BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKETS NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

RESPONSE TESTIMONY OF DAVID J. GARRETT
ON BEHALF OF THE
WASHINGTON STATE OFFICE OF ATTORNEY GENERAL
PUBLIC COUNSEL UNIT

EXHIBIT DJG-1T

October 3, 2019

DOCKET NOS. UE-190334, UG-190335 & UE-190222 (*Consolidated*)

RESPONSE TESTIMONY OF DAVID J. GARRETT

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I. INTRODUCTION

Q. State your name and occupation.

A. My name is David J. Garrett. I am a consultant specializing in public utility regulation. I am the managing member of Resolve Utility Consulting, PLLC. I focus my practice on the primary capital recovery mechanisms for public utility companies: cost of capital and depreciation.

Q. Summarize your educational background and professional experience.

A. I received a B.B.A., with a major in Finance, an M.B.A., and a Juris Doctor from the University of Oklahoma. I worked in private legal practice for several years before accepting a position as assistant general counsel at the Oklahoma Corporation Commission in 2011. At the Oklahoma Commission, I worked in the Office of General Counsel in regulatory proceedings. In 2012, I began working for the Public Utility Division as a regulatory analyst providing testimony in regulatory proceedings. I am a Certified Depreciation Professional with the Society of Depreciation Professionals. I am also a Certified Rate of Return Analyst with the Society of Utility and Regulatory Financial Analysts. I have testified in many regulatory proceedings on cost of capital, depreciation, and other issues. A more complete description of my qualifications and regulatory experience is included in my curriculum vitae.[1]

[1] David J. Garrett, Exh. DJG-2.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of the Public Counsel Unit of the Washington Office of Attorney General ("Public Counsel").

Q. Describe the scope and organization of your testimony.

A. The purpose of my testimony is to present an independent analysis and opinion of the cost of equity capital and a prudent capital structure for Avista Corp. (Avista or the Company). Based on my estimates of the Company's weighted average cost of capital, I present a recommendation for the allowed rate of return for the Company. My testimony primarily addresses issues raised in the Direct Testimony of Adrien M. McKenzie. I also respond to issues raised in the Direct Testimony of Mark T. Thies regarding capital structure.

II. EXECUTIVE SUMMARY

Q. Explain the concept of the "weighted average cost of capital."

A. The term "cost of capital" refers to the weighted average cost of all types of components.

Q. Explain the weighted average cost of capital and how the Company's cost of equity and capital structure affect this equation.

A. The term "cost of capital" refers to the weighted average cost of all types of securities within a company's capital structure, including debt and equity. Determining the cost of debt is relatively straight-forward. Interest payments on bonds are contractual, "embedded costs" that are generally calculated by dividing total interest payments by the book value of outstanding debt. Determining the cost of equity, on the other hand, is more complex. Unlike the known, contractual cost of debt, there is no explicit "cost" of common equity. To determine the appropriate cost of equity capital, companies must estimate the return their equity investors will demand in exchange for giving up their opportunity to invest in other securities or postponing their own consumption, in light of the level of risk associated with the investment. Thus, the overall weighted average cost of capital (WACC), includes the cost of debt and the estimated cost of equity. It is a "weighted average," because it is based upon the Company's relative levels of debt and equity. Companies in the competitive market often use their WACC as the discount rate to determine the value of various capital projects. The basic WACC equation used in regulatory proceedings is presented below:[2]

Equation 1:
Weighted Average Cost of Capital

$$WACC = \left(\frac{D}{D+E}\right)C_D + \left(\frac{E}{D+E}\right)C_E$$

where:	$WACC$	=	*weighted average cost of capital*
	D	=	*book value of debt*
	C_D	=	*embedded cost of debt capital*
	E	=	*book value of equity*
	C_E	=	*market-based cost of equity capital*

Thus, the term "cost of capital" is synonymous with the "weighted average cost of capital," which includes both debt and equity components. As discussed further below,

[2] David J. Garrett, Exh. DJG-3 (Roger A. Morin, NEW REGULATORY FINANCE 449-450 (Pub. Util. Rep., Inc. 2006)). The traditional practice uses current market returns and market values of the company's outstanding securities to compute the WACC, but in the ratemaking context, analysts usually employ a hybrid computation consisting of embedded costs of debt from the utilities books, and a market-based cost of equity. Additionally, the traditional WACC equation usually accounts for the tax shield provided by debt, but taxes are accounted for separately in the ratemaking revenue requirement).

the Commission's determination of a fair awarded rate of return should be based on a reasonable estimate of the Company's weighted average cost of capital.

In this Application, the Company has proposed a cost of equity of 9.9 percent, as discussed in the direct testimony of Mr. McKenzie. The Company has also proposed a cost of debt of 5.62 percent and a debt ratio of 50 percent. These three factors equate to a proposed weighted average cost of capital of 7.7 percent for the Company. In the sections below, I discuss several significant errors upon which the Company's requested weighted average cost of capital is based.

Q. Summarize your analyses and conclusions regarding Avista's Cost of Equity.

A. In formulating my recommendation, I performed thorough independent analyses to calculate Avista's cost of equity. To do this, I selected a proxy group of companies that represents a relevant sample with asset and risk profiles similar to those of Avista. Based on this proxy group, I evaluated the results of two widely accepted financial models for calculating cost of equity: (1) the Discounted Cash Flow (DCF) Model; and (2) the Capital Asset Pricing Model (CAPM). I evaluated these models to ensure a balanced approach that meets the legal standards, objective market considerations, and regulatory goals for establishing an appropriate awarded return for Avista. Based on my quantitative and qualitative analyses, as discussed throughout my testimony below, I recommend an awarded return on equity of nine percent, which represents the midpoint within a reasonable a range of 8.75 percent and 9.25 percent. While Avista's actual cost of capital is much lower, my recommendation represents a gradual, rather than abrupt move towards market-based cost of equity.

Q. Summarize your analyses and conclusions regarding Avista's capital structure.

A. The Company's actual capital structure consists of 53 percent debt and 47 percent equity.[3] However, the Company is requesting an imputed debt ratio of only 50 percent. A lower debt ratio in this case would unreasonably increase the Company's overall awarded rate of return and revenue requirement. An objective analysis, including a comparison of competitive industry debt ratios and the debt ratios of the proxy group indicate that Avista's actual debt ratio of 53 percent is fair and reasonable.

Q. Provide an overview of the problems you have identified with the Company's cost of capital estimate.

A. In this case, Mr. McKenzie supports the Company's request for a very high awarded rate of return of 9.9 percent.[4] Mr. McKenzie's recommendations are based on several models, including the CAPM and DCF Model, however, several of his key assumptions and inputs to these models violate fundamental, widely-accepted tenants in finance and valuation. In the sections below, I will discuss my concerns regarding the Company's requested cost of capital in further detail. However, the key areas of concern are summarized as follows:

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[3] *See* David J. Garrett, Exh. DJG-4 (Elizabeth Andrews, Workpapers, 'Section 1 -- Electric Pro Forma.pdf' at 30 and 'Section 2 -- Nat Gas Pro Forma.pdf' at 28).

[4] *See generally* Direct Testimony of Adrien M. McKenzie, Exh. AMM-1T

1. In his DCF Model, Mr. McKenzie used long-term growth rates as high as 12.5 percent, which is more than three times the projected growth rate of the entire U.S. economy, as measured by GDP. It is a fundamental concept in finance that, in the long run, a company cannot grow at a faster rate than the aggregate economy in which it operates. This is especially true for a regulated utility with a defined service territory. Avista's own projections for more qualitative growth indicators, such as customer growth, indicate that the Company's actual growth rate is much less than what is implied in Mr. McKenzie's DCF Model.

3. Mr. McKenzie's estimate for the Equity Risk Premium ("ERP"), the single most important factor in estimating the cost of equity, is nearly twice as high as the estimate reported by thousands of other financial experts across the country. Mr. McKenzie inappropriately bases his equity risk premium estimate in part on awarded returns in other jurisdictions – a non-market factor that bears no meaningful relationship to the market-based ERP. Mr. McKenzie's ERP input to the CAPM is so unreasonably high that it should be considered an error.

4. Mr. McKenzie suggests that Company-specific risk factors have an increasing effect on its cost of equity. However, this overlooks the fundamental concept that the market does not reward diversifiable, firm-specific risk; therefore, investors do not expect a return for such risk. Mr. McKenzie also erroneously suggests that the Company's relative size should have an increasing effect on its cost of equity despite the overwhelming evidence confirming that the "size premium" phenomenon was short-lived and has not been seen for over a quarter-century.

5. Mr. McKenzie and Mr. Thies request the Commission impute a capital structure consisting of more equity than the Company's actual capital structure, which would simply have the effect of increasing the Company's rate of return. Objective analysis and indicators show that the Company's actual debt ratio of 53 percent is reasonable. Mr. Thies offers a misleading narrative regarding the Commission's duty as it relates to capital structure and credit ratings by suggesting that it is the Commission's responsibility to support the Company's credit ratings. However, this arrangement is not contemplated by the regulatory model under which Avista and other regulated utilities operate.

In short, the assumptions employed by Mr. McKenzie skew the results of his financial models such that they do not reflect the economic realities of the market upon which cost of equity recommendation should be based. In the testimony below, I demonstrate how correcting the various erroneous assumptions in the DCF and CAPM financial models results in appropriate ROE recommendations which better align with today's market and Avista's risk profile.

Q. Please summarize your recommendation regarding the Company's awarded return on equity and capital structure.

A. I recommend the Commission award Avista with a return on equity of nine percent, which is the midpoint between a reasonable range of 8.75 percent - 9.25 percent. I also recommend that the Commission reject the Company's requested debt ratio of only 50 percent and instead adopt the Company's actual debt ratio of 53 percent.[5]

III. LEGAL STANDARDS FOR ESTABLISHING COST OF CAPITAL

Q. Discuss the legal standards governing the allowed rate of return on capital investments for regulated utilities.

A. In *Wilcox v. Consolidated Gas Co. of New York*, the U.S. Supreme Court first addressed the meaning of a fair rate of return for public utilities.[6] The Court found that "the amount of risk in the business is a most important factor" in determining the appropriate allowed rate of return.[7] Later, in two landmark cases, the Court set forth the standards by which public utilities are allowed to earn a return on capital investments. In *Bluefield Water*

[5] The Company's actual debt ratio is 52.77 percent, which throughout this testimony I round to 53 percent. To be clear, I am recommending approval of Avista's actual capital structure, which consists of 52.77 percent debt.

[6] *Wilcox v. Consolidated Gas Co. of New York*, 212 U.S. 19 (1909).

[7] *Id*. at 48.

Works & Improvement Co. v. Public Service Commission of West Virginia, the Court held:

> A public utility is entitled to such rates as will permit it to earn a return on the value of the property which it employs for the convenience of the public . . . but it has no constitutional right to profits such as are realized or anticipated in highly profitable enterprises or speculative ventures. The return should be reasonably sufficient to assure confidence in the financial soundness of the utility and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise the money necessary for the proper discharge of its public duties.[8]

In *Federal Power Commission v. Hope Natural Gas Company*, the Court expanded on the guidelines set forth in *Bluefield* and stated:

> From the investor or company point of view it is important that there be enough revenue not only for operating expenses ***but also for the capital costs of the business***. These include service on the debt and dividends on the stock. By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital.[9]

The cost of capital models I have employed in this case are in accord with all of the foregoing legal standards.

Q. Is it important that the "allowed" rate of return be based on the Company's actual cost of capital?

A. Yes. The Supreme Court in *Hope* makes it clear that the allowed return should be based on the cost of capital. Under the rate base rate of return model, a utility should be allowed

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[8] *Bluefield Water Works & Improvement Co. v. Pub. Serv. Comm'n of W. Va.*, 262 U.S. 679, 692-93 (1923).

[9] *Fed. Power Comm'n v. Hope Nat. Gas Co*., 320 U.S. 591, 603 (1944) (emphasis added).

to recover all of its reasonable expenses, its capital investments through depreciation, and a return on its capital investments sufficient to satisfy the required return of its investors. The "required return" from the investors' perspective is synonymous with the "cost of capital" from the utility's perspective. Scholars agree that the allowed rate of return should be based on the cost of capital:

> Since by definition the cost of capital of a regulated firm represents precisely the expected return that investors could anticipate from other investments while bearing no more or less risk, and since investors will not provide capital unless the investment is expected to yield its opportunity cost of capital, the correspondence of the definition of the cost of capital with the court's definition of legally required earnings appears clear.[10]

The models I have employed in this case closely estimate the Company's true cost of equity. If the Commission sets the awarded return based on my lower, and more reasonable rate of return, it will comply with the Supreme Court's standards, allow the Company to maintain its financial integrity under prudent and efficient management, and satisfy the required return of its investors commensurate with the very low risk inherent of their investment. On the other hand, if the Commission sets the allowed rate of return much *higher* than the true cost of capital, it arguably results in an inappropriate transfer of wealth from ratepayers to shareholders. This point is underscored as follows:

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[10] David J. Garrett, Exh. DJG-5 (A. Lawrence Kolbe, James A. Read, Jr. & George R. Hall, THE COST OF CAPITAL: ESTIMATING THE RATE OF RETURN FOR PUBLIC UTILITIES 21 (The MIT Press 1984)).

> [I]f the allowed rate of return is greater than the cost of capital, capital investments are undertaken and investors' opportunity costs are more than achieved. Any excess earnings over and above those required to service debt capital accrue to the equity holders, and the stock price increases. In this case, the wealth transfer occurs from ratepayers to shareholders.[11]

Thus, it is important to understand that *awarded* returns and *actual* cost of capital are two separate concepts. Awarded returns are set through the regulatory process and may be influenced by a number of factors other than objective market drivers. Cost of capital, on the other hand, should be evaluated objectively and closely tie to the economic market realities. In other words, cost of capital it is driven by stock prices, dividends, growth rates, and, most importantly, it is driven by risk. Cost of capital can be estimated through the use of financial models used by firms, investors, and academics around the world for decades. The problem is, with respect to regulated utilities, there has been a trend in which awarded returns fail to closely track with actual market-based cost of capital. To the extent this occurs, the results are detrimental to ratepayers and the state's economy.

Q. If the Commission sets the allowed return at a level far greater than the market-based cost of capital, will this permit an excess transfer of wealth from Washington ratepayers to Company shareholders and the federal government?

A. Yes. As discussed further in the sections below, Mr. McKenzie's recommendation of a 9.9 percent awarded ROE is far higher than Avista's true cost of capital based on objective market data and risk profiles of comparable firms. If the Commission were to adopt the Company's position in this case, it would be permitting an excess transfer of

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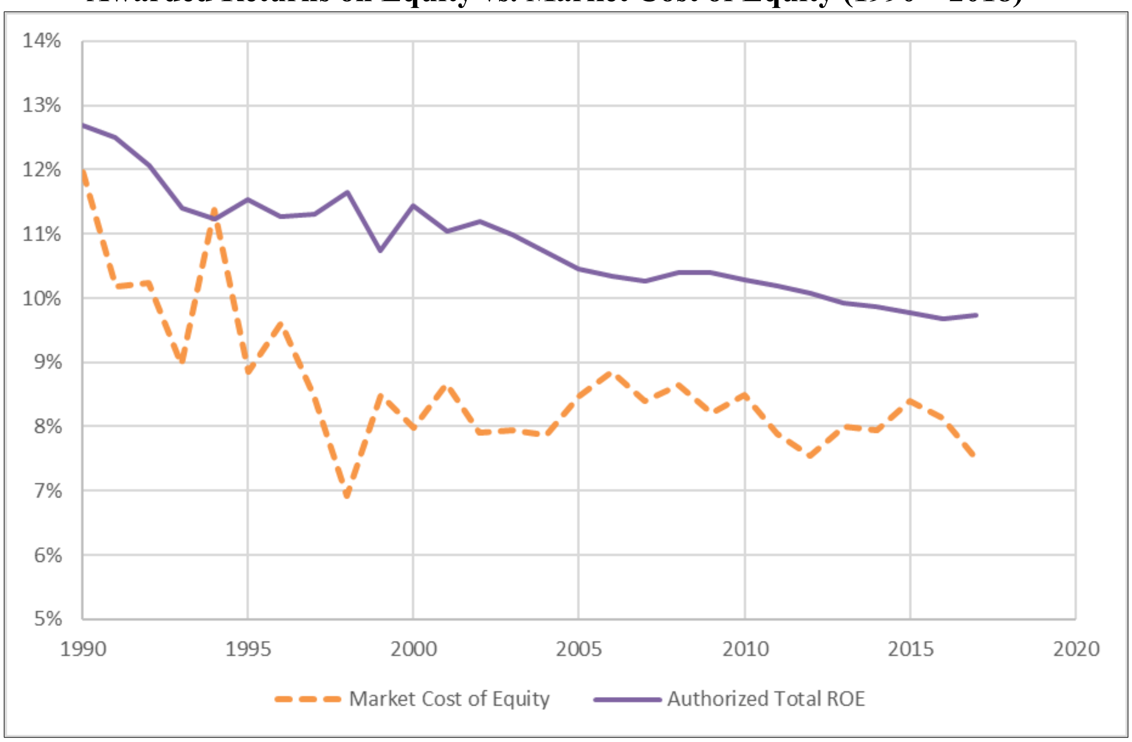
[11] Garrett, Exh. DJG-3 (Roger A. Morin, NEW REGULATORY FINANCE 23-24 (Pub. Util. Rep., Inc. 2006) (1994)).

wealth from Washington customers to Company shareholders. The negative impact to ratepayers and the state's economy is clear. Establishing an awarded return based on flawed assumptions which overstate the cost of capital effectively prevents the awarded returns from changing along with economic conditions. As shown in the figure below, awarded returns for public utilities have been well above the average required market return for at least 30 years. Due to the fact that utility stocks are consistently far less risky than the average stock in the marketplace, the cost of equity for utility companies is *less* than the market cost of equity.

Figure 1:
Awarded Returns on Equity vs. Market Cost of Equity (1990 – 2018)[12]



[12] *See* David J. Garrett, Exh. DJG-6.

In other words, awarded ROEs that are actually based upon (i.e., much closer to) utility cost of equity should be below the dotted line in the graph (in only one year in the last 30 years, 1994, did this occur). The gap between the average awarded returns and utility cost of equity has resulted in an excess of ratepayer wealth being transferred to utility shareholders and the IRS for nearly 30 years (at least). This is likely due, in part, to the fact that interest rates were much higher in the 1990s, and there was also an average required market return around 12 percent. In that environment, the cost of equity for low-risk utility stocks might have been about nine percent. Since that time, however, interest rates have dramatically declined among other economic changes, and it is clear that awarded returns have failed to keep pace with decreasing equity costs. As shown in the graph, since 1990 there was only one year in which the average awarded ROE was below the market cost of equity – 1994. In other words, 1994 was the year that regulators awarded ROEs that were the closest to utilities' market-based cost of equity. In my opinion, when awarded ROEs for utilities are below the market cost of equity, they more closely conform to the standards set forth by *Hope* and *Bluefield* and minimize the excess wealth transfer from ratepayers to shareholders.

Q. Have other analysts commented on this national phenomenon of awarded ROEs exceeding market-based cost equity for utilities?

A. Yes. In his article published in Public Utilities Fortnightly in 2016, Steve Huntoon observed that even though utility stocks are less risky than the stocks of competitive industries, utility stocks have nonetheless outperformed the broader market.[13] Specifically, Huntoon notes the following three points which lead to this problematic conclusion:

> 1. Jack Bogle, the founder of Vanguard Group and a Wall Street legend, provides rigorous analysis that the long-term total return for the broader market will be around 7 percent going forward. Another Wall Street legend, Professor Burton Malkiel, corroborates that 7 percent in the latest edition of his seminal work, A Random Walk Down Wall Street.
>
> 2. Institutions like pension funds are validating [the first point] by piling on risky investments to try and get to a 7.5 percent total return, as reported by the Wall Street Journal.
>
> 3. Utilities are being granted returns on equity around 10 percent.[14]

In a follow-up article analyzing and agreeing with Mr. Huntoon's findings, Leonard Hyman and William Tilles found that utility equity investors expect about a 7.5 percent annual return.[15]

Other scholars have also observed that awarded ROEs have not appropriately tracked with declining interest rates over the years, and that excessive awarded ROEs have negative economic impacts. In a white paper issued last year, Charles S. Griffey stated:

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[13] David J. Garrett, Exh. DJG-7 (Steve Huntoon, *Nice Work If You Can Get It*, PUB. UTIL. FORTNIGHTLY (Aug. 2016)).

[14] *Id*.

[15] David J. Garrett, Exh. DJG-8 (Leonard Hyman & William Tilles, *Don't Cry for Utility Shareholders, America*, PUB. UTIL. FORTNIGHTLY (Oct. 2016)).

> The "risk premium" being granted to utility shareholders is now higher than it has ever been over the last 35 years. Excessive utility ROEs are detrimental to utility customers and the economy as a whole. From a societal standpoint, granting ROEs that are higher than necessary to attract investment creates an inefficient allocation of capital, diverting available funds away from more efficient investments. From the utility customer perspective, if a utility's awarded and/or achieved ROE is higher than necessary to attract capital, customers pay higher rates without receiving any corresponding benefit.[16]

It is interesting that both Mr. Huntoon and Mr. Griffey use the word "sticky" in their articles to describe the fact that awarded ROEs have declined at a much slower rate than interest rates and other economic factors resulting in a decline in capital costs and expected returns on the market. It is not hard to see why this phenomenon of sticky ROEs has occurred. Because awarded ROEs are often based primarily on a comparison with other awarded ROEs around the country, the average awarded returns effectively fail to adapt to true market conditions, and regulators seem reluctant to deviate from the average. Once utilities and regulatory commissions become accustomed to awarding rates of return higher than market conditions actually require, this trend becomes difficult to reverse. The fact is, utility stocks are *less risky* than the average stock in the market, and thus, awarded ROEs should be less than the expected return on the market. However, that is rarely the case. Ratepayers can only hope that "[s]ooner or later, regulators may see the gap between allowed returns and cost of capital."[17]

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[16] David J. Garrett, Exh. DJG-9 (Charles S. Griffey, WHEN 'WHAT GOES UP' DOES NOT COME DOWN: RECENT TRENDS IN UTILITY RETURNS (2017)).

[17] Garrett, Exh. DJG-8 (Leonard Hyman & William Tilles, *Don't Cry for Utility Shareholders, America*, PUB. UTIL. FORTNIGHTLY, Oct. 2016).

Q. Please summarize the legal standards governing the awarded ROE issue.

A. The Commission should strive to move the awarded return to a level more closely aligned with the Company's actual, market-derived cost of capital while keeping in mind the following legal principles:

1. <u>Risk is the most important factor when determining the awarded return. The awarded return should be commensurate with those on investments of corresponding risk.</u>

The legal standards articulated in *Hope* and *Bluefield* demonstrate that the Court understands one of the most basic, fundamental concepts in financial theory: the more (or less) risk an investor assumes, the more (or less) return the investor requires. Since utility stocks are very low risk, the return required by equity investors should be relatively low. I have used financial models in this case to closely estimate the Company's cost of equity, and these financial models account for risk. The public utility industry is one of the least risky industries in the entire country. This is not surprising due to the presence of stable revenues, captive customers, the consistent demand for utility service, and operations that are essentially supported by the state. This means that, in the long run, the profits realized in riskier industries should be higher than the profits realized in the utility industry. To the extent awarded returns for utilities remain comparatively higher than the returns for companies in riskier industries, this is further evidence of the disconnect resulting from the regulatory process, rather than financial or market drivers.

2. The awarded return should be sufficient to assure financial soundness under efficient management.

Because awarded returns in the regulatory environment have not closely tracked market-based trends and commensurate risk, utility companies have been able to remain more than financially sound, perhaps in spite of management efficiencies. In fact, the transfer of wealth from ratepayers to shareholders has been so far removed from actual cost-based drivers, that even under relatively inefficient management a utility could remain financially sound. Therefore, regulatory commissions should strive to set the awarded return to a regulated utility at a level based on accurate market conditions, to promote prudent and efficient management and minimize economic waste.

IV. GENERAL CONCEPTS AND METHODOLOGY

Q. Discuss your general approach in estimating the cost of equity in this case.

A. While a competitive firm must estimate its own cost of capital to assess the profitability of capital projects, regulators should determine a utility's cost of capital to establish a fair rate of return. The legal standards set forth above do not include specific guidelines regarding the specific models that must be used to estimate the cost of equity. Over the years, however, regulatory commissions have consistently relied on several models. The models I have employed in this case have been widely used and accepted in regulatory proceedings for many years. These models include the Discounted Cash Flow Model (DCF) and the Capital Asset Pricing Model (CAPM). The specific inputs and calculations for these models are described in more detail below.

Q. Explain why you used multiple models to estimate the cost of equity.

A. The models used to estimate the cost of equity attempt to measure the required return of equity investors by estimating a number of different inputs. It is preferable to use multiple models because the results of any one model may contain a degree of inconsistency, especially depending on the reliability of the inputs used at the time of conducting the model. By using multiple models, the analyst can compare the results of the models and look for outlying results and inconsistencies. Likewise, if multiple models produce a similar result, it may indicate a more narrow range for the cost of equity estimate.

V. THE PROXY GROUP

Q. Explain the benefits of choosing a proxy group of companies in conducting cost of capital analyses.

A. The cost of equity models in this case can be used to estimate the cost of capital of any individual, publicly-traded company. There are advantages, however, to conducting cost of capital analysis on a "proxy group" of companies that are comparable to the target company. First, it is better to assess the financial soundness of a utility by comparing it a group of other financially sound utilities. Second, using a proxy group provides more reliability and confidence in the overall results because there is a larger sample size. Finally, the use of a proxy group is often a pure necessity when the target company is a subsidiary that is not publicly traded, as is the case with Avista. This is because the financial models used in this case require information from publicly-traded firms, such as stock prices and dividends.

Q. Describe the proxy group you selected.

A. In this case, I used the same proxy group for my analysis as the group selected by Mr. McKenzie.[18] There could be reasonable arguments made for the inclusion or exclusion of particular companies in a proxy group, but for all intents and purposes, the cost of equity estimates in rate cases are influenced far more by the assumptions and inputs to the various financial models than the composition of the proxy groups. A summary of the proxy group appears in my Exhibit DJG-10 at page 2.

VI. RISK AND RETURN CONCEPTS

Q. Discuss the general relationship between risk and return.

A. As discussed above, risk is among the most important factors for the Commission to consider when determining the allowed return. In order to comply with this standard, it is necessary to understand the relationship between risk and return. There is a direct relationship between risk and return: the more (or less) risk an investor assumes, the larger (or smaller) return the investor will demand. There are two primary types of risk that affect equity investors: firm-specific risk and market risk. Firm-specific risk affects individual firms, while market risk affects all companies in the market to varying degrees.

[18] David J. Garrett, Exh. DJG-10.

Q. Discuss the differences between firm-specific risk and market risk.

A. Firm-specific risk affects individual companies, rather than the entire market. For example, a competitive firm might overestimate customer demand for a new product, resulting in reduced sales revenue. This is an example of project risk.[19] There are several other types of firm-specific risks, including: (1) financial risk – the risk that equity investors of leveraged firms face as residual claimants on earnings; (2) default risk – the risk that a firm will default on its debt securities; and (3) business risk – which encompasses all other operating and managerial factors that may result in investors realizing more or less than their expected return in that particular company. While firm-specific risk affects individual companies, market risk affects all companies in the market to varying degrees. Examples of market risk include interest rate risk, inflation risk, and the risk of major socio-economic events. When there are changes in these risk factors, they affect all firms in the market to some extent.[20]

Q. Is it possible for investors to mitigate or eliminate firm-specific risk?

A. Yes. One of the fundamental concepts in finance is that firm-specific risk can be eliminated through diversification.[21] If someone irrationally invested all of their funds in one firm, they would be exposed to all of the firm-specific risk and the market risk

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[19] *See* David J. Garrett, Exh. DJG-11 (Aswath Damodaran, INVESTMENT VALUATION: TOOLS AND TECHNIQUES FOR DETERMINING THE VALUE OF ANY ASSET 62-63 (John Wiley & Sons, Inc. 3d. ed. 2012)).

[20] David J. Garrett, Exh. DJG-12 (Zvi Bodie, Alex Kane & Alan J. Marcus, ESSENTIALS OF INVESTMENTS 149 (McGraw-Hill/Irwin 9th ed. 2013)).

[21] David J. Garrett, Exh. DJG-13 (John R. Graham, Scott B. Smart & William L. Megginson, CORPORATE FINANCE: LINKING THEORY TO WHAT COMPANIES DO 179-80 (S. W. Cengage Learning 3d ed. 2010)).

inherent in that single firm. Rational investors, however, are risk-averse and seek to eliminate risk they can control. Investors can eliminate firm-specific risk by simply adding more stocks to their portfolio through a process called "diversification." There are two reasons why diversification eliminates firm-specific risk. First, each stock in a diversified portfolio represents a much smaller percentage of the overall portfolio than it would in a portfolio of just one or a few stocks. Thus, any firm-specific action that changes the stock price of one stock in the diversified portfolio will have only a small impact on the entire portfolio. For example, an investor who had his or his entire portfolio invested in Enron stock at the beginning of 2001 would have lost the entire investment by the end of the year, as a result of exposure to the firm-specific risk of Enron's imprudent management. On the other hand, a rational, diversified investor who owned every stock in the S&P 500 would have incurred a much smaller loss over the same period of time.

The second reason why diversification eliminates firm-specific risk is that the effects of firm-specific actions on stock prices can be either positive or negative for each stock. Thus, in large portfolios, the net effect of these positive and negative firm-specific risk factors will be essentially zero and will not affect the value of the overall portfolio. Firm-specific risk is also called "diversifiable risk" due to the fact that it can be easily eliminated through diversification.

Q. Is the assumption of firm-specific risk rewarded by the market through higher returns?

A. No. Because investors eliminate firm-specific risk through diversification, they know they cannot expect a higher return for assuming the firm-specific risk in any one company. Thus, the risks associated with an individual firm's operations, as well as managerial risk and default risk are not rewarded by the market. In fact, firm-specific risk is also called "unrewarded" risk for this reason. Market risk, on the other hand, cannot be eliminated through diversification. Market risks, such as interest rate risk and inflation risk, affect all stocks in the market to different degrees. Because market risk cannot be eliminated through diversification, investors who assume higher levels of market risk also expect higher returns. Market risk is also called "systematic risk."

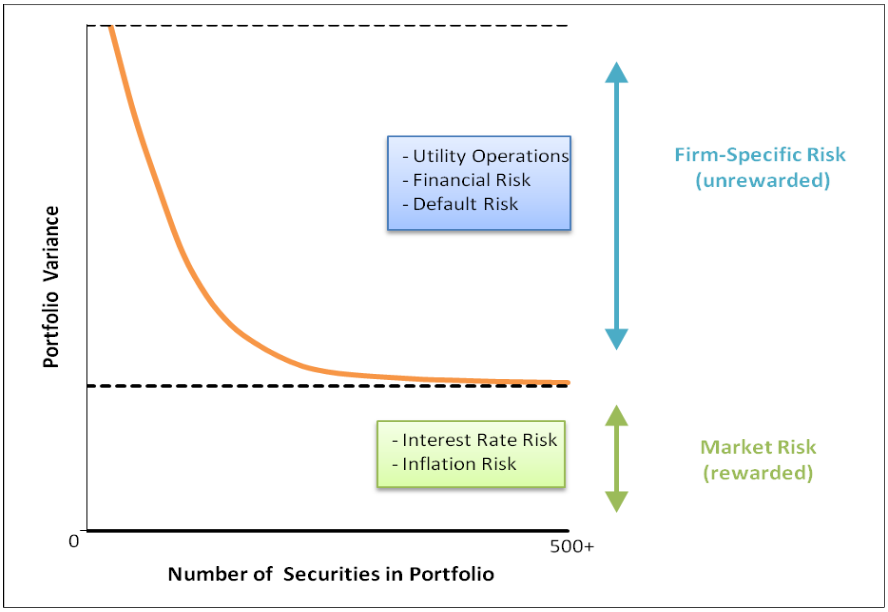
Scholars recognize the fact that market risk, or "systematic risk," is the only type of risk for which investors expect a return for bearing:

> If investors can cheaply eliminate some risks through diversification, then we should not expect a security to earn higher returns for risks that can be eliminated through diversification. Investors can expect compensation only for bearing systematic risk (i.e., risk that cannot be diversified away).[22]

These important concepts are illustrated in the figure below.

[22] *See* Garrett, Exh. DJG-13 (John R. Graham, Scott B. Smart & William L. Megginson, CORPORATE FINANCE: LINKING THEORY TO WHAT COMPANIES DO 180 (S. W. Cengage Learning 3d. ed. 2010)).

Figure 2:
Effects of Portfolio Diversification



This figure shows that as stocks are added to a portfolio, the amount of firm-specific risk is reduced until it is essentially eliminated. No matter how many stocks are added, however, there remains a certain level of fixed market risk. The level of market risk will vary from firm to firm. Market risk is the only type of risk that is rewarded by the market and is thus the primary type of risk the Commission should consider when determining the allowed return.

Q. Describe how market risk is measured.

A. Investors who want to eliminate firm-specific risk must hold a fully diversified portfolio. To determine the amount of risk that a single stock adds to the overall market portfolio, investors measure the covariance between a single stock and the market portfolio. The result of this calculation is called "beta."[23] Beta represents the sensitivity of a given security to the market as a whole. The market portfolio of all stocks has a beta equal to one. Stocks with betas greater than one are relatively more sensitive to market risk than the average stock. For example, if the market increases (or decreases) by 1.0 percent, a stock with a beta of 1.5 will, on average, increase (or decrease) by 1.5 percent. In contrast, stocks with betas of less than one are less sensitive to market risk. For example, if the market increases (or decreases) by 1.0 percent, a stock with a beta of 0.5 will, on average, only increase (or decrease) by 0.5 percent. Thus, stocks with low betas are relatively insulated from market conditions. The beta term is used in the Capital Asset Pricing Model to estimate the required return on equity, which is discussed in more detail later.

