/22/2007	10.50	10	4.91	5.59
11/4/2003	9/21/2004	10.50	10	5.21	5.29
10/3/1997	8/26/1998	10.93	10	5.90	5.03
3/1/1996	1/22/1997	11.30	10	6.81	4.49
3/8/1991	1/22/1992	12.84	10	8.09	4.75
11/14/1980	10/2/1981	14.80	10	13.19	1.61
12/11/2020	10/27/2021	9.37	10	2.06	7.31
4/11/2017	2/21/2018	9.80	10	2.86	6.94
1/26/1999	12/14/1999	10.50	10	5.89	4.61
1/2/2014	10/29/2014	10.80	10	3.42	7.38
8/1/1985	11/8/1985	12.94	3	10.52	2.42
8/31/1982	11/30/1982	12.98	3	11.30	1.68
9/25/2017	5/29/2018	9.40	8	2.96	6.44
7/13/1981	4/18/1982	14.70	9	13.98	0.72
6/25/1980	4/29/1981	13.50	10	11.90	1.60
9/30/2016	7/20/2017	9.55	9	2.92	6.63
7/29/1996	10/31/1997	11.25	15	6.73	4.52
4/7/1980	12/22/1980	13.45	8	11.10	2.35
3/31/2003	10/30/2003	11.00	7	5.09	5.91
5/8/1991	12/6/1991	12.70	7	8.15	4.55
3/27/1986	11/10/1986	14.00	7	7.49	6.51
4/27/1983	12/12/1983	15.50	7	11.38	4.12
4/1/2019	10/31/2019	9.70	7	2.48	7.22
5/31/2013	12/17/2013	10.00	6	3.69	6.31
3/31/2008	10/24/2008	10.60	6	4.47	6.13
3/28/2002	10/28/2002	11.30	7	5.47	5.83
3/31/2000	10/5/2000	11.30	6	5.89	5.41
12/21/1990	7/22/1991	12.90	7	8.28	4.62
5/14/1985	12/11/1985	14.90	7	10.45	4.45
4/30/1982	11/30/1982	15.65	7	12.51	3.14
6/26/1981	2/2/1982	16.24	7	14.01	2.23
3/31/2016	10/28/2016	9.70	7	2.43	7.27
3/31/2008	10/24/2008	10.60	6	4.47	6.13
4/2/1998	10/30/1998	11.40	7	5.57	5.83
3/9/1994	10/7/1994	11.87	7	7.43	4.44

4/1/1991	11/1/1991	12.90	7	8.20	4.70
4/5/1989	11/5/1989	13.20	7	8.33	4.87
4/11/1986	11/19/1986	13.75	7	7.49	6.26
4/19/1985	11/20/1985	14.90	7	10.61	4.29
1/19/1983	8/18/1983	15.30	7	10.91	4.39
10/20/1981	5/14/1982	15.80	6	13.72	2.08
6/10/1980	1/12/1981	14.95	7	11.30	3.65
8/24/1981	4/12/1982	15.10	7	14.02	1.08
12/15/2006	6/13/2007	10.75	6	4.85	5.90
4/18/2019	11/13/2019	9.60	6	2.43	7.17
8/31/2016	6/30/2017	9.60	10	2.86	6.74
3/10/2009	12/17/2009	10.30	9	4.21	6.09
4/16/2002	11/20/2002	10.00	7	5.41	4.59
12/13/1990	9/30/1991	12.40	9	8.23	4.17
12/16/1988	1/18/1990	12.50	13	8.45	4.05
12/12/1986	12/8/1987	12.50	12	8.49	4.01
12/15/1981	5/21/1982	15.50	5	13.71	1.79
3/30/2021	11/17/2021	9.60	7	2.08	7.52
3/28/2019	11/13/2019	9.60	7	2.48	7.12
11/20/2007	10/3/2008	10.30	10	4.48	5.82
4/5/1993	1/5/1994	11.50	9	6.43	5.07
8/22/1991	6/24/1992	12.20	10	7.87	4.33
8/7/1990	2/15/1991	12.70	6	8.59	4.11
3/30/1989	3/21/1990	12.80	11	8.30	4.50
6/29/1987	12/31/1987	12.85	6	9.14	3.71
10/11/1985	7/30/1986	13.30	9	8.52	4.78
1/21/1983	6/9/1983	14.85	4	10.67	4.18
5/19/1981	12/17/1981	14.75	7	13.82	0.93
1/12/2018	10/29/2018	9.60	9	3.10	6.50
5/29/2009	6/18/2010	10.30	12	4.43	5.87
9/30/2005	11/9/2006	10.00	13	4.85	5.15
5/21/2001	1/9/2002	10.00	7	5.44	4.56
11/14/1991	12/30/1992	12.00	13	7.68	4.32
7/1/1983	3/23/1984	15.50	8	11.78	3.72
2/13/1981	2/11/1982	16.00	12	13.68	2.32
4/2/1979	5/8/1980	13.75	13	10.07	3.68
3/13/2020	9/23/2020	9.60	6	1.38	8.22
1/27/2017	10/20/2017	9.60	8	2.91	6.69
11/29/2013	9/30/2014	9.75	10	3.51	6.24
1/15/2010	9/16/2010	10.30	8	4.29	6.01
8/29/2003	7/8/2004	10.00	10	5.24	4.76

1/16/1996	1/27/1997	11.25	12	6.74	4.51
1/7/1994	12/14/1994	11.50	11	7.37	4.13
7/19/1991	8/10/1992	12.10	12	7.87	4.23
4/16/1987	3/23/1988	13.00	11	8.90	4.10
3/30/1984	2/15/1985	15.00	10	12.37	2.63
1/28/1983	5/19/1983	14.85	3	10.62	4.23
8/27/1981	10/8/1982	15.00	13	13.58	1.42
12/23/2019	12/16/2020	9.38	11	1.57	7.81
3/25/2011	1/31/2012	10.00	10	3.65	6.35
5/30/2006	6/29/2007	9.53	13	4.91	4.62
1/10/2003	1/13/2004	10.25	12	5.11	5.14
8/28/1995	2/13/1997	11.00	17	6.63	4.37
8/28/1987	8/8/1988	12.74	11	9.05	3.69
2/27/1984	11/7/1984	15.00	8	12.71	2.29
12/26/1982	10/26/1983	14.75	10	11.03	3.72
11/25/1981	8/30/1982	16.25	9	13.57	2.68
3/31/1980	7/27/1981	15.50	16	11.93	3.57
6/6/2016	12/22/2016	9.50	6	2.51	6.99
6/3/2013	12/16/2013	9.73	6	3.69	6.04
6/1/2010	12/20/2010	10.10	6	4.00	6.10
10/3/2005	4/26/2006	10.60	6	4.69	5.91
12/15/1992	6/7/1993	11.50	5	7.03	4.47
7/26/1991	1/31/1992	12.00	6	7.89	4.11
12/15/1987	6/24/1988	11.50	6	8.86	2.64
1/12/1983	5/9/1983	15.50	3	10.64	4.86
3/2/1981	8/28/1981	15.00	5	13.35	1.65
4/30/1980	11/4/1980	15.00	6	10.74	4.26
9/1/2021	3/22/2022	9.40	6	2.05	7.35
9/1/2021	3/22/2022	9.40	6	2.05	7.35
2/28/2020	9/25/2020	9.25	7	1.38	7.87
2/28/2020	9/25/2020	9.25	7	1.38	7.87
5/29/2018	12/24/2018	9.25	6	3.15	6.10
5/29/2018	12/24/2018	9.25	6	3.15	6.10
4/4/2012	10/31/2012	10.00	7	2.84	7.16
4/4/2012	10/31/2012	9.30	7	2.84	6.46
4/3/2009	10/28/2009	10.15	6	4.25	5.90
4/3/2009	10/28/2009	10.15	6	4.25	5.90
3/8/2004	8/26/2004	10.50	5	5.28	5.22
3/8/2004	8/26/2004	10.50	5	5.28	5.22
3/1/1993	10/25/1993	11.55	7	6.55	5.00
10/13/1983	4/9/1984	15.20	5	11.95	3.25