Q. Please describe the level of risk typically associated with of public utilities.

A. Recall that although market risk affects all firms in the market, it affects different firms to varying degrees. Firms with high betas are affected more than firms with low betas, which is why firms with high betas are riskier. Stocks with betas greater than one are generally known as "cyclical stocks." Firms in cyclical industries are sensitive to recurring patterns of recession and recovery known as the "business cycle."[24] Thus, cyclical firms are exposed to a greater level of market risk. Securities with betas less than one, on the other hand, are known as "defensive stocks." Companies in defensive

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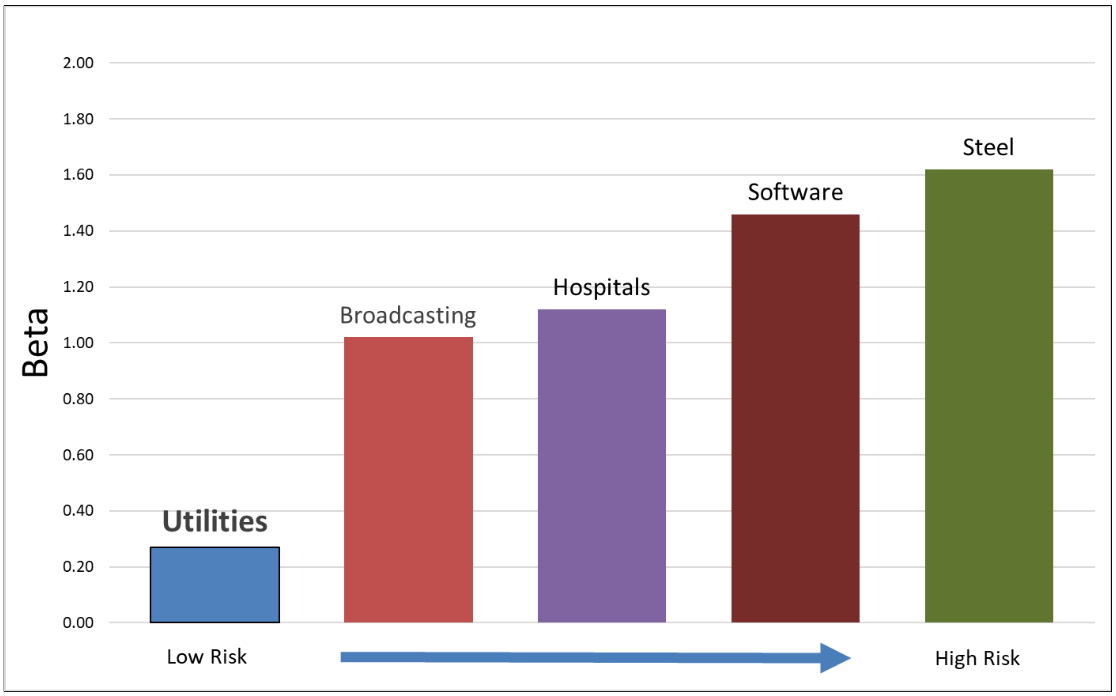
[23] *Id*. at 180-81.

[24] Garrett, Exh. DJG-12 (Zvi Bodie, Alex Kane & Alan J. Marcus, ESSENTIALS OF INVESTMENTS 382 (McGraw-Hill/Irwin 9th ed. 2013)).

industries, such as public utility companies, "will have low betas and performance that is comparatively unaffected by overall market conditions."[25] The figure below compares the betas of several industries and illustrates that the utility industry is one of the least risky industries in the U.S. market.[26]

Figure 3:
Beta by Industry



The fact that utilities are defensive firms that are exposed to little market risk is beneficial to society. When the business cycle enters a recession, consumers can be assured that

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[25] *Id*. at 383.

[26] Aswath Damodaran, *Betas by Sector (US)*, N.Y. UNIV. (Jan. 5, 2019) http://www.stern.nyu.edu/~adamodar/pc/datasets/betas.xls. The exact beta calculations are not as important as illustrating the well-known fact that utilities are very low-risk companies. The fact that the utility industry is one of the lowest risk industries in the country should not change from year to year.

their utility companies will be able to maintain normal business operations, and utility investors can be confident that utility stock prices will not widely fluctuate. Thus, because utilities are defensive firms that experience little market risk and are relatively insulated from market conditions, this fact should also be appropriately reflected in the Commission's awarded rate of return.

Q. Does this generally mean that investors in firms with low betas require a smaller return than the average required return on the market?

A. Yes. This is the basic concept of the risk and return doctrine: The more (or less) risk an investor assumes, the larger (or smaller) return the investor will demand. So, if a particular stock is less risky than the market average, then an investor in that stock will require a smaller return than the average return on the market. Since utilities are low-risk companies with low betas, the required return (i.e., cost of capital) for utilities should be lower than the required return on the overall market.

VII. DISCOUNTED CASH FLOW ANALYSIS

Q. Describe the Discounted Cash Flow model.

A. The Discounted Cash Flow ("DCF") Model is based on a fundamental financial model called the "dividend discount model," which maintains that the value of a security is equal to the present value of the future cash flows it generates. Cash flows from common stock are paid to investors in the form of dividends. There are several variations of the DCF Model. A general form of the DCF Model used in utility proceedings is expressed as follows:

Equation 2:
Constant Growth Discounted Cash Flow

$$K = \frac{D_1}{P_0} + g$$

where:	K	=	*discount rate / required return on equity*
	D_1	=	*expected dividend per share one year from now*
	P_0	=	*current stock price*
	g	=	*expected growth rate of future dividends*

The Constant Growth DCF Model may be considered in two parts. The first part is the dividend yield (D_1/P_0), and the second part is the growth rate (g). One of the inherent assumptions in the DCF Model is that the growth rate is constant, or infinite. Thus, it is especially important not to overestimate the growth rate.

Q. Describe the Quarterly Approximation DCF Model.

A. The basic form of the Constant Growth DCF Model described above is sometimes referred to as the “Annual” DCF Model. This is because the model assumes an annual dividend payment to be paid at the end of every year, as well as an increase in dividends once each year. In reality, however, most utilities pay dividends on a quarterly basis. The Constant Growth DCF equation may be modified to reflect the assumption that investors receive successive quarterly dividends and reinvest them throughout the year at the discount rate. This variation is called the Quarterly Approximation DCF Model.

Equation 3:
Quarterly Approximation Discounted Cash Flow

$$K = \left[\frac{d_0(1+g)^{1/4}}{P_0} + (1+g)^{1/4}\right]^4 - 1$$

where: K = *discount rate / required return*
d_0 = *current quarterly dividend per share*
P_0 = *stock price*
g = *expected growth rate of future dividends*

The Quarterly Approximation DCF Model assumes that dividends are paid quarterly and that each dividend is constant for four consecutive quarters. There are several other variations of the Constant Growth (or Annual) DCF Model, including a Semi-Annual DCF Model which is used by the Federal Energy Regulatory Commission (FERC). These models, along with the Quarterly Approximation DCF Model, have been accepted in regulatory proceedings as useful tools for estimating the cost of equity. For this case, I have chosen to use the Quarterly Approximation DCF Model described above, which results in the highest cost of equity estimate relative to the other models, all else held constant.

Q. Describe the inputs to the DCF Model.

A. There are three primary inputs in the DCF Model: (1) stock price; (2) dividend; and (3) the long-term growth rate. The stock prices and dividends are known inputs based on recorded data, while the growth rate projection must be estimated. I will discuss each of these inputs in turn.

A. Stock Price

Q. Describe how you determined the stock price input of the DCF Model.

A. For the stock price, I used a 30-day average of stock prices for each company in the proxy group.[27] Analysts sometimes rely on average stock prices for longer periods (e.g., 60, 90, or 180 days). According to the efficient market hypothesis, however, markets reflect all relevant information available at a particular time, and prices adjust instantaneously to the arrival of new information.[28] Past stock prices, in essence, reflect outdated information. The DCF Model used in utility rate cases is a derivation of the dividend discount model, which is used to determine the current value of an asset. Thus, according to the dividend discount model and the efficient market hypothesis, the value for the "price" term in the DCF Model should technically be the current stock price, rather than an average.

Q. Explain why you used a 30-day average for the current stock price input.

A. Using a short-term average of stock prices for the current stock price input adheres to market efficiency principles which avoids any irregularities that may arise from using a single current stock price. In the context of a utility rate proceeding, there is a significant length of time from when an application is filed and responsive testimony is due. Choosing a current stock price for one particular day during that time could raise a

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[27] Garrett, Exh. DJG-14.

[28] David J. Garrett, Exh. DJG-15 (Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, Vol. 25, No. 2, The Journal of Finance 383 (1970)).

separate issue concerning which day was chosen to be used in the analysis. In addition, a single stock price on a particular day may be unusually high or low. It is arguably ill-advised to use a single stock price in a model that is ultimately used to set rates for several years, especially if a stock is experiencing some volatility. Thus, it is preferable to use a short-term average of stock prices, which represents a good balance between adhering to well-established concepts of market efficiency while avoiding any irregularities that may arise from using a single stock price on a given day. The stock prices I used in my DCF analysis are based on 30-day averages of adjusted closing stock prices for each company in the proxy group.[29]

B. Dividend

Q. Describe how you determined the dividend input of the DCF Model.

A. The dividend term in the Quarterly Approximation DCF Model is the current quarterly dividend per share. I obtained recent quarterly dividends for each proxy company.[30] The Quarterly Approximation DCF Model assumes that the company increases its dividend payments each quarter. Thus, the model assumes that each quarterly dividend is greater than the previous one by $(1 + g)^{0.25}$. This expression could be described as the dividend quarterly growth rate, where the term "g" is the growth rate and the exponential term

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[29] Garrett, DJG-14. Adjusted closing prices, rather than actual closing prices, are ideal for analyzing historical stock prices. The adjusted price provides an accurate representation of the firm's equity value beyond the mere market price because it accounts for stock splits and dividends.

[30] *Dividend History*, NASDAQ, http://www.nasdaq.com/quotes/dividend-history.aspx (last visited Sept. 30, 2019).

"0.25" signifies one quarter of the year.[31]

Q. Does the Quarterly Approximation DCF Model result in the highest cost of equity relative to other DCF Models, all else held constant?

A. Yes. The DCF Model I employed in this case results in a higher DCF cost of equity estimate than the annual or semi-annual DCF Models due to the quarterly compounding of dividends inherent in the model.

C. Growth Rate

Q. Summarize the growth rate input in the DCF Model.

A. The most critical input in the DCF Model is the growth rate. Unlike the stock price and dividend inputs, the growth rate input must be estimated. As a result, the growth rate is often the most contentious DCF input in utility rate cases. The DCF model used in this case is based on the constant growth valuation model. Under this model, a stock is valued by the present value of its future cash flows in the form of dividends. Before future cash flows are discounted by the cost of equity, however, they must be "grown" into the future by a long-term growth rate. As stated above, one of the inherent assumptions of this model is that these cash flows in the form of dividends grow at a constant rate forever. Thus, the growth rate term in the constant growth DCF model is often called the "constant," "stable," or "terminal" growth rate. For young, high-growth firms, estimating the growth rate to be used in the model can be especially difficult, and may require the

[31] David J. Garrett, Exh. DJG-16.

use of multi-stage growth models. For mature, low-growth firms such as utilities, however, estimating the terminal growth rate is more transparent. The growth term of the DCF Model is one of the most important, yet apparently most misunderstood aspects of cost of equity estimations in utility regulatory proceedings. Therefore, I have devoted a more detailed explanation of this issue in the following sections, which are organized as follows:

1) The Various Determinants of Growth
2) Reasonable Estimates for Long-Term Growth
3) Quantitative vs. Qualitative Determinants of Utility Growth: Circular References, "Flatworm" Growth, and the Problem with Analysts' Growth Rates
4) Growth Rate Recommendation

1. The Various Determinants of Growth

Q. Describe the various determinants of growth.

A. Although the DCF Model directly considers the growth of dividends, there are a variety of growth determinants that should be considered when estimating growth rates. It should be noted that these various growth determinants are used primarily to determine the short-term growth rates in multi-stage DCF models. For utility companies, it is necessary to focus primarily on long-term growth rates, which are discussed in the following section. That is not to say that these growth determinants cannot be considered when estimating long-term growth; however, as discussed below, long-term growth must be constrained much more than short-term growth, especially for young firms with high growth opportunities. Additionally, I briefly discuss these growth determinants here because it may reveal some of the source of confusion in this area.

1. Historical Growth

Looking at a firm's actual historical experience may theoretically provide a good starting point for estimating short-term growth. However, past growth is not always a good indicator of future growth. Some metrics that might be considered here are a historical growth in revenues, operating income, and net income. Since dividends are paid from earnings, estimating historical earnings growth may provide an indication of future earnings and dividend growth.

2. Analyst Growth Rates

Analyst growth rates refer to short-term projections of earnings growth published by institutional research analysts such as Value Line and Bloomberg. A more detailed discussion of analyst growth rates, including the problems with using them in the DCF Model to estimate utility cost of equity, is provided in a later section.

3. Fundamental Determinants of Growth

Fundamental growth determinants refer to firm-specific financial metrics that arguably provide better indications of near-term sustainable growth. One such metric for fundamental growth considers the return on equity and the retention ratio. The idea behind this metric is that firms with high ROEs and retention ratios should have higher opportunities for growth.[32]

[32] Garrett, Exh. DJG-11 at 285.

Q. Did you use any of these growth determinants in your DCF Model?

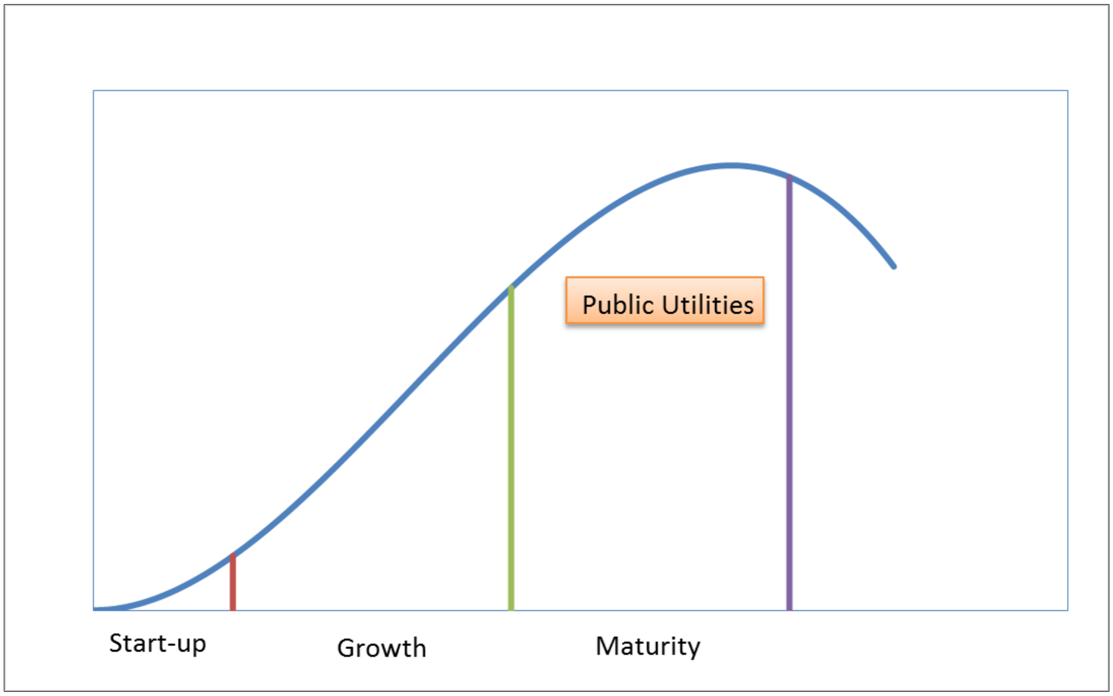
A. No. Primarily, these growth determinants discussed above would provide better indications of short to mid-term growth for firms with average to high growth opportunities. Utilities, however, are mature, low-growth firms. While it may not be unreasonable on its face to use any of these growth determinants for the growth input in the DCF Model, we must keep in mind that the stable growth DCF Model considers only long-term growth rates, which are constrained by certain economic factors, as discussed further below.

2. Reasonable Estimates for Long-Term Growth

Q. Describe what is meant by long-term growth.

A. In order to make the DCF a viable, practical model, an infinite stream of future cash flows must be estimated and then discounted back to the present. Otherwise, each annual cash flow would have to be estimated separately. Some analysts use "multi-stage" DCF Models to estimate the value of high-growth firms through two or more stages of growth, with the final stage of growth being constant. However, it is not necessary to use multi-stage DCF Models to analyze the cost of equity of regulated utility companies. This is because regulated utilities are already in their "terminal," low growth stage. Unlike most competitive firms, the growth of regulated utilities is constrained by physical service territories and limited primarily by the customer and load growth within those territories. The figure below illustrates the well-known business / industry life-cycle pattern.

Figure 4:
Industry Life Cycle



In an industry's early stages, there are ample opportunities for growth and profitable reinvestment. In the maturity stage however, growth opportunities diminish, and firms choose to pay out a larger portion of their earnings in the form of dividends instead of reinvesting them in operations to pursue further growth opportunities. Once a firm is in the maturity stage, it is not necessary to consider higher short-term growth metrics in multi-stage DCF Models; rather, it is sufficient to analyze the cost of equity using a stable growth DCF Model with one terminal, long-term growth rate. Because utilities are in their maturity stage, their real growth opportunities are primarily limited to the population growth within their defined service territories, which is usually less than two percent.

Q. Is it true that the terminal growth rate cannot exceed the growth rate of the economy, especially for a regulated utility company?

A. Yes. A fundamental concept in finance is that no firm can grow forever at a rate higher than the growth rate of the economy in which it operates.[33] Thus, the terminal growth rate used in the DCF Model should not exceed the aggregate economic growth rate. This is especially true when the DCF Model is conducted on public utilities because these firms have defined service territories. As stated by Dr. Damodaran: "If a firm is a purely domestic company, either because of internal constraints . . . or external constraints (such as those imposed by a government), the growth rate in the domestic economy will be the limiting value."[34] In fact, it is reasonable to assume that a regulated utility would grow at a rate that is less than the U.S. economic growth rate. Unlike competitive firms, which might increase their growth by launching a new product line, franchising, or expanding into new and developing markets, utility operating companies with defined service territories cannot do any of these things to grow. Gross domestic product (GDP) is one of the most widely-used measures of economic production and is used to measure aggregate economic growth. According to the Congressional Budget Office's Budget Outlook, the long-term forecast for nominal U.S. GDP growth is 3.9 percent, which includes an inflation rate of two percent.[35] For mature companies in mature industries, such as utility

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[33] Garrett, Exh. DJG-11 at 306.

[34] *Id*.

[35] *The 2016 Long-Term Budget Outlook*, CONGRESSIONAL BUDGET OFFICE (Jul. 12, 2016) https://www.cbo.gov/publication/51580.

companies, the terminal growth rate will likely fall between the expected rate of inflation and the expected rate of nominal GDP growth. Thus, Avista's terminal growth rate is realistically between about two percent and four percent.

Q. Is it reasonable to assume that the terminal growth rate will not exceed the risk-free rate?

A. Yes. In the long term, the risk-free rate will converge on the growth rate of the economy. For this reason, financial analysts sometimes use the risk-free rate for the terminal growth rate value in the DCF model.[36] I discuss the risk-free rate in further detail later in this testimony.

Q. Please summarize the various long-term growth rate estimates that can be used as the terminal growth rate in the DCF Model.

A. The reasonable long-term growth rate determinants are summarized as follows:

1) Nominal GDP Growth
2) Inflation
3) Current Risk-Free Rate

Any of the foregoing growth determinants could provide a reasonable input for the terminal growth rate in the DCF Model for a utility company, including Avista. In general, we should expect that utilities will, at the very least, grow at the rate of projected

[36] Garrett, Exh. DJG-11 (Aswath Damodaran, INVESTMENT VALUATION: TOOLS AND TECHNIQUES FOR DETERMINING THE VALUE OF ANY ASSET 307 (John Wiley & Sons, Inc. 3d ed. 2012)).

inflation. However, the long-term growth rate of any U.S. company, especially utilities, will be constrained by nominal U.S. GDP growth.

3. Qualitative Growth: The Problem with Analysts' Growth Rates

Q. Describe the differences between "quantitative" and "qualitative" growth determinants.

A. Assessing "quantitative" growth simply involves mathematically calculating a historic metric for growth (such as revenues or earnings) or calculating various fundamental growth determinants using various figures from a firm's financial statements (such as ROE and the retention ratio). However, any thorough assessment of company growth should be based upon a "qualitative" analysis. Such an analysis would consider specific strategies that company management will implement to achieve a sustainable growth in earnings. Therefore, it is important to begin the analysis of Avista's growth rate with this simple, qualitative question: How is this regulated utility going to achieve a sustained growth in earnings? If this question were asked of a competitive firm, there could be several answers depending on the type of business model, such as launching a new product line, franchising, rebranding to target a new demographic, or expanding into a developing market. Regulated utilities, however, cannot engage in these potential growth opportunities.

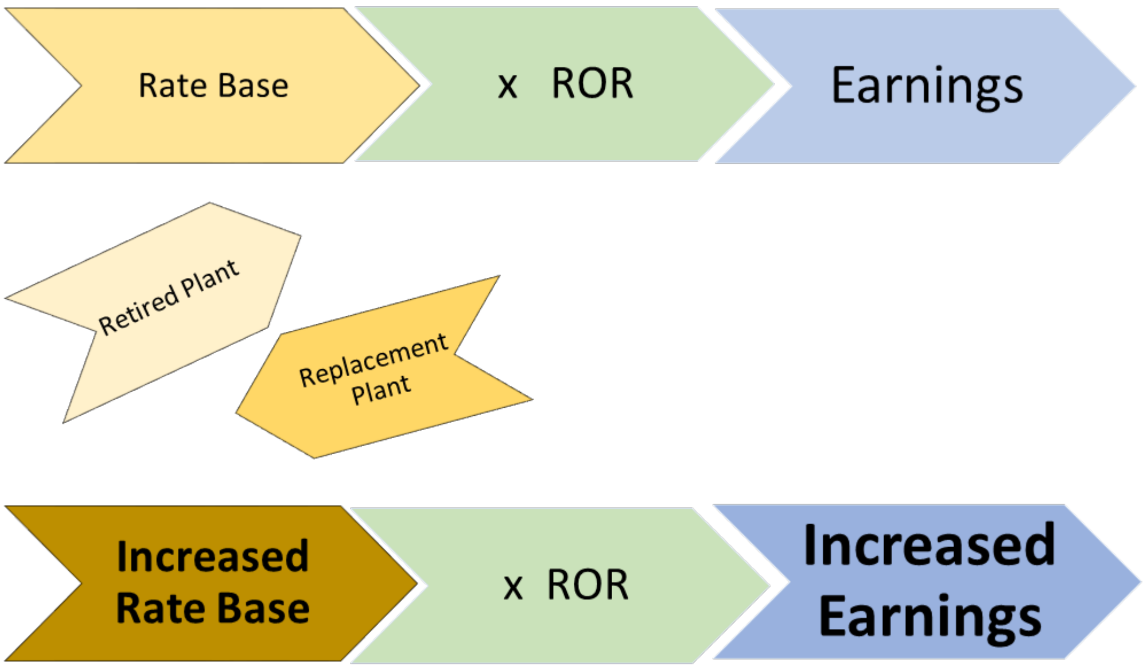
Q. Why is it especially important to emphasize real, qualitative growth determinants when analyzing the growth rates of regulated utilities?

A. While qualitative growth analysis is important regardless of the entity being analyzed, it is especially important in the context of utility ratemaking. This is because the rate base rate of return model inherently possesses two factors that can contribute to distorted views of utility growth when considered exclusively from a quantitative perspective. These two factors are (1) rate base and (2) the awarded ROE. I will discuss each factor further below. It is important to keep in mind that the ultimate objective of this analysis is to provide a foundation upon which to base the fair rate of return for the utility. Thus, we should strive to ensure that each individual component of the financial models used to estimate the cost of equity are also "fair." If we consider only quantitative growth determinants, it may lead to projected growth rates that are overstated and ultimately unfair, because they result in inflated cost of equity estimates.

Q. How does rate base relate to growth determinants for utilities?

A. Under the rate base rate of return model, a utility's rate base is multiplied by its awarded rate of return to produce the required level of operating income. Therefore, increases to rate base generally result in increased earnings. Thus, utilities have a natural financial incentive to increase rate base. This concept is also discussed in Part II of my direct testimony as it relates to accelerated depreciation and the misleading narrative of "intergenerational inequity." In short, utilities have a financial incentive to increase rate base regardless of whether such increases are driven by a corresponding increase in demand. A good, relevant example of this is seen in the early retirement of old, but otherwise functional coal plants in response to environmental regulations. Under these circumstances, utilities have been able to increase their rate bases by a far greater extent than what any concurrent increase in demand would have required. In other words, utilities "grew" their earnings by simply retiring old assets and replacing them with new assets. If the tail of a flatworm is removed and regenerated, it does not mean the flatworm actually grew. Likewise, if a competitive, unregulated firm announced plans to close production plants and replace them with new plants, it would not be considered a real determinant of growth unless analysts believed this decision would directly result in increased market share for the company and a real opportunity for sustained increases in revenues and earnings. In the case of utilities, the mere replacement of old plant with new plant does not increase market share, attract new customers, create franchising opportunities, or allow utilities to penetrate developing markets, but may result in short-term, quantitative earnings growth. However, this "flatworm growth" in earnings was merely the quantitative byproduct of the rate base rate of return model, and not an indication of real, fair, or qualitative growth. The following diagram illustrates this concept.

Figure 5:
Analysts' Earnings Growth Projections: The "Flatworm Growth" Problem

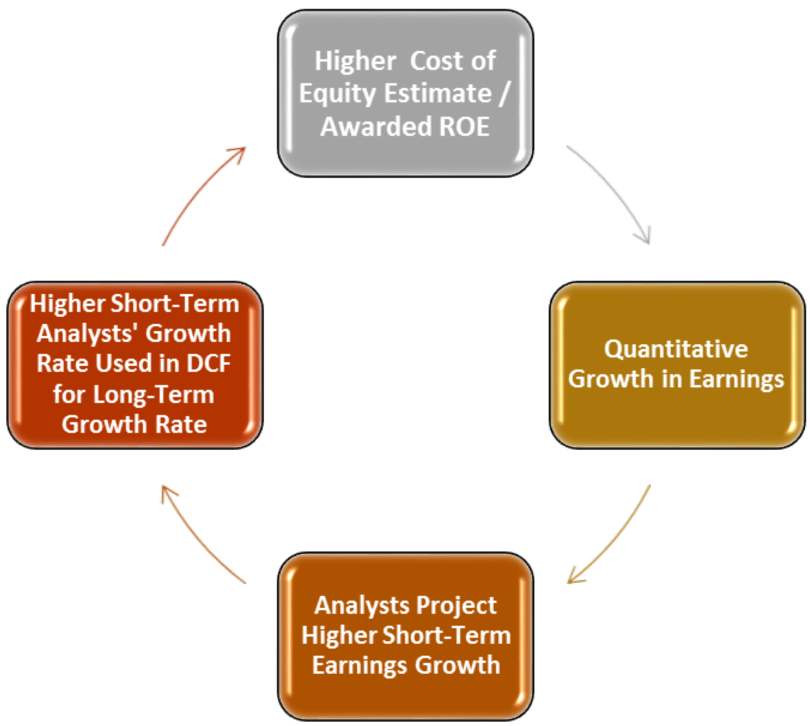


Of course, utilities might sometimes add new plant to meet a modest growth in customer demand. However, as the foregoing discussion demonstrates, it would be more appropriate to consider load growth projections and other qualitative indicators, rather than mere increases to rate base or earnings, to attain a fair assessment of growth.

Q. Please discuss the other way in which analysts' earnings growth projections do not provide indications of fair, qualitative growth for regulated utilities.

A. If we give undue weight to analysts' projections for utilities' earnings growth, it will not provide an accurate reflection of real, qualitative growth because a utility's earnings are heavily influenced by the ultimate figure that all this analysis is supposed to help us estimate: the awarded return on equity. This creates a circular reference problem or feedback loop. In other words, if a regulator awards an ROE that is above market-based cost of capital (which is often the case, as discussed above), this could lead to higher short-term growth rate projections from analysts. If these same inflated, short-term growth rate estimates are used in the DCF Model (and they often are by utility witnesses), it could lead to higher awarded ROEs; and the cycle continues, as illustrated in the following figure:

Figure 6:
Analysts' Earnings Growth Projections: The "Circular Reference" Problem



Therefore, it is not advisable to simply consider the quantitative growth projections published by analysts, as this practice will not necessarily provide fair indications of real utility growth.

Q. Are there any other problems with relying on analysts' growth projections?

A. Yes. While the foregoing discussion shows two reasons why we cannot rely on analysts' growth rate projections to provide fair, qualitative indicators of utility growth in a stable growth DCF Model, the third reason is perhaps the most obvious and undisputable. Various institutional analysts, such as Zacks, Value Line, and Bloomberg, publish estimated projections of earnings growth for utilities. These estimates, however, are short-term growth rate projections, ranging from three to 10 years. Many utility ROE analysts, however, inappropriately insert these short-term growth projections into the DCF Model as *long-term* growth rate projections. For example, assume that an analyst at Bloomberg estimates that a utility's earnings will grow by seven percent per year over the next three years. This analyst may have based this short-term forecast on a utility's plans to replace depreciated rate base (i.e., "flatworm" growth) or on an anticipated awarded return that is above market-based cost of equity (i.e., "circular reference" problem). When a utility witness uses this figure in a DCF Model, however, it is the *witness*, not the Bloomberg analyst, that is testifying to the regulator that the utility's earnings will qualitatively grow by seven percent per year over the *long-term*, which is an unrealistic assumption.

4. Long-Term Growth Rate Recommendation

Q. Describe the growth rate input used in your DCF Model.

A. I considered various qualitative determinants of growth for Avista, along with the maximum allowed growth rate under basic principles of finance and economics. The following chart shows three of the long-term growth determinants discussed in this section.[37]

Figure 7:
Terminal Growth Rate Determinants

Terminal Growth Determinants		Rate
Nominal GDP		3.9%
Inflation		2.0%
Risk Free Rate		2.1%
Highest		**3.9%**

For the long-term growth rate in my DCF model, I selected the maximum, reasonable long-term growth rate of 3.9 percent, which means my model assumes that Avista's qualitative growth in earnings will match the nominal growth rate of the entire U.S. economy over the long run. This is a very charitable assumption. As the following discussion will show, there are several qualitative growth determinants specific to Avista that indicate the Company's real growth over the long run will be much less than 3.9 percent.

[37] David J. Garrett, Exh. DJG-17.

Q. Please compare the market-based growth determinants you have discussed, as well other specific growth determinants provided by the Company.

A. As discussed above, there are several reasonable, long-term growth rate determinants that could be used in the DCF Model to estimate Avista's cost of equity, including nominal GDP, inflation, and the risk-free rate. In addition, there are several other factors we could consider in order to assess the qualitative long-term growth rate for Avista. These factors include Avista's own projections for growth in customers and load. These factors have analytical value because they provide better indications of qualitative growth for Avista, and they avoid the circular reference problem created by using analysts' short-term, quantitative growth rates, or by using Avista's projections for earnings (which are directly tied to the ultimate figure we are trying to determine – the ROE). The table below summarizes these various growth determinants.[38]

Figure 8:
Other Qualitative Growth Determinants for Avista

Company-Specific Qualitiative Growth Determinants		Rate
Electric Customer Growth		0.8%
Gas System Wide Growth		1.2%
Population Growth		1.1%
Average		**1.0%**

[38] Garrett, Exh. DJG-17.

As shown in this table, Avista's own projections for these growth determinants are only about one percent. These figures are widely divergent from the growth rates as high as 12.5 percent that Mr. McKenzie relied upon as part of his DCF Model.[39]

Q. Please describe the final results of your DCF Model.

A. I used the Quarterly Approximation DCF Model discussed above to estimate Avista's cost of equity capital. I obtained an average of reported dividends and stock prices from the proxy group, and I used a reasonable terminal growth rate estimate for Avista. My DCF cost of equity estimate for Avista is 7.3 percent.[40] As noted above, this estimate is likely at the higher end of a reasonable range due to my relatively high estimate for the long-term growth rate. That is, my long-term growth rate input of 3.9 percent far exceeds any of Avista's qualitative growth factors discussed above, and it assumes Avista will grow at the same rate as the U.S. economy over the long-run – a very generous assumption.

D. Response to Mr. McKenzie's DCF Model

Q. Mr. McKenzie's DCF Model yielded much higher results. Did you find any errors in his analysis?

A. Yes. Mr. McKenzie's DCF Model produced cost of equity results as high as 11.2 percent.[41] The results of Mr. McKenzie's DCF Model are overstated primarily because of

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[39] McKenzie, Exh. AMM-6.

[40] David J. Garrett, Exh. DJG-18.

[41] McKenzie, Exh. AMM-4.

a fundamental error regarding his growth rate inputs. In addition, Mr. McKenzie has included a flotation cost adjustment, which is unreasonable in my opinion. Finally, Mr. McKenzie conducted a non-utility DCF Model, which is also an unreasonable approach in estimating utility cost of equity. I will discuss these three issues below.

1. Long-Term Growth Rates

Q. Describe the problems with Mr. McKenzie's long-term growth input.

A. Mr. McKenzie used long-term growth rates in his proxy group as high as 12.5 percent,[42] which is more than three times as high as projected, long-term U.S. GDP growth (only 3.9 percent). This means Mr. McKenzie's growth rate assumption violates the basic principle that no company can grow at a greater rate than the economy in which it operates over the long-term, especially a regulated utility company with a defined service territory. Furthermore, Mr. McKenzie used short-term, quantitative growth estimates published by analysts. As discussed above, these analysts' estimates are inappropriate to use in the DCF Model as long-term growth rates because they are estimates for <u>short-term</u> growth. For example, Mr. McKenzie considered a growth rate estimate of 12.5 percent from Value Line for CenterPoint Energy Corp.[43] This means that an analyst at Value Line apparently thinks that CenterPoint's earnings will quantitatively increase by 12.5 percent each year over the next <u>several</u> years. However, it is *Mr. McKenzie*, not the Value Line analyst, who is suggesting to the Commission that CenterPoint's earnings will

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[42] McKenzie, Exh. AMM-6.

[43] *Id*.

grow by more than three times the amount of U.S. GDP every year for many decades into the future.[44] This assumption is simply not realistic, and it contradicts fundamental concepts of long-term growth. The growth rate assumptions used by Mr. McKenzie for many of the other proxy companies suffer from the same shortcomings.[45]

2. Flotation Costs

Q. What additional errors did you find in Mr. McKenzie's DCF analysis?

A. A proper DCF analysis considers the market-based stock price of a firm for the stock price input of the model. In this case, Mr. McKenzie inappropriately added a flotation cost adjustment to his DCF Model results.[46] When companies issue equity securities, they typically hire at least one investment bank as an underwriter for the securities. "Flotation costs" generally refer to the underwriter's compensation for the services it provides in connection with the securities offering.

Q: Do you agree with Mr. McKenzie's flotation cost allowance?

A. No. Mr. McKenzie's flotation cost allowance is inappropriate for several reasons, as discussed further below.

1. <u>Flotation costs are not actual "out-of-pocket" costs</u>.

Avista has not experienced any out-of-pocket costs for flotation. Underwriters are not compensated in this fashion. Instead, underwriters are compensated through an

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[44] *Id*. Technically, the constant growth rate in the DCF Model grows dividends each year to "infinity." Yet even if we assumed that the growth rate applied to only a few decades, the annual growth rate would still be too high to be considered realistic.

[45] McKenzie, Exh. AMM-6.

[46] McKenzie, Exh. AMM-4.

"underwriting spread." An underwriting spread is the difference between the price at which the underwriter purchases the shares from the firm, and the price at which the underwriter sells the shares to investors.[47] If the Company has experienced out-of-pocket flotation costs, those costs should be accounted for in the Company's expense schedules.

2. The market already accounts for flotation costs.

When an underwriter markets a firm's securities to investors, the investors are well aware of the underwriter's fees. In other words, the investors know that a portion of the price they are paying for the shares does not go directly to the company, but instead goes to compensate the underwriter for its services. In fact, federal law requires that the underwriter's compensation be disclosed on the front page of the prospectus.[48] Thus, investors have already considered and accounted for flotation costs when making their decision to purchase shares at the quoted price. As a result, there is no need for the Company's shareholders to receive additional compensation to account for costs they have already considered and agreed to. We see similar compensation structures in other kinds of business transactions. For example, a homeowner may hire a realtor and sell a home for $100,000. After the realtor takes a six percent commission, the seller nets $94,000. The buyer and seller agreed to the transaction notwithstanding the realtor's commission. Obviously, it would be unreasonable for the buyer or seller to demand

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[47] *See* Garrett, Exh. DJG-13 (John R. Graham, Scott B. Smart & William L. Megginson, CORPORATE FINANCE: LINKING THEORY TO WHAT COMPANIES DO 509 (S. W. Cengage Learning 3d ed. 2010)).

[48] Regulation S-K, 17 C.F.R. § 229.501(b)(3) (requiring that the underwriter's discounts and commissions be disclosed on the outside cover page of the prospectus). A prospectus is a legal document that provides details about an investment offering.

additional funds from anyone after the deal is completed to reimburse them for the realtor's fees. Likewise, investors of competitive firms do not expect additional compensation for flotation costs. Thus, it would not be appropriate for a commission standing in the place of competition to award a utility's investors with this additional compensation.

3. The DCF Model itself does not include a flotation cost adjustment.

The DCF Model that has been used to estimate cost of equity in utility rate cases is derived from the Gordon Growth Model, a highly regarded valuation model which was first proposed in 1956.[49] In Gordon's original publication, there is no mention of flotation costs. Likewise, when the model is presented in objective financial textbooks, there is no additional factor or "adjustment" for flotation costs that I have seen; the model is simply presented with essentially three variables: stock price, dividends, and growth rate. For a model that has been used for decades by companies, analysts, investors, and academics around the world to analyze the value of stocks and cost of capital as a part of crucial decision-making processes, it is curious that apparently nobody (except for utility ROE witnesses) has thought to add an adjustment to the model to account for flotation costs.

4. It is inappropriate to add any additional basis points to an awarded ROE proposal that is already far above the Company's cost of equity.

For the reasons discussed above, flotation costs should be disallowed from a technical standpoint; they should also be disallowed from a practical standpoint. Avista is

[49] David J. Garrett, Exh. DJG-19 (Myron J. Gordon and Eli Shapiro, *Capital Equipment Analysis: The Required Rate of Profit*, Vol. 3, No. 1 Management Science 102-10 (Oct. 1956)).

asking this Commission to award it a cost of equity that is more than 300 basis points above its market-based cost of equity. Under these circumstances, it is especially inappropriate to suggest that flotation costs should be considered in any way to increase an already inflated ROE proposal.

3. Non-Utility DCF Model

Q: Did Mr. McKenzie also conduct the DCF Model on a group of non-utility companies?

A. Yes. Mr. McKenzie conducted the DCF Model on a group of non-utility companies.

Q: Do you agree with his analysis?

A. No. There are several problems with Mr. McKenzie's non-utility DCF analysis. First, the analysis is unnecessary. The DCF Model (and the CAPM) were designed to be conducted on any single firm. However, in utility regulatory proceedings, it is customary to conduct these models on a peer group of utilities because often the subject utility is not publicly traded. Furthermore, conducting the analyses on a peer group promotes the "commensurate risk" standard set forth by the *Hope* Court.[50] Conducting the analysis on non-utility companies is unnecessary because we have plenty of utilities in the peer group on which to conduct the analysis. Moreover, because utilities are among the least risky industries in the U.S., extending the analysis to non-utility companies is actually at odds with the *Hope* Court's "commensurate risk" standard. As discussed above, higher risk leads to higher cost of equity. Thus, a DCF Model conducted on non-utility companies

[50] *Hope Nat. Gas Co*., 320 U.S. at 603 (emphasis added).

will result in a cost of equity estimate than is higher than that of regulated utility. For these reasons, the Commission should reject the results of Mr. McKenzie's non-utility DCF analysis.

VIII. CAPITAL ASSET PRICING MODEL ANALYSIS

Q. Describe the Capital Asset Pricing Model.

A. The Capital Asset Pricing Model (CAPM) is a market-based model founded on the principle that investors demand higher returns for incurring additional risk.[51] The CAPM estimates this required return.

Q. Is the CAPM approach consistent with the legal standards set forth by the U.S. Supreme Court?

A. Yes. Our courts have recognized that "the amount of risk in the business is a most important factor" in determining the allowed rate of return,[52] and that "the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks."[53] The CAPM is a useful model because it directly considers the amount of risk inherent in a business. It is arguably the strongest of the models usually presented in rate cases because unlike the DCF Model, the CAPM directly measures the most important component of a fair rate of return analysis: Risk.

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[51] David J. Garrett, Exh. DJG-20 (William F. Sharpe, *A Simplified Model for Portfolio Analysis* 277-93 (Management Science IX 1963)).

[52] *Wilcox*, 212 U.S. at 48 (emphasis added).

[53] *Hope Nat. Gas Co*., 320 U.S. at 603 (emphasis added).

Q. Describe the CAPM equation.

A. The basic CAPM equation is expressed as follows:

Equation 4:
Capital Asset Pricing Model

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

where: K = *required return*
R_F = *risk-free rate*
β = *beta coefficient of asset i*
R_M = *required return on the overall market*

There are essentially three terms within the CAPM equation that are required to calculate the required return (K): (1) the risk-free rate (R_F); (2) the beta coefficient (β); and (3) the equity risk premium (R_M – R_F), which is the required return on the overall market less the risk-free rate. Each term is discussed in more detail below, along with the inputs I used for each term.

A. The Risk-Free Rate

Q. Explain the risk-free rate.

A. The first term in the CAPM is the risk-free rate. The risk-free rate is simply the level of return investors can achieve without assuming any risk. The risk-free rate represents the bare minimum return that any investor would require on a risky asset. Even though no investment is technically void of risk, investors often use U.S. Treasury securities to represent the risk-free rate because they accept that those securities essentially contain no default risk. The Treasury issues securities with different maturities, including short-term Treasury Bills, intermediate-term Treasury Notes, and long-term Treasury Bonds.

Q. Is it preferable to use the yield on long-term Treasury bonds for the risk-free rate in the CAPM?

A. Yes. In valuing an asset, investors estimate cash flows over long periods of time. Common stock is viewed as a long-term investment, and the cash flows from dividends are assumed to last indefinitely. Thus, short-term Treasury bill yields are rarely used in the CAPM to represent the risk-free rate. Short-term rates are subject to greater volatility and can thus lead to unreliable estimates. Instead, long-term Treasury bonds are usually used to represent the risk-free rate in the CAPM. I considered a 30-day average of daily Treasury yield curve rates on 30-year Treasury bonds in my risk-free rate estimate, which resulted in a risk-free rate of 2.42 percent.[54]

B. The Beta Coefficient

Q. Describe the beta coefficient.

A. As discussed above, beta represents the sensitivity of a given security to movements in the overall market. The CAPM states that in efficient capital markets, the expected risk premium on each investment is proportional to its beta. Recall that a security with a beta greater (or less) than one is more (or less) risky than the market portfolio. The historical betas for publicly traded firms are published by several commercial sources.[55] Beta may also be calculated through a linear regression analysis, which provides additional

[54] David J. Garrett, Exh. DJG-21.

[55] E.g., Value Line, Bloomberg, and Merrill Lynch.

statistical information about the relationship between a single stock and the market portfolio. Also, as discussed above, beta represents the sensitivity of a given security to the market as a whole. The market portfolio of all stocks has a beta equal to one. Stocks with betas greater than one are relatively more sensitive to market risk than the average stock. For example, if the market increases (or decreases) by one percent, a stock with a beta of 1.5 will, on average, increase (or decrease) by 1.5 percent. In contrast, stocks with betas of less than one are less sensitive to market risk. For example, if the market increases (or decreases) by one percent, a stock with a beta of 0.5 will, on average, only increase (or decrease) by 0.5 percent.

Q. Describe the source for the betas you used in your CAPM analysis.

A. I used betas recently published by Value Line Investment Survey.[56] The beta for each proxy company was less than 1.0, and the average beta for the proxy group is 0.63. Thus, we have an objective measure to prove the well-known concept that utility stocks are less risky than the average stock in the market, which has a beta of 1.0.

C. The Equity Risk Premium

Q. Describe the equity risk premium.

A. The final term of the CAPM is the equity risk premium (ERP), which is the required return on the market portfolio less the risk-free rate. In other words, the ERP is the level of return investors expect above the risk-free rate in exchange for investing in risky

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[56] David J. Garrett, Exh. DJG-22.

securities. Many experts would agree that "the single most important variable for making investment decisions is the equity risk premium."[57] Likewise, the ERP is arguably the single most important factor in estimating the cost of capital in this matter. There are three basic methods to estimate the ERP: (1) calculating a historical average; (2) taking a survey of experts; and (3) calculating the implied equity risk premium. I incorporated each one of these methods in determining the ERP used in my CAPM analysis. I will discuss each method in turn.

1. Historical Average

Q. Describe the historical equity risk premium.

A. The historical ERP may be calculated by simply taking the difference between returns on stocks and returns on government bonds over a certain period of time. Ibbotson, one of the most widely cited source for the historical ERP in the U.S.,[58] reports both the geometric mean and arithmetic mean for the returns of stocks and government bonds in its annual yearbooks. Many practitioners rely on the historical ERP as an estimate for the forward-looking ERP because it is easy to obtain. However, there are disadvantages to relying on the historical ERP as an indication of the current ERP.

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[57] David J. Garrett, Exh. DJG-23 (Elroy Dimson, Paul Marsh & Mike Staunton, TRIUMPH OF THE OPTIMISTS: 101 YEARS OF GLOBAL INVESTMENT RETURNS 4 (Princeton Univ. Press 2002).

[58] *Id*. at 173.

Q. What are the limitations of relying solely on a historical average to estimate the current or forward-looking ERP?

A. Many investors use the historic ERP because it is convenient and easy to calculate. What matters in the CAPM model, however, is not the actual risk premium from the past, but rather the current and forward-looking risk premium.[59] Some investors may think that a historic ERP provides some indication of what the prospective risk premium is, but there is empirical evidence to suggest the prospective, forward-looking ERP is actually lower than the historical ERP. In a landmark publication on risk premiums around the world, *Triumph of the Optimists*, the authors suggest through extensive empirical research that the prospective ERP is lower than the historical ERP.[60] This is due in large part to what is known as "survivorship bias" or "success bias" – a tendency for failed companies to be excluded from historical indices.[61] From their extensive analysis, the authors make the following conclusion regarding the prospective ERP: "The result is a forward-looking, geometric mean risk premium for the United States . . . of around 2½ to 4 percent and an arithmetic mean risk premium . . . that falls within a range from a little below 4 to a little above 5 percent."[62] Indeed, these results are lower than many reported historical risk premiums. Other noted experts agree:

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[59] *See* Garrett, Exh. DJG-13 (John R. Graham, Scott B. Smart & William L. Megginson, CORPORATE FINANCE: LINKING THEORY TO WHAT COMPANIES DO 330 (S. W. Cengage Learning 3d ed. 2010)).

[60] Garrett, Exh. DJG-23 (Elroy Dimson, Paul Marsh & Mike Staunton, TRIUMPH OF THE OPTIMISTS: 101 YEARS OF GLOBAL INVESTMENT RETURNS 194 (Princeton Univ. Press 2002)).

[61] *Id*. at 34.

[62] *Id*. at 194.

> The historical risk premium obtained by looking at U.S. data is biased upwards because of survivor bias . . . . The true premium, it is argued, is much lower. This view is backed up by a study of large equity markets over the twentieth century (*Triumph of the Optimists*), which concluded that the historical risk premium is closer to 4%.[63]

Regardless of the variations in historic ERP estimates, many scholars and practitioners agree that simply relying on a historic ERP to estimate the risk premium going forward is not ideal. Fortunately, "a naïve reliance on long-run historical averages is not the only approach for estimating the expected risk premium."[64]

2. Expert Surveys

Q. Describe the expert survey approach to estimating the ERP.

A. As its name implies, the expert survey approach to estimating the ERP involves conducting a survey of experts including professors, analysts, chief financial officers and other executives around the country and asking them what they think the ERP is. Graham and Harvey have performed such a survey every year since 1996. In their 2016 survey, they found that experts around the country believe that the current risk premium is only four percent.[65] The IESE Business School conducts a similar expert survey, and recently

[63] David J. Garrett, Exh. DJG-24 (Aswath Damodaran, EQUITY RISK PREMIUMS: DETERMINANTS, ESTIMATION AND IMPLICATIONS – THE 2015 EDITION 17 (N. Y. Univ. 2015)).

[64] *See* Garrett, Exh. DJG-13 (John R. Graham, Scott B. Smart & William L. Megginson, CORPORATE FINANCE: LINKING THEORY TO WHAT COMPANIES DO 330 (S. W. Cengage Learning 3d ed. 2010)).

[65] David J. Garrett, Exh. DJG-25 (John R. Graham and Campbell R. Harvey, THE EQUITY RISK PREMIUM IN 2016, at 3 (Fuqua Sch. of Bus., Duke Univ. 2014), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2816603).

reported an average ERP of 5.7 percent.[66]

3. Implied Equity Risk Premium

Q. Describe the implied equity risk premium.

A. The third method of estimating the ERP is arguably the best. The implied ERP relies on the stable growth model proposed by Gordon, often called the "Gordon Growth Model," which is a basic stock valuation model widely used in finance for many years:[67]

Equation 5:
Gordon Growth Model

$$P_0 = \frac{D_1}{K - g}$$

where: P_0 = *current value of stock*
D_1 = *value of next year's dividend*
K = *cost of equity capital / discount rate*
g = *constant growth rate in perpetuity for dividends*

This model is similar to the Constant Growth DCF Model presented in Equation 3 above ($K=D_1/P_0+g$). In fact, the underlying concept in both models is the same: The current value of an asset is equal to the present value of its future cash flows. Instead of using this model to determine the discount rate of one company, we can use it to determine the discount rate for the entire market by substituting the inputs of the model. Specifically, instead of using the current stock price (P_0), we will use the current value of the S&P 500

[66] David J. Garrett, Exh. DJG-26 (Pablo Fernandez, Vitaly Pershin & Isabel F. Acin, MARKET RISK PREMIUM USED IN 71 COUNTRIES IN 2016: A SURVEY WITH 6,932 ANSWERS, at 3 (IESE Bus. Sch. 2015), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2954142).

[67] Garrett, Exh. DJG-19 (Myron J. Gordon & Eli Shapiro, *Capital Equipment Analysis: The Required Rate of Profit* Vol 3, No. 1 Management Science 102-10 (Oct. 1956)).

(V_{500}). Instead of using the dividends of a single firm, we will consider the dividends paid by the entire market. Additionally, we should consider potential dividends. In other words, stock buybacks should be considered in addition to paid dividends, as stock buybacks represent another way for the firm to transfer free cash flow to shareholders. Focusing on dividends alone without considering stock buybacks could understate the cash flow component of the model, and ultimately understate the implied ERP. The market dividend yield plus the market buyback yield gives us the gross cash yield to use as our cash flow in the numerator of the discount model. This gross cash yield is increased each year over the next five years by the growth rate. These cash flows must be discounted to determine their present value. The discount rate in each denominator is the risk-free rate (R_F) plus the discount rate (K). The following formula shows how the implied return is calculated. Since the current value of the S&P is known, we can solve for K: The implied market return.[68]

Equation 6:
Implied Market Return

$$V_{500} = \frac{CY_1(1+g)^1}{(1+R_F+K)^1} + \frac{CY_2(1+g)^2}{(1+R_F+K)^2} + \cdots + \frac{CY_5(1+g)^5 + TV}{(1+R_F+K)^5}$$

where:	V_{500}	=	*current value of index (S&P 500)*
	$CY_{1\text{-}5}$	=	*average cash yield over last five years (includes dividends and buybacks)*
	g	=	*compound growth rate in earnings over last five years*
	R_F	=	*risk-free rate*
	K	=	*implied market return (this is what we are solving for)*
	TV	=	*terminal value = $CY_5\ (1+R_F)\ /\ K$*

[68] David J. Garrett, Exh. DJG-27.

The discount rate is called the "implied" return here because it is based on the current value of the index as well as the value of free cash flow to investors projected over the next five years. Thus, based on these inputs, the market is "implying" the expected return. After solving for the implied market return (K), we simply subtract the risk-free rate from it to arrive at the implied ERP.

Equation 7:
Implied Equity Risk Premium

$$Implied\ Expected\ Market\ Return - R_F = Implied\ ERP$$

Q. Discuss the results of your implied ERP calculation.

A. After collecting data for the index value, operating earnings, dividends, and buybacks for the S&P 500 over the past six years, I calculated the dividend yield, buyback yield, and gross cash yield for each year. I also calculated the compound annual growth rate (g) from operating earnings. I used these inputs, along with the risk-free rate and current value of the index to calculate a current expected return on the entire market of 8.4 percent.[69] I subtracted the risk-free rate to arrive at the implied equity risk premium of 6.0 percent.[70] Dr. Damodaran, one of the world's leading experts on the ERP, promotes the implied ERP method discussed above. He calculates monthly and annual implied

[69] Garrett, Exh. DJG-27.

[70] *Id*.

ERPs with this method and publishes his results. Dr. Damodaran's average ERP estimate for September 2019 was only 5.1 percent.[71]

Q. Discuss the results of your final ERP estimate.

A. For the final ERP estimate I used in my CAPM analysis, I averaged the results of the ERP surveys along with Dr. Damodaran's published ERP and my implied ERP calculation.[72] The results are presented in the following figure:

Figure 9:
Equity Risk Premium Results

IESE Business School Survey		5.6%
Graham & Harvey Survey		4.4%
Duff & Phelps Report		5.5%
Damodaran		5.1%
Garrett		6.0%
Average		**5.3%**
Highest		**6.0%**

While it would be reasonable to select any one of these ERP estimates, or the average of these estimates, I selected the highest ERP estimate of six percent for my CAPM in the

[71] Aswath Damodaran, *Implied Equity Risk Premium Update*, N.Y. UNIV., http://pages.stern.nyu.edu/~adamodar/ (last visited Oct 2. 2019).

[72] David J. Garrett, Exh. DJG-28.

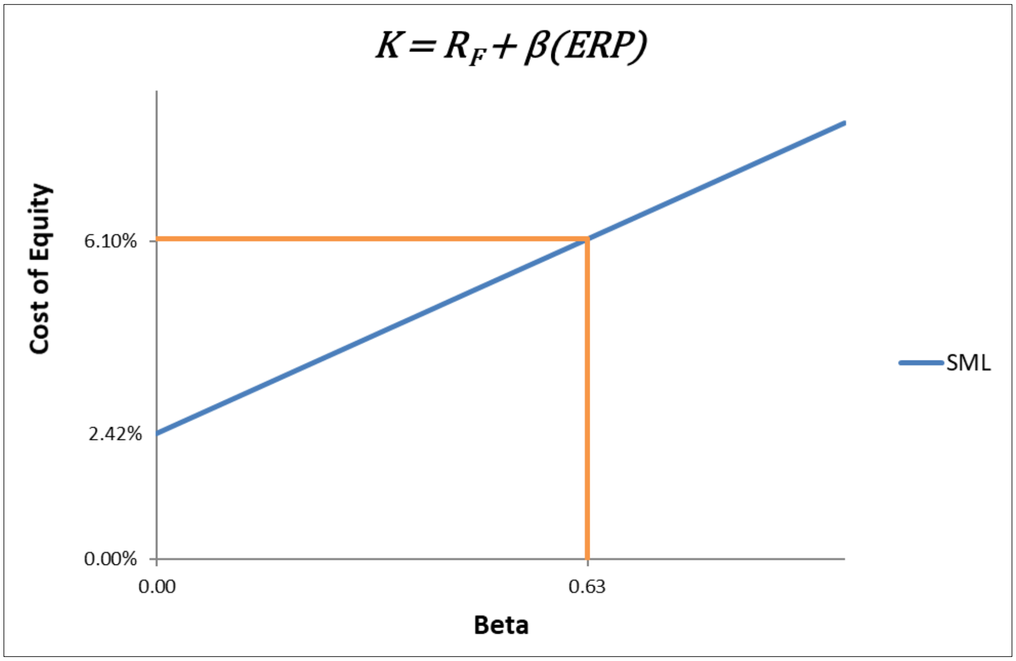
interest of reasonableness. All else held constant, a higher ERP will result in a higher CAPM cost of equity estimate.

Q. Explain the final results of your CAPM analysis.

A. Using the inputs for the risk-free rate, beta coefficient, and equity risk premium discussed above, I calculated the CAPM cost of equity for each proxy company. The results of my CAPM indicate a cost of equity of only 6.1 percent for Avista.[73] The CAPM may be displayed graphically through what is known as the Security Market Line (SML). The following figure shows the expected return (cost of equity) on the y-axis, and the average beta for the proxy group on the x-axis. The SML intercepts the y-axis at the level of the risk-free rate. The slope of the SML is the equity risk premium.

[73] David J. Garrett, Exh. DJG-29.

Figure 10:
CAPM Graph



The SML provides the required rate of return that will compensate investors for the beta risk of that investment. Thus, at an average beta of 0.63 for the proxy group, the estimated cost of equity for Avista is 6.1 percent.

D. Response to Mr. McKenzie's CAPM Analysis

Q: Mr. McKenzie's DCF Model yielded much higher results. Did you find any errors in his analysis?

A. Yes. Mr. McKenzie's CAPM cost of equity estimates are as high as 10.2 percent. This is primarily due to overestimation of the risk-free rate and equity risk premium.

1. Risk-Free Rate

Q: Do you agree with Mr. McKenzie's estimate of the risk-free rate?

A. No. Instead of simply using the current yield on U.S. Treasury securities for the risk-free rate, which is the most common method in financial modeling, Mr. McKenzie attempted to estimate a "forward-looking" risk free rate.[74] Utility ROE witnesses typically attempt these types of "forward-looking" analysis for the risk-free rate, and in every instance that I can recall (which includes the review of dozens of testimonies over many years) the "forward-looking" risk-free rate is always higher than the current risk-free rate. A higher risk-free rate, all else held constant, results in a higher cost of equity estimate in the CAPM. In this case, Mr. McKenzie estimated a forward-looking risk-free rate of 3.1 percent.[75] Since filing his testimony in this case, however, the yield on 30-year Treasury bonds has declined to about two percent.[76] Thus, Mr. McKenzie's risk-free rate estimate is overstated and further inflates his CAPM cost of equity estimate.

2. Equity Risk Premium

Q: Did Mr. McKenzie rely on a reasonable measure for the ERP?

A. No. Mr. McKenzie estimates an ERP of 10.1 percent.[77] The ERP is one of three inputs in the CAPM equation, and it is one of the most single important factors for estimating the

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[74] *See* McKenzie, Exh. AMM-1T at 36:1-3.

[75] McKenzie, Exh. AMM-8.

[76] The Daily Treasury Yield Curve Rate for 9-24-19 was 2.09 percent. U.S. DEPT. OF TREASURY (Sept. 30, 2019) https://www.treasury.gov/resource-center/data-chart-center/interest-rates/pages/TextView.aspx?data=yieldYear&year=2019.

[77] McKenzie, Exh. AMM-8.

cost of equity in this case. As discussed above, I used three widely accepted methods for estimating the ERP, including consulting expert surveys, calculating the implied ERP based on aggregate market data, and considering the ERPs published by reputable analysts. The highest ERP found from my research and analysis is six percent. This means that Mr. McKenzie's ERP estimate over 400 basis points higher than the highest reasonable ERP I could find or calculate, and about twice as high as the average ERP estimated by thousands of other experts across the country.[78]

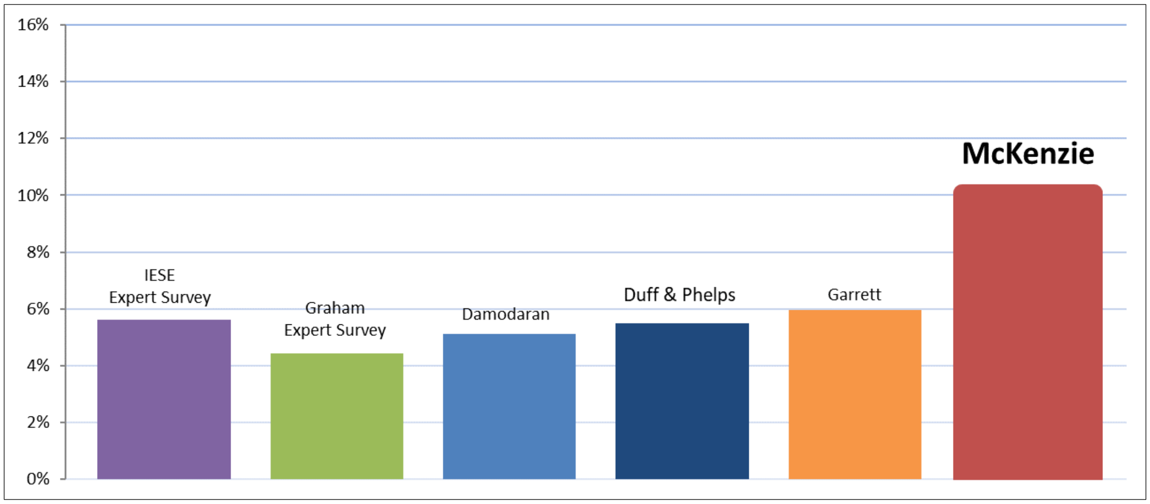
Q: Please discuss and illustrate how Mr. McKenzie's ERP compares with other estimates for the ERP.

A. As discussed above, Graham and Harvey's 2018 expert survey reports an average ERP of 4.4 percent. The 2018 IESE Business School expert survey reports an average ERP of 5.4 percent. Similarly, Duff & Phelps recently estimated an ERP of 5.5 percent. The following chart illustrates that Mr. McKenzie's ERP estimate is far out of line with industry norms[79].

[78] Garrett, Exh. DJG-28.

[79] The ERP estimated by Dr. Damodaran is the average of several ERP estimates under slightly differing assumptions.

Figure 11:
Equity Risk Premium Comparison



When compared with other independent sources for the ERP (as well as my estimate), which do not have a wide variance, Mr. McKenzie's ERP estimate is clearly not within the range of reasonableness. As a result, his CAPM cost of equity estimate is overstated and should be rejected by the Commission.

3. Other Risk Premium Analyses

Q: Did you review Mr. McKenzie's other risk premium analyses?

A. Yes. I am addressing Mr. McKenzie's other risk premium analyses in this section because the CAPM itself is a risk premium model. Many utility company ROE witnesses, including Mr. McKenzie in this case, conduct what they call a "historical risk premium analysis," "bond yield plus risk premium analysis" or "allowed return premium analysis." In short, this analysis simply compares the difference between awarded ROEs in the past with bond yields.

Q: Do you agree with the results of Mr. McKenzie's risk premium analysis?

A. No. Not only do I disagree with the results of Mr. McKenzie's risk premium analysis, I also disagree with the entire premise of the analysis. According to Mr. McKenzie, he examined the historical risk premiums implied in the ROEs allowed by regulatory commissions for electric utilities dating back several decades – to 1974.[80] This procedure alone contradicts Mr. McKenzie's multiple assertions that cost of equity estimates are "forward looking."[81] As discussed earlier in this testimony, it is clear that awarded ROEs are consistently higher than market-based cost of equity, and they have been for many years. Thus, these types of risk premium "models" seem to be clever devices used to perpetuate the discrepancy between awarded ROEs and market-based cost of equity. In other words, since awarded ROEs are consistently higher than market-based cost, a model that simply compares the discrepancy between awarded ROEs and any market-based factor (such as bond yields) will simply ensure that discrepancy continues. The following graph, which I discussed previously, shows the clear disconnection between awarded ROEs and utility cost of equity.

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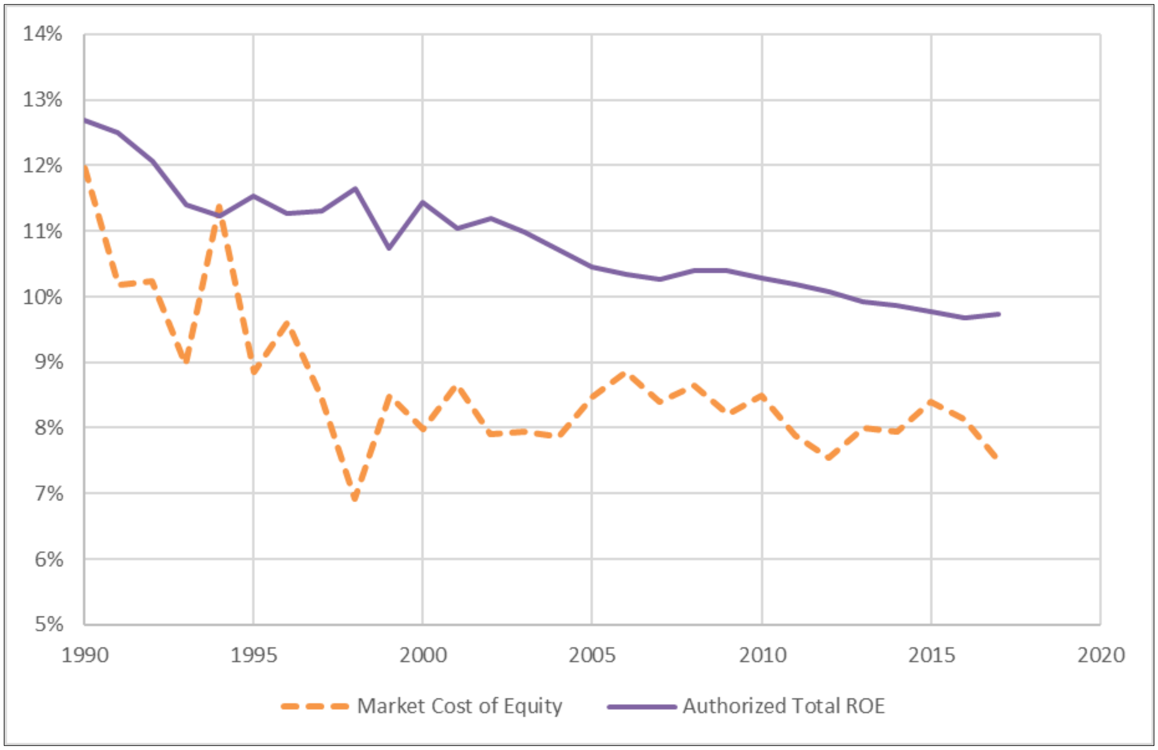
[80] McKenzie, Exh. AMM-10.

[81] *See e.g.* McKenzie, Exh. AMM-1T at 35:4.

Figure 1:[82]
Awarded Returns on Equity vs. Market Cost of Equity (1990 – 2018)[83]



Since it is indisputable that utility stocks are less risky than average stock in the market (with a beta equal to 1.0), utility cost of equity is below the market cost of equity (the dotted line, above). The gap between the market cost of equity and inflated ROEs represents an excess transfer of wealth from customers to shareholders.

Furthermore, the risk premium analysis offered by Mr. McKenzie is completely unnecessary when we already have a real risk premium model to use: the CAPM. The CAPM itself is a "risk premium" model; it takes the bare minimum return any investor

[82] Please note that the same Figure 1 is also featured on page 11, above.

[83] David J. Garrett, Exh. DJG-6.

would require for buying a stock (the risk-free rate), then adds a *premium* to compensate the investor for the extra risk he or she assumes by buying a stock rather than a riskless U.S. Treasury security. The CAPM has been utilized by companies around the world for decades for the same purpose we are using it in this case – to estimate cost of equity.

In stark contrast to the Nobel-prize-winning CAPM, the risk premium models relied upon by utility company witnesses like Mr. McKenzie are not market-based, and therefore have no value in helping us estimate the market-based cost of equity. Unlike the CAPM, which is found in almost every comprehensive financial textbook, the risk premium models used by utility witnesses are almost exclusively found in the texts and testimonies of such witnesses. Specifically, these risk premium models attempt to create an inappropriate link between market-based factors, such as interest rates, with awarded returns on equity. Inevitably, this type of model is used to justify a cost of equity that is much higher than one that would be dictated by market forces.

4. Empirical CAPM

Q: Please summarize Mr. McKenzie's empirical CAPM analysis

A. Mr. McKenzie offers another version of the CAPM that he calls the "empirical CAPM" (ECAPM). The premise of Mr. McKenzie's ECAPM is that the real CAPM underestimates the return required from low-beta securities, such as those of the proxy group.[84]

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[84] *See* McKenzie, Exh. AMM-1T at 35:17-20.

Q: Do you agree with Mr. McKenzie's ECAPM results?

A. No. First, the betas both Mr. McKenzie and I used in the real CAPM already account for the theory that low-beta stocks might have a tendency to be underestimated. In other words, the raw betas for each of the utility stocks in the proxy groups have already been adjusted by Value Line to be higher. Second, there is empirical evidence suggesting that the type of beta-adjustment method used by Value Line actually overstates betas from consistently low-beta industries like utilities. According to this research, it is better to employ an adjustment method that adjusts raw betas toward an industry average, rather than the market average, which ultimately would result in betas that are lower than those published in Value Line.[85] Moreover, Mr. McKenzie's ECAPM still suffers from the same overestimated risk-free rate and ERP inputs discussed above. Thus, regardless of the differing theories regarding the mean reversion tendencies of low-beta securities, Mr. McKenzie's ECAPM should be disregarded for its improper risk-free rate and ERP inputs alone.

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[85] David J. Garrett, Exh. DJG-30 (Michael J. Gombola and Douglas R. Kahl, *Time-Series Processes of Utility Betas: Implications for Forecasting Systematic Risk,* Vol. 19, No. 3 Financial Management 92 (1990) (emphasis added)).

IX. OTHER COST OF EQUITY ISSUES

Q. Are there any other issues raised in Mr. McKenzie's testimony to which you would like to respond?

A. Yes, in his direct testimony Mr. McKenzie raises several other issues in his testimony: (1) firm-specific risks and (2) the size premium.

A. Firm-Specific Risks

Q. Do you agree that the Company's firm-specific risk factors cited by Mr. McKenzie materially influence its cost of equity?

A. No. Mr. McKenzie argues that "operating risks" and other company-specific risks should have an impact on the awarded ROE.[86] Recall that there are two primary types of risk: market risk, which affects all firms to varying degrees, and firm-specific risk, which affects individual firms. As discussed above, it is a well-known concept in finance that firm-specific risks are unrewarded by the market. This is because investors can easily eliminate firm-specific risks through portfolio diversification. Therefore, the Company's few and relatively small firm-specific business risks, while perhaps relevant to other issues in the rate case, have no meaningful effect on the cost of equity estimate. Rather, it is market risk that is rewarded by the market, and this concept is thoroughly addressed in my CAPM analysis discussed above.

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[86] McKenzie, Exh. AMM-1T at 9:17-28.