7/30/1982	11/30/1982	16.00	4	11.70	4.30
7/30/1982	1/24/1983	16.00	5	11.34	4.66
10/14/1981	4/12/1982	16.70	6	13.84	2.86
5/6/1980	10/27/1980	15.20	5	10.68	4.52
4/30/1980	10/27/1980	15.20	6	10.68	4.52
11/22/1989	10/17/1990	11.90	10	8.56	3.34
11/14/1988	9/21/1989	12.10	10	8.69	3.41
11/24/1982	10/19/1983	15.20	10	10.97	4.23
11/25/1981	10/19/1982	15.90	10	13.30	2.60
11/23/1981	10/10/1984	15.50	35	12.20	3.30
11/25/1980	10/20/1981	16.50	10	13.28	3.22
10/11/1979	9/4/1980	14.00	10	10.77	3.23
7/31/2008	6/22/2009	10.00	10	3.87	6.13
11/11/1995	10/3/1996	10.00	10	6.65	3.35
11/12/1992	12/16/1993	10.60	13	6.71	3.89
8/10/1990	7/1/1991	11.70	10	8.46	3.24
5/23/1984	4/16/1985	15.70	10	12.16	3.54
2/16/1983	1/10/1984	15.90	10	11.25	4.65
11/23/1981	10/15/1982	15.90	10	13.32	2.58
8/21/1980	7/14/1981	16.90	10	12.49	4.41
11/20/1990	10/3/1991	11.30	10	8.24	3.06
11/9/1984	11/25/1985	13.30	12	11.00	2.30
7/7/1981	6/7/1982	16.00	11	13.86	2.14
4/11/1979	3/7/1980	13.50	11	9.81	3.69
2/27/2020	5/19/2021	8.80	14	1.68	7.12
12/31/1991	11/25/1992	11.00	11	7.69	3.31
1/25/1991	11/26/1991	11.60	10	8.17	3.43
2/27/1989	1/26/1990	12.10	11	8.35	3.75
5/27/1983	12/9/1983	15.30	6	11.52	3.78
2/26/1982	1/24/1983	15.50	11	12.37	3.13
4/28/2016	4/20/2017	8.70	11	2.69	6.01
1/29/2007	12/21/2007	9.10	10	4.84	4.26
10/21/1994	9/15/1995	10.40	10	7.31	3.09
8/27/1990	7/19/1991	12.30	10	8.44	3.86
8/29/1989	7/19/1990	11.70	10	8.33	3.37
8/26/1988	7/19/1989	11.80	10	8.88	2.92
8/27/1987	7/18/1988	12.00	10	9.04	2.96
5/10/1985	4/2/1986	12.90	10	9.91	2.99
1/28/1983	12/20/1983	15.40	10	11.20	4.20
1/29/1982	12/21/1982	15.70	10	12.71	2.99
1/30/1981	12/22/1981	15.70	10	13.55	2.15

5/23/1980	12/26/1980	14.00	7	11.17	2.83
6/16/1979	3/14/1980	14.00	9	10.05	3.95
2/4/1994	4/19/1995	11.00	14	7.51	3.49
2/19/1993	2/2/1994	10.40	11	6.47	3.93
1/31/1992	2/2/1993	11.40	12	7.65	3.75
4/20/1984	3/14/1985	15.50	10	12.31	3.19
4/29/1983	3/20/1984	16.00	10	11.56	4.44
4/30/1982	3/23/1983	15.40	10	11.86	3.54
4/16/1981	3/8/1982	17.10	10	13.85	3.25
4/18/1980	3/12/1981	15.65	10	11.41	4.24
4/6/1979	2/29/1980	14.00	10	9.74	4.26
8/28/1991	7/22/1992	11.20	10	7.85	3.35
2/27/1990	1/25/1991	11.70	11	8.63	3.07
8/29/1988	7/25/1989	12.80	11	8.86	3.94
4/11/1988	3/8/1989	13.00	11	9.06	3.94
5/18/1984	4/9/1985	15.50	10	12.20	3.30
5/27/1983	4/18/1984	16.20	10	11.75	4.45
2/18/1982	1/11/1983	15.90	10	12.48	3.42
8/28/1979	7/22/1980	14.10	10	10.55	3.55
3/18/1985	2/11/1986	12.50	11	10.44	2.06
7/7/1982	5/31/1983	14.00	10	11.23	2.77
1/5/1981	12/1/1981	16.00	11	13.45	2.55
5/1/1979	3/27/1980	12.69	11	10.01	2.68
2/15/2002	3/7/2003	9.96	12	5.38	4.58
8/2/1991	6/29/1992	11.00	11	7.89	3.11
8/3/1990	6/25/1991	11.70	10	8.46	3.24
8/15/1989	7/6/1990	12.10	10	8.32	3.78
8/21/1987	7/20/1988	13.40	11	9.04	4.36
8/22/1986	6/15/1987	13.20	9	7.78	5.42
8/17/1984	7/9/1985	15.00	10	11.52	3.48
8/19/1983	7/10/1984	16.00	10	12.27	3.73
8/27/1982	7/19/1983	15.10	10	10.89	4.21
8/21/1981	7/13/1982	16.80	10	13.88	2.92
8/28/1980	7/10/1981	16.00	10	12.52	3.48
8/24/1979	7/18/1980	13.80	10	10.54	3.26
3/3/2008	12/3/2008	10.39	9	4.39	6.00
3/6/1991	11/27/1991	12.70	8	8.18	4.52
7/5/1988	10/17/1989	12.41	15	8.77	3.64
12/16/1982	11/9/1983	16.51	10	11.05	5.46
12/9/1982	11/9/1983	16.51	11	11.04	5.47
1/12/1982	9/15/1982	16.04	8	13.49	2.55

12/31/1981	9/9/1982	16.04	8	13.54	2.50
10/29/1980	8/12/1981	13.72	9	12.91	0.81
10/17/1980	8/12/1981	13.72	9	12.86	0.86
7/9/2012	11/13/2013	9.84	16	3.18	6.66
7/18/2007	5/28/2008	10.50	10	4.60	5.90
7/31/2001	6/11/2002	11.77	10	5.50	6.27
1/8/1996	12/12/1996	11.96	11	6.72	5.24
4/2/1990	1/3/1991	13.02	9	8.66	4.36
3/6/1984	11/20/1984	15.92	8	12.68	3.24
4/16/1981	1/27/1982	16.84	9	13.83	3.01
4/2/1991	2/20/1992	13.00	10	8.05	4.95
10/21/1983	8/7/1984	16.69	9	12.49	4.20
2/6/1981	9/30/1981	15.94	7	13.48	2.46
8/7/1979	5/7/1980	14.27	9	10.56	3.71
1/4/1983	8/19/1983	15.79	7	10.88	4.91
11/13/1981	8/4/1982	15.58	8	13.63	1.95
10/31/1980	8/12/1981	14.41	9	12.91	1.50
10/2/1979	7/9/1980	14.51	9	10.74	3.77
5/28/2004	4/13/2005	10.60	10	4.98	5.62
7/26/2001	12/4/2002	10.75	16	5.42	5.33
1/30/1985	1/17/1986	14.50	11	10.66	3.84
7/9/1982	9/16/1983	15.51	14	11.26	4.25
6/20/1980	2/20/1981	14.50	8	11.58	2.92
5/28/2021	11/30/2021	9.40	6	2.00	7.40
7/8/2015	1/6/2016	9.50	6	2.96	6.54
6/26/2009	12/14/2009	10.50	5	4.30	6.20
1/28/2005	10/4/2005	9.90	8	4.51	5.39
5/23/1985	12/20/1985	14.88	7	10.38	4.50
12/17/1982	10/27/1983	14.88	10	11.02	3.86
6/15/1981	3/31/1982	16.25	9	13.92	2.33
6/30/1980	2/11/1981	14.50	7	11.61	2.89
6/15/1979	2/8/1980	14.50	7	9.71	4.79
3/16/2020	12/10/2020	9.40	8	1.44	7.96
3/15/2019	10/8/2019	9.40	6	2.54	6.86
11/30/2016	9/13/2017	9.40	9	2.95	6.45
5/1/2015	2/29/2016	9.40	10	2.93	6.47
9/2/2014	4/9/2015	9.50	7	2.82	6.68
6/25/2009	10/26/2009	10.10	4	4.29	5.81
4/9/2003	9/25/2003	10.25	5	5.05	5.20
3/31/2020	1/6/2021	9.40	9	1.46	7.94
12/30/2019	10/16/2020	9.40	9	1.54	7.86

12/29/2017	10/26/2018	9.40	10	3.08	6.32
12/30/2011	10/26/2012	9.50	10	2.94	6.56
10/16/1998	11/12/1999	10.25	13	5.68	4.57
1/6/1989	10/18/1989	13.25	9	8.57	4.68
3/11/1983	3/23/1983	16.10	0	10.68	5.42
8/31/1982	10/1/1982	16.50	1	12.07	4.43
3/1/1982	4/1/1982	16.50	1	13.54	2.96
2/27/1981	4/1/1981	15.30	1	12.70	2.60
3/1/1980	4/1/1980	14.75	1	12.34	2.41
4/24/2020	2/19/2021	9.86	10	1.54	8.32
12/28/1989	9/20/1990	12.50	8	8.61	3.89
11/28/1983	8/27/1984	14.52	9	12.58	1.94
7/29/1981	1/14/1982	11.95	5	14.09	(2.14)
3/31/1980	8/28/1980	13.61	5	10.57	3.04
2/21/1990	11/21/1990	12.50	9	8.70	3.80
1/4/1985	9/26/1985	14.50	8	11.03	3.47
10/12/1982	7/8/1983	15.50	8	10.69	4.81
5/30/1980	10/24/1980	14.00	4	10.73	3.27
3/8/1994	12/1/1994	11.00	8	7.54	3.46
4/3/1990	12/20/1990	12.50	8	8.68	3.82
4/3/1989	12/21/1989	12.80	8	8.26	4.54
8/28/1987	5/27/1988	13.18	9	9.04	4.14
2/25/1986	11/25/1986	13.15	9	7.56	5.59
12/10/1982	4/29/1983	15.05	4	10.64	4.41
6/26/1981	3/26/1982	16.00	9	13.97	2.03
10/29/1979	8/28/1980	14.00	10	10.81	3.19
9/30/2020	6/17/2021	10.24	8	1.98	8.26
4/16/1987	1/15/1988	13.15	9	9.00	4.15
7/29/1983	4/27/1984	15.85	9	11.93	3.92
9/28/1981	6/25/1982	16.50	9	13.79	2.71
3/30/1979	1/4/1980	13.75	9	9.40	4.35
4/28/1988	1/26/1989	12.60	9	9.07	3.53
1/28/1986	10/30/1986	13.00	9	7.71	5.29
4/15/1983	1/13/1984	15.50	9	11.40	4.10
4/16/1982	11/5/1982	14.73	6	12.78	1.95
4/30/1981	9/23/1981	14.34	4	13.73	0.61
4/29/1980	8/21/1980	13.03	3	10.30	2.73
4/27/2006	2/8/2007	10.40	9	4.94	5.46
4/29/1983	1/26/1984	15.90	9	11.46	4.44
3/31/1982	12/17/1982	16.25	8	12.47	3.78
4/30/1981	10/23/1981	15.50	5	13.90	1.60

4/27/2012	12/20/2012	9.50	7	2.81	6.69
4/1/2008	11/24/2008	10.50	7	4.43	6.07
2/16/1995	11/17/1995	10.90	9	6.85	4.05
1/15/1993	10/14/1993	11.20	9	6.67	4.53
5/17/1990	2/15/1991	12.80	9	8.56	4.24
8/4/1988	5/4/1989	13.00	9	9.05	3.95
1/23/1987	7/27/1987	13.50	6	8.17	5.33
2/27/1984	11/30/1984	15.50	9	12.62	2.88
9/28/1981	6/23/1982	15.50	8	13.79	1.71
4/26/2005	10/31/2005	10.25	6	4.45	5.80
6/1/1989	11/28/1989	12.75	6	8.09	4.66
6/5/1987	11/12/1987	12.75	5	9.07	3.68
6/13/1983	9/28/1983	14.25	3	11.50	2.75
6/15/2018	9/26/2018	10.20	3	3.05	7.15
6/15/2017	9/27/2017	10.20	3	2.81	7.39
6/15/2016	10/13/2016	10.20	4	2.31	7.89
5/3/2002	11/1/2002	12.60	6	5.40	7.20
5/8/1995	11/7/1995	12.50	6	6.64	5.86
11/25/2014	5/11/2015	9.80	5	2.64	7.16
6/22/2012	11/8/2012	10.10	4	2.78	7.32
10/15/2008	3/9/2009	10.30	4	3.49	6.81
5/4/2007	10/8/2007	10.48	5	4.99	5.49
5/11/1989	11/9/1989	12.60	6	8.18	4.42
8/21/1986	2/13/1987	12.60	5	7.50	5.10
12/15/1984	6/10/1985	15.75	5	11.39	4.36
11/16/2009	5/24/2010	10.05	6	4.55	5.50
6/30/2006	12/5/2006	10.20	5	4.90	5.30
1/26/2004	10/20/2004	10.20	8	5.19	5.01
5/1/1997	10/7/1998	11.06	17	6.06	5.00
8/3/1993	1/25/1994	12.00	5	6.16	5.84
8/16/1985	2/12/1986	15.20	6	10.00	5.20
6/28/1982	12/13/1982	16.00	5	12.00	4.00
9/2/2011	1/23/2012	10.20	4	3.06	7.14
6/1/1996	12/17/1996	11.50	6	6.85	4.65
3/28/1991	9/27/1991	12.50	6	8.25	4.25
6/9/1989	11/3/1989	12.93	4	8.10	4.83
5/15/1987	11/13/1987	12.75	6	9.04	3.71
4/26/1985	10/25/1985	15.25	6	10.64	4.61
9/17/1982	3/16/1983	16.00	6	10.82	5.18
9/27/2019	4/21/2020	9.80	6	1.99	7.81
10/11/2018	5/21/2019	9.80	7	3.08	6.72