B. Size Premium

Q. Does a Company's relative size warrant a premium addition to the cost of equity estimate?

A. No. Mr. McKenzie suggests that Avista's cost of equity should be further inflated due to its relatively small size.[87] Utility company ROE witnesses often refer to this as a "size premium." The size premium refers to the idea that the additional risk associated with smaller firms is not fully accounted for in their betas. The "size effect" phenomenon arose from a 1981 study conducted by Banz, which found that "in the 1936 – 1975 period, the common stock of small firms had, on average, higher risk-adjusted returns than the common stock of large firms."[88] According to Ibbotson, Banz's size effect study was "[o]ne of the most remarkable discoveries of modern finance."[89] Perhaps there was some merit to this idea at the time, but the size effect phenomenon was short lived. Banz's 1981 publication generated much interest in the size effect and spurred the launch of significant new small-cap investment funds. However, this "honeymoon period lasted for approximately two years." [90]

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[87] McKenzie, Exh. AMM-1T at 13:1-4.

[88] David J. Garrett, Exh. DJG-31 (Rolf W. Banz, *The Relationship Between Return and Market Value of Common Stocks* Vol. 9 Journal of Financial Economics 3-81 (1981)).

[89] David J. Garrett, Exh. DJG-32 (Morningstar, 2015 IBBOTSON STOCKS, BONDS, BILLS, AND INFLATION CLASSIC YEARBOOK 99 (2015)).

[90] Garrett, Exh. DJG-23 (Elroy Dimson, Paul Marsh & Mike Staunton, TRIUMPH OF THE OPTIMISTS: 101 YEARS OF GLOBAL INVESTMENT RETURNS 131 (Princeton Univ. Press 2002)).

After 1983, U.S. small-cap stocks actually underperformed relative to large cap stocks. In other words, the size effect essentially reversed. In *Triumph of the Optimists*, the authors conducted an extensive empirical study of the size effect phenomenon around the world. They found that after the size effect phenomenon was discovered in 1981, it disappeared within a few years:

> It is clear . . . that there was a global reversal of the size effect in virtually every country, with the size premium not just disappearing but going into reverse. Researchers around the world universally fell victim to Murphy's Law, with the very effect they were documenting – and inventing explanations for – promptly reversing itself shortly after their studies were published.[91]

In other words, the authors assert that the very discovery of the size effect phenomenon likely caused its own demise. The authors ultimately concluded that it is "inappropriate to use the term 'size effect' to imply that we should automatically expect there to be a small-cap premium," Yet this is exactly what utility witnesses often do in attempting to artificially inflate the cost of equity with a size premium.

Other prominent sources have agreed that the size premium is no longer a relevant phenomenon. According to Ibbotson:

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[91] Garrett, Exh. DJG-23 at 133.

> The unpredictability of small-cap returns has given rise to another argument against the existence of a size premium: that markets have changed so that the size premium no longer exists. As evidence, one might observe the last 20 years of market data to see that the performance of large-cap stocks was basically equal to that of small cap stocks. In fact, large-cap stocks have outperformed small-cap stocks in five of the last 10 years.[92]

In addition to the studies discussed above, other scholars have concluded similar results. According to Kalesnik and Beck:

> Today, more than 30 years after the initial publication of Banz's paper, the empirical evidence is extremely weak even before adjusting for possible biases. . . . The U.S. long-term size premium is driven by the extreme outliers, which occurred three-quarters of a century ago. . . . Finally, adjusting for biases . . . makes the size premium vanish. If the size premium were discovered today, rather than in the 1980s, it would be challenging to even publish a paper documenting that small stocks outperform large ones.[93]

For all of these reasons, the Commission should reject the arbitrary size premium proposed by the Company.

X. COST OF EQUITY SUMMARY

Q. Please summarize the results of the DCF and CAPM cost of equity models you presented in testimony.

A. The following table shows the cost of equity results from each of the models I employed in this case.

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[92] Garrett, Exh. DJG-32 (Morningstar, 2015 IBBOTSON STOCKS, BONDS, BILLS, AND INFLATION CLASSIC YEARBOOK 112 (2015)).

[93] Vitali Kalesnik and Noah Beck, *Busting the Myth About Size*, RESEARCH AFFILIATES (Dec. 2014), https://www.researchaffiliates.com/Our%20Ideas/Insights/Fundamentals/Pages/284_Busting_the_Myth_About_Size.aspx.

Figure 12:
Cost of Equity Summary[94]

Model		Cost of Equity
Discounted Cash Flow Model		7.3%
Capital Asset Pricing Model		6.1%
Average		**6.7%**

The average cost of equity indicated by the CAPM and DCF Model in this case is about 6.7 percent.

Q. Is there a market indicator that you can use to test the reasonableness of your cost of equity estimate?

A. Yes, there is. The CAPM is a risk premium model based on the fact that all investors will require, at a minimum, a return equal to the risk-free rate when investing in equity securities. Of course, the investors will also require a premium on top of the risk-free rate to compensate them for the risk they have assumed. If an investor bought every stock in the market portfolio, they would require the risk-free rate, plus the ERP discussed above. Recall that the risk-free rate plus the ERP is called the required return on the market portfolio. This could also be called the "market cost of equity." It is undisputed that the cost of equity of utility stocks must be less than the total market cost of equity. This is because utility stocks are less risky than the average stock in the market. (We proved this

[94] David J. Garrett, Exh. DJG-33.

above by showing that utility betas were less than one). Therefore, once we determine the market cost of equity, it gives us a "ceiling" below which Avista's actual cost of equity must lie.

Q. Describe how you estimated the market cost of equity.

A. The methods used to estimate the market cost of equity are necessarily related to the methods used to estimate the ERP discussed above. In fact, the ERP is calculated by taking the market cost of equity less the risk-free rate. Therefore, in estimating the market cost of equity, I relied on the same methods discussed above to estimate the ERP: (1) consulting expert surveys; and (2) calculating the implied ERP. The results of my market cost of equity analysis are presented in the following table:[95]

Source		Estimate
IESE Survey		8.0%
Graham Harvey Survey		6.8%
Damodaran		7.5%
Garrett		8.4%
Average		7.7%

As shown in this table, the average market cost of equity from these sources is only 7.7 percent. Therefore, it is not surprising that the CAPM and DCF Model indicate a cost of equity for Avista of only 6.7 percent. In other words, any <u>cost</u> of equity estimates for

[95] Garrett, Exh. DJG-34.

Avista (or any regulated utility) that is above the market cost of equity should be viewed as unreasonable. In this case, Mr. McKenzie suggests a cost of equity for Avista more than 200 basis points above the market cost of equity (i.e., the "ceiling"), which is simply unreasonable.

Q. What do you recommend for the awarded return on equity?

A. The Commission should strive to award a return on equity that reflects the market-based cost of equity. However, the awarded return must also consider broader ratemaking principles and be reasonable under the circumstances. The results of the financial models presented in this case indicate a cost of equity estimate of about 6.7 percent. In the interest of achieving a gradual movement toward the appropriate market-based cost of equity, I recommend the Commission in this case adopt an awarded return on equity within the reasonable range of 8.75 percent to 9.25 percent. Specifically, I recommend the Commission award a return on equity of nine percent, which is the midpoint in that range of reasonableness.

XI. CAPITAL STRUCTURE

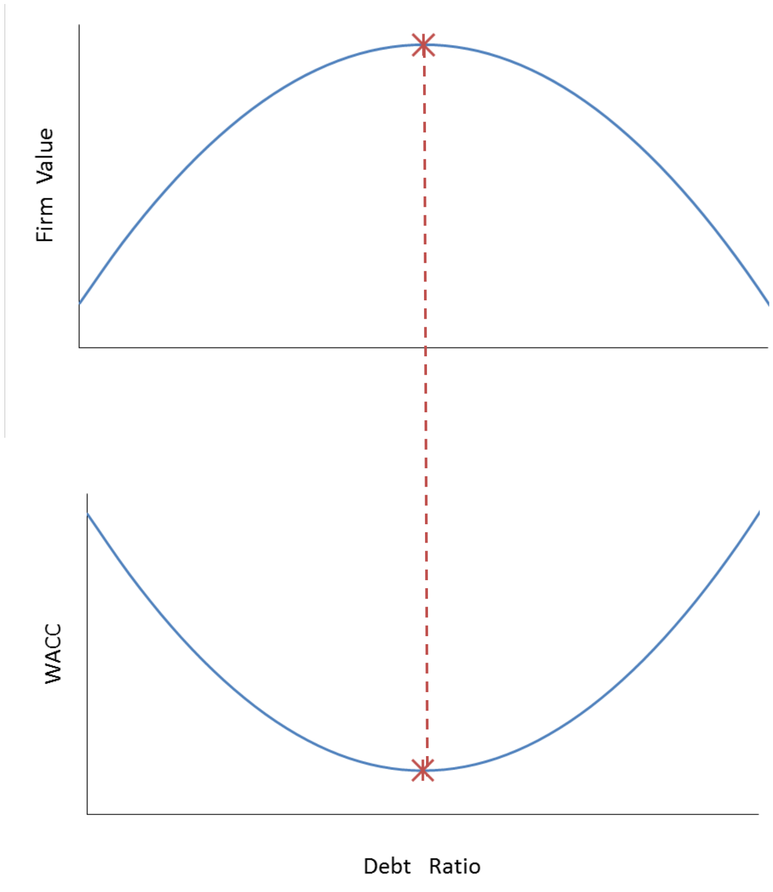
Q. Describe, in general, the concept of a company's "capital structure."

A. "Capital structure" refers to the way a firm finances its overall operations through external sources. The primary sources of long-term, external financing are debt capital and equity capital. Debt capital usually comes in the form of contractual bond issues that require the firm make payments, while equity capital represents an ownership interest in the form of stock. Because a firm cannot pay dividends on common stock until it satisfies its debt obligations to bondholders, stockholders are referred to as "residual claimants." The fact that stockholders have a lower priority to claims on company assets increases their risk and required return relative to bondholders. Thus, equity capital has a higher cost than debt capital. Firms can reduce their weighted average cost of capital (WACC) by recapitalizing and increasing their debt financing. In addition, because interest expense is tax deductible, increasing debt also adds value to the firm by reducing the firm's tax obligation.

Q. Is it true that by increasing debt, competitive firms can add value and reduce their WACC?

A. Yes. A competitive firm can add value by increasing debt. After a certain point, however, the marginal cost of additional debt outweighs its marginal benefit. This is because the more debt the firm uses, the higher interest expense it must pay, and the likelihood of loss increases. This increases the risk of recovery for both bondholders and shareholders, causing both groups of investors to demand a greater return on their investment. Thus, if debt financing is too high, the firm's WACC will increase instead of decrease. The following figure illustrates these concepts.

Figure 13: Optimal Debt Ratio



As shown in this figure, a competitive firm's value is maximized when the WACC is minimized. In both of these graphs, the debt ratio [D/(D+E)] is shown on the x-axis. By increasing its debt ratio, a competitive firm can minimize its WACC and maximize its value. At a certain point, however, the benefits of increasing debt do not outweigh the costs of the additional risks to both bondholders and shareholders, as each type of investor will demand higher returns for the additional risk they have assumed.

Q. Does the rate base rate of return model effectively incentivize utilities to operate at the optimal capital structure?

A. No. While it is true that competitive firms maximize their value by minimizing their WACC, this is not the case for regulated utilities. Under the rate base rate of return model, a higher WACC results in higher rates, all else held constant. The basic revenue requirement equation is as follows:

Equation 8:
Revenue Requirement for Regulated Utilities

$$RR = O + d + T + \boldsymbol{r}(A - D)$$

where:	RR	=	*revenue requirement*
	O	=	*operating expenses*
	d	=	*depreciation expense*
	T	=	*corporate tax*
	$\boldsymbol{r}$	=	***weighted average cost of capital (WACC)***
	A	=	*plant investments*
	D	=	*accumulated depreciation*

As shown in this equation, utilities can increase their revenue requirement by <u>increasing</u> their WACC, not by minimizing it. Thus, because there is no incentive for a regulated utility to minimize its WACC, a Commission standing in the place of competition must ensure that the regulated utility is operating at the lowest reasonable WACC.

Q. Do you believe that, generally speaking, utilities can afford to have higher debt levels than other industries?

A. Yes. Because regulated utilities have large amounts of fixed assets, stable earnings, and low risk relative to other industries, they can afford to have higher debt ratios (or "leverage"). As aptly stated by Dr. Damodaran:

> Since financial leverage multiplies the underlying business risk, it stands to reason that firms that have high business risk should be reluctant to take on financial leverage. It also stands to reason that firms that operate in stable businesses should be much more willing to take on financial leverage. Utilities, for instance, have historically had high debt ratios but have not had high betas, mostly because their underlying businesses have been stable and fairly predictable.[96]

Note in the passage above that the author explicitly contrasts utilities with firms that have high underlying business risk. Because utilities have low levels risk and operate a stable business, they should generally operate with relatively high levels of debt to achieve their optimal capital structure. There are objective methods available to estimate the optimal capital structure, as discussed further below.

A. Objective Analysis

Q. Describe an objective approach to estimating a firm's optimal capital structure.

A. My analysis of the optimal capital structure includes objective methods to measure the effects of increasing debt on both the cost of debt and cost of equity. I will discuss the effects of increasing the debt ratio on each type of security separately.

Cost of Debt

As discussed above, increasing the debt ratio will increase the cost of debt. To objectively measure how much the cost of debt increases, I considered the spreads above the risk-free rate for various levels of bond ratings and interest coverage ratios. The following table shows increasing interest rates for debt based on different bond rating levels.

[96] Garrett, Exh. DJG-11 (Aswath Damodaran, INVESTMENT VALUATION: TOOLS AND TECHNIQUES FOR DETERMINING THE VALUE OF ANY ASSET (John Wiley & Sons, Inc. 3d. ed. 2012)).

Figure 14:
Bond Rating Spreads

Ratings Table			
Coverage Ratio	Bond Rating	Spread	Interest Rate
8.5 - 10.00	Aaa/AAA	0.75%	3.17%
6.5 - 8.49	Aa2/AA	1.00%	3.42%
5.5 - 6.49	A1/A+	1.25%	3.67%
4.25 - 5.49	A2/A	1.38%	3.80%
3.0 - 4.24	A3/A-	1.56%	3.98%
2.5 - 2.99	Baa2/BBB	2.00%	4.42%
2.25 - 2.49	Ba1/BB+	3.00%	5.42%
2.0 - 2.24	Ba2/BB	3.60%	6.02%
1.75 - 1.99	B1/B+	4.50%	6.92%
1.5 - 1.74	B2/B	5.40%	7.82%
1.25 - 1.49	B3/B-	6.60%	9.02%
0.8 - 1.24	Caa/CCC	9.00%	11.42%

As shown in this table, the spreads over the risk-free rate gradually increase as bond ratings fall.[97] The spread is added to the risk-free rate to obtain the interest rates shown in the far-right column. This concept is somewhat comparable to the interest rate a mortgage lender would charge a borrower. The mortgage lender's advertised rate is usually the lowest rate, or the "prime" rate, which is available to borrowers with stellar credit scores. As credit scores decrease, however, the offered interest rate will increase. The bond ratings in this figure are based on various levels of interest coverage ratios shown in the far-left column. The interest coverage ratio, as its name implies, is a metric used by

[97] The link between interest coverage ratios and ratings was developed by looking at all rated companies in the U.S. The default spreads are obtained from traded bonds. The spreads are added to the risk-free rate to obtain the interest rates in the table. Aswath Damodaran, *Ratings, Interest Coverage Ratios and Default Spread*, N.Y. UNIV. (Jan. 2019) http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ratings.htm.

financial analysts to gauge a firm's ability to pay its interest expense from its available earnings before interest and taxes (EBIT). (Likewise, the mortgage lender would consider the borrower's personal income-debt ratio). The formula for the interest coverage ratio is as follows:

Equation 9:
Interest Coverage Ratio

$$\frac{Earnings\ before\ Interest\ and\ Taxes}{Interest\ Expense}$$

As the debt ratio rises, the interest coverage ratio falls, the bond ratings increase, and the cost of debt increases. Now that we have an objective way of measuring how increasing the debt ratio affects the cost of debt, we need to measure how increasing the debt ratio affects the cost of equity.

Cost of Equity

As with the cost of debt, increasing the debt ratio also increases the cost of equity. To objectively measure how much the cost of equity increases, I first calculated the Company's unlevered beta. The unlevered beta is determined by the assets owned by the firm and removes the effects of financial leverage. As leverage increases, equity investors bear increasing amounts of risk, leading to higher betas. Before the effects of financial leverage can be accounted for, however, the effects of leverage must first be removed, which is accomplished through the unlevered beta equation:[98]

[98] Garrett, Exh. DJG-11 (Aswath Damodaran, INVESTMENT VALUATION: TOOLS AND TECHNIQUES FOR DETERMINING THE VALUE OF ANY ASSET (John Wiley & Sons, Inc. 3d. ed. 2012)).

Equation 10:
Unlevered Beta

$$\beta_U = \frac{\beta_L}{\left[1 + (1 - T_c)\left(\frac{D}{E}\right)\right]}$$

where:	β_U	=	*unlevered beta (or "asset" beta)*
	β_L	=	*average levered beta of proxy group*
	T_C	=	*corporate tax rate*
	D	=	*book value of debt*
	E	=	*book value of equity*

Using this equation, the beta for the firm can be unlevered, and then "re-levered" based on various debt ratios (by rearranging this equation to solve for β_L). So, by using the Bond Rating Spreads table and the unlevered beta equation, the costs of both debt and equity can be increased in correspondence with increasing the debt ratio, until the ideal capital structure is found: where the weighted average cost of capital is minimized.

Q. Describe Avista's optimal capital structure.

A. I analyzed the Company's optimal capital structure based on the approach discussed above. The following table presents different levels of Avista's weighted average cost of capital (WACC) based on increasing debt ratios.[99]

[99] David J. Garrett, Exh. DJG-35.

Figure 15:[100]
Avista's WACC at Various Debt Ratios

Debt Ratio	Levered Beta	Cost of Equity	Proposed ROE	Coverage Ratio	After-tax Debt Cost	Optimal WACC	WACC at 9.0% ROE
0%	0.342	4.46%	9.00%	∞	2.50%	4.46%	9.00%
20%	0.410	4.86%	9.00%	6.74	2.70%	4.43%	7.74%
30%	0.458	5.15%	9.00%	4.49	3.00%	4.50%	7.20%
40%	0.522	5.53%	9.00%	3.37	3.14%	4.58%	6.66%
50%	0.612	6.07%	9.00%	2.69	3.49%	4.78%	6.25%
52%	0.635	6.20%	9.00%	2.59	3.49%	4.79%	6.14%
53%	0.647	6.27%	9.00%	2.54	3.49%	4.80%	6.08%
55%	0.673	6.42%	9.00%	2.45	4.28%	5.25%	6.40%
60%	0.748	6.87%	9.00%	2.25	4.28%	5.32%	6.17%

In the figure above, the column on the far left shows increasing levels of debt ratios. At a debt ratio of zero percent, the utility's beta is completely unlevered. As the debt ratio in the far-left column increases, both the cost of equity and the cost of debt increase; however, the weighted average cost of capital generally decreases to a certain point. This table indicates that at my recommended nine percent ROE, the Company's overall weighted average cost of capital would be minimized at a debt ratio of about 53 percent.

Q. Did you also look at other competitive firms around the country to compare their debt ratios?

A. Yes. In fact, there are currently more than 1,000 firms across the country with debt ratios of 55 percent or greater, with an average debt ratio of 64 percent, as shown in the following figure:[101]

[100] Garrett, Exh. DJG. 35.

[101] David J. Garrett, Exh. DJG-36.

Figure 16:
Industries with Debt Ratios of 55% or Greater

Industry	# Firms	Debt Ratio
Hospitals/Healthcare Facilities	34	88%
Tobacco	17	88%
Broadcasting	24	83%
Brokerage & Investment Banking	38	77%
Auto & Truck	14	76%
Retail (Building Supply)	17	76%
Advertising	48	75%
Retail (Automotive)	24	74%
Software (Internet)	44	74%
Bank (Money Center)	10	67%
Trucking	28	65%
Food Wholesalers	18	64%
Hotel/Gaming	70	63%
Beverage (Soft)	37	63%
Packaging & Container	27	62%
R.E.I.T.	238	62%
Retail (Grocery and Food)	12	61%
Green & Renewable Energy	21	**60%**
Transportation	19	59%
Retail (Distributors)	88	59%
Telecom. Services	67	**58%**
Aerospace/Defense	85	58%
Air Transport	18	58%
Oil/Gas Distribution	20	58%
Farming/Agriculture	33	57%
Construction Supplies	48	56%
Utility (Water)	19	**56%**
Power	51	**56%**
Cable TV	14	**56%**
Office Equipment & Services	24	56%
Telecom (Wireless)	21	**55%**
Computers/Peripherals	57	55%
Business & Consumer Services	168	55%
Recreation	72	55%
Total / Average	**1,525**	**64%**

Many of the industries shown here, like public utilities, are generally well-established industries with large amounts of capital assets. The shareholders of these industries demand higher debt ratios in order to maximize their profits.

Q. Did you also analyze the average debt ratio of the proxy group?

A. Yes. Although it is not necessarily advisable to consider the debt ratios of the proxy group alone when doing a capital structure analysis for the target utility, such analysis can be a helpful factor to consider along with the objective analysis discussed above. Interestingly, the average debt ratio of the proxy group is the same as Avista's actual debt ratio, which is 53 percent.[102]

Q. What is your recommendation regarding the Company's capital structure?

A. The objective analysis above, as well as the proxy group analysis, strongly indicates that Avista's actual debt ratio of 53 percent is fair and reasonable. The competitive industry analysis indicates that a prudent debt ratio could be even higher. However, the Company is requesting a lower imputed debt ratio of only 50 percent. Given the evidence presented above, the Company's requested debt ratio is unreasonably low and would have the effect of unnecessarily increasing the awarded rate of return and resulting revenue requirement. Thus, I recommend the Commission approve Avista's actual capital structure consisting of 53 percent debt.

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[102] David J. Garrett, Exh. DJG-37.

B. Response to Avista Regarding Capital Structure and Credit Ratings

Q. Summarize the Company's support of its requested capital structure as it relates to credit ratings.

A. Company witness Mr. Thies supports Avista's requested capital structure consisting of 50 percent debt and equity. Mr. Thies states that accepting the Company's proposed hypothetical capital structure would send a "positive signal" to rating agencies.[103] Mr. Thies also says that a "supportive regulatory environment" is essential in maintaining our current credit rating."[104]

Q. Do you have a response to these arguments?

A. Yes. In general, I do not agree with Mr. Thies's narrative regarding capital structure as it relates to credit ratings. In contrast to the implications of Mr. Thies testimony, it is not the Commission's duty to "support" the Company's shareholders or its credit rating. Mr. Thies, like many other utility witnesses who testify on this issue, attempts to create a direct link between capital structure (and/or the awarded ROE) and credit ratings. Doing this, however, implicitly absolves utility management of its duties to manage the company in a prudent and efficient manner. In reality, the Commission does not have control over the Company's credit ratings. In fact, it does not even have control over the Company's capital structure. The Company's actual capital structure, like many other aspects of its business operations, are within the complete discretion of Company

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[103] Thies, Exh. MTT-1T at 17:15-17.

[104] *Id*. at 19:4-6.

personnel. For example, even if the Commission decided to impute a higher equity ratio as requested by the Company, the Company may simply use the additional profits to increase dividends rather than pay down debt to improve its credit ratings. In other words, by imputing a higher debt ratio, the Commission is simply authorizing an additional transfer of wealth from ratepayers to the Company. There is no guarantee that the Company would even recapitalize to a 50/50 capital structure.

It is simply not the Commission's duty to improve the Company's financial health for the benefit of shareholders. Instead, the Commission's duty to authorize an awarded rate of return (including capital structure) that would likely exist in a competitive environment. This will give the Company's *management* an opportunity to earn a fair return for its investors. If the Commission adopted the awarded ROE and capital structure I have recommended in this case, it would accomplish that objective.

XII. CONCLUSION AND RECOMMENDATION

Q. Summarize the key points of your testimony.

A. The key points of my testimony are summarized as follows:

1. The legal standards governing this issue are clear that the awarded rate of return should be based on the Company's cost of capital.

2. When the awarded rate of return exceeds the actual cost of capital, it results in an inappropriate transfer of excess wealth from customers to shareholders.

3. The models I used in this case indicate the Company's cost of equity is about 6.7 percent. However, under principles of gradualism, the Commission should award Avista's shareholders with a return on equity of 9.0 percent, which is within a reasonable range of 8.75 percent - 9.25 percent. Although we should move awarded returns in general towards market-based cost of equity, we should do so gradually rather than abruptly to avoid volatility within the industry.

4. The Commission should authorize the Company's actual capital structure consisting of 53 percent debt.

Q. Does this conclude your testimony?

A. Yes.

101 Park Avenue, Suite 1125
Oklahoma City, OK 73102

DAVID J. GARRETT

405.249.1050
dgarrett@resolveuc.com

EDUCATION

University of Oklahoma — Norman, OK
Master of Business Administration — 2014
Areas of Concentration: Finance, Energy

University of Oklahoma College of Law — Norman, OK
Juris Doctor — 2007
Member, American Indian Law Review

University of Oklahoma — Norman, OK
Bachelor of Business Administration — 2003
Major: Finance

PROFESSIONAL DESIGNATIONS

Society of Depreciation Professionals
Certified Depreciation Professional (CDP)

Society of Utility and Regulatory Financial Analysts
Certified Rate of Return Analyst (CRRA)

The Mediation Institute
Certified Civil / Commercial & Employment Mediator

WORK EXPERIENCE

Resolve Utility Consulting PLLC — Oklahoma City, OK
Managing Member — 2016 – Present
Provide expert analysis and testimony specializing in depreciation and cost of capital issues for clients in utility regulatory proceedings.

Oklahoma Corporation Commission — Oklahoma City, OK
Public Utility Regulatory Analyst — 2012 – 2016
Assistant General Counsel — 2011 – 2012
Represented commission staff in utility regulatory proceedings and provided legal opinions to commissioners. Provided expert analysis and testimony in depreciation, cost of capital, incentive compensation, payroll and other issues.

Perebus Counsel, PLLC — Oklahoma City, OK
Managing Member — 2009 – 2011
Represented clients in the areas of family law, estate planning, debt negotiations, business organization, and utility regulation.

Moricoli & Schovanec, P.C. — Oklahoma City, OK
Associate Attorney — 2007 – 2009
Represented clients in the areas of contracts, oil and gas, business structures and estate administration.

TEACHING EXPERIENCE

University of Oklahoma — Norman, OK
Adjunct Instructor – "Conflict Resolution" — 2014 – Present
Adjunct Instructor – "Ethics in Leadership"

Rose State College — Midwest City, OK
Adjunct Instructor – "Legal Research" — 2013 – 2015
Adjunct Instructor – "Oil & Gas Law"

PUBLICATIONS

American Indian Law Review — Norman, OK
"Vine of the Dead: Reviving Equal Protection Rites for Religious Drug Use" — 2006
(31 Am. Indian L. Rev. 143)

VOLUNTEER EXPERIENCE

Calm Waters — Oklahoma City, OK
Board Member — 2015 – 2018
Participate in management of operations, attend meetings, review performance, compensation, and financial records. Assist in fundraising events.

Group Facilitator & Fundraiser — 2014 – 2018
Facilitate group meetings designed to help children and families cope with divorce and tragic events. Assist in fundraising events.

St. Jude Children's Research Hospital — Oklahoma City, OK
Oklahoma Fundraising Committee — 2008 – 2010
Raised money for charity by organizing local fundraising events.

PROFESSIONAL ASSOCIATIONS

Oklahoma Bar Association — 2007 – Present

Society of Depreciation Professionals — 2014 – Present
Board Member – President — 2017
Participate in management of operations, attend meetings, review performance, organize presentation agenda.

Society of Utility Regulatory Financial Analysts — 2014 – Present

SELECTED CONTINUING PROFESSIONAL EDUCATION

Society of Depreciation Professionals — Austin, TX
"Life and Net Salvage Analysis" — 2015
Extensive instruction on utility depreciation, including actuarial and simulation life analysis modes, gross salvage, cost of removal, life cycle analysis, and technology forecasting.

Society of Depreciation Professionals — New Orleans, LA
"Introduction to Depreciation" and "Extended Training" — 2014
Extensive instruction on utility depreciation, including average lives and net salvage.

Society of Utility and Regulatory Financial Analysts — Indianapolis, IN
46th Financial Forum. "The Regulatory Compact: Is it Still Relevant?" — 2014
Forum discussions on current issues.

New Mexico State University, Center for Public Utilities — Santa Fe, NM
Current Issues 2012, "The Santa Fe Conference" — 2012
Forum discussions on various current issues in utility regulation.

Michigan State University, Institute of Public Utilities — Clearwater, FL
"39th Eastern NARUC Utility Rate School" — 2011
One-week, hands-on training emphasizing the fundamentals of the utility ratemaking process.

New Mexico State University, Center for Public Utilities — Albuquerque, NM
"The Basics: Practical Regulatory Training for the Changing Electric Industries" — 2010
One-week, hands-on training designed to provide a solid foundation in core areas of utility ratemaking.

The Mediation Institute — Oklahoma City, OK
"Civil / Commercial & Employment Mediation Training" — 2009
Extensive instruction and mock mediations designed to build foundations in conducting mediations in civil matters.

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Public Utilities Commission of the State of California	Pacific Gas & Electric Company	18-12-009	Depreciation rates, service lives, net salvage	The Utility Reform Network
Oklahoma Corporation Commission	The Empire District Electric Company	PUD 201800133	Cost of capital, authorized ROE, depreciation rates	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Arkansas Public Service Commission	Southwestern Electric Power Company	19-008-U	Cost of capital, depreciation rates, net salvage	Western Arkansas Large Energy Consumers
Public Utility Commission of Texas	CenterPoint Energy Houston Electric	PUC 49421	Depreciation rates, service lives, net salvage	Texas Coast Utilities Coalition
Massachusetts Department of Public Utilities	Massachusetts Electric Company and Nantucket Electric Company	D.P.U. 18-150	Depreciation rates, service lives, net salvage	Massachusetts Office of the Attorney General, Office of Ratepayer Advocacy
Oklahoma Corporation Commission	Oklahoma Gas & Electric Company	PUD 201800140	Cost of capital, authorized ROE, depreciation rates	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Public Service Commission of the State of Montana	Montana-Dakota Utilities Company	D2018.9.60	Depreciation rates, service lives, net salvage	Montana Consumer Counsel and Denbury Onshore
Indiana Utility Regulatory Commission	Northern Indiana Public Service Company	45159	Depreciation rates, grouping procedure, demolition costs	Indiana Office of Utility Consumer Counselor
Public Service Commission of the State of Montana	NorthWestern Energy	D2018.2.12	Depreciation rates, service lives, net salvage	Montana Consumer Counsel
Oklahoma Corporation Commission	Public Service Company of Oklahoma	PUD 201800097	Depreciation rates, service lives, net salvage	Oklahoma Industrial Energy Consumers and Wal-Mart
Nevada Public Utilities Commission	Southwest Gas Corporation	18-05031	Depreciation rates, service lives, net salvage	Nevada Bureau of Consumer Protection
Public Utility Commission of Texas	Texas-New Mexico Power Company	PUC 48401	Depreciation rates, service lives, net salvage	Alliance of Texas-New Mexico Power Municipalities
Oklahoma Corporation Commission	Oklahoma Gas & Electric Company	PUD 201700496	Depreciation rates, service lives, net salvage	Oklahoma Industrial Energy Consumers and Oklahoma Energy Results
Maryland Public Service Commission	Washington Gas Light Company	9481	Depreciation rates, service lives, net salvage	Maryland Office of People's Counsel
Indiana Utility Regulatory Commission	Citizens Energy Group	45039	Depreciation rates, service lives, net salvage	Indiana Office of Utility Consumer Counselor
Public Utility Commission of Texas	Entergy Texas, Inc.	PUC 48371	Depreciation rates, decommissioning costs	Texas Municipal Group
Washington Utilities & Transportation Commission	Avista Corporation	UE-180167	Depreciation rates, service lives, net salvage	Washington Office of Attorney General

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
New Mexico Public Regulation Commission	Southwestern Public Service Company	17-00255-UT	Cost of capital and authorized rate of return	HollyFrontier Navajo Refining; Occidental Permian
Public Utility Commission of Texas	Southwestern Public Service Company	PUC 47527	Depreciation rates, plant service lives	Alliance of Xcel Municipalities
Public Service Commission of the State of Montana	Montana-Dakota Utilities Company	D2017.9.79	Depreciation rates, service lives, net salvage	Montana Consumer Counsel
Florida Public Service Commission	Florida City Gas	20170179-GU	Cost of capital, depreciation rates	Florida Office of Public Counsel
Washington Utilities & Transportation Commission	Avista Corporation	UE-170485	Cost of capital and authorized rate of return	Washington Office of Attorney General
Wyoming Public Service Commission	Powder River Energy Corporation	10014-182-CA-17	Credit analysis, cost of capital	Private customer
Oklahoma Corporation Commission	Public Service Co. of Oklahoma	PUD 201700151	Depreciation, terminal salvage, risk analysis	Oklahoma Industrial Energy Consumers
Public Utility Commission of Texas	Oncor Electric Delivery Company	PUC 46957	Depreciation rates, simulated analysis	Alliance of Oncor Cities
Nevada Public Utilities Commission	Nevada Power Company	17-06004	Depreciation rates, service lives, net salvage	Nevada Bureau of Consumer Protection
Public Utility Commission of Texas	El Paso Electric Company	PUC 46831	Depreciation rates, interim retirements	City of El Paso
Idaho Public Utilities Commission	Idaho Power Company	IPC-E-16-24	Accelerated depreciation of North Valmy plant	Micron Technology, Inc.
Idaho Public Utilities Commission	Idaho Power Company	IPC-E-16-23	Depreciation rates, service lives, net salvage	Micron Technology, Inc.
Public Utility Commission of Texas	Southwestern Electric Power Company	PUC 46449	Depreciation rates, decommissioning costs	Cities Advocating Reasonable Deregulation
Massachusetts Department of Public Utilities	Eversource Energy	D.P.U. 17-05	Cost of capital, capital structure, and rate of return	Sunrun Inc.; Energy Freedom Coalition of America
Railroad Commission of Texas	Atmos Pipeline - Texas	GUD 10580	Depreciation rates, grouping procedure	City of Dallas
Public Utility Commission of Texas	Sharyland Utility Company	PUC 45414	Depreciation rates, simulated analysis	City of Mission
Oklahoma Corporation Commission	Empire District Electric Company	PUD 201600468	Cost of capital, depreciation rates	Oklahoma Industrial Energy Consumers

Utility Regulatory Proceedings

Regulatory Agency	Utility Applicant	Docket Number	Issues Addressed	Parties Represented
Railroad Commission of Texas	CenterPoint Energy Texas Gas	GUD 10567	Depreciation rates, simulated plant analysis	Texas Coast Utilities Coalition
Arkansas Public Service Commission	Oklahoma Gas & Electric Company	160-159-GU	Cost of capital, depreciation rates, terminal salvage	Arkansas River Valley Energy Consumers; Wal-Mart
Florida Public Service Commission	Peoples Gas	160-159-GU	Depreciation rates, service lives, net salvage	Florida Office of Public Counsel
Arizona Corporation Commission	Arizona Public Service Company	E-01345A-16-0036	Cost of capital, depreciation rates, terminal salvage	Energy Freedom Coalition of America
Nevada Public Utilities Commission	Sierra Pacific Power Company	16-06008	Depreciation rates, net salvage, theoretical reserve	Northern Nevada Utility Customers
Oklahoma Corporation Commission	Oklahoma Gas & Electric Co.	PUD 201500273	Cost of capital, depreciation rates, terminal salvage	Public Utility Division
Oklahoma Corporation Commission	Public Service Co. of Oklahoma	PUD 201500208	Cost of capital, depreciation rates, terminal salvage	Public Utility Division
Oklahoma Corporation Commission	Oklahoma Natural Gas Company	PUD 201500213	Cost of capital, depreciation rates, net salvage	Public Utility Division

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

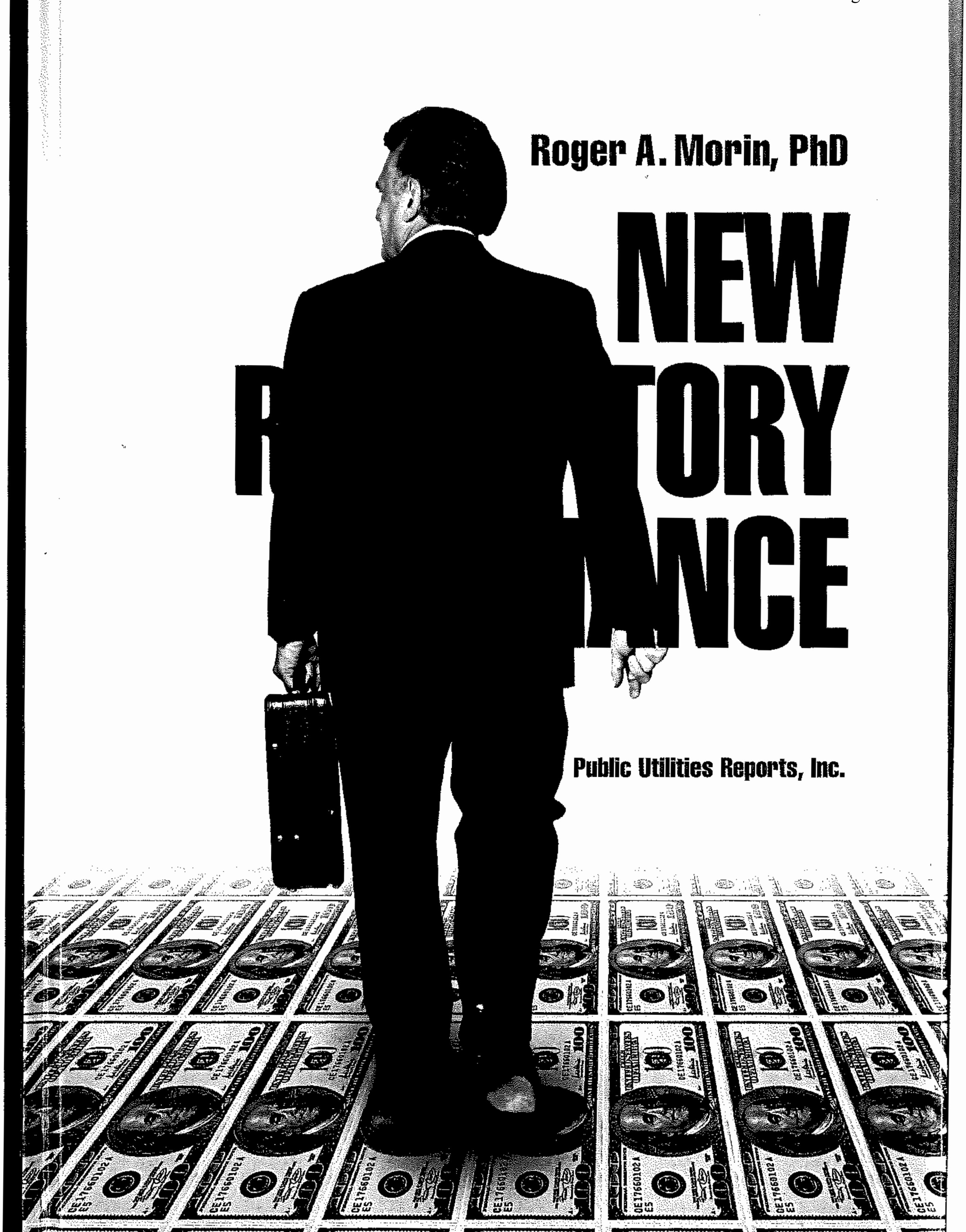
DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-3

Robert Morin: *New Regulatory Finance (Excerpt)*

October 3, 2019


Roger A. Morin, PhD
NEW
TORY
NCE
Public Utilities Reports, Inc.

supply side of capital markets, but also by reference to the demand side of the capital markets.