5/31/2012	12/4/2012	10.50	6	2.77	7.73
4/24/2009	1/26/2010	10.40	9	4.35	6.05
10/26/2007	6/24/2008	10.00	8	4.50	5.50
5/31/2006	3/29/2007	10.00	10	4.88	5.12
5/23/2003	5/25/2004	10.00	12	5.16	4.84
11/14/2019	6/16/2020	9.65	7	1.78	7.87
11/16/2016	5/23/2017	9.60	6	3.03	6.57
7/2/2012	12/4/2012	10.00	5	2.79	7.21
12/3/2010	4/18/2011	10.05	4	4.53	5.52
7/31/2009	2/23/2010	10.50	6	4.39	6.11
3/6/2008	10/20/2008	10.06	7	4.47	5.59
12/20/2019	8/4/2020	9.50	7	1.61	7.89
3/31/2016	9/27/2016	9.50	6	2.43	7.07
6/3/2010	12/14/2010	10.33	6	3.99	6.34
7/1/2013	2/21/2014	9.85	7	3.75	6.10
12/3/2009	4/8/2010	10.35	4	4.61	5.74
12/19/2007	6/27/2008	10.00	6	4.50	5.50
5/3/2002	12/30/2002	11.20	8	5.35	5.85
4/2/1993	1/10/1994	11.00	9	6.43	4.57
3/30/1990	11/21/1990	12.10	7	8.73	3.37
8/8/1984	2/7/1985	14.85	6	11.85	3.00
1/9/1981	6/22/1981	16.00	5	12.93	3.07
1/4/1980	5/19/1980	15.50	4	11.46	4.04
5/3/2010	12/17/2010	10.10	7	4.04	6.06
5/4/1993	6/23/1994	10.60	13	6.62	3.98
4/30/1990	11/29/1990	12.75	7	8.72	4.03
7/1/2005	7/24/2006	10.00	12	4.74	5.26
7/22/1982	12/20/1982	15.00	5	11.65	3.35
6/6/1990	4/3/1991	13.00	10	8.51	4.49
3/17/1988	10/28/1988	13.00	7	9.07	3.93
10/30/2020	9/27/2021	9.40	11	2.01	7.39
4/30/2019	3/25/2020	9.40	11	2.26	7.14
5/26/2017	4/26/2018	9.50	11	2.89	6.61
2/9/2015	1/6/2016	9.50	11	2.89	6.61
3/23/2010	11/19/2010	10.20	8	4.12	6.08
1/23/2009	12/22/2009	10.20	11	4.13	6.07
3/4/2008	12/29/2008	10.20	10	4.26	5.94
4/26/2007	12/19/2007	10.20	7	4.86	5.34
3/29/2005	12/21/2005	10.40	8	4.52	5.88
10/22/1999	9/29/2000	11.16	11	6.07	5.09
6/27/1997	12/24/1997	10.75	6	6.36	4.39

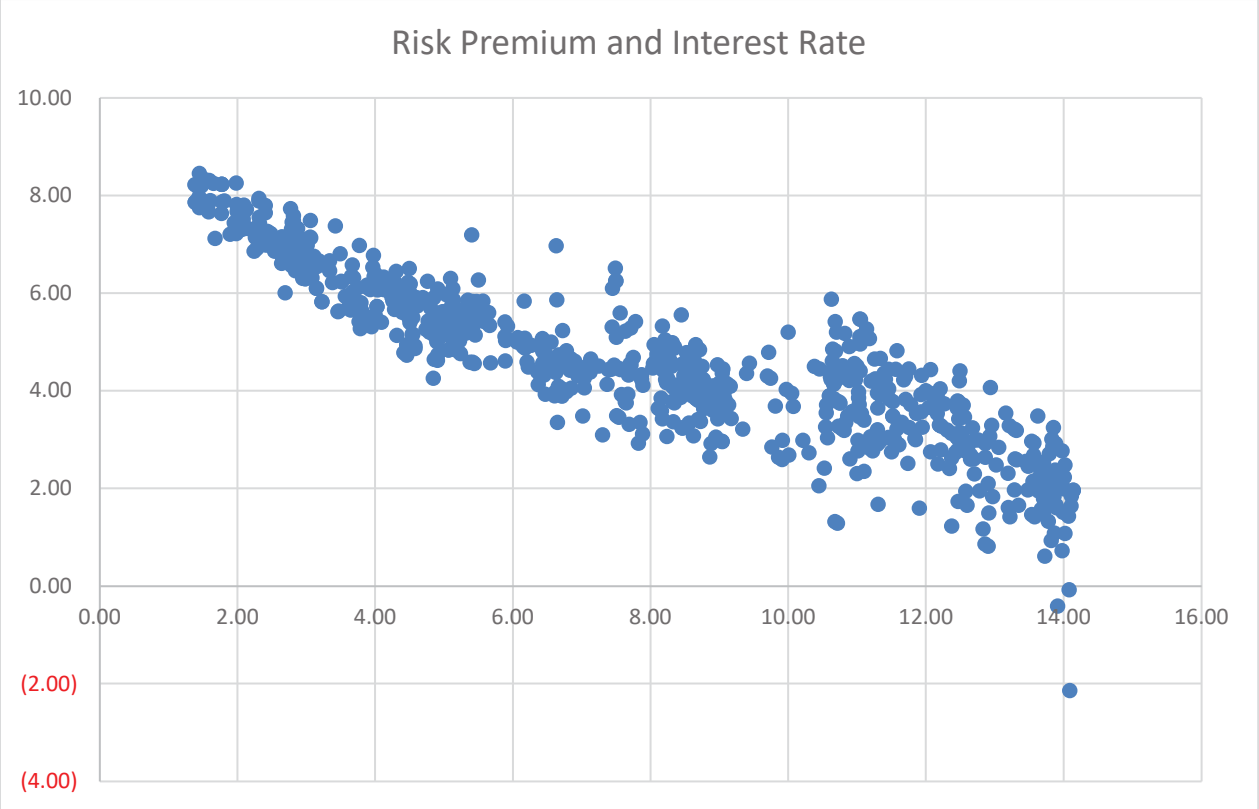
9/1/1988	10/20/1989	12.90	13	8.70	4.20
3/17/1982	12/29/1982	16.25	9	12.46	3.79
3/6/1981	11/25/1981	15.25	8	13.67	1.58
3/3/1980	1/26/1981	15.25	10	11.33	3.92
6/19/2020	5/18/2021	9.40	11	1.77	7.63
3/29/2019	2/3/2020	9.40	10	2.42	6.98
8/31/2017	7/20/2018	9.40	10	2.96	6.44
12/11/1995	7/22/1996	11.25	7	6.61	4.64
6/24/1986	1/23/1987	13.55	7	7.45	6.10
11/8/1982	6/20/1983	16.50	7	10.63	5.87
5/6/1982	8/6/1982	16.50	3	13.57	2.93
8/7/1981	4/9/1982	16.50	8	14.02	2.48
11/12/1980	4/29/1981	14.25	5	12.60	1.65
12/31/2018	10/21/2019	9.40	9	2.65	6.75
3/28/2008	12/26/2008	10.10	9	4.26	5.84
6/20/2019	7/8/2020	9.40	12	1.95	7.45
1/13/2017	12/5/2017	9.50	10	2.90	6.60
2/1/2013	6/25/2013	9.80	4	3.14	6.66
6/13/2011	5/7/2012	9.80	10	3.34	6.46
5/8/2009	4/2/2010	10.10	10	4.43	5.67
12/3/2007	10/8/2008	10.15	10	4.47	5.68
2/15/2006	1/5/2007	10.40	10	4.92	5.48
4/5/2004	2/18/2005	10.30	10	5.09	5.21
11/26/2001	8/28/2002	11.00	9	5.58	5.42
7/27/1992	9/27/1993	10.50	14	7.01	3.49
8/15/1984	12/28/1984	16.25	4	11.94	4.31
4/13/1983	10/1/1983	16.25	5	11.18	5.07
5/16/1982	12/29/1982	16.25	7	12.21	4.04
3/21/1980	11/19/1980	13.50	8	11.00	2.50
8/28/2020	11/24/2020	9.80	2	1.53	8.27
4/8/2016	11/9/2016	9.80	7	2.44	7.36
4/17/2014	11/26/2014	10.20	7	3.26	6.94
3/23/2012	11/9/2012	10.30	7	2.87	7.43
4/22/2010	1/12/2011	10.30	8	4.10	6.20
4/29/2009	12/22/2009	10.40	7	4.33	6.07
5/7/2007	12/14/2007	10.80	7	4.87	5.93
4/19/2005	12/12/2005	11.00	7	4.49	6.51
5/5/2004	12/22/2004	11.50	7	5.16	6.34
5/30/2003	1/13/2004	12.00	7	5.17	6.83
5/1/2002	2/28/2003	12.30	10	5.30	7.00
4/17/2000	11/28/2000	12.90	7	5.87	7.03

4/15/1998	12/10/1998	12.20	7	5.49	6.71
9/3/1996	7/17/1997	12.00	10	6.80	5.20
4/14/1994	12/8/1994	11.70	7	7.63	4.07
10/26/1992	6/3/1993	12.00	7	7.15	4.85
9/29/1989	6/15/1990	13.20	8	8.33	4.87
9/30/1988	6/8/1989	13.50	8	8.97	4.53
10/9/1987	6/14/1988	13.50	8	8.95	4.55
10/10/1986	5/28/1987	13.50	7	7.76	5.74
10/25/1985	5/29/1986	13.90	7	8.72	5.18
6/15/1984	7/26/1985	14.50	13	11.72	2.78
5/27/1983	2/28/1984	14.50	9	11.62	2.88
6/18/1982	6/2/1983	14.50	11	11.37	3.13
9/11/1981	7/22/1982	14.50	10	13.82	0.68
5/31/1979	2/14/1980	13.00	8	9.70	3.30
5/4/2017	12/7/2017	9.80	7	2.84	6.96
5/29/2015	12/3/2015	10.00	6	2.98	7.02
5/31/2013	12/5/2013	10.20	6	3.67	6.53
6/1/2011	12/22/2011	10.40	6	3.52	6.88
6/1/2007	1/8/2008	10.75	7	4.83	5.92
11/14/1997	9/15/1998	11.90	10	5.81	6.09
3/15/1996	11/26/1996	11.30	8	6.87	4.43
6/1/1995	12/14/1995	11.30	6	6.52	4.78
6/1/1992	1/12/1993	12.00	7	7.53	4.47
5/31/1991	12/19/1991	12.60	6	8.11	4.49
8/21/1989	12/27/1989	12.50	4	8.01	4.49
6/1/1987	12/22/1987	12.00	6	9.07	2.93
7/30/1982	7/19/1983	15.00	11	11.05	3.95
3/28/2019	10/31/2019	10.00	7	2.49	7.51
5/30/2014	11/14/2014	10.20	5	3.24	6.96
3/23/2012	11/28/2012	10.40	8	2.86	7.54
3/13/2009	12/18/2009	10.40	9	4.22	6.18
5/7/2007	1/17/2008	10.75	8	4.82	5.93
6/1/2005	1/25/2006	11.20	7	4.50	6.70
3/28/2019	10/31/2019	10.20	7	2.49	7.71
3/23/2012	11/28/2012	10.50	8	2.86	7.64
3/13/2009	12/18/2009	10.50	9	4.22	6.28
5/7/2007	1/17/2008	10.75	8	4.82	5.93
6/1/2005	1/25/2006	11.20	7	4.50	6.70
3/31/1993	11/12/1993	11.80	7	6.48	5.32
3/31/1992	10/29/1992	12.75	7	7.65	5.10
3/28/1991	10/15/1991	13.40	6	8.22	5.18

4/28/1989	10/31/1989	13.60	6	8.25	5.35
6/30/1986	12/30/1986	13.90	6	7.46	6.44
6/28/1985	12/20/1985	15.00	5	10.35	4.65
6/28/1984	12/20/1984	15.00	5	12.26	2.74
6/28/1983	12/29/1983	15.00	6	11.66	3.34
6/28/1982	1/18/1983	15.00	6	11.73	3.27
8/4/1981	4/6/1982	15.00	8	14.03	0.97
5/15/1980	12/18/1980	14.00	7	11.12	2.88
1/16/1996	2/13/1997	11.80	13	6.74	5.06
3/27/1995	9/11/1995	11.30	5	6.89	4.41
12/30/1992	8/31/1993	11.90	8	6.84	5.06
12/30/1991	10/13/1992	12.75	9	7.70	5.05
12/27/1990	8/29/1991	13.30	8	8.27	5.03
12/23/1987	9/27/1988	13.65	9	8.96	4.70
11/7/1983	8/28/1984	14.75	9	12.53	2.22
9/30/1982	9/8/1983	14.75	11	10.90	3.85
2/5/1982	10/28/1982	14.75	8	13.08	1.67
2/16/1981	9/29/1981	14.50	7	13.49	1.01
5/1/2020	12/23/2020	10.00	7	1.47	8.53
5/24/2018	9/14/2018	10.00	3	3.04	6.96
4/9/2014	6/6/2014	10.40	1	3.43	6.97
5/3/2012	6/15/2012	10.40	1	2.83	7.57
5/8/2009	12/18/2009	10.40	7	4.33	6.07
3/17/2006	1/19/2007	10.80	10	4.94	5.86
9/17/2004	7/19/2005	11.50	10	4.69	6.81
3/6/2003	12/19/2003	12.00	9	5.11	6.89
5/7/2002	4/3/2003	12.00	11	5.26	6.74
4/1/1996	4/29/1997	11.70	13	6.85	4.85
2/4/1994	12/8/1994	11.50	10	7.46	4.04
1/4/1993	9/30/1993	11.60	8	6.74	4.86
12/30/1991	12/22/1992	12.40	11	7.67	4.73
12/29/1989	6/27/1990	12.90	6	8.54	4.36
12/30/1988	11/9/1989	13.00	10	8.53	4.47
2/29/1988	10/13/1988	13.10	7	9.03	4.07
1/5/1987	3/31/1987	13.00	2	7.49	5.51
12/30/1985	8/14/1986	13.50	7	7.96	5.54
12/28/1984	8/29/1985	14.50	8	11.09	3.41
12/30/1983	10/9/1984	14.75	9	12.62	2.13
1/10/1983	8/31/1983	14.75	7	10.93	3.82
3/28/2019	10/31/2019	10.00	7	2.49	7.51
4/17/2015	11/19/2015	10.00	7	2.96	7.04