The demand side viewpoint recognizes that regulated utilities are private corporations with shareholders-owners, and that management's principal responsibility is to maximize their well-being, as measured by stock price. Thus, only those investment decisions that maximize the price of the stock should be undertaken. A utility company will continue to invest in real physical assets if the return on these investments exceeds or equals its cost of capital. The cost of capital is the minimum rate of return that must be earned on assets to justify their acquisition, and the regulator must set the allowed return so that optimal investment rates are obtained, and that no other investment rate would result in a higher share price.

In this context, the cost of capital is the expected earnings on the utility's investments that are required in order for the value of the previously invested capital to remain unchanged. If new capital does not earn its price or required rate of return, the value of existing equity has to make up the difference. If the new capital earns a return greater than its price, existing shareholders will participate in the difference. The converse is true as well. If earnings on the investment of capital meet the required rate of return, existing shareholders will neither gain nor lose.

$$\text{Cost of Capital} = \text{Required Rate of Return} \\ = \text{Required Earnings / Capital Invested}$$

1.8 The Allowed Rate of Return and Cost of Capital

The regulator should set the allowed rate of return equal to the cost of capital so that the utility can achieve the optimal rate of investment at the minimum price to the ratepayers. This can be demonstrated as follows.

In Example 1-2 shown earlier, a utility with a rate base of $900 million was considered, financed 60% by debt and 40% by equity. The cost of capital was estimated at 8.2%. Now, suppose the regulator sets the allowed return at 6% instead. To service the claims of both the bondholders and shareholders, earnings over costs should amount to $73.8 million, that is, 8.2% × $900 million.

If the utility is allowed a return of only 6% on a rate base of $900 million, earnings of only $54.0 million are produced. While the earnings are sufficient to cover the interest payments of $37.8 million ($900 × .60 × 7%) to the bondholders who have a prior claim on earnings, they are not enough to cover the claims of shareholders in the amount of $36 million ($900 × .40 ×

10%). The stock price has to fall to a level such that an investor who purchases the stock after the price reduction will just obtain his opportunity cost. If the utility nevertheless undertakes mandatory capital investments that are allowed to earn 6%, while the cost of the funds is 8.2%, the inevitable result is a reduction in stock price and a wealth transfer from shareholders to ratepayers.

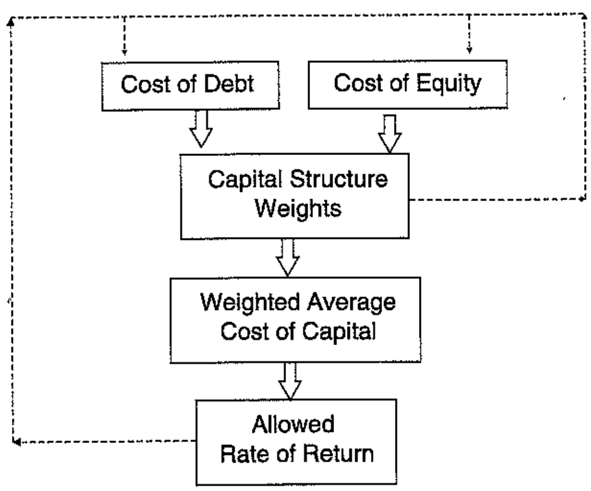
Conversely, if the allowed rate of return is greater than the cost of capital, capital investments are undertaken and investors' opportunity costs are more than achieved. Any excess earnings over and above those required to service debt capital accrue to the equity holders, and the stock price increases. In this case, the wealth transfer occurs from ratepayers to shareholders.

Investments are undertaken by the utility with no wealth transfer between ratepayers and shareholders only if the allowed rate of return is set equal to the cost of capital. In this case, the expected earnings generated from investments are just sufficient to service the claims of the debt and equity holders, no more no less. Setting the allowed return equal to the cost of capital is the only policy that will produce optimal investment rates at the minimum price to the ratepayer.

1.9 Determining the Cost of Capital

The general procedure that has evolved for determining the allowed rate of return is schematically depicted in Figure 1-6. The cost of debt and common equity are first determined separately, then weighted by the proportions of

FIGURE 1-6
SCHEMATIC REPRESENTATION OF COST OF CAPITAL DETERMINATION



enunciated in the *Bluefield* and *Hope* cases. Some of the techniques treat risk explicitly and directly as a separate variable in the model; others treat risk implicitly and indirectly as somehow subsumed in security prices. These techniques are summarized in Figure 1-7.

1.10 The Use of Multiple Methods in Cost of Equity Determination

The court cases discussed previously indicated that there are no specific rules or infallible models for determining a fair rate of return. It is dangerous and inappropriate to rely on only one methodology in determining the cost of equity. The results from only one method are likely to contain a high degree of measurement error. The regulator's hands should not be bound to one methodology of estimating equity costs, nor should the regulator ignore relevant evidence and back itself into a corner. For instance, by relying solely on the DCF model at a time when the fundamental assumptions underlying the DCF model are tenuous, a regulatory body greatly limits its flexibility and increases the risk of authorizing unreasonable rates of return. The same is true for any one specific model.

There are four generic methodologies available to measure the cost of equity: DCF, Risk Premium, and CAPM, which are market-oriented, and Comparable Earnings, which is accounting-oriented. Each generic market-based methodology in turn contains several variants.

When measuring equity costs, which essentially deals with the measurement of investor expectations, no one single methodology provides a foolproof panacea. Each methodology requires the exercise of considerable judgment on the reasonableness of the assumptions underlying the methodology and on the reasonableness of the proxies used to validate the theory. It follows that more than one methodology should be employed in arriving at a judgment on the cost of equity and that these methodologies should be applied across a series of comparable risk companies. More on this issue in Chapter 15.

The concept of cost of capital described in this chapter can be succinctly summarized as follows: A regulated utility should be entitled to a return that allows it to raise the necessary capital to meet service demand without cost to existing shareholders. This return is the weighted average of the embedded cost of debt and preferred capital, and a return on the common equity capital equal to the currently required return on equity. The two principal problems in implementing the approach are the determination of the appropriate set of capital structure weights and the estimation of the required return on equity. The optimal capital structure issue is treated in Chapters 16, 17, and 18.

these two years excluded. It is clear from this example that a long time period is required to accurately estimate the equity risk premium. The shorter 30-year period places too much emphasis on the poor market performances of 1973–1974. In fact, the equity risk premium recovers significantly in more recent periods once the years 1973 and 1974 are truncated from the analysis, as seen in the rolling 20-year and 10-year Ibbotson data.

Some analysts employ a rolling average approach. For example, the analyst arbitrarily assumes a given time frame over which the equity risk premium should be calculated, say 30 years, and calculates a 30-year equity risk premium for all time periods from 1926 to the present. There is a premium for 1926–1955, 1927–1956, and so on to the present. The successive premiums are averaged to arrive at the eventual equity risk premium. This approach is highly suspect because it overweighs the middle years. In the example, the year 1926 appears in one 30-year average, 1927 in two 30-year averages, etc. Yet, the most current (and relevant) time period only appears once. The middle periods are given an inordinate amount of weight using this approach. The other fallacy of the approach is that it assumes that a 30-year period is an appropriate historical window over which to estimate the equity risk premium. This assumption is highly arbitrary.

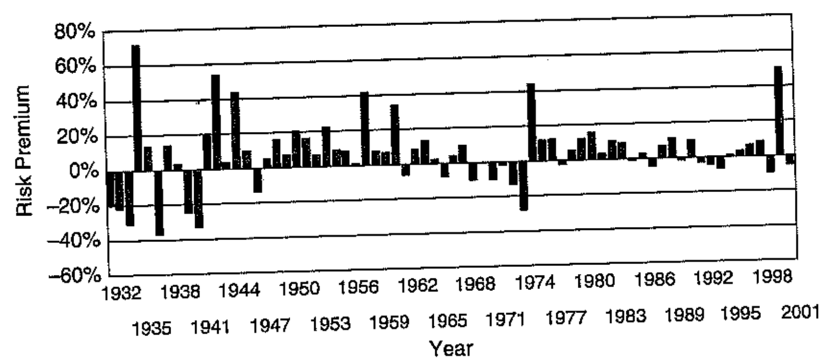
While forward-looking risk premiums based on expected returns are preferable, historical return studies over long periods still provide a useful guide for the future. This is because over long periods, investors' expectations are eventually revised to match historical realizations, as market prices adjust to match anticipated and actual investment results. Otherwise, investors would never commit investment capital. In the long run, the difference between expected and realized risk premiums will decline because short-run periods during which investors earn a lower risk premium than they expect are offset by short-run periods during which investors earn a higher risk premium than they expect. Second, the investors' current expectations concerning the amount by which the return on equity will exceed the bond yield will be strongly influenced by historical differences in returns to bond and stock investors. For these reasons, we can estimate investors' current expected returns from an equity investment from knowledge of current bond yields and past differences between returns on stocks and bonds.

Computational Issues: Arithmetic vs Geometric Average

The second problem in relying on historical return results is the method of averaging historical returns, that is, whether to use the ordinary average (arithmetic mean) or the geometric mean return. Because valuation is forward-looking, the appropriate average is the one that most accurately approximates the expected future rate of return. The best estimate of expected returns over a given future holding period is the arithmetic average. Only arithmetic means are correct for forecasting purposes and for estimating the cost of capital. There is no theoretical or empirical justification for the use of geometric mean rates of returns as a measure of the appropriate discount rate in computing the cost of capital or in computing present values. There is no dispute in academic circles as to whether the arithmetic or geometric average should be used for purposes of computing the cost of capital. The arithmetic mean should always be used in calculating the present value of a cash flow stream. Appendix A contains a comprehensive discussion of this issue, including the underlying theory, empirical evidence, and formal demonstrations.

Drawn from an actual rate case, the implementation of the historical Risk Premium approach is illustrated in Example 4-1 for the electric utility industry. Over the long term, realized utility equity risk premiums were 5.6% above Treasury bond yields for electric utilities.

FIGURE 4-2
EQUITY RISK PREMIUM
Electric Utilities 1931–2002



EXAMPLE 4-1

As a proxy for the risk premium applicable to the electric utility industry, a historical risk premium for the electric utility industry is estimated with an annual time series analysis applied to the industry as a whole, using *Moody's Electric Utility Index* as an industry proxy. The analysis is depicted in Figure 4-2. The risk premium is estimated by computing the actual return on equity capital for Moody's Index for each year, using the actual stock prices and dividends of the index, and then subtracting the long-term government bond return for that year. Dividend yields and stock prices on the index are obtained from *Moody's*

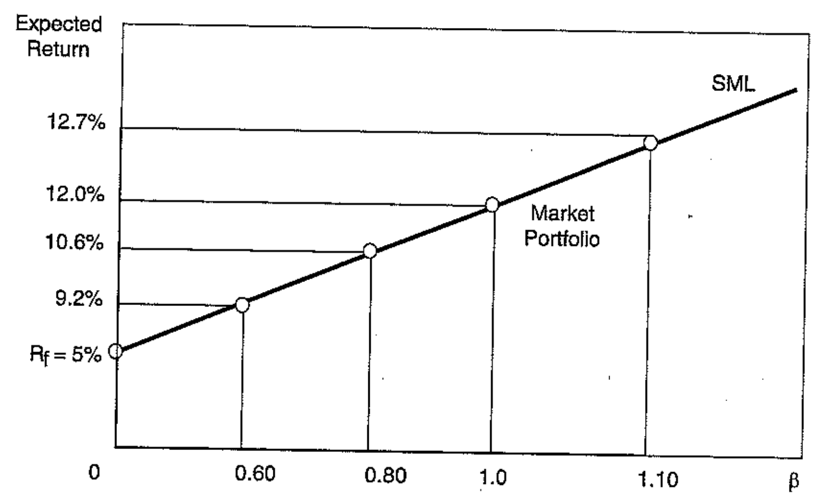
(continued next page)

is therefore the return necessary to attract capital to investments of a given risk, taking into account the soundness criterion of *Bluefield.*

5.3 CAPM Application

At first glance, the CAPM appears simple in application. Numerical values of the CAPM's three input parameters, R_F, beta, and the market risk premium ($R_M - R_F$) are estimated and inserted into the CAPM formula to produce the cost of equity estimate, or used in reading the cost of equity directly from the SML. A numerical example is shown in Figure 5-3.

FIGURE 5-3
CAPM ESTIMATES OF UTILITY COST OF CAPITAL: ILLUSTRATION



Assuming a 5% risk-free rate, and a 12% market return, that is, a market risk premium of 7%, the cost of equity estimates for three companies are 9.2%, 10.6%, and 12.7%, respectively, corresponding to their respective betas of 0.60, 0.80, and 1.10.

Despite the CAPM's conceptual appeal and mechanistic simplicity, operationalizing the CAPM to estimate a fair return on equity presents several practical difficulties. From the start, the model itself is a prospective, forward-looking model. To stress this point, the following equation restates the CAPM formula with expectational operators attached to each input variable:

$$E(K) = E(R_F) + E(\beta) \times [E(R_M) - E(R_F)] \qquad (5\text{-}2)$$

historical risk premium approach assumes that the average realized return is an appropriate surrogate for expected return, or, in other words, that investor expectations are realized. However, realized returns can be substantially different from prospective returns anticipated by investors, especially when measured over short time periods.

The prospective (forecast) approach examines the returns expected from investments in common equities and bonds. The risk premium is simply the difference between the expected returns on stocks and bonds. The prospective approach is subject to the inevitable measurement errors involved in computing expected returns.

Therefore, a regulatory body should rely on the results of both historical and prospective studies in arriving at an appropriate risk premium, data permitting. Each proxy for the expected risk premium brings information to the judgment process from a different light. Neither proxy is without blemish, each has advantages and shortcomings. Historical risk premium data are available and verifiable, but may no longer be applicable if structural shifts have occurred. Prospective risk premium data may be more relevant since they encompass both history and current changes, but are nevertheless imperfect proxies. Giving equal weight to the historical risk premium and the prospective risk premium forecast represents a compromise between the certainty of the past and its possible irrelevance versus the greater relevance of the forecast and its possible estimation error.[13]

Faced with this myriad, and often conflicting, evidence on the magnitude of the risk premium, a regulator might very well be confused about the correct market risk premium. The author's opinion is that a range of 5% to 8% is reasonable for the United States with a slight preference for the upper end of the range.

As in the case of the beta estimate and risk-free rate estimate, a sensitivity analysis of possible CAPM cost of capital estimates should be conducted for a specified utility using a reasonable range of estimates for the market return. See Figure 5-6 for an illustration.

The range of cost of capital estimates obtained using a separate range for each of the three input variables to the CAPM, beta, risk-free rate, and market

[13] A survey of professional practices published in 1998 by Bruner, Eades, Harris, and Higgins (1998) found that 71% of textbooks/tradebooks used a historical arithmetic mean as the market risk premium and 60% of financial advisors used either a market risk premium of 7.0–7.4% (similar to the arithmetic mean) or a long-term arithmetic mean. For corporations, there was no single method that represented a consensus.

1. That investors, in fact, evaluate common stocks in the classical valuation framework, and trade securities rationally at prices reflecting their perceptions of value. Given the universality and pervasiveness of the classical valuation framework in investment education and in the professional investment community, this assumption is plausible.
2. That investors discount the expected cash flows at the same rate K in every future period. In other words, a flat yield curve is assumed. If K varies over time, there is no single required return rate, and practical estimates of the required return must be considered as weighted averages of $\{K_1, K_2, K_3 \ldots K_n\}$. Since each of the 1-period return requirements can be thought of as an interest rate plus a risk premium, the required return to a multiple time horizon can be viewed as an average interest rate plus an average risk premium. More complex discounting models that incorporate these varying "yield curve effects" are available, but are of limited practical usefulness.
3. That the K obtained from the fundamental DCF equation corresponds to that specific stream of future cash flows alone, and no other. There may be alternate company policies (dividend payout, capital structure) that would generate the same future cash flows, but these policies may alter the risk of the cash flow stream, and hence modify the investor's required return, K.
4. That dividends, rather than earnings, constitute the source of value. The rationale for computing the value of common stock from dividends is that the only cash values ever received by investors are dividends. This does not mean that earnings are unimportant for they provide the basis for paying dividends.

Focusing on the present value of expected earnings can be misleading. It is earnings net of any investment required to produce the earnings that are of interest, and not earnings alone. For example, a company expects earnings per share of $1.00 per year; but to sustain the stream of future earnings, the company needs to invest in real assets at the rate of $1.00 per share each year. Since an amount equal to each year's earnings must be channeled into new asset investment, no sustainable dividend payout, hence value, is possible. In general, even for a non-dividend-paying company, earnings will eventually outrun the firm's need for additional asset investment, creating the capacity to pay dividends.

The finance literature has produced three general approaches to determine value, each involving discounting three different streams of money: (1) the present value of expected dividends, (2) the present value of expected earnings net of required investment, and (3) the present value of the cash flows produced by assets. All three approaches are equivalent, provided they are properly formulated.[2]

[2] The equivalence between the three approaches is demonstrated in several financial texts. See for example Morin (2002) and Francis (2000).

8.3 The Standard DCF Model

The general common stock valuation model embodied in Equation 8-5 is not very operational, since it requires an estimation of an infinite stream of dividends. But by assigning a particular configuration to the dividend stream, a more practical formula can be derived. A formal derivation of the standard DCF model is provided in Appendix 8-A. Basically, assuming that dividends grow at a constant rate forever, that is,

$$D_t = D_0(1 + g)^t \qquad (8\text{-}6)$$

Where g = expected dividend per share growth
D_0 = current dividend per share
D_1 = expected dividend per share one year from now

and substituting these values of future dividends per share into Equation 8-5, the familiar reduced form of the general dividend valuation model is obtained:

$$P_0 = \frac{D_1}{K - g} \qquad (8\text{-}7)$$

In words, this fundamental equation states that the market price of a share of common stock is the value of next year's expected dividend discounted at the market's required return net of the effect of growth. Solving the equation for K, the cost of equity capital, the standard DCF formulation widely used in regulatory proceedings is obtained:

$$K = \frac{D_1}{P_0} + g \qquad (8\text{-}8)$$

This formula states that under certain simplifying assumptions discussed below, which investors frequently make, the equity investor's expected return, K, can be envisaged as the sum of an expected dividend yield, (D_1/P_0), plus the expected growth rate of future dividends, g. Investors set the equity price so as to obtain an appropriate return consistent with the risk of the investment and with the return forgone in investments of comparable risk. The basic idea of the standard DCF approach to estimating the cost of equity capital is to infer K from the observed share price and from an estimate of investors' expected future dividends. The principal appeal of the approach is its simplicity and its correspondence with the intuitive notion of dividends plus capital appreciation as a measure of investors' total expected return. The assumptions underlying the model are discussed in detail below. Essentially, a constant average growth trend for both dividends and earnings, a stable dividend payout and capital structure policy, and a discount rate in excess of the expected growth rate are assumed. A simple example will illustrate the standard DCF model, sometimes referred to as the "annual" or "single-period" DCF model.

EXAMPLE 8-1

We have the following market data for Utility X:

current dividend per share = \$1.62
current stock price = \$25.00
expected dividend growth = 4%

From Equation 8-8, the standard DCF model produces a cost of equity of:

$$K = D_1 / P_0 + g$$
$$= D_0(1+g) / P_0 + g$$
$$= \$1.62\ (1.04) / \$25 + .04$$
$$= 6.7\% + 4.0\% = 10.7\%$$

Note that next year's expected dividend is the current spot dividend increased by the expected growth rate in dividends. In general, implementation of the approach requires finding D_0 and P_0 from readily available sources of market data; the growth rate, g, can be estimated using several techniques. One way is to rely on analysts' long-term growth forecasts. Chapter 9 will discuss the application of the DCF formulation in detail.

Standard DCF Model Assumptions

The assumptions underlying the standard DCF model have been the source of controversy, confusion, and misunderstanding in rate hearings. This section clarifies these assumptions.

Theories are simplifications of reality and the models articulated from theories are necessarily abstractions from and simplifications of the existing world so as to facilitate understanding and explanation of the real world. The DCF model is no exception to the rule. The assumptions of the standard DCF model are as follows:

Assumption #1. The four assumptions discussed earlier in conjunction with the general classical theory of security valuation still remain in force.

Assumption #2. The discount rate, K, must exceed the growth rate, g. In other words, the standard DCF model does not apply to growth stocks. In Equation 8-7, it is clear that as g approaches K, the denominator gets progressively smaller, and the price of the stock infinitely large. If g exceeds K, the price becomes negative, an implausible situation. In the derivation of the standard

DCF equation (8-7) from the general stock valuation equation (8-5), it was necessary to assume g is less than K in order for the series of terms to converge toward a finite number. With this assumption, the present value of steadily growing dividends becomes smaller as the discounting effect of K in the denominator more than offsets the effect of such growth in the numerator.

This assumption is realistic for most public utilities. Investors require a return commensurate with the amount of risk assumed, and this return likely exceeds the expected growth rate in dividends for most public utilities. Although it is possible that a firm could sustain very high growth rates for a few years, no firm could double or triple its earnings and dividends indefinitely.

Assumption #3. The dividend growth rate is constant in every year to infinity. This assumption is not as problematic as it appears. It is not necessary that g be constant year after year to make the model valid. The growth rate may vary randomly around some average expected value. Random variations around trend are perfectly acceptable, as long as the mean expected growth is constant. The growth rate must be "expectationally constant," to use formal statistical jargon. This assumption greatly simplifies the model without detracting from its usefulness.

If investors expect growth patterns to prevail in the future other than constant infinite growth, more complex DCF models are available. For example, investors may expect dividends to grow at a relatively modest pace for the first 5 years and to resume a higher normal steady-state course thereafter, or conversely. The general valuation framework of Equation 8-5 can handle such situations. The "non-constant growth" model presented later in the chapter is a popular version of the DCF model.

It should be pointed out that the standard DCF model does not require infinite holding periods to remain valid. It simply assumes that the stock will be yielding the same rate of return at the time of sale as it is currently yielding. Example 8-2 illustrates this point.

Another way of stating this assumption is that the DCF model assumes that market price grows at the same rate as dividends. Although g has been specified in the model to be the expected rate of growth in dividends, it is also implicitly the expected rate of increase in stock price (expected capital gain) as well as the expected growth rate in earnings per share. This can be seen from Equation 8-7, which in period 1 would give:

$$P_1 = D_2 / (K - g)$$

But $\quad D_2 = D_1(1 + g)$ and $P_0 = D_1 / (K - g)$

so that $\quad P_1 = D_1(1 + g)/(K - g) = P_0(1 + g)$

yield must be adjusted for the flotation cost allowance by dividing it by (1 – f), where f is the flotation cost factor.[6]

$$K = D_1/P_0\,(1 - f) + g \qquad (9\text{-}4)$$

9.3 Growth Estimates: Historical Growth

The principal difficulty in calculating the required return by the DCF approach is in ascertaining the growth rate that investors are currently expecting. While there is no infallible method for assessing what the growth rate is precisely, an explicit assumption about its magnitude cannot be avoided. Estimating the growth component is the most difficult and controversial step in implementing DCF since it is a quantity that lies buried in the minds of investors. Three general approaches to estimating expected growth can be used, each with its own strengths and blemishes:

1. historical growth rates
2. analysts' forecasts
3. sustainable growth rates

This section describes the historical growth approach while the next two sections address the other two approaches.

Historical growth rates in dividends, earnings, and book value are often used as proxies for investor expectations in DCF analysis. Investors are certainly influenced to some extent by historical growth rates in formulating their future growth expectations. In addition, these historical indicators are widely used by analysts, investors, and expert witnesses in regulatory proceedings, at least as a starting point in their company analyses. Professional certified financial analysts are also well-versed in the use of historical growth indicators. To wit, the calculation of historical growth rates is normally one of the first steps in security analysis. Historical indicators are also used extensively in scholarly research. There exists a vast literature in empirical finance designed to evaluate the use of historical financial information as surrogates for expected values. This literature is discussed in the next section.

When using historical growth rates in a regulatory environment, a convenient starting point is to focus on the utility in question, and to assume that its growth profile is relatively stable and predictable. Under circumstances of stability, it is reasonable to examine past growth trends in earnings, dividends,

[6] The conceptual and empirical support for the flotation cost adjustment is fully discussed in Chapter 10.

and book values as proxies for investor expectations. The fundamental assumption is made that investors arrive at their expected growth forecast by simply extrapolating past history. In other words, historical growth rates influence investor anticipations of long-run growth rates.

In using historical growth rates, three decisions must be made: (1) which historical data series is most relevant; (2) over what past period; and (3) which computational method is most appropriate.

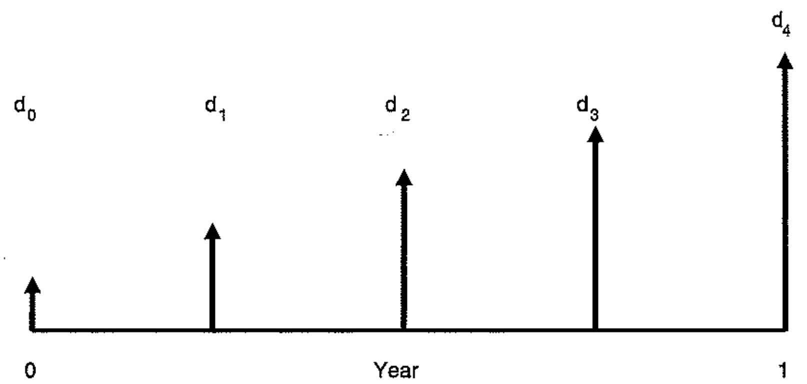
Historical Series

DCF proponents have variously based their historical computations on earnings per share, dividends per share, and book value per share. Of the three possible growth rate measures, growth in dividends per share is likely to be preferable, at least conceptually. DCF theory states clearly that it is expected future cash flows in the form of dividends that constitute investment value.

However, since the ability to pay dividends stems from a company's ability to generate earnings, growth in earnings per share can be expected to strongly influence the market's dividend growth expectations. After all, dividend growth can only be sustained if there is growth in earnings. It is the expectation of earnings growth that is the principal driver of stock prices. On the down side, using earnings growth as a surrogate for expected dividend growth can be problematic since historical earnings per share are frequently more volatile than dividends per share. Past growth rates of earnings per share tend to be very volatile and can sometimes lead to unreasonable results, such as negative growth rates. For example, in the 1990s and early 2000s, electric and gas company earnings growth rates were unstable and volatile, and such growth rates could not reasonably be expected to continue. Historically based DCF estimates of the cost of equity were downward-biased by the anemic historical growth rates of earnings and dividends in those years of major restructuring efforts, writeoffs, mergers and acquisitions, and shrinking profitability in the passage from a regulated monopoly to a competitive industry.

The relative stability of earnings and dividends is displayed in Figure 9-1 for The Southern Company. Under normal circumstances, dividend growth rates are not nearly as affected by year-to-year inconsistencies in accounting procedures as are earnings growth rates, and they are not as likely to be distorted by an unusually poor or bad year. Dividend growth is more stable than earnings growth because dividends reflect normalized long-term earnings rather than transitory earnings, because investors value stable dividends, and because companies are reluctant to cut dividends because of the information effect of dividend payments.

FIGURE 11-3
QUARTERLY DCF CONSTANT GROWTH



$d_1 = d_0(1 + g)^{0.25}$

$d_2 = d_0(1 + g)^{0.50}$

$d_3 = d_0(1 + g)^{0.75}$

$d_4 = d_0(1 + g)^{1.00}$

is computationally laborious. The following quarterly DCF model is a useful approximation and is far less laborious, although it does require the assumption that the company increases its dividend payments each quarter. The model assumes that each quarterly dividend differs from the previous one by $(1 + g)^{0.25}$, where g is the growth rate and the term 0.25 denotes one quarter of the year. Figure 11-3 shows the assumed dividend pattern. If it is assumed that dividends grow at a constant rate of g% every quarter starting from a base of d_0, the current quarterly rate, the company's stock price is given by:

$$P_0 = \sum_{n=1}^{4} \frac{d_0(1 + g)^{n/4}}{(1 + K)^{n/4}} + g$$

Which simplifies to:

$$P_0 = \frac{d_0(1 + g)^{1/4}}{(1 + K)^{1/4} - (1 + g)^{1/4}}$$

Solving the above equation for K, the simplified DCF formula for estimating the cost of equity under quarterly dividend payments emerges as Equation 11-4.

$$K = \left[\frac{d_0(1 + g)^{1/4}}{P_0} + (1 + g)^{1/4}\right] - 1 \qquad (11\text{-}4)$$

volume of trading on public exchanges, and a ceiling on the amount of dividend cuts over a past period.

In defining a population of comparable-risk companies, care must be taken not to include other utilities in the sample, since the rate of return on other utilities depends on the allowed rate of return. The historical book return on equity for regulated firms is not determined by competitive forces but instead reflects the past actions of regulatory commissions. It would be circular to set a fair return based on the past actions of other regulators, much like observing a series of duplicate images in multiple mirrors. The rates of return earned by other regulated utilities may very well have been reasonable under historical conditions, but they are still subject to tests of reasonableness under current and prospective conditions.

Time Period

The cost of capital of a company refers to the expected long-run earnings level of other firms with similar risk. But a company's achieved earnings in any given year are likely to exceed or be less than their long-run average. Such deviations from expectations occur at the macroeconomic level as well. At the peak of the business cycle, firms generally earn more than their cost of capital, while at the trough the reverse is typical. Aggregating returns over a large number of comparable-risk unregulated firms averages the abnormally high and low rates of profitability in any given year. Furthermore, to dampen cyclical aberrations and remove the effects of cyclical peaks and troughs in profitability, an average over several time periods should be employed. The time period should include at least one full business cycle that is representative of prospective economic conditions for the next cycle. Such cyclical variations can be gauged by the official turning points in the U.S. business cycle, reported in *Business Conditions Digest*.

Averaging achieved returns over a full business cycle can serve as a reasonable compromise between the dual objectives of being representative of current economic conditions and of smoothing out cyclical fluctuations in earnings on unregulated firms. Some analysts confine their return study to the most recent time period. The most serious flaw of this approach is that historical returns on equity vary from year to year, responding to the cyclical forces of recession and expansion and to economic, industry-specific and company-specific trends. The most recent period is not likely to mirror expectations and be representative of prospective business conditions. Moreover, in the short run, reported book profitability frequently moves in the opposite direction to interest rates and to investors' required returns. For example, a period of disinflation and falling interest rates will increase company earnings and earned equity returns, while investors' return requirements are falling, and conversely.