4/1/2014	11/6/2014	10.20	7	3.30	6.90
3/29/2013	11/6/2013	10.20	7	3.47	6.73
3/30/2012	10/24/2012	10.30	6	2.85	7.45
4/1/2010	1/13/2011	10.30	9	4.15	6.15
3/31/2006	1/11/2007	10.90	9	4.95	5.95
4/1/2005	12/22/2005	11.00	8	4.51	6.49
4/1/2004	12/21/2004	11.50	8	5.18	6.32
4/1/2003	12/19/2003	12.00	8	5.12	6.88
3/28/2002	3/20/2003	12.00	11	5.33	6.67
3/31/2000	11/30/2000	12.10	8	5.86	6.24
4/1/1998	12/17/1998	12.10	8	5.49	6.61
4/1/1996	2/20/1997	11.80	10	6.83	4.97
4/15/1994	12/19/1994	11.50	8	7.65	3.86
3/31/1993	12/21/1993	11.30	8	6.45	4.85
3/31/1992	12/22/1992	12.30	8	7.63	4.67
4/1/1991	12/19/1991	12.80	8	8.14	4.66
3/30/1990	12/18/1990	13.10	8	8.68	4.42
3/31/1989	12/21/1989	12.90	8	8.27	4.63
4/15/1988	1/27/1989	13.00	9	9.07	3.93
6/19/1987	1/29/1988	13.20	7	9.07	4.13
4/28/1986	7/10/1987	12.90	14	7.73	5.17
4/13/1984	1/31/1985	14.75	9	12.42	2.33
7/2/1982	3/24/1983	15.00	8	11.44	3.56
7/15/1981	4/27/1982	15.00	9	13.95	1.05
7/15/1980	5/21/1981	14.00	10	12.15	1.85
9/30/2020	7/27/2021	9.54	10	1.98	7.56
10/16/2008	11/20/2009	9.45	13	3.94	5.51
1/4/1993	10/29/1993	10.20	9	6.66	3.54
11/5/1984	8/30/1985	14.38	9	11.17	3.21
4/6/1982	1/31/1983	15.00	10	12.18	2.82
1/16/1981	11/12/1981	15.00	10	13.54	1.46
1/2/1980	10/28/1980	13.00	10	11.05	1.95
3/6/2019	12/26/2019	9.75	9	2.49	7.26
1/5/2015	10/13/2015	9.75	9	2.81	6.94
11/4/2011	10/31/2012	9.90	12	2.95	6.95
1/4/1993	10/29/1993	10.10	9	6.66	3.44
1/17/1992	11/9/1992	10.60	9	7.71	2.89
10/23/1986	8/25/1987	11.40	10	8.04	3.36
7/30/1982	6/7/1983	14.50	10	11.04	3.46
7/27/1981	6/2/1982	14.50	10	13.89	0.61
6/3/2019	12/11/2019	9.40	6	2.31	7.09

2/26/2010	12/23/2010	9.92	10	4.18	5.74
2/28/2006	9/20/2006	11.00	6	5.03	5.97
11/17/2017	7/16/2018	9.60	8	3.00	6.60
12/2/2013	7/31/2014	9.90	8	3.57	6.33
12/1/2011	6/18/2012	9.60	6	3.05	6.55
3/1/2007	11/29/2007	10.90	9	4.87	6.03
4/18/2005	10/4/2005	10.75	5	4.42	6.33
5/23/2019	1/15/2020	9.35	7	2.33	7.02
11/1/2019	8/21/2020	9.35	9	1.70	7.65



Average Interest Rate for last 9 months:	2.04
Risk Premium	7.04
Expected Return	9.08

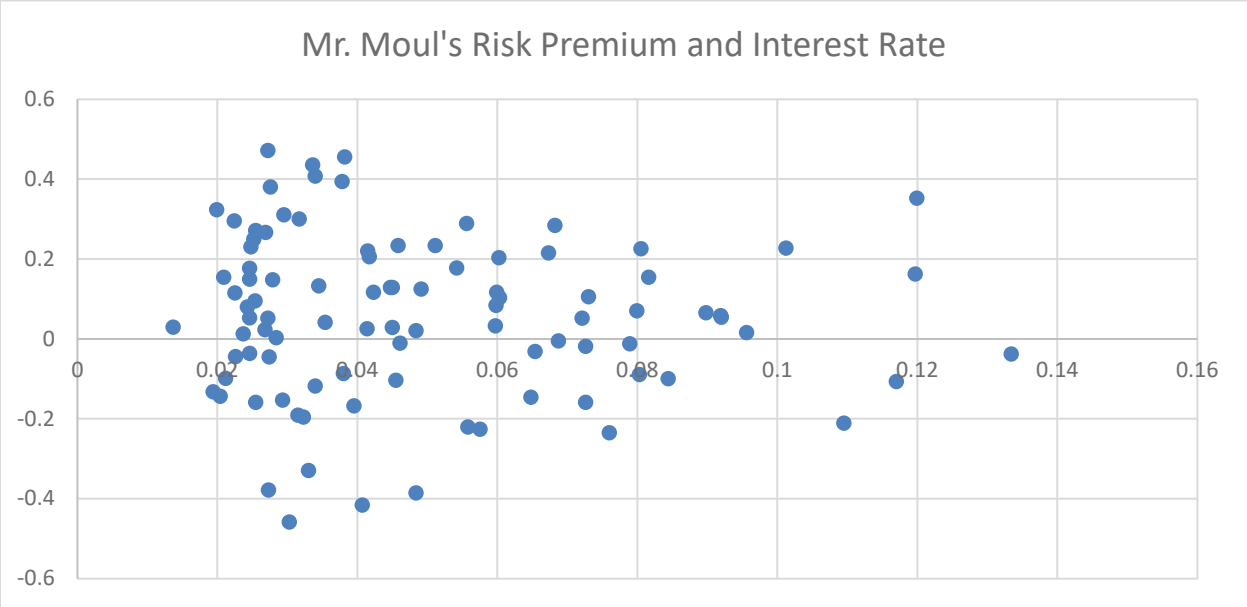
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.905695
R Square	0.820283
Adjusted R Squ	0.820093
Standard Error	0.72158
Observations	950

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	1	2252.944	2252.944	4326.95	0
Residual	948	493.602	0.520677		
Total	949	2746.546			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	7.886741	0.052279	150.8579	0	7.784144	7.989337	7.784144	7.989337
Interest Rate	-0.41569	0.006319	-65.7796	0	-0.42809	-0.40328	-0.42809	-0.40328



SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.05247226					
R Square	0.002753338					
Adjusted R Square	-0.007969744					
Standard Error	0.200820242					
Observations	95					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	0.010355114	0.010355114	0.256767413	0.613549046	
Residual	93	3.750575564	0.04032877			
Total	94	3.760930677				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.075763779	0.042979829	1.76277526	0.081223505	-0.009585643	0.161113202
Long-Term Govt. Bonds Yields	-0.38624131	0.762234794	-0.506722224	0.613549046	-1.899888548	1.127405927

The Hamada Beta Adjustment and the Cost of Capital for the Regulated Utilities

By
Scott Linn and Zhen Zhu[25]

I. Introduction

Despite many issues with the Capital Asset Pricing Model (CAPM), it is still one of main methods that is used to estimate the expected rate of return on equity for regulated utilities in rate proceedings in the United States. A primary underpinning of the model is that investors require compensation for bearing undiversifiable systematic risk. A product of the theory is that the degree of systematic risk (beta risk) an investor bears for investing in any equity security is measured by how closely the stock's price changes (returns) covary with the overall market, proxied by the returns on a market index. The expected cost of equity is the sum of two parts: a risk-free rate and a risk premium which is the product of the beta of the company's stock and a market risk premium. A key ingredient of course is the stock's beta, which depends upon the nature of the business as well as how the business is financed. Our focus in this note is on the latter relation between beta and how a company is financed (specifically the debt/equity ratio), and how this relation if not considered correctly can lead to incorrect estimates of a company's required return on equity, and consequently to incorrect rate adjustments.

Technical Box A: CAPM

$$R = R_f + \beta (R_m - R_f),$$

Where R is the required or expected return on equity for the utility, R_f is the risk-free rate, β is the company beta, and R_m is the market return. $(R_m - R_f)$ is the market risk premium.

In the practice of a rate proceeding, various methods have been utilized to model each of the three components of the CAPM: the risk-free return, the market risk premium, and the beta. Some rate-setting commissions have specific requirements regarding how to model each component. For example, the Federal Energy Regulatory Commission (FERC) requires the risk-free interest rate to be a long-term Treasury Bond yield, the company stock beta is the beta value provided by Value Line, and the market risk premium is measured by the difference between the market return based on a one-step DCF model applied to the dividend paying S&P 500 companies and the risk-free rate. The rules however are not uniform across state commissions, so that an estimate in one jurisdiction could potentially deviate from an estimate in another for the

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same company. At the same time there has been increasing advocacy for methods designed to adjust beta. The point of this note is to consider one such adjustment and to highlight how that adjustment can lead to a biased estimate of a company's beta and hence the required return on equity.

Theory tells us that beta as generally measured, is under certain conditions, positively related to the company's debt to equity ratio, where the ratio is measured using the total market values of a company's debt and equity. It is important to recognize that the beta computed by most popular commercial services, such as Value Line and Bloomberg, is based upon market returns. What does this mean? Specifically, the returns on a stock are based upon the assessment by capital market participants of changes in the stock's value which are then reflected in changes in its market price. Changes in valued reflect market participants' interpretation of fundamental information about the company, including how it is financed. The market value debt to equity ratio reflects the extent to which the shareholders share the total value of the company with the debtholders, and hence the shareholders' exposure to debt financing. Recognize that the total value of a company equals, in usual parlance, the total market value of the debt and equity, which would only by accident equal the book value of debt plus the book value of equity. In other words, market participants know this information and condition changes in prices on knowledge of a company's market value debt to equity ratio.

Hence, the implied cost of capital, whether the equity required return or the weighted average cost of capital, is a number based upon the market values of debt and equity not book values.[26]

This leads us to an important issue confronting rate setting commissions. One common practice on the side of the ROE requesting utilities is to use what is commonly referred to as the Hamada equation to make an adjustment to the beta value obtained from an investment service. The argument for this so-called leverage adjustment is that the capital structure used in calculating the weighted average cost of capital is based on book value but the return on equity is based on the market value, and in addition, the rate base is based on book value.

Setting aside how the weighted average cost of capital is computed, whether using book value or market value weights, we explore the implications of adjusting beta using the book value versus market value debt to equity ratio. As the market value of most utility's equity nowadays is typically higher than the book value of the equity, the book value debt ratio will typically be larger than if the market value debt/equity ratio is employed. As the beta computed using market returns reflects the market debt/equity ratio, if instead it is adjusted to conform to a book value debt/equity ratio, the resulting beta will be larger than the observed beta provided by say Value Line. Such an adjustment would lead to higher beta values and thus a higher calculated expected rate of return on equity given the estimate of the risk-free rate and the market risk premium.

II. What is the Hamada equation?

Professor Hamada, once the dean of the famed Booth College of Business at the University of Chicago, was the first to derive the relation between a company's stock's beta and the company's market value debt/equity ratio. Specifically he shows that beta increases as the market debt/equity ratio increases. Hamada defines two different betas for a company's stock. One beta is what we usually obtain from the investment services such as Value Line, and this beta is called the levered beta as it is derived from the market data reflecting the company's existing capital

[26] The general practice in the rate making process, however, is to use book value capital structure in weighting the cost of capital, for some reasons, see, for example, Roger A. Morin, New Regulatory Finance, Public Utilities Reports, Inc., 2006, page 452. This has been another important and interesting issue in the practice. However, it goes beyond the scope of this note.

structure, that is, its market value debt/equity ratio. In contrast, suppose the same company used no debt financing, then the corresponding beta would be what we would observe for an unlevered (no debt financing) company, and is typically referred to as the unlevered beta. The levered beta exceeds the unlevered beta which the company uses debt financing. Note that all terms are measured in market values.

The equation shown nearby shows how a company's beta changes as the company's market

Technical Box B – The Hamada Equation:

$$\beta_L = \beta_U * [1 + (1-t)\, D/E\,],$$

where β_L is the levered beta, which measures the firm's systematic risk with the impact of debt and β_U is the unlevered beta, which measures the firm's systematic risk without the impact of debt, t is the marginal tax rate, D/E is the company's debt-to-equity ratio which measures the company's financial leverage.

value debt/equity ratio changes. The higher the market value debt/equity ratio (leverage), the higher the financial risk and thus the higher is beta. For example, if a company's unlevered beta is 1.0, the market value debt/equity ratio is 0.5, and the marginal tax rate is 21%, then the levered beta would be 1.395, an increase of 39.5%.

The beauty of the Hamada Equation is that it can be used to infer what a company's beta would equal for any assumed debt/equity ratio, including what an analyst might argue is the debt/equity ratio that goes with an 'optimal' capital structure for the company.[27] The process of finding a new levered beta involves what is often referred to as first unlevering and then relevering. The starting levered beta is observed by consulting an investment service such as Value Line. The unlevered beta is not directly observable but can be backed out of the Hamada formula if other information such as the tax rate and an estimate of the market value debt ratio are available. This process is called unlevering. The unlevered beta can then be relevered to obtain the new levered beta estimate that is conditional on an assumed debt/equity ratio which could be the one that goes with the optimal capital structure. This process of course makes the explicit assumption that the current debt/equity ratio is not what is desired and that shortly in the future the company will rearrange its financing to reflect a better mix and a new debt/equity ratio.