Chapter 16
Weighted Average Cost of Capital

Traditionally, the allowed rate of return in regulatory hearings is calculated as the weighted average of the cost of each individual component of the capital structure weighted by its book value. This is illustrated in Table 16-1, where the capital structure, expressed as percent of book value, consists of 40% debt, 10% preferred stock, and 50% common stock, with individual cost rates of 8%, 6%, and 12%, respectively.

The estimated allowed rate of return of 9.8%, also known as the *weighted average cost of capital* (''WACC''), is then applied to the book value of the rate base to determine the total revenue requirements (costs of service) needed to service the capital employed by the utility.

Knowledge of the 9.8% allowed rate of return on total capital is not enough to determine the total cost of capital to the ratepayers, however, for it ignores the tax burden. Assuming a 50% tax rate, in order to provide a $1 return to the bondholders, the utility requires only $1 of revenue. But it takes $2 of pre-tax revenue to provide a $1 return to the preferred and common equity holders because the utility must pay corporate income taxes. Returning to the above example, if the rate base is $100 and the tax rate 50%, to provide a return of $3.20 on the bondholders' $40 investment, the utility requires $3.20 of pre-tax revenues. But to provide a return of $0.60 + $6.00 = $6.60 to the preferred and common equity holders' $60 investment, the regulatory commission must allow a profit of 2 x $6.60 = $13.20. From the ratepayers' viewpoint, the total cost of capital inclusive of taxes is $3.20 + $13.20 = $16.40, or 16.4%. The computation is shown on Table 16-2.

An alternate and equivalent computational procedure, shown in Table 16-3, is to express the cost of debt directly on an after-tax basis, and then compute the after-tax weighted average cost of capital (''ATWACC'').

TABLE 16-1
ILLUSTRATIVE COST OF CAPITAL CALCULATION

Source	$$ Amount	% Weight	% Cost	Weighted Cost
Debt	$40	40%	8%	3.2%
Preferred	$10	10%	6%	0.6%
Equity	$50	50%	12%	6.0%
				9.8%

TABLE 16-2
ILLUSTRATIVE COST OF CAPITAL CALCULATION

Source	$$ Amount	% Weight	% Cost	Weighted Cost	Tax Factor	Capital Cost Including Tax
Debt	$40	40%	8%	3.2%	1.0	3.2%
Preferred	$10	10%	6%	0.6%	2.0	1.2%
Equity	$50	50%	12%	6.0%	2.0	12.0%
				9.8%		**16.4%**

Note: The tax factor is 1/(1 − tax rate): with a 50% corporate tax rate 1/(1 − 0.50) = 1/0.50 = 2.0

TABLE 16-3
ILLUSTRATIVE COST OF CAPITAL CALCULATION
Alternate Version

Source	% Weight	Return	After-tax Cost	Weighted Cost
Debt	40.0%	8.0%	4.0%	1.6%
Preferred	10.0%	6.0%	6.0%	0.6%
Equity	50.0%	12.0%	12.0%	6.0%
				8.2%

The resulting ATWACC is then multiplied by the tax factor to obtain directly the cost of capital inclusive of taxes. Going back to the above example, the after-tax cost of debt is 8% (1 − T) = 8% (1 − .50) = 4%, where T is the tax rate. The weighted cost of debt is then 1.6%, for a total WACC of 8.2%, instead of the 9.8% shown above. The pre-tax cost of capital is then simply the post-tax figure of 8.2% multiplied by the tax factor of 2, or 16.4%, the same figure obtained with the first procedure. Appendix 16-A shows that the dollar revenue requirement is the same whether the tax shield from debt financing is treated implicitly by multiplying the cost of debt by (1 − T) or explicitly as a separate line item in computing the revenue requirement.

More generally, if K_d and K_e are the costs of debt and equity, and W_d and W_e are, respectively, the weights of debt and equity to the total value of capital, the weighted average cost of capital, K, can be expressed as:

$$K = K_d W_d + K_e W_e \qquad (16\text{-}1)$$

Several issues regarding the WACC arise in regulatory proceedings, particularly with regard to the optimal set of weights W_d and W_e. Section 16.1

BEFORE THE WASHINGTON

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Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-4

Elizabeth Andrews Workpapers, Section 1 – Electric Pro Forma and Section 2 – Natural Gas Pro Forma (Excerpt)

October 3, 2019

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET NO. UE-19________

DOCKET NO. UG-19________

WORKPAPERS

ELIZABETH M. ANDREWS

REPRESENTING AVISTA CORPORATION

Section 1 – Electric Pro Forma

RESULTS OF OPERATIONS	Report ID:	AVISTA UTILITIES
ELECTRIC INTEREST DEDUCTION FOR FIT	**E-INT-12A**	
For Twelve Months Ended December 31, 2018		
Average of Monthly Averages Basis		

Ref/Basis	Description	System	Washington	Idaho
	Debt			
1	Capital Structure - Debt Ratio		52.77%	52.77%
2	Cost of Debt		5.514%	5.480%
	Total Weighted Cost		2.910%	2.892%
E-APL	Net Rate Base	2,399,205,592	1,596,053,312	803,152,280
	Interest Deduction for FIT Calculation	69,672,315	46,445,151	23,227,164

1 AMA Actual Debt Ratio
2 AMA Actual Debt Cost

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET NO. UE-19________

DOCKET NO. UG-19________

WORKPAPERS

ELIZABETH M. ANDREWS

REPRESENTING AVISTA CORPORATION

Section 2 – Natural Gas Pro Forma

RESULTS OF OPERATIONS	Report ID:
INTEREST DEDUCTION FOR FIT--GAS NORTH	**G-INT-12A**
For Twelve Months Ended December 31, 2018	
Average of Monthly Averages Basis	

AVISTA UTILITIES

Ref/Basis	Description	System	Washington	Idaho
	Debt			
1	Capital Structure - Debt Ratio		52.77%	52.77%
2	Cost of Debt		5.514%	5.480%
	Total Cost of Debt		2.910%	2.892%
	Total Weighted Cost		2.910%	2.892%
G-APL	Net Rate Base	502,698,521	348,658,022	154,040,499
	Interest Deduction for FIT Calculation	14,600,799	10,145,948	4,454,851

1 AMA Actual Debt Ratio
2 AMA Actual Debt Cost

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BEFORE THE WASHINGTON

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-5

A. Lawrence Kolbe et al.: *The Cost of Capital* (Excerpt)

October 3, 2019

The Cost of Capital

A. Lawrence Kolbe
and James A. Read, Jr.
with George R. Hall

and Discounted Cash Flow (the techniques mentioned here are defined and evaluated in chapter 3). Since these methods look only at firms in a single "risk class," they do not require that the analyst estimate the entire risk-return line shown in figure 2.1; they focus directly on the vertical axis.

To use the second strategy, the analyst must examine (at least implicitly) both measures of the stock's risk and the current position of the market line. Methods that require explicit risk measurement include the Capital Asset Pricing Model and the Risk Positioning techniques. These methods first position the firm on the horizontal axis of figure 2.1, and then (again, at least implicitly) use an estimate of the risk-return line to find the proper level for the cost of capital on the vertical axis.

The advantages of one strategy are the disadvantages of the other. The first strategy avoids the need for an estimate of the market line but requires that the evidence used must be from investments of comparable risk. This immediately excludes data from other firms of differing risk. More subtly, it can exclude data on the firm whose cost of capital is now being estimated, if either its risk or the market line has changed since the evidence was collected.

This focus on estimation strategies may be premature. If the reader does not accept that the cost of capital as just defined is the right target for regulators, the general approaches to cost of capital estimation may be of little interest. The remainder of the chapter uses two approaches to develop the reasons that the cost of capital is indeed the appropriate allowed rate of return for a regulated company's investors.[7]

2. Why the Allowed Rate of Return Should Equal the Cost of Capital

Law

The United States Supreme Court has established that investors in companies subject to rate regulation must be allowed *an opportunity* to earn returns sufficient to attract capital and comparable to those they would expect in the unregulated sector for bearing the same degree of risk. The *Bluefield* and *Hope* cases provide the seminal decisions.[8]

The *Hope* test is the basic criterion for a legally sufficient rate of return on equity. The court stated:

> The rate-making process under the act, i.e., the fixing of "just and reasonable" rates, involves a balancing of the investor and the consumer interests. Thus we stated in the *Natural Gas Pipeline Co.* case that "regulation does not insure that the business shall produce net revenues." 315 U.S. p. 590. But such considerations aside, the investor interest has a legitimate concern with the financial integrity of the company whose rates are being regulated. From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock . . . . By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital.[9]

Since by definition the cost of capital of a regulated firm represents precisely the expected return that investors could anticipate from other investments while bearing no more and no less risk, and since investors will not provide capital unless the investment is expected to yield its opportunity cost of capital, the correspondence of the definition of the cost of capital with the court's definition of legally required earnings appears clear. *Hope* refers to both "commensurate" earnings and the attraction of capital. These two approaches are harmonized when the allowed rate of return is set equal to the cost of capital.

Hope is sometimes cited for the proposition that some specific method of establishing the rate of return on equity is the only legally permissible technique. However, *Hope* states clearly that it is the "end result" of the regulation process that determines legality, not the specific technique used to calculate rate of return. All the standard cost-of-capital estimation techniques can meet the requisite legal tests; it is the way they are applied that is important.

Despite the obvious correspondence between the precepts of *Hope* and the financial concept of the cost of capital, public utility statutes and the applicable case law give no detailed prescription for what constitutes a "just and reasonable" rate of return on equity. In the absence of detailed guidelines from legislatures or the higher courts, various general judicial concepts about rate setting have been developed and applied by courts. The key concepts are:

1. Balance: the establishment of a just and reasonable rate involves a balancing of the investor and consumer interests.

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EXHIBIT DJG-6

Historic Trends

October 3, 2019

Market Cost of Equity vs. Awarded Returns

	[1]		[2]		[3]		[4]	[5]	[6]	[7]
	Electric Utilities		Gas Utilities		Total Utilities		S&P 500	T-Bond	Risk	Market
Year	ROE	#	ROE	#	ROE	#	Returns	Rate	Premium	COE
1990	12.70%	38	12.68%	33	12.69%	71	-3.06%	8.07%	3.89%	11.96%
1991	12.54%	42	12.45%	31	12.50%	73	30.23%	6.70%	3.48%	10.18%
1992	12.09%	45	12.02%	28	12.06%	73	7.49%	6.68%	3.55%	10.23%
1993	11.46%	28	11.37%	40	11.41%	68	9.97%	5.79%	3.17%	8.96%
1994	11.21%	28	11.24%	24	11.22%	52	1.33%	7.82%	3.55%	11.37%
1995	11.58%	28	11.44%	13	11.54%	41	37.20%	5.57%	3.29%	8.86%
1996	11.40%	18	11.12%	17	11.26%	35	22.68%	6.41%	3.20%	9.61%
1997	11.33%	10	11.30%	12	11.31%	22	33.10%	5.74%	2.73%	8.47%
1998	11.77%	10	11.51%	10	11.64%	20	28.34%	4.65%	2.26%	6.91%
1999	10.72%	6	10.74%	6	10.73%	12	20.89%	6.44%	2.05%	8.49%
2000	11.58%	9	11.34%	13	11.44%	22	-9.03%	5.11%	2.87%	7.98%
2001	11.07%	15	10.96%	5	11.04%	20	-11.85%	5.05%	3.62%	8.67%
2002	11.21%	14	11.17%	19	11.19%	33	-21.97%	3.81%	4.10%	7.91%
2003	10.96%	20	10.99%	25	10.98%	45	28.36%	4.25%	3.69%	7.94%
2004	10.81%	21	10.63%	22	10.72%	43	10.74%	4.22%	3.65%	7.87%
2005	10.51%	24	10.41%	26	10.46%	50	4.83%	4.39%	4.08%	8.47%
2006	10.32%	26	10.40%	15	10.35%	41	15.61%	4.70%	4.16%	8.86%
2007	10.30%	38	10.22%	35	10.26%	73	5.48%	4.02%	4.37%	8.39%
2008	10.41%	37	10.39%	32	10.40%	69	-36.55%	2.21%	6.43%	8.64%
2009	10.52%	40	10.22%	30	10.39%	70	25.94%	3.84%	4.36%	8.20%
2010	10.37%	61	10.15%	39	10.28%	100	14.82%	3.29%	5.20%	8.49%
2011	10.29%	42	9.92%	16	10.19%	58	2.10%	1.88%	6.01%	7.89%
2012	10.17%	58	9.94%	35	10.08%	93	15.89%	1.76%	5.78%	7.54%
2013	10.03%	49	9.68%	21	9.93%	70	32.15%	3.04%	4.96%	8.00%
2014	9.91%	38	9.78%	26	9.86%	64	13.52%	2.17%	5.78%	7.95%
2015	9.85%	30	9.60%	16	9.76%	46	1.38%	2.27%	6.12%	8.39%
2016	9.77%	42	9.54%	26	9.68%	68	11.77%	2.45%	5.69%	8.14%
2017	9.74%	53	9.72%	24	9.73%	77	21.64%	2.41%	5.08%	7.49%
2018	9.59%	48	9.59%	41	9.59%	89	-4.23%	2.68%	5.96%	8.64%

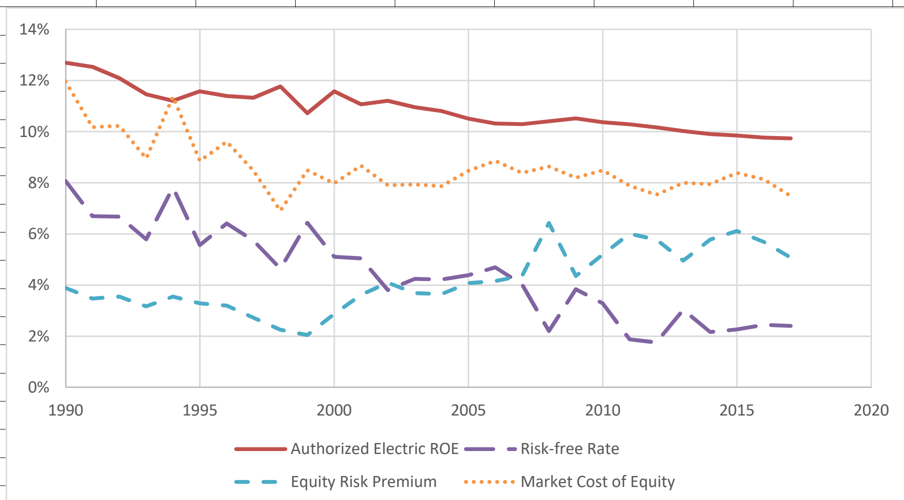
[1], [2], [3] Average annual authorized ROE for electric and gas utilities, RRA Regulatory Focus: Major Rate Case Decisions

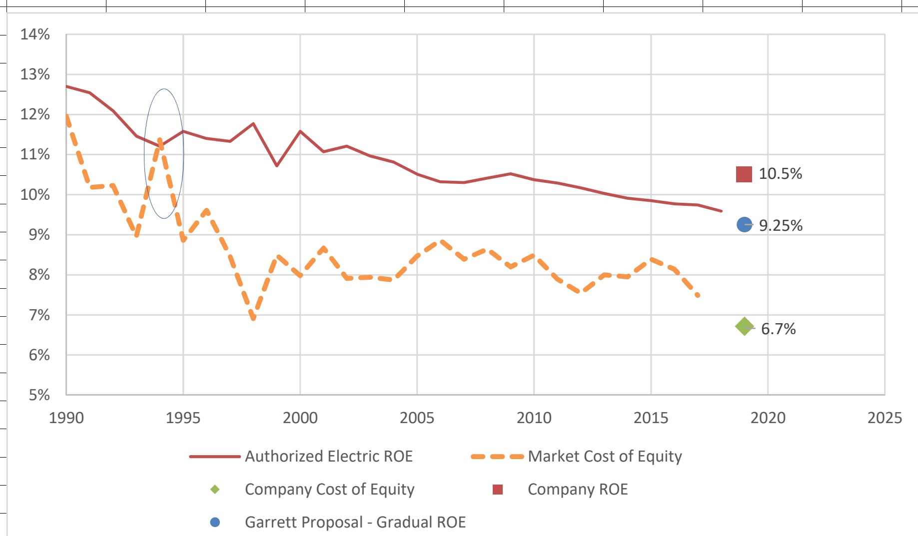
[3] = [1] + [2]

[4], [5], [6] Annual S&P 500 return, 10-year T-bond Rate, and equity risk premium published by NYU Stern School of Business

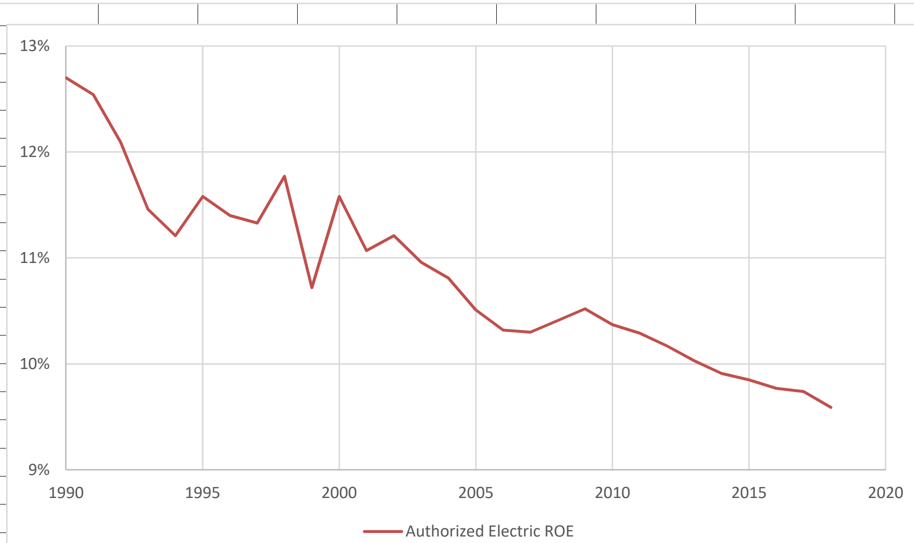
[7] = [5] + [6] ; Market cost of equity represents the required return for investing in all stocks in the market for a given year

Market Cost of Equity vs. Awarded Returns





My Estimate	
	6.7%
Company ROE	
	10.5%
Gradual ROE	
	9.25%



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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-7

Steven Huntoon: *Nice Work If You Can Get It*

October 3, 2019

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ENERGY, MONEY, POWER

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Let's admit one thing right off the bat. Rate of return is one of the most arcane subjects in utility regulation's ocean of arcania.

But one thing that makes rate of return interesting is the amount of money involved. It's roughly $58 billion each year for electric utilities.[1]

Now you may be thinking, OK, so there's big money involved. But what's in it for me? In the spirit of BLUF, Bottom Line Up Front, let me tackle that question.

There is mounting evidence that investment in utility stocks has outperformed the broader market in the past, and will continue to do so. This is a conundrum. Regulated utilities are less risky than competitive industries, and therefore are supposed to produce a lower total return over time. But instead the opposite is happening.

We'll get into the evidence for this, and then speculate as to how this can be so. But if you want actionable intelligence up front, here it is: invest in regulated utilities.

Vanguard Group gives you low-cost index-fund options for utility investment. The symbol for the mutual fund is VUIAX and for the ETF is VPU. You may now skip the rest of this column if so inclined.

By the way, if your interest is the welfare of utility customers, there is more at stake than just higher than needed equity rates. When allowed equity returns exceed the true cost of equity, utilities have an artificial incentive to expand utility facilities upon which they can earn that extra return, including favoring themselves over others in resource procurement. This is the well-known Averch-Johnson effect first described in 1962.

OK, for those sticking around for the substance here it is. The historical evidence of outperformance comes in three data points:

1. A study released by PJM showing lower-risk regulated generation outperforming higher-risk, market-based generation over a long-term horizon.[2]

2. Broader studies of markets showing lower-beta, lower-risk stocks outperforming higher-beta, higher-risk stocks over a long-term horizon.[3]

3. Utility stocks outperforming the broader market over the last 12 years, the longest period tracked in Google Finance, with the Dow Jones Utility Average at a total return of 161 percent and the Dow Jones Industrial Average at a total return of 133 percent.[4]

These are astounding, counter-intuitive results.

This counter-intuitive past seems destined to continue into the future. Three data points point the way:

1. Jack Bogle, the founder of Vanguard Group and a Wall Street legend, provides rigorous analysis that the long-term total return for the broader market will be around 7 percent going forward.[5] Another Wall Street legend, Professor Burton Malkiel, corroborates that 7 percent in the latest edition of his seminal work, *A Random Walk Down Wall Street*.[6]

2. Institutions like pension funds are validating #1 by piling on risky investments to try and get to a 7.5 percent total return, as reported by the *Wall Street Journal.*[7]

3. Utilities are being granted returns on equity around 10 percent.[8]

Let's reflect on what #3 means relative to #1 and 2.

It means that the less risky utilities are being awarded much higher returns, roughly 40 percent higher, than the broader market is expected to earn. The extra is about $17 billion per year.[9] Not too shabby.

So let's repeat the actionable intelligence. If you're a professional money manager it means you should buy the Vanguard utility index fund (or a comparable fund) and spend the next 10 years in Maui drinking Mai Tai's with those little umbrellas.

The rest of us should make the same investment. But we'll still have to work because we can't drink Mai Tai's in Maui for a living.

Now that we've gotten the practical stuff out of the way, let's think about why this might be so. The efficient market hypothesis says it isn't possible to have an anomaly like lower risk stocks consistently outperforming higher risk stocks. And yet they are.

Why? One thing we know off the bat is that utility stocks are the only stocks where Wall Street analysts actually set earnings, instead of just forecasting earnings. That is because utility regulators use Wall Street analysts' forecasts of earnings and dividend growth to set the "g" factor, and dividend yield plus g becomes the allowed return on equity.

You might observe that there is some circularity to this. If Wall Street analysts set g high, then the allowed return on equity will be high, and then g will be high, etc.

But it's not all circular. There may be some reasons for Wall Street to think g ought to be high. Wall Street forecasts tend to be led by guidance from the companies themselves. Utility companies have decades of experience in maximizing earnings under regulation, and partial deregulation, and they do very well at it.

How exactly? Well, we need to get in the weeds to explore some of the ways, but here goes. Utilities often can take advantage of double leveraging their capital structure. That's pretty esoteric so let's take an example.

Suppose you have an operating utility company with a 50 percent debt, 50 percent equity capital structure, with 5 percent debt cost and 10 percent equity cost. Now, let's suppose a holding company is created that finances the 50 percent operating company equity with 40 percent debt and 60 percent equity. How much does the parent company equity earn on equity? It earns 13.3 percent, not 10 percent, because of the double leverage.[10]

And it also works in reverse. Wall Street forecasts a return of equity of 13.3 percent on the double leveraged parent equity, and that percent is applied to the capital structure of the operating company where the equity cost is only 10 percent. Pretty neat, eh?

Beyond capital structure, the nature of regulation has evolved favorably over time for the regulated. Utilities have been able to enlist regulators in risky endeavors so as to eliminate or mitigate financial losses from failures.

Nuclear and clean coal plants come to mind. New such plants are concentrated in areas of the country where traditional rate regulation for generation has continued. In contrast to areas where generation investment is subject to market conditions and competitive pressures.[11]

Utilities also have exhibited some facility for shifting regulatory paradigms as market conditions change. Ohio and Illinois illustrate this. As part of the deal to allow competition, utilities received stranded cost payments.

Then, rising wholesale prices became a bonus. And now with wholesale prices back down, some of those same utilities are seeking subsidies for their generation. This ability to shift among regulatory paradigms is unique to the utility industry.

Utility rates also tend to be downward sticky. It is easier for a utility to initiate and prosecute rate increases than for consumer advocates to initiate and prosecute rate decreases, with an imbalance in information being one obvious reason why.

And utilities have some ability to influence timing of expenses with, for example, workforce reductions coming a polite period after the resolution of a rate case. And utilities over time have been able to implement automatic pass-through of various types of costs so, for example, some costs can be passed through without comprehensive review of the utility's overall revenues and costs.

All of this is nice work if you can get it.

You may be thinking, is there a risk that regulators look at all this and reduce allowed returns to something closer to what the riskier broader market is expected to earn? So utilities would no longer be an anomalously great investment?

No worries. This is our little secret.

1. According to EEI data, there is $356 billion in electric utility common equity. Assume a 10 percent return on equity plus an income tax allowance of 6.4 percent. The income tax allowance is based on a composite federal or state income tax rate of 39 percent. The 10 percent return is divided by 61 percent (1 minus 39 percent). This gives a pre-tax total return of 16.4 percent, which amounts to $58 billion on the $356 billion in common equity.

2. "... one would expect merchant firms to earn a much higher level of return than the firms that are more tightly regulated. However, the opposite seems to be true as the consistently positive alphas for regulated firms indicates these companies are earning returns higher than what they should be expected to earn given their much lower level of risk." Resource Investment in Competitive Markets, Technical Appendix, May 5, 2016.

3. "In an efficient market, investors earn higher returns only to the extent that they bear higher risk. Despite the intuitive appeal of a positive risk-return relationship, this pattern has been surprisingly hard to find in the data, dating at least to Black (1972). For example, sorting stocks by using measures of market beta or volatility shows just the opposite. Panel A of Figure 1 shows that from 1968 through 2012 in the U.S. equity market, portfolios of low-risk stocks delivered on the promise of lower risk as expected but had surprisingly

higher average returns. A dollar invested in the lowest-risk portfolio grew to $81.66, whereas a dollar invested in the highest-risk portfolio grew to only $9.76." The Low Risk Anomaly: A Decomposition into Micro and Macro Effects, *Financial Analysts Journal,* March/April 2014.

4. These returns are from Google Finance, comparing Dow Jones Utility Average Total Return with Dow Jones Industrial Average Total Return from August 31, 2004, earliest common date, to June 28, 2016.

5. "Thus, the prospective nominal investment return on stocks seems likely to run in the range of 7 percent..." Occam's Razor Redux: Establishing Reasonable Expectations for Financial Market Returns, *Journal of Portfolio Management*. This conclusion is supported by unprecedented lows in the risk-free rate, even negative interest on some sovereign debt. For an excellent summary of the Bogle study see Jason Zweig's column, This Simple Way Is the Best Way to Predict the Market, *Wall Street Journal,* December 24, 2015.

6. "Adding the initial yield and growth rate together, we get a projected total return for the S&P 500 of just under seven percent per year ...." (*A Random Walk*, page 346).

7. "To even come close these days to what is considered a reasonably strong return of 7.5 percent, pension funds and other large endowments are reaching ever further into riskier investments..." *Wall Street Journal,* June 1, 2016.

8. FERC set the base allowed return for New England transmission owners at 10.57 percent in its Opinion Numbers 531, 531-A and 531-B. State commission allowed returns for electric utilities have averaged 9.78 percent according to an analysis of *Public Utilities Fortnightly* data in the PJM Study, earlier referenced.

9. Here's the math: 16.4 percent pretax return on $356 billion equity is $58 billion. If the equity return is 30 percent less, 7 percent versus 10 percent, then the reduction in return is $17 billion.

10. Here's an example of the math. Assume the operating company's equity is $100 million. At a 10 percent allowed return it earns $10 million. Now let's suppose the holding company finances that $100 million with 40 percent debt costing 5 percent and 60 percent equity. The holding company pays $2 million for the debt and thus earns $8 million on the $60 million equity for an actual return on equity of 13.3 percent. The key is the difference between the holding company's consolidated capital structure and the utility operating company's capital structure. Indeed, the leveraging is even more lucrative because the phantom equity also gets a phantom income tax allowance.

11. For more on this see the PJM Study, earlier referenced.

"Rate of return is one of the most arcane subjects in utility regulation's ocean of arcania." – Steve Huntoon

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BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-8

Leonard Hyman: *Don't Cry for Utility Shareholders, America*

October 3, 2019

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ENERGY, MONEY, POWER

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What do utility shareholders want? Answer: to earn a total return, dividends plus capital gains, at least commensurate with the risk incurred.

That is, to earn a return equal to, or in excess of, the cost of capital.

Did shareholders earn this in the past? And what do they require now?

In a recent piece written for *Public Utilities Fortnightly,* Steve Huntoon didn't directly answer those questions. Rather he concluded, much more elegantly, that whatever shareholders want, they get too much of it.[1]

Steve is a lawyer. So what does he know?

The authors of this column spent years on Wall Street, complaining that regulators did not provide investors with adequate returns. So we decided to check out the numbers.

Understand first, the market determines cost of capital. Regulators don't.

Second, to determine expected return, investors and academics have lately begun to rely more on historical data.

They are taking into account the tendency of markets to revert to the mean. We will try to apply that technique to answer the questions.

Let's cut to the chase. In the past century or more, globally, common stocks earned real returns of about five and a half percent to six and a half percent. Per year. Adjusted for inflation.

In the U.S., return on stocks have exceeded return on risk-free Treasury bonds. The equity risk premium was roughly two-point-four to five percentage points.

Recent Federal Reserve Bank monetary policy makes Treasuries a dubious benchmark. So we will use seasoned Baa corporate bonds instead.

Those bonds offered yields of one to two percentage points more than Treasuries in the past. And two to three percentage points more recently.

We estimate that investors, over the long term, expect that corporate bonds will earn two percentage points over Treasuries. And equities will earn five percentage points over Treasuries.

For a rule of thumb, equities will earn about three percentage points over corporate bond yields. Why bother with a rate case? Just use that handy rule of thumb.

Two additional points. Bond yields track inflationary expectations. So our calculation in current dollars indirectly takes inflation into account.

Also, over the post war period, utility stocks have performed at least as well as industrial stocks. So conclusions derived from the general market probably apply to them as well.

The first question is, what did utility investors earn? And was that good enough?

In the postwar period, investors earned just less than ten percent per year. That's six and a half percent in real terms.

Dividends made up about sixty-three percent of this return. See Figure 1.

Our rough-and-ready formula calculated a required return of ten and a half percent per year. That's six-point-nine percent in real terms. See Figure 2.

Utility stocks then earned in-line with long-term market expectations.

But utility stock prices exceeded their book value in fifty-six of the past seventy years. With sub-par pricing during energy and nuclear crises.

This indicates that utilities earned more than the cost of capital in most years.

Thus, utility investors earned an average market return, while taking a lower than average risk. Return probably exceeded the cost of capital.

The numbers tell us about anticipated growth. We define this as expected total return, minus dividend yield.

Over the postwar period, we calculate that investors expected growth of about four and a half percent per year. See Figure 3.

At the end of June 2016, corporate bonds yielded four and a half percent. Utility stocks yielded three-point-four percent.

This indicates, based on historical precedent, that equity investors want a seven and a half percent annual return. Three-point-four percent from dividends. Four-point-one percent from capital gains.

Is seven and a half percent, the number implied by Steve Huntoon, the nominal cost of equity capital? Imagine using that level of return in a utility rate case.

Sooner or later, regulators may see the gap between allowed returns and cost of capital. They might reduce returns.

Or regulators could impose British-style incentive regulation. It would offer utilities the opportunity to take higher risks, in order to maintain returns.

Either option could endanger dividends. That is the downside.

Income-starved investors are looking for means to meet their long-term obligations. They may accept even lower returns than the cost of equity capital we calculated.

The trick is for utilities to find ways to utilize that pool of capital.

Investors just want a better return on a safe investment than the one and a half percent they can get on ten-year Treasuries. Both utilities and electricity consumers might benefit from this trying financial situation.

And yes, it looks as if Steve Huntoon was right after all. Even if he is a lawyer.

Endnotes:

1. Steve Huntoon, "Nice Work If You Can Get It," *Public Utilities Fortnightly,* August 2016.

Robert D. Arnott and Peter L. Bernstein, "What Risk Premium Is Normal?" *Financial Analysts Journal*, March/April 2002, is a pioneering paper on the topic. It is comprehensive and comprehensible. For more recent data and analysis, see Martin Leibowitz, Andrew W. Lo, Robert C. Merton, Stephen A. Ross, and Jeremy Siegel, "Q Group Panel Discussion: Looking to the Future," *Financial Analysts Journal*, July/August 2016.

Media:

"British-style incentive regulation would offer utilities the opportunity to take higher risks, in order to maintain returns." – Leonard Hyman

FIG. 1 PERCENT TOTAL RETURN, DIVIDEND YIELD

Percent total return, dividend yield for five-year periods, 1946-2015. Data for 1946-1985 from Hyman, *America's Electric Utilities: Past, Present and Future*, 8th edition, based on Moody's Electric Utility Average. Data for 1986-2015 from Hyman, op. cit., and from Edison Electric Institute, EEI Index. Total return is a compound rate for the five-year period. Dividend yield is a simple average for the five-year period.