Take the example of finding the beta for a company's stock assuming the current debt/equity ratio is not the best but the analyst believes she knows what the best debt/equity ratio equals. Suppose the current observable beta or levered beta is 0.8 for a utility that has a debt ratio of 1.25. With a tax rate of 0.21, the unlevering process would generate an unlevered beta of 0.40. Conceptually, if the company used no debt financing the beta would be 0.40.

[27] We do not take up the issue of what an 'optimal' capital structure might be for any particular utility. Some argue this can be inferred by looking at industry averages, but that presumes the industry participants are themselves choosing optimally. Needless to say, the concept of what is an optimal capital structure is by no means a resolved issue.

Suppose the optimal capital structure is 50% debt and 50% equity, so the debt-to-equity ratio would equal 1.0, then the relevered beta would equal 0.716. Specifically with the optimal capital structure, the company's beta would equal 0.716, a value less than the current levered beta value of 0.8.

Two important assumptions underlying the Hamada equation are first that the beta of the company's debt is zero, and second that the CAPM model is valid.

III. How is the Hamada equation used to adjust the beta in rate proceedings?

Sometimes, the Hamada equation is used in rate proceedings to adjust the unlevered beta using the book value debt/equity ratio. If the book value of equity is less than the total market value of equity, which is typical nowadays, this will lead to a beta that is inflated more than it should be, and consequently a required return on equity computed using the CAPM that is larger than it should be. The argument goes that such a "book value leverage adjustment" is necessary because the required rate of return on equity will be used to compute a weighted average cost of capital using weights based upon the book values of debt and equity. According to advocates of this suggested adjustment, beta based on a market value capital structure mis-represents the financial risk of the company, and therefore, the conventionally available betas cannot be used directly in the CAPM, unless the cost of equity developed using these betas is applied to the computation of a weighted average cost of capital in which the weights are based upon market values. The market value capital structure of a utility and the company's book value capital structure typically are not the same. The argument that, there is a need to make the so-called leverage adjustment to adjust the beta to reflect the utility's risk based on book value capital structure, is simply incorrect as true risk is not based upon historic book values. The reason is that the book value of the assets of the company is not a true reflection of the assets' market value and it is the market value of the assets which indicates the true support for the company's debt.

The following example illustrates how the Hamada equation used incorrectly leads to a cost of capital that is too large.

Assume a utility with a market value debt/equity ratio[28] of 0.8 has a Value Line reported beta of 0.75. Suppose the company's marginal tax rate equals 21% , then the company's unlevered beta can be computed as shown earlier, and will equal 0.46.

Utility total equity market values are usually significantly higher than the book values, leading to a significantly higher book value debt/equity ratio than would be the case for the market value debt/equity ratio. This comparison is typically the reason why some analysts claim that the financial risk represented by the book value is higher than the financial risk represented by the market value.[29] But this is inherently a flawed argument as we have just commented.

Assume for our example company that the book value debt/equity ratio is 1.0. The unlevered beta value of 0.46 is then relevered by the book value capital structure to arrive at an adjusted estimate of beta that would for our illustration, equal 0.82, a 9% increase in the beta to be used in the cost of capital calculation

[28] The market value of equity can be based on the market capitalization. Utility debt instruments are frequently not traded and so do not have observable market prices. However, under current reporting requirements, fair value estimates of a utility's debt can be obtained from the utility's 10K report.

[29] Again, the notion of two different financial risks is dubious as a company cannot have two different measures of financial risks that are not the same.

The book value relevered beta value when used in the CAPM model will therefore lead to a required return on equity that is larger than it should be.

IV. Is the Hamada adjustment reasonable?

In summary we repeat the limitations of the book value debt/equity adjustment process as well as a more general limitation of the Hamada model.

First, unlike the process of unlevering and relevering the market value beta to obtain a levered market value beta that reflects the optimal market value capital structure, relevering the market value unlevered beta using the book value debt/equity ratio, yields a beta estimate that **cannot be interpreted**, and therefore cannot legitimately be used in the estimation of the cost of capital in the CAPM model.

Second, the Hamada adjustment process assumes, even if we are using the correct market value deb/equity ratio, that the beta of the company's debt is zero. This assumption is simply not strictly met, although academic studies that present estimates of bond betas generally find that they are small but nevertheless positive.[30] Thus the **formula is invalid** for any levering or unlevering operations in general if the company's debt beta is not zero or the risk is systematic[31].

V. Conclusions

We have demonstrated in this short note what the Hamada leverage adjustment is and how it should be applied. We also pointed out that one of the applications of this formula is in the context of capital cost estimation in the rate case proceedings for public utilities. That application involves an adjustment based upon the book values of debt and equity of the utility. We illustrate how such an adjustment leads to an incorrect estimate of the beta used in the Capital Asset Pricing Model formula, which in turns leads to an estimated required return on equity that is too large. While this adjustment is used to justify the higher requested return on equity by utilities, this is an incorrect use of the Hamada equation adjustment. We have pointed out the invalidity of the adjustment process using book values for debt and equity as the theory underlying the Hamada equation requires a debt/equity ratio based upon market values. In other words, if the adjustment is to be correct there is no room for the use of book values.

Many analysts in the past rate proceedings have pointed out various issues with the application of the Hamada leverage adjustment; however, to our knowledge, there is no clear demonstration of how this Hamada leverage adjustment application is invalid in its process. It is our hope that practitioners engaged in the estimation of utility cost of capital recognize the issues we raise and the biases that can arise from the incorrect application of the Hamada adjustment. Our second objective with this note is to inform the many jurisdictional authorities faced with the task of deciding on rate adjustments of the potential biases we have highlighted. Perhaps, these decision makers have recognized the potential problems we outline as no such Hamada adjustment has yet been allowed in any utility rate proceedings to our knowledge. However, this is not to say that cost of capital witnesses have not been advocating the type of book value debt/equity adjustment we have illustrated which makes the information we provide both timely and of potentially important. In our opinion, due to its lack of theoretical support and the upward bias it

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[30] See a study of bond returns by Backaert and De Santis, "Risk and return in international corporate bond markets", Journal of International Financial Markets, Institutions & Money, Vol. 72, 2021.

[31] By systematic we mean that the returns on the bond vary with the returns on a market index the way the returns on a stock vary with an index. Conine demonstrated that the Hamada formula is not compatible with the assumption of issuing risky debt. See Conine, T. (1980) Corporate Debt and Corporate Taxes: An Extension. The journal of Finance, 35(4), 1033-1037.

introduces, the idea of making the so-call book value leverage adjustment to beta should be put to rest.

Summary: Testimony Direct Testimony of Zhen Zhu, Ph.D. On Behalf of Office of The Ohio Consumers' Counsel and Northeast Ohio Public Energy Council electronically filed by Mrs. Tracy J. Greene on behalf of O'Brien, Angela D