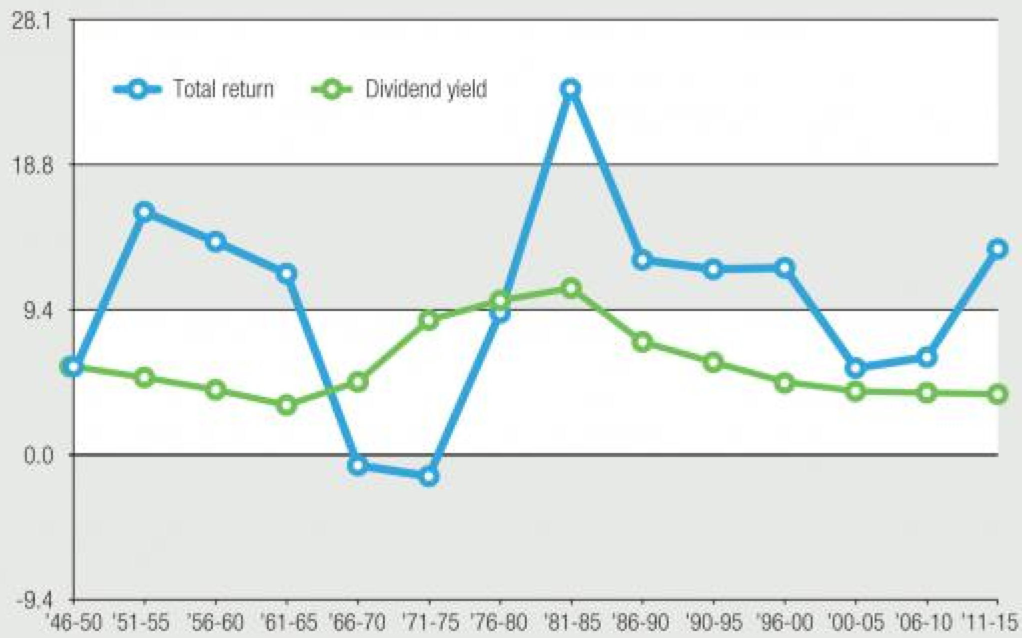

Figure 1 - Percent Total Return, Dividend Yield

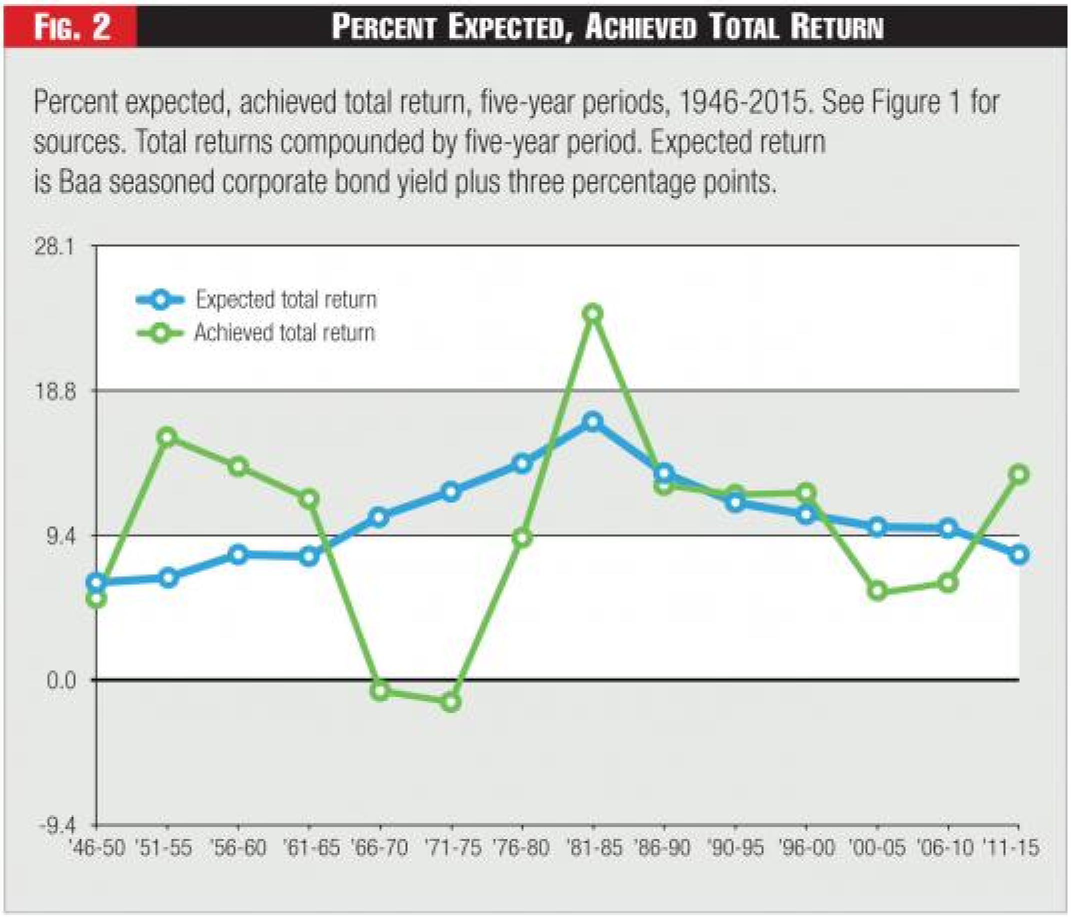

Figure 2 - Percent Expected, Achieved Total Return

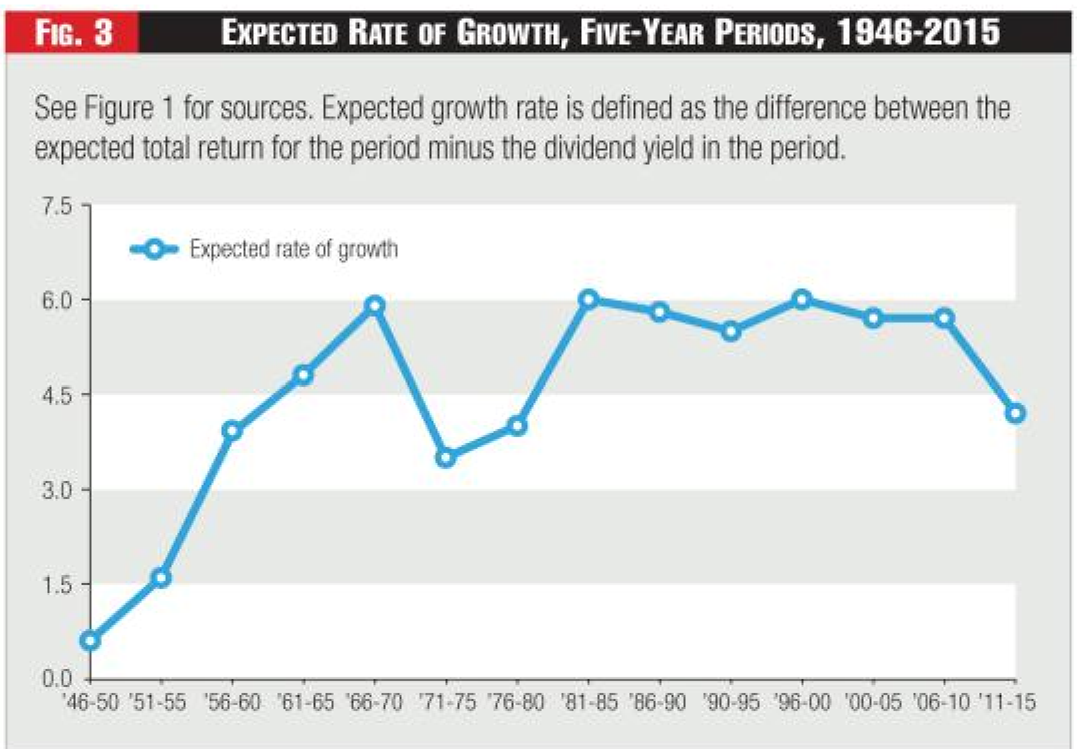

Figure 3 - Expected Rate of Growth, Five-Year Periods, 1946-2015

Source URL: https://www.fortnightly.com/fortnightly/2016/10/dont-cry-utility-shareholders-america

BEFORE THE WASHINGTON

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-9

Charles Griffey: *When "What Goes Up" Does Not Come Down*

October 3, 2019

WHEN "WHAT GOES UP" DOES NOT COME DOWN:
RECENT TRENDS IN UTILITY RETURNS

Charles S. Griffey, P.E., CFA[1]
February 15, 2017

I. Executive Summary

- *Returns on Equity (ROEs) granted to regulated utilities are near an all-time high relative to interest rates.*
- *Yet, the risks faced by regulated utilities are at an all-time low.*
- *Returns achieved by regulated utilities are equal to or greater than the returns of much riskier enterprises.*
- *Utilities could attract necessary capital at much lower awarded ROEs. Excessive ROEs encourage overbuilding and harm utility customers.*
- *Policymakers should reassess the ROEs being granted to utilities, and should be skeptical of requests for additional alternate rate-setting mechanisms without significant ROE reductions.*

II. Overview

Awarded and achieved utility ROEs have been much higher than necessary to induce appropriate investment in recent years. Utility ROEs have failed to track either the utilities' level of regulatory risk or general economic indicators. This trend can drive inefficient investment decisions by utilities and inflates rates for utility customers.

The risks faced by most utilities today are significantly lower than over the last three or four decades.[2] For example, utilities are generally not attempting to place capital-intensive coal and nuclear plants in rates today, as natural-gas-fired generation has emerged as the preferred plant technology. Natural gas plants have a lower up-front capital cost, so they carry significantly less financial risk in a regulatory review than an expensive coal or nuclear plant.[3]

[1] Mr. Griffey is an energy consultant whose clients have included large industrial customers, generators, retail electric providers, electric cooperatives, municipal utilities, and the Staff of the Public Utility Commission of Texas. He is a former utility and energy company executive and is Adjunct Professor of Management at Rice University's Jones Business School.

[2] A view shared by the rating agency Moody's Investor Service (Sector-in-Depth Analysis, March 2015): "Across the US, we continue to see regulators approving mechanisms that allow for more timely recovery of costs, a material credit positive. These mechanisms, which keep utilities' business risk profile low compared to most industrial corporate sectors, include: formulaic rate structures; special purpose trackers or riders; decoupling programs (which delink volumes from revenue); the use of future test years or other pre-approval arrangements. We also see a sustained increase in the frequency of rate case filings."

[3] https://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf

The risks and uncertainty associated with transitioning to retail competition—such as the potential for stranded utility generation investment—have largely been settled, further reducing utilities' risk. Rate riders, interim "cost recovery factors," and other features that allow a utility to increase its rates without a full rate review have also proliferated over the past two decades, allowing accelerated capital recovery and substantially reducing regulatory lag in the ratemaking process. Over time, these and other factors have materially reduced risk for regulated utilities, making high risk premiums unnecessary to attract capital or induce investment.

Yet, ROEs for regulated utilities are higher than ever relative to US Treasuries. ROEs have not been significantly reduced to recognize the lower risk faced by regulated utilities today, or even general economic trends. Utility ROEs have not fallen at nearly the same rate as interest rates. One cause of this "stickiness" in regulated utility ROEs (compared to interest rates) is the peer-group methodology used by most ROE witnesses and often adopted by regulators. This approach is inherently backward-looking, and when each utility's ROE is based on the ROEs granted to the utility's peers, inflated utility ROEs are self-perpetuating. Further, as Public Utilities Fortnightly observed in its 2016 Annual Rate Case Survey, the trend of sustained, unnecessarily high ROEs for utilities is also a product of utility scare tactics in regulatory proceedings, where risk-averse regulators are led to believe that appropriately reducing ROEs will deter necessary investment—despite robust evidence to the contrary.[4] As a result of these and other factors, utilities are receiving premium ROEs today compared to other industries.

The "risk premium" being granted to utility shareholders is now higher than it has ever been over the last 35 years. Excessive utility ROEs are detrimental to utility customers and the economy as a whole. From a societal standpoint, granting ROEs that are higher than necessary to attract investment creates an inefficient allocation of capital, diverting available funds away from more efficient investments. From the utility customer perspective, if a utility's awarded and/or achieved ROE is higher than necessary to attract capital, customers pay higher rates without receiving any corresponding benefit. Inflated ROEs also encourage utilities to make inefficient investment decisions so that they can earn a return on additional capital, harming both society and customers. As one observer has aptly noted, "When allowed equity returns exceed the true cost of equity, utilities have an artificial incentive to expand utility facilities upon which they can earn that extra return, including favoring themselves over others in resource procurement."[5] This compounds the excess earnings for utilities and further increases rates for customers. In addition, the combination of low debt costs and high utility ROEs in recent years has encouraged a type of arbitrage known as "back-leveraging" or "double-leveraging," where a utility parent or holding company borrows money at a low rate to use as equity at the utility level. This common strategy of translating low cost debt at the parent into equity returns at the utility increases returns for shareholders even beyond the premium levels authorized by regulators.[6]

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[4] Cross, P., "2016 Annual Rate Case Survey," Public Utilities Fortnightly (Nov. 2016).

[5] *See* Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016).

[6] Notably, "back-leveraging" also creates significant risk for utility customers by increasing the financial stakes of a default, which could compromise the utility's financial integrity and impede appropriate investment to maintain reliability.

Importantly, an excessive utility ROE has more than a dollar-for-dollar impact on customer rates because rates are grossed up to cover federal income tax liability on utility earnings. Take, for example, a utility with a total rate base (total investment) of $1 billion, and a capital structure of 40% equity, 60% debt, which is common. A one percent increase in this utility's ROE would not just translate to a rate increase of $4 million, but to ***$6.2 million*** because the return would be grossed up to cover corporate federal income tax liability (roughly 35%) on the additional earnings.[7] Investor-owned utilities in Texas have an aggregate rate base of approximately $25 billion.[8] Historically, a typical utility risk premium would be in the range of 450 basis points above Treasuries (in other words, if 30-year treasury bonds yield 3%, the utility ROE would have been 7.5%). However, risk premiums have been on the order of 650 basis points over the last several years, with Treasury bonds at 3% and utility ROEs at 9.5%. In Texas, this 200 basis point differential means, all else being equal, rates could have been reduced by approximately $300 - $350 million[9] annually without adversely impacting investment in utility infrastructure.

As a result of all these factors, utilities have been very profitable investment vehicles in the current economic climate,[10] and investors are eager to provide capital for utility infrastructure. Even if utilities do not achieve their allowed ROE, they have been successful in achieving a return in excess of their cost of capital.[11] Thus, there is no shortage of interest from both traditional utilities and non-traditional players such as pension funds, sovereign wealth funds, and private equity groups to invest in utility projects. This is, generally speaking, because the actual cost of capital required for investment is much lower than the ROEs being granted in the utility sector. A recent analysis concluded that most utility investors are looking for an annual rate of return around 7.5%,[12] while awarded utility ROEs have continued to be around 10%.[13] The result is a risk-adjusted rate of return that is superior to competing investments, and

[7] $1 billion rate base * 40% equity in capital structure * 1% increase = $4 million. Tax gross-up is $4 million/(1-0.35) = $6.2 million.

[8] *See* Tietjen, D., "Alternative Ratemaking: Is It Time For A Shock To The Rate-Setting System?," presented to Gulf Coast Power Association, November 21, 2016. This figure does not include transmission investments held by municipally owned utilities or electric cooperatives, which are also included in the postage stamp transmission rates in ERCOT. Rate base equals net plant in service of $33 billion from Mr. Tietjen's presentation, less ADFIT of $8 billion, taken from each utility's earnings monitoring reports in the following docket: http://bit.ly/2ibTVke.

[9] $25 billion * 40% equity * 2%/(1-0.35) = $308 million. Non-ERCOT utilities typically have approximately 50% equity in their capital structure, not the 40% used in Transmission and Distribution utilities in ERCOT, so the actual amount would be in excess of $308 million.

[10] Hyman, L. and Tilles, W., "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly at 65 (Oct. 2016).

[11] The cost of capital is set by the market, not regulators.

[12] Hyman, L. and Tilles, W., "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly at 65 (Oct. 2016).

[13] *See* Cross, P., "2016 Annual Rate Case Survey," Public Utilities Fortnightly (Nov. 2016); *see also* Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016) at n. 8, citing recent FERC-issues ROEs in the 10% range for New England utilities.

higher than necessary to induce investment. The keen interest of numerous investors in recent utility mergers and acquisitions at premium prices is another sign of this phenomenon.[14]

The evidence showing that awarded utility ROEs far exceed the levels that actual risk factors and general economic trends would support is substantial, and mounting. As one author on this topic has stated, "[r]egulated utilities are less risky than competitive industries, and therefore are supposed to produce a lower total return over time. But instead the opposite is happening."[15]

Mounting evidence indicates that awarded ROEs and actual utility earnings are too high, and that it is time to reevaluate the status quo and reduce utility ROEs to reflect actual risk and economic factors.

III. Current utility ROEs are higher than risk factors and economic trends support.

Rates of return for regulated utilities must achieve two competing goals: (1) they must allow the utility to attract enough capital to make the investments needed to provide reliable, continuous service, and (2) they must protect customers against monopoly pricing by ensuring that rates replicate what a competitive market would produce. A seminal scholar on utility regulation, James Bonbright, famously described the rate-setting process as follows:

> Regulation, it is said, is a substitute for competition. Hence its objective should be to compel a regulated enterprise, despite its possession of complete or partial monopoly, to charge rates approximating those which it would charge if free from regulation but subject to the market forces of competition. In short, regulation should be not only a substitute for competition, but a closely imitative substitute.[16]

If a utility's awarded ROE is too low relative to its risk profile, the utility will not be able to attract capital, which will result in underinvestment. If a utility's awarded ROE is too high, customers will pay more than necessary to incentivize appropriate investment, and the utility will be encouraged to pursue inefficient investments and to "gold plate" infrastructure to inflate its returns. The overall economy is also harmed in these conditions because capital is inefficiently diverted from other potential investments.

With this context, a historical comparison of the returns earned on "risk-free" investments (represented here by thirty-year Treasury yields) and the ROEs granted to regulated utilities strongly suggests that utility ROEs are not appropriately tracking either the risk level of utility investments or general economic trends. As shown in Figure 1, both utility ROEs and Treasuries have fallen since the early 1980s, but the gap has widened because utility ROEs have not declined nearly as quickly as Treasury yields—particularly over the last ten years:

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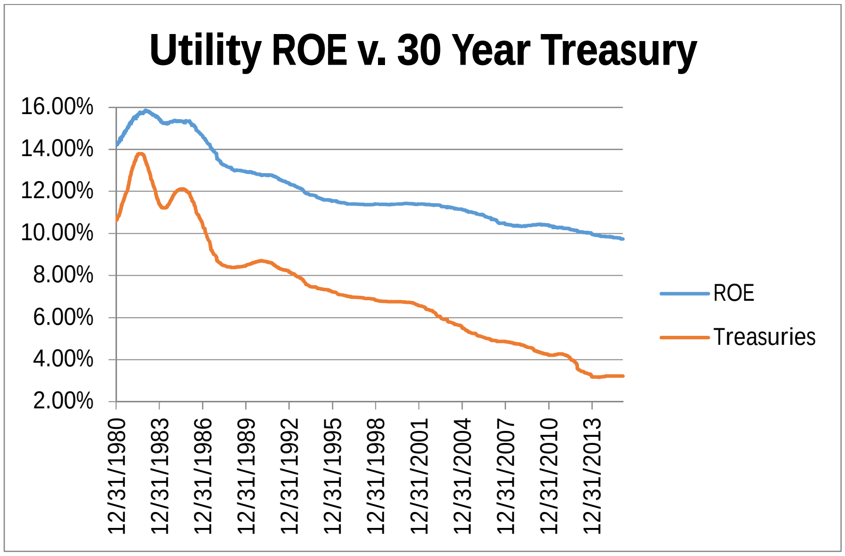
[14] "Recent acquisition activity has been a little troubling, with above-average premiums being paid and, consequently, a more debt-financed profile to the transactions." Standard & Poors Ratings Service, "Industry Top Trends 2016," December 2015 at 22.

[15] Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016).

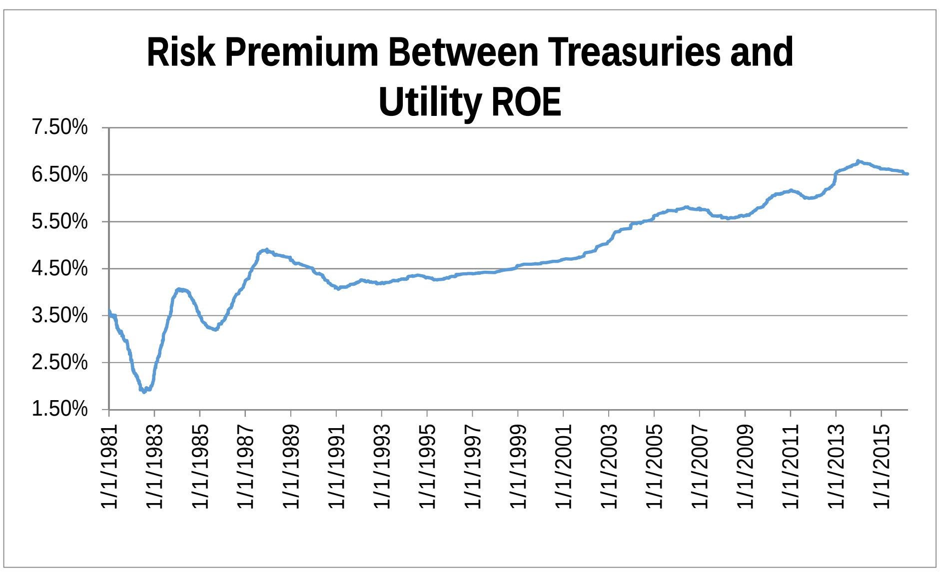
[16] Bonbright, J., Principles of Public Utility Rates at 3 (1966).

Figure 1: Comparison of Utility Allowed ROEs to 30-Year Treasury Yields[17]



This gap between utility ROEs and returns on "risk-free" investments represents a "risk premium." Risk premiums should compensate utility shareholders for the increased risk they bear relative to simply holding a theoretically risk-free asset—the 30-year Treasury bond in this case. As utility risk declines, the difference between utility ROEs and risk-free interest rates should become smaller—but the opposite is happening. The figure below focuses solely on the risk premium:

Figure 2: Comparison of Risk Premiums



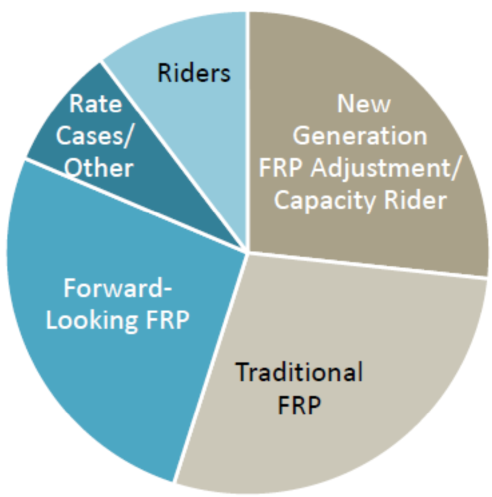
[17] Data is smoothed to be the 12-month moving average for both utility ROEs and Treasuries. Data is from SNL Financial and Bloomberg (see Direct Testimony of Robert Hevert in Docket 45414, Exhibit RBH-8, and Exhibit 1 to March 10, 2015 Moody's Sector-in-Depth Analysis for Electric Power).

As the chart above illustrates, the average risk premium over 1980-2016 was about 4.5%, or 450 basis points. Until the year 2000, risk premiums for utility investments had never exceeded 500 basis points. *Since that time, the gap has steadily increased and stands at approximately 650 basis points today***.** If investing in utilities were riskier today than in the past, this result might be appropriate—but the opposite is true, as discussed below. Risk in the utility sector has declined over the last few decades, yet ROEs have not been reduced to reflect this lower risk, or even to track the general decline in expected yields from "risk-free" investments. This strongly suggests that the ROEs being granted to regulated utilities should be reevaluated.

IV. Texas: A Case Study

The utility business in Texas has become significantly less risky over the last two decades. From an investor's viewpoint, "risk" in the utility business includes anything that delays or prevents the investor from earning a return on invested capital. Among other factors, traditional utility risks include the potential that regulators may exclude an investment from rates (*e.g.*, for imprudence in the construction of generating plant), significant delay between the time an investment is made and the time when it is reflected in rates (also called "regulatory lag"),[18] and factors that influence utility revenues such as fluctuations in weather and load growth. Nationally, utilities have been successful in minimizing regulatory lag over the past decade through "alternative" rate mechanisms like future test years, formula rate plans, various riders to collect specific costs, and other forms of piecemeal (or "single-item") ratemaking. The chart below was created by a large multi-jurisdictional utility to show investors how little it relies on traditional rate cases compared to alternate ratemaking mechanisms to recover capital:

Figure 3: Illustrative Recovery of Incremental Utility Capital[19]



[18] Regulatory lag is a complex issue, as it can both hurt and help investors depending on the circumstances. If a utility is over-earning, regulatory lag benefits shareholders by increasing the time it takes to adjust rates downward. When a utility is under-earning, regulatory lag can delay setting rates that reflect the utility's actual revenue requirement.

[19] Entergy Presentation to Investors, February 26, 2016 at 13. http://files.shareholder.com/downloads/ETR/3875534036x0x877819/1D8DC9CC-7551-4A2F-8658-7DDB4147F73A/Handout_-_Investor_Meetings_Feb_26.pdf.

In Texas, there has been a profound trend of declining risk in the utility business over the last 15 years. Regulatory lag has been materially reduced (if not almost completely eliminated) for utilities—inside and outside of ERCOT—through the myriad of riders and cost-recovery factors that are now granted. Utilities can now increase rates without a full rate case to reflect: (1) transmission investment through Transmission Cost of Service (TCOS) and Transmission Cost Recovery Factor (TCRF) updates,[20] (2) distribution investment through Distribution Cost Recovery Factor (DCRF) updates,[21] (3) purchased power contracts through the Purchased Power Cost Recovery Factor (PCRF),[22] (4) changes in fuel costs through the Fuel Factor,[23] and (4) costs of complying with energy efficiency mandates through the energy efficiency cost recovery factor (EECRF).[24] Many of these updates can be filed at the utility's discretion, which means utilities can selectively file only when they believe a rate increase is supported. Some of these mechanisms fail to account for potential reductions in related cost drivers, such as deferred federal income taxes (a reduction to rate base) and load growth. Given that these mechanisms largely eliminate risk and can actually *increase* a utility's earned return, it is indisputable that utilities in Texas face much less regulatory lag or risk than they did in the 1980s or 1990s.

In ERCOT, generation service is now competitive and is no longer provided by rate-regulated utilities. Compared to generation investment, transmission and distribution investment carries a much lower risk of being excluded from rates because: (1) the investments are more granular and gradual, and (2) the utility has significantly less discretion in defining the type of technology and size of the investment. This is particularly true in ERCOT, given that ERCOT independently studies and pre-approves the need for new, large transmission facilities.[25] Outside of ERCOT, utilities still retain some risk and regulatory lag associated with generation investment, but the shorter lead time and lower capital cost for natural gas-fired generation (which has been the leading technology for new utility generation) reduces the impact of regulatory lag and imprudence risk. When combined with the myriad rate riders discussed above, it is hard to dispute that regulatory risk has declined significantly for both ERCOT and non-ERCOT utilities.

Yet, utility ROEs have not declined as ratemaking theory, market factors, and risk analyses would predict. Instead, the risk premiums reflected in utility ROEs have caused regulated utility stocks to closely track the Dow Jones Industrial Average (DJIA), which is comprised of enterprises that are traditionally much riskier than the utility sector. Utilities have historically been "low-beta" stocks, meaning that they are inherently less risky and, accordingly, have traditionally had lower equity returns than the DJIA. But in the recent past, utility stocks

[20] PUC Subst. R. 25.192 and 25.193 (ERCOT) and 25.239 (non-ERCOT).

[21] PUC Subst. R. 25.234 (both ERCOT and non-ERCOT).

[22] PUC Subst. R. 25.238 (non-ERCOT).

[23] PUC Subst. R. 25.235 (non-ERCOT)

[24] PUC Subst. R. 25.181 (both ERCOT and non-ERCOT).

[25] By rule, the PUCT gives "great weight" to ERCOT's need determination. *See* PUC Subst. R. 25.101(b)(3)(ii).

have actually had *higher* returns than the DJIA, strongly indicating that utility ROEs are far above appropriate risk premium levels.[26]

These high risk premiums for utilities allowing equity investor returns equivalent or superior than what is available in the markets generally, but for *a lower level or risk*. This runs completely counter to rationale economics or market theory. As one observer colorfully put it, ". . . if you want actionable [investment] intelligence up front, here it is: invest in regulated utilities."[27]

As discussed below, a large part of the problem appears to be the feedback loop created when ROEs in regulated utility rate cases are set based on the historical ROEs awarded to *other* utilities. This approach makes it difficult to implement a significant change when economic conditions or regulatory changes would merit significant reductions in ROEs. Regulators are understandably hesitant to reduce ROEs relative to what other jurisdictions are awarding for fear of deterring investment, and utilities have been successful in appealing to this conservativism to keep ROEs higher than they should be. However, the data shows that it is imperative to overcome this collective action problem and broadly reevaluate whether regulated ROEs are at appropriate levels.

V. Time to Reassess

The foregoing discussion begs the question: why have utilities continued to receive inflated ROEs in spite of all these compelling factors? The primary drivers behind the "stickiness" of utility ROEs appear to be: (1) the method by which regulated utility ROEs have traditionally been established (the "peer-group" method mentioned previously), and (2) strategic utility appeals to the risk aversion of regulators when it comes to investment and reliability.

Regulators are responsible for making sure customers receive reliable electricity service from their monopoly provider—an issue that is keenly important to the public and policymakers. Because of this, regulators are understandably sensitive to arguments that reducing utility ROEs will decrease investment below an acceptable level, harm a utility's credit profile, or compromise reliability. In recent years, utilities appear to have been particularly successful in persuading regulators that any reduction in ROEs will have unacceptable consequences, despite extensive countervailing data. For example, utilities will often describe an ROE reduction as "credit negative" to deter regulators from pursuing such a reduction. Of course, it is always "credit positive" to grant utilities higher ROEs and "credit negative" to lower ROEs; this says nothing about appropriate return levels. Rebalancing must occur at some point, and reducing ROEs will not harm investment incentives if the reductions appropriately reflect the overall economic climate or the specific risks faced by a utility. Similarly, in its 2016 Annual Rate Case Survey, Public Utilities Fortnightly described a recent case where Michigan regulators set aside extensive record evidence and the Administrative Law Judge's ROE recommendation based on the utility's unsubstantiated claim that investors would view Michigan as a "volatile" regulatory

[26] Some analyses show that utility stocks have outperformed industrial stocks since 2004. *See* Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016).

[27] *See* Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016); Hyman, L. and Tilles, W., "Don't Cry for Utility Shareholders, America," Public Utilities Fortnightly at 65 (Oct. 2016).

environment if its ROE were set at 10%.[28] *It cannot be the case that utility ROEs must only go up and never down, irrespective of industry risk or prevailing economic trends.* Again, this claim of "volatility" was a successful scare tactic that resulted in an excessive awarded ROE.

Structural features of the ratemaking process can also make it difficult to reduce utility earnings to reflect lower risk profiles or overall market trends. As one industry analyst recently noted, "Utility rates also tend to be downward sticky. It is easier for a utility to initiate and prosecute rate increase than for consumer advocates to initiate and prosecute rate decreases, with an imbalance in information being one obvious reason why."[29] Utilities have a natural incentive to file a rate case when they believe a rate increase will be approved, but not when rates would be reduced. Many of the largest regulated utilities in Texas have not had a rate case in many years. For example, Oncor, the state's single largest utility, has not had a rate case in more than five years and still has an awarded ROE of 10.25%.[30] ROEs are still being set in Texas in excess of 9.5%.[31]

Critically, as noted above, the "peer group" method of setting ROEs can create a feedback loop that perpetuates inflated ROEs. The most commonly accepted starting point for setting a utility's ROE is through a peer group analysis, where a survey is conducted of the ROEs for utility companies are claimed to be "peers" of the utility in question. This methodology effectively creates an echo chamber, where past regulatory decisions inform future ROEs and undue conservatism is reinforced—often in the face of contrary market data. As the data discussed above indicates, the ROEs that would be justified by objective market data appears to be in conflict with current awarded ROEs. This indicates that "peer group" ROE methodologies should be revisited to better account for changes in utility risk and other economic factors, rather than relying almost exclusively on the returns that have been awarded in the past.

In fairness, utilities offer a number of arguments to support the current risk premiums in awarded ROEs. For one, utilities argue that the reduction in risk-free ROE yields is an aberration, and utility ROEs should be set based on longer periods or on a lagging/historical basis. While this theory could justify a temporary increase in the observed risk premiums for utility ROEs over one or two years, the trend has far outlasted the limits of this justification. The US has overwhelmingly been a low-interest rate environment since late 2008, and there are a number of structural reasons why these relatively low interest rates may continue.[32,33] Yet, utility

[28] Cross, P., "2016 Annual Rate Case Survey," Public Utilities Fortnightly (Nov. 2016).

[29] Huntoon, S., "Nice Work If You Can Get It," Public Utilities Fortnightly (Aug. 2016).

[30] *Application of Oncor Electric Delivery Company, LLC for Authority to Change Rates*, Docket No. 38929, Final Order at Finding of Fact No. 32 (Aug. 29, 2011).

[31] *See, e.g., Year-end 2015 PUC Earnings Reports for Electric Utilities*, Project No. 45636, Staff Memorandum (Oct. 21, 2016).

[32] Rates for treasury bonds increased immediately following the recent election, but this increase is small (only an increase of about 45-50 basis points) relative to the drop in interest rates over the last decade, which has been hundreds of basis points. These interest rate increases are from historical lows – current treasury yields are at the same level as the beginning of 2016. Some investors are already seeing the Treasuries market as oversold and are recommending bond purchases instead. *See* http://www.wsj.com/articles/government-bond-sell-off-continues-on-trumps-economic-plans-1479114743 *and* http://www.wsj.com/articles/the-trump-trade-is-getting-out-of-hand-buy-some-bonds-1479143922.

ROEs have not been reduced to appropriately track this reduction over the past *eight years*. Utilities also argue that high risk premiums are correlated with low Treasury rates;[34] however, this argument confuses causation with correlation. The historical trend of risk premiums rising as Treasury rates fall is simply a reflection of the "stickiness" of high utility returns relative to interest rates, for the reasons discussed previously, and is not some independent economic principle that regulators should pursue. Utility ROE witnesses will also claim that unique utility business risks or size/scale issues support higher ROEs for particular utilities, but the reality is that there are no persuasive arguments for sustaining high risk premiums when risk in the utility business in Texas has been significantly reduced by legislative and regulatory changes, or when other comparably risky enterprises are earning lower returns in general. Notably, Moody's Investor Service has even concluded that reducing utility ROEs would not harm the credit profile of utilities in general because of the lower business risk and the many credit-positive cost recovery mechanisms that have been adopted.[35] This perspective from an independent bond rating agency reinforces the other substantial data demonstrating that reducing utility ROEs will not harm their ability to attract investment, and is a strong signal that the status quo should be holistically reexamined.

VI. Conclusion

The ROEs awarded to and achieved by regulated utilities are higher than needed to attract appropriate levels of investment. Customers and the economy in general would be well-served by a comprehensive reexamination of utility ROEs in light of relevant risk factors and economic trends. This includes reexamining the application of "peer-group" based ROE analyses, as well critical analysis of utility claims regarding the allegedly adverse impacts of reducing ROEs. Certainly, utility requests for "alternative" or "streamlined" ratemaking should be met with a rigorous analysis of the impacts that existing and proposed mechanisms have in shifting risk from the utility to its customers, and those impacts should translate to lower ROEs. In the world of utility ROEs, "what goes up" should also come down when risk factors and overall economic circumstances overwhelmingly support a lower level of returns.

[33] Structural reasons for low rates include the aging of the US population, persistent excess savings in the rest of the world, and lower productivity growth. *See* http://voxeu.org/article/causes-and-consequences-persistently-low-interest-rates and https://www.allianz.com/v_1453369613000/media/economic_research/publications/working_papers/en/WPRealzinse.pdf.

[34] A utility ROE witness has made this argument in recent rate cases in Texas.

[35] Moody's Investor Service, Sector-in-Depth Analysis, March 2015.

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-10

Proxy Group Summary

October 3, 2019

Proxy Group Summary

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3					[1]		[2]		[3]		[4]
4											
5	Company		Ticker		Market Cap. ($ millions)		Market Category		Value Line Safety Rank		Financial Strength
6											
7	Algonquin Pwr & Util		AQN		6,400		Mid Cap		NR		NR
8	Ameren Corp.		AEE		18,000		Large Cap		2		A
9	Avangrid, Inc.		AGR		16,000		Large Cap		2		B++
10	Avista Corp.		AVA		3,000		Mid Cap		2		A
11	Black Hills Corp.		BKH		4,800		Mid Cap		2		A
12	CenterPoint Energy		CNP		14,000		Large Cap		3		B+
13	CMS Energy Corp.		CMS		16,000		Large Cap		2		B++
14	Dominion Energy		D		60,000		Large Cap		2		B++
15	DTE Energy Co.		DTE		23,000		Large Cap		2		B++
16	Edison International		EIX		23,000		Large Cap		3		B+
17	El Paso Electric Co.		EE		2,700		Mid Cap		2		B++
18	Emera Inc.		EMA		12,500		Large Cap		2		B+
19	Entergy Corp.		ETR		19,000		Large Cap		3		B++
20	Exelon Corp.		EXC		44,000		Large Cap		2		B++
21	FirstEnergy Corp.		FE		23,000		Large Cap		2		B++
22	Hawaiian Elec.		HE		4,800		Mid Cap		2		A
23	IDACORP, Inc.		IDA		5,300		Mid Cap		2		A
24	NorthWestern Corp.		NWE		3,700		Mid Cap		2		B++
25	OGE Energy Corp.		OGE		8,500		Mid Cap		2		A
26	Otter Tail Corp.		OTTR		2,000		Mid Cap		2		A
27	PNM Resources		PNM		3,900		Mid Cap		3		B+
28	Sempra Energy		SRE		38,000		Large Cap		2		A
29											
30											
31											
32	[1], [3], [4] Value Line Investment Survey										
33	[2] Large Cap > $10 billion; Mid Cap > $2 billion; Small Cap > $200 million										
34											

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

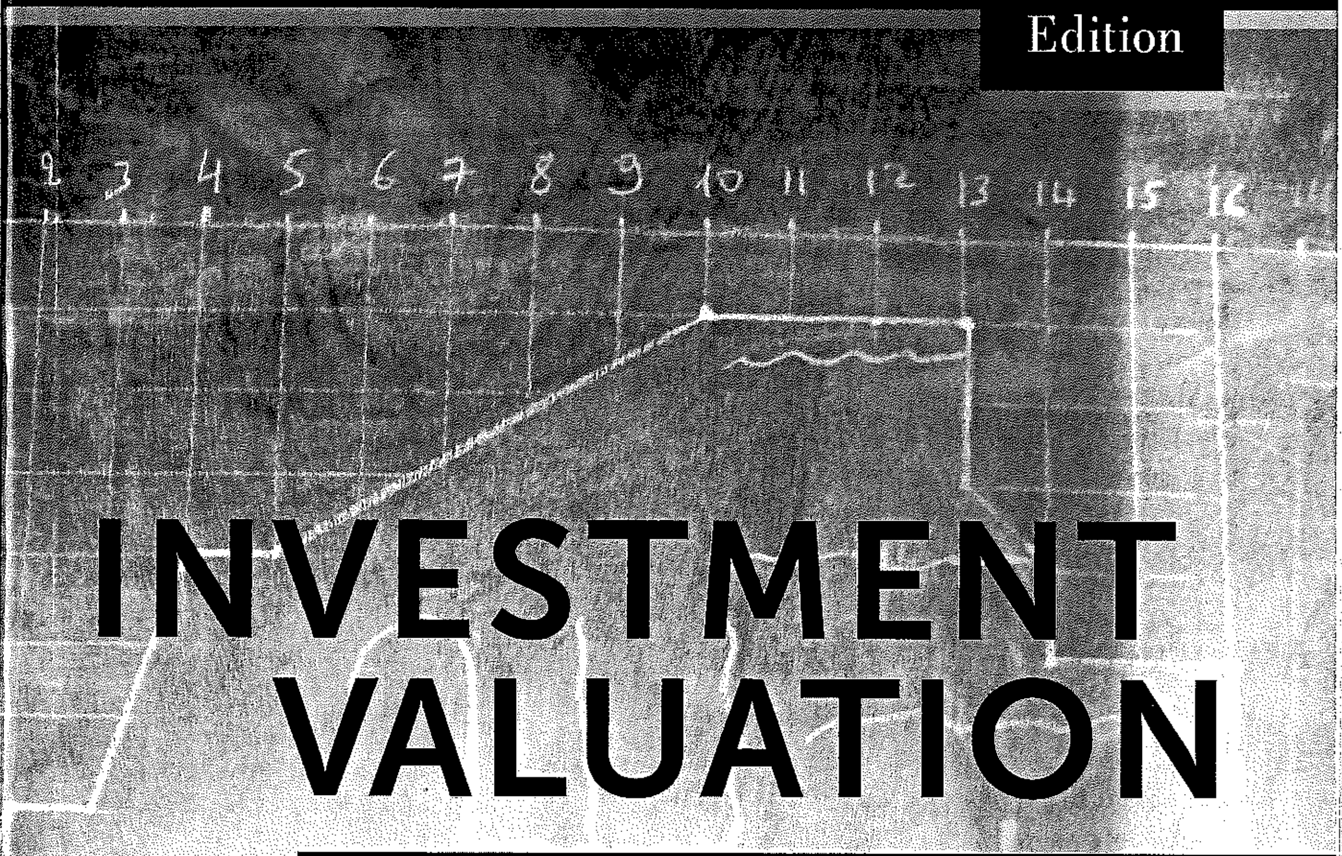
EXHIBIT DJG-11

Aswath Damodaran: *Investment Valuation* (Excerpt)

October 3, 2019

Wiley Finance Series

3rd Edition



INVESTMENT VALUATION

UNIVERSITY EDITION

Tools and Techniques for Determining the Value of Any Asset

ASWATH DAMODARAN

When return distributions are normal, the characteristics of any investment can be measured with two variables—the expected return, which represents the opportunity in the investment, and the standard deviation or variance, which represents the danger. In this scenario, a rational investor, faced with a choice between two investments with the same standard deviation but different expected returns, will always pick the one with the higher expected return.

In the more general case, where distributions are neither symmetric nor normal, it is still conceivable that investors will choose between investments on the basis of only the expected return and the variance, if they possess utility functions that allow them to do so.[1] It is far more likely, however, that they prefer positive skewed distributions to negatively skewed ones, and distributions with a lower likelihood of jumps (lower kurtosis) over those with a higher likelihood of jumps (higher kurtosis). In this world, investors will trade off the good (higher expected returns and more positive skewness) against the bad (higher variance and kurtosis) in making investments.

In closing, it should be noted that the expected returns and variances that we run into in practice are almost always estimated using past returns rather than future returns. The assumption made when using historical variances is that past return distributions are good indicators of future return distributions. When this assumption is violated, as is the case when the asset's characteristics have changed significantly over time, the historical estimates may not be good measures of risk.

optvar.xls: **This is a dataset on the Web that summarizes standard deviations and variances of stocks in various sectors in the United States.**

Diversifiable and Nondiversifiable Risk

Although there are many reasons why actual returns may differ from expected returns, we can group the reasons into two categories: firm-specific and marketwide. The risks that arise from firm-specific actions affect one or a few investments, while the risks arising from marketwide reasons affect many or all investments. This distinction is critical to the way we assess risk in finance.

Components of Risk When an investor buys stock or takes an equity position in a firm, he or she is exposed to many risks. Some risk may affect only one or a few firms, and this risk is categorized as firm-specific risk. Within this category, we would consider a wide range of risks, starting with the risk that a firm may have misjudged the demand for a product from its customers; we call this project risk. For instance, consider

[1]A utility function is a way of summarizing investor preferences into a generic term called "utility" on the basis of some choice variables. In this case, for instance, the investors' utility or satisfaction is stated as a function of wealth. By doing so, we effectively can answer questions such as, Will investors be twice as happy if they have twice as much wealth? Does each marginal increase in wealth lead to less additional utility than the prior marginal increase? In one specific form of this function, the quadratic utility function, the entire utility of an investor can be compressed into the expected wealth measure and the standard deviation in that wealth.

Boeing's investment in a Super Jumbo jet. This investment is based on the assumption that airlines want a larger airplane and are willing to pay a high price for it. If Boeing has misjudged this demand, it will clearly have an impact on Boeing's earnings and value, but it should not have a significant effect on other firms in the market. The risk could also arise from competitors proving to be stronger or weaker than anticipated, called competitive risk. For instance, assume that Boeing and Airbus are competing for an order from Qantas, the Australian airline. The possibility that Airbus may win the bid is a potential source of risk to Boeing and perhaps some of its suppliers, but again, few other firms will be affected by it. Similarly, Disney recently launched magazines aimed at teenage girls, hoping to capitalize on the success of its TV shows. Whether it succeeds is clearly important to Disney and its competitors, but it is unlikely to have an impact on the rest of the market. In fact, risk measures can be extended to include risks that may affect an entire sector but are restricted to that sector; we call this sector risk. For instance, a cut in the defense budget in the United States will adversely affect all firms in the defense business, including Boeing, but there should be no significant impact on other sectors. What is common across the three risks described—project, competitive, and sector risk—is that they affect only a small subset of firms.

There is another group of risks that is much more pervasive and affects many if not all investments. For instance, when interest rates increase, all investments are negatively affected, albeit to different degrees. Similarly, when the economy weakens, all firms feel the effects, though cyclical firms (such as automobiles, steel, and housing) may feel it more. We term this risk market risk.

Finally, there are risks that fall in a gray area, depending on how many assets they affect. For instance, when the dollar strengthens against other currencies, it has a significant impact on the earnings and values of firms with international operations. If most firms in the market have significant international operations, it could well be categorized as market risk. If only a few do, it would be closer to firm-specific risk. Figure 4.4 summarizes the spectrum of firm-specific and market risks.

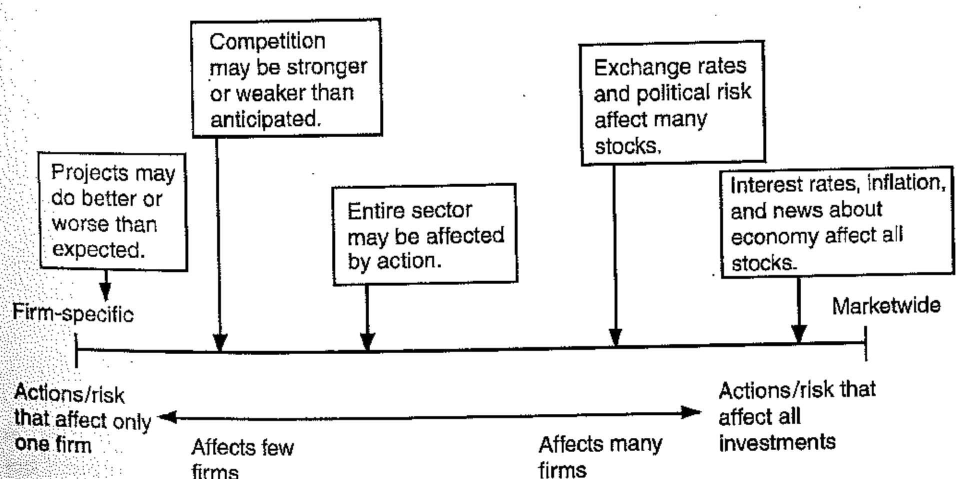


FIGURE 4.4 Breakdown of Risk

Why Diversification Reduces or Eliminates Firm-Specific Risk: An Intuitive Explanation As an investor, you could invest all your portfolio in one asset. If you do so, you are exposed to both firm-specific and market risk. If, however, you expand your portfolio to include other assets or stocks, you are diversifying, and by doing so you can reduce your exposure to firm-specific risk. There are two reasons why diversification reduces or, at the limit, eliminates firm-specific risk. The first is that each investment in a diversified portfolio is a much smaller percentage of that portfolio than would be the case if you were not diversified. Any action that increases or decreases the value of only that investment or a small group of investments will have only a small impact on your overall portfolio, whereas undiversified investors are much more exposed to changes in the values of the investments in their portfolios. The second reason is that the effects of firm-specific actions on the prices of individual assets in a portfolio can be either positive or negative for each asset for any period. Thus, in very large portfolios this risk will average out to zero and will not affect the overall value of the portfolio.

In contrast, the effects of marketwide movements are likely to be in the same direction for most or all investments in a portfolio, though some assets may be affected more than others. For instance, other things being equal, an increase in interest rates will lower the values of most assets in a portfolio. Being more diversified does not eliminate this risk.

A Statistical Analysis of Diversification-Reducing Risk The effects of diversification on risk can be illustrated fairly dramatically by examining the effects of increasing the number of assets in a portfolio on portfolio variance. The variance in a portfolio is partially determined by the variances of the individual assets in the portfolio and partially by how they move together; the latter is measured statistically with a correlation coefficient or the covariance across investments in the portfolio. It is the covariance term that provides an insight into why diversification will reduce risk and by how much.

Consider a portfolio of two assets. Asset A has an expected return of μ_A and a variance in returns of σ^2_A, while asset B has an expected return of μ_B and a variance in returns of σ^2_B. The correlation in returns between the two assets, which measures how the assets move together, is ρ_{AB}. The expected returns and variances of a two-asset portfolio can be written as a function of these inputs and the proportion of the portfolio going to each asset.

$$\mu_{portfolio} = w_A\mu_A + (1 - w_A)\mu_B$$

$$\sigma^2_{portfolio} = w_A^2\sigma_A^2 + (1 - w_A)^2\sigma_B^2 + 2w_A(1 - w_A)\rho_{AB}\sigma_A\sigma_B$$

where w_A = Proportion of the portfolio in asset A

The last term in the variance formulation is sometimes written in terms of the covariance in returns between the two assets, which is:

$$\sigma_{AB} = \rho_{AB}\sigma_A\sigma_B$$

The savings that accrue from diversification are a function of the correlation coefficient. Other things remaining equal, the higher the correlation in returns between the two assets, the smaller are the potential benefits from diversification. It is rationale presented by those who use shorter periods is that the risk aversion of the average investor is likely to change over time, and that using a shorter time period provides a more updated estimate. This has to be offset against a cost associated with using shorter time periods, which is the greater noise in the risk premium estimate. In fact, given the annual standard deviation in stock prices[7] between 1926 and 2010 of 20 percent, the standard error[8] associated with the risk premium estimate can be estimated for different estimation periods in Table 7.2.

Note that to get reasonable standard errors, we need very long time periods of historical returns. Conversely, the standard errors from 10-year and 20-year estimates are likely to be almost as large as or larger than the actual risk premium estimated. This cost of using shorter time periods seems, in our view, to overwhelm any advantages associated with getting a more updated premium.

2. *Choice of risk-free security.* The Ibbotson database reports returns on both Treasury bills (T-bills) and Treasury bonds (T-bonds), and the risk premium for stocks can be estimated relative to each. Given that the yield curve in the United States has been upward-sloping for most of the past seven decades, the risk premium is larger when estimated relative to shorter-term government securities (such as Treasury bills). *The risk-free rate chosen in computing the premium has to be consistent with the risk-free rate used to compute expected returns.* Thus, if the Treasury bill rate is used as the risk-free rate, the premium has to be the premium earned by stocks over that rate. If the Treasury bond rate is used as the risk-free rate, the premium has to be estimated relative to that rate. For the most part, in corporate finance and valuation, the risk-free rate will be a long-term default-free Treasury (government) bond rate and not a Treasury bill rate. Thus, the risk premium used should be the premium earned by stocks over Treasury bonds.

3. *Arithmetic and geometric averages.* The final sticking point when it comes to estimating historical premiums relates to how the average returns on stocks, Treasury bonds, and Treasury bills are computed. The arithmetic average return measures the simple mean of the series of annual returns, whereas the geometric

TABLE 7.2 Standard Errors in Risk Premium Estimates

Estimation Period	Standard Error of Risk Premium Estimate
5 years	$20\%/\sqrt{5} = 8.94\%$
10 years	$20\%/\sqrt{10} = 6.32\%$
25 years	$20\%/\sqrt{25} = 4.00\%$
50 years	$20\%/\sqrt{50} = 2.83\%$

[7]For the historical data on stock returns, bond returns, and bill returns, check under "Updated Data" in www.stern.nyu.edu/~adamodar.

[8]These estimates of the standard error are probably understated, because they are based on the assumption that annual returns are uncorrelated over time. There is substantial empirical evidence that returns are correlated over time, which would make this standard error estimate much larger.

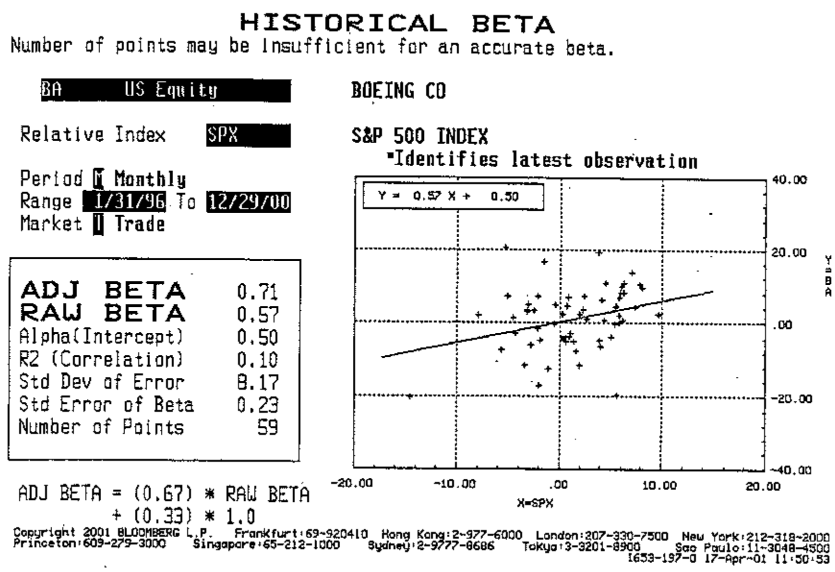


FIGURE 8.2 Beta Estimate for Boeing

from Bloomberg for Boeing, using the same period as our regression (January 1996 to December 2000).

While the time period used is identical to the one used in our earlier regression, there are subtle differences between this regression and the one in Figure 8.1. First, Bloomberg uses price appreciation in the stock and the market index in estimating betas and ignores dividends.[4] The fact that dividends are ignored does not make much difference for a company like Boeing, but it could make a difference for a company that either pays no dividends or pays significantly higher dividends than the market. This explains the mild differences in the intercept (0.50% versus 0.54%) and the beta (0.57 versus 0.56).

Second, Bloomberg also computes what it calls an adjusted beta, which is estimated as follows:

$$\text{Adjusted beta} = \text{Raw beta}(0.67) + 1.00(0.33)$$

These weights (0.67 and 0.33) do not vary across stocks, and this process pushes all estimated betas toward 1. Most services employ similar procedures to adjust betas toward 1. In doing so, they are drawing on empirical evidence that suggests that the betas for most companies, over time, tend to move toward the average beta, which is 1. This may be explained by the fact that firms get more diversified in their product mix and client base as they get larger. While we agree with the notion that betas move toward 1 over time, the weighting process used by most services strikes us as arbitrary and not particularly useful.

[4]This is done purely for computational convenience.

The unlevered beta of a firm is determined by the nature of its products and services (cyclicality, discretionary nature) and its operating leverage. It is often also referred to as the asset beta, since it is determined by the assets owned by the firm. Thus, the levered beta, which is also the beta for an equity investment in a firm, is determined both by the riskiness of the business it operates in and by the amount of financial leverage risk it has taken on.

Since financial leverage multiplies the underlying business risk, it stands to reason that firms that have high business risk should be reluctant to take on financial leverage. It also stands to reason that firms that operate in stable businesses should be much more willing to take on financial leverage. Utilities, for instance, have historically had high debt ratios but have not had high betas, mostly because their underlying businesses have been stable and fairly predictable.

ILLUSTRATION 8.3: Effects of Leverage on Betas: Boeing

From the regression for the period from 1996 to 2000, Boeing had a historical beta of 0.56. Since this regression uses stock prices of Boeing over this period, we began by estimating the average debt-to-equity ratio between 1996 and 2000, using market values for debt and equity.

$$\text{Average debt-to-equity ratio between 1996 and 2000} = 15.56\%$$

The beta over the 1996–2000 period reflects this average leverage. To estimate the unlevered beta over the period, a marginal tax rate of 35% is used:

$$\begin{aligned}\text{Unlevered beta} &= \text{Current beta}/[1 + (1 - \text{Tax rate})(\text{Average debt/Equity})]\\ &= 0.56/[1 + (1 - 0.35)(0.1556)] = 0.51\end{aligned}$$

The unlevered beta for Boeing over the 1996–2000 period is 0.51. The levered beta at different levels of debt can then be estimated:

$$\text{Levered beta} = \text{Unlevered beta} \times [1 + (1 - \text{Tax rate})(\text{Debt/Equity})]$$

For instance, if Boeing were to increase its debt equity ratio to 10%, its equity beta will be:

$$\text{Levered beta (@10\% D/E)} = 0.51 \times [1 + (1 - 0.35)(0.10)] = 0.543$$

If the debt equity ratio were raised to 25%, the equity beta would be:

$$\text{Levered beta (@25\% D/E)} = 0.51 \times [1 + (1 - 0.35)(0.25)] = 0.59$$

The following table summarizes the beta estimates for different levels of financial leverage ranging from 0% to 90% debt.

Debt to Capital	*Debt/Equity Ratio*	*Beta*	*Effect of Leverage*
0%	0.00%	0.51	0.00
10%	11.11%	0.55	0.04
20%	25.00%	0.59	0.08
30%	42.86%	0.65	0.14
40%	66.67%	0.73	0.22
50%	100.00%	0.84	0.33
60%	150.00%	1.00	0.50
70%	233.33%	1.28	0.77
80%	400.00%	1.83	1.32
90%	900.00%	3.48	2.98

As Boeing's financial leverage increases, the beta increases concurrently.

***levbeta.xls.* This spreadsheet allows you to estimate the unlevered beta for a firm and compute the betas as a function of the leverage of the firm.**

Bottom-Up Betas Breaking down betas into their business risk and financial leverage components provides us with an alternative way of estimating betas, in which we do not need past prices on an individual firm or asset to estimate its beta.

To develop this alternative approach, we need to introduce an additional property of betas that proves invaluable. The beta of two assets put together is a weighted average of the individual asset betas, with the weights based on market value. Consequently, the beta for a firm is a weighted average of the betas of all the different businesses it is in. We can estimate the beta for a firm in five steps:

Step 1: Identify the business or businesses the firm operates in.

Step 2: Find other publicly traded firms in each business and obtain their regression betas, which we use to compute an average beta for the firms.

Step 3: Estimate the average unlevered beta for the business by unlevering the average (or median) beta for the firms by their average (or median) debt-to-equity ratio. Alternatively, we could estimate the unlevered beta for each firm and then compute the average of the unlevered betas. The first approach is preferable because unlevering an erroneous regression beta is likely to compound the error.

$$\text{Unlevered beta}_{\text{business}} = \text{Beta}_{\text{comparable firms}}/[1 + (1 - t)(\text{D/E ratio}_{\text{comparable firms}})]$$

Step 4: Estimate an unlevered beta for the firm being analyzed, taking a weighted average of the unlevered betas for the businesses it operates in, using the proportion of firm value derived from each business as the weights. If values are not available, use operating income or revenues as weights. This weighted average is called the bottom-up unlevered beta.

$$\text{Unlevered beta}_{\text{firm}} = \sum_{j=1}^{j=k}\left(\text{Unlevered beta}_j \times \text{Value weight}_j\right)$$

where the firm is assumed to operating in k different businesses.

Step 5: Finally, estimate the current market values of debt and equity at the firm and use this debt-to-equity ratio to estimate a levered beta.

The betas estimated using this processs are called bottom-up betas.

The Case for Bottom-Up Betas At first sight, the use of bottom-up betas may seem to leave us exposed to all of the problems noted with regression betas. After

3. *Extent of disagreement between analysts.* While consensus earnings growth rates are useful in valuation, the extent of disagreement between analysts measured by the standard deviation in growth predictions is also a useful measure of the reliability of the consensus forecasts. Givoly and Lakonsihok (1984) found that the dispersion of earnings is correlated with other measures of risk such as beta and is a good predictor of expected returns.

4. *Quality of analysts following the stock.* This is the hardest of the variables to quantify. One measure of quality is the size of the forecast error made by analysts following a stock, relative to models that use only historical data—the smaller this relative error, the larger the weight that should be attached to analyst forecasts. Another measure is the effect on stock prices of analyst revisions—the more informative the forecasts, the greater the effect on stock prices. There are some who argue that the focus on consensus forecasts misses the point that some analysts are better than others in predicting earnings, and that their forecasts should be isolated from the rest and weighted more.

Analyst forecasts may be useful in coming up with a predicted growth rate for a firm, but there is a danger to blindly following consensus forecasts. Analysts often make significant errors in forecasting earnings, partly because they depend on the same data sources (which might have been erroneous or misleading) and partly because they sometimes overlook significant shifts in the fundamental characteristics of the firm. The secret to successful valuation often lies in discovering inconsistencies between analysts' forecasts of growth and a firm's fundamentals. The next section examines this relationship in more detail.

FUNDAMENTAL DETERMINANTS OF GROWTH

With both historical and analyst estimates, growth is an exogenous variable that affects value but is divorced from the operating details of the firm. The soundest way of incorporating growth into value is to make it endogenous i.e., tie in more closely to the actions that a business takes to create and sustain that growth. This section begins by considering the relationship between fundamentals and growth in equity income, and then moves on to look at the determinants of growth in operating income.

Growth in Equity Earnings

When estimating cash flows to equity, we usually begin with estimates of net income, if we are valuing equity in the aggregate, or earnings per share, if we are valuing equity per share. This section begins by presenting the fundamentals that determine expected growth in earnings per share and then move on to consider a more expanded version of the model that looks at growth in net income.

Growth in Earnings per Share The simplest relationship determining growth is one based on the retention ratio (percentage of earnings retained in the firm) and the return on equity on its projects. Firms that have higher retention ratios and earn higher returns on equity should have much higher growth rates in earnings per share than firms that do not share these characteristics. To establish this, note that:

$$g_t = (NI_t - NI_{t-1})/NI_{t-1}$$

where g_t = Growth rate in net income
NI_t = Net income in year t

Also note that the ROE in period t can be written as NI in period t divided by the Book value of equity in period t − 1. Given the definition of return on equity, the net income in year t − 1 can be written as:

$$NI_{t-1} = \text{Book value of equity}_{t-2} \times ROE_{t-1}$$

where ROE_{t-1} = Return on equity in year t − 1

The net income in year t can be written as:

$$NI_t = (\text{Book value of equity}_{t-2} + \text{Retained earnings}_{t-1}) \times ROE_t$$

Assuming that the return on equity is unchanged (i.e., $ROE_t = ROE_{t-1} = ROE$):

$$\begin{aligned} g_t &= \text{Retained earnings}_{t-1}/NI_{t-1} \times ROE \\ &= \text{Retention ratio} \times ROE \\ &= b \times ROE \end{aligned}$$

where b is the retention ratio. Note that the firm is not being allowed to raise equity by issuing new shares. Consequently, the growth rate in net income and the growth rate in earnings per share are the same in this formulation.

ILLUSTRATION 11.5: Growth in Earnings per Share

This illustration considers the expected growth rate in earnings based on the retention ratio and return on equity for three firms—Consolidated Edison, a regulated utility that provides power to New York City and its environs; Procter & Gamble, a leading brand-name consumer product firm; and Intel, the technology giant—in 2010. The following table summarizes the returns on equity, retention ratios, and expected growth rates in earnings for the three firms in 2010:

	Return on Equity	*Retention Ratio*	*Expected Growth Rate*
Consolidated Edison	9.79%	36.00%	3.52%
Procter & Gamble	20.09%	50.26%	10.10%
Intel	32.00%	70.00%	22.40%

Intel has the highest expected growth rate in earnings per share, assuming that it can maintain its current return on equity and retention ratio. Procter & Gamble also can be expected to post a healthy growth rate, notwithstanding the fact that it pays out more than 50% of its earnings as dividends because of its high return on equity. Con Ed, on the other hand, has a very low expected growth rate because its return on equity and retention ratio are anemic.

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

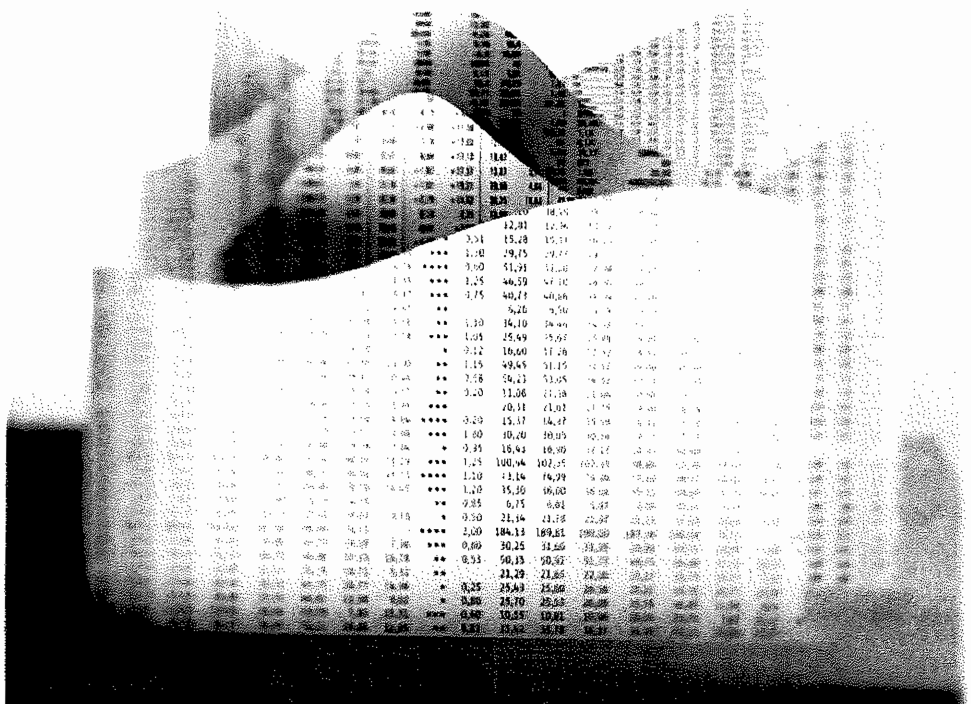
EXHIBIT DJG-12

Zvi Bodie et al.: *Essentials of Investments* (Excerpt)

October 3, 2019

BODIE | KANE | MARCUS

Essentials of Investments



Ninth Edition

6.1 DIVERSIFICATION AND PORTFOLIO RISK

Suppose you have in your risky portfolio only one stock, say, Dell Computers. What are the sources of risk affecting this "portfolio"?

We can identify two broad sources of uncertainty. The first is the risk from general economic conditions, such as business cycles, inflation, interest rates, exchange rates, and so forth. None of these macroeconomic factors can be predicted with certainty, and all affect Dell stock. Then you must add firm-specific influences, such as Dell's success in R&D, its management style and philosophy, and so on. Firm-specific factors are those that affect Dell without noticeably affecting other firms.

Now consider adding another security to the risky portfolio. If you invest half of your risky portfolio in ExxonMobil, leaving the other half in Dell, what happens to portfolio risk? Because the firm-specific influences on the two stocks differ (statistically speaking, the influences are independent), this strategy should reduce portfolio risk. For example, when oil prices fall, hurting ExxonMobil, computer prices might rise, helping Dell. The two effects are offsetting, which stabilizes portfolio return.

But why stop at only two stocks? Diversifying into many more securities continues to reduce exposure to firm-specific factors, so portfolio volatility should continue to fall. Ultimately, however, there is no way to avoid all risk. To the extent that virtually all securities are affected by common (risky) macroeconomic factors, we cannot eliminate exposure to general economic risk, no matter how many stocks we hold.

Figure 6.1 illustrates these concepts. When all risk is firm-specific, as in Figure 6.1A, diversification can reduce risk to low levels. With all risk sources independent, and with investment spread across many securities, exposure to any particular source of risk is negligible. This is an application of the law of large numbers. The reduction of risk to very low levels because of independent risk sources is called the *insurance principle.*

market risk, systematic risk, nondiversifiable risk
Risk factors common to the whole economy.

When a common source of risk affects all firms, however, even extensive diversification cannot eliminate all risk. In Figure 6.1B, portfolio standard deviation falls as the number of securities increases, but it is not reduced to zero. The risk that remains even after diversification is called **market risk,** risk that is attributable to marketwide risk sources. Other terms are **systematic risk** or **nondiversifiable risk.** The risk that *can* be eliminated by diversification is called **unique risk, firm-specific risk, nonsystematic risk,** or **diversifiable risk.**

unique risk, firm-specific risk, nonsystematic risk, diversifiable risk
Risk that can be eliminated by diversification.

This analysis is borne out by empirical studies. Figure 6.2 shows the effect of portfolio diversification, using data on NYSE stocks. The figure shows the average standard deviations of equally weighted portfolios constructed by selecting stocks at random as a function of the number of stocks in the portfolio. On average, portfolio risk does fall with diversification, but

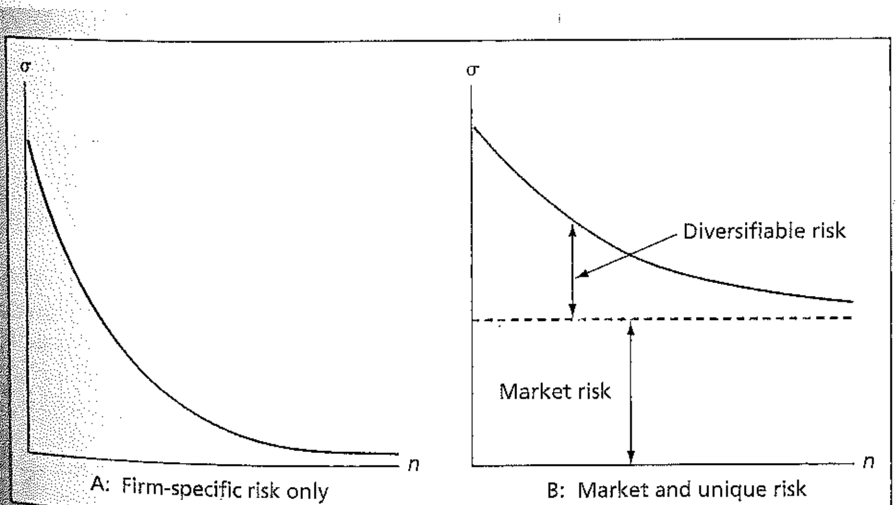


FIGURE 6.1
Portfolio risk as a function of the number of stocks in the portfolio

the economy toward this goal. In contrast, supply-side policies treat the issue of the productive capacity of the economy. The goal is to create an environment in which workers and owners of capital have the maximum incentive and ability to produce and develop goods.

Supply-side economists also pay considerable attention to tax policy. While demand-siders look at the effect of taxes on consumption demand, supply-siders focus on incentives and marginal tax rates. They argue that lowering tax rates will elicit more investment and improve incentives to work, thereby enhancing economic growth. Some go so far as to claim that reductions in tax rates can lead to increases in tax revenues because the lower tax rates will cause the economy and the revenue tax base to grow by more than the tax rate is reduced.

CONCEPT check 12.3

Large tax cuts in 2001 were followed by relatively rapid growth in GDP. How would demand-side and supply-side economists differ in their interpretations of this phenomenon?

12.6 BUSINESS CYCLES

We've looked at the tools the government uses to fine-tune the economy, attempting to maintain low unemployment and low inflation. Despite these efforts, economies repeatedly seem to pass through good and bad times. One determinant of the broad asset allocation decision of many analysts is a forecast of whether the macroeconomy is improving or deteriorating. A forecast that differs from the market consensus can have a major impact on investment strategy.

The Business Cycle

The economy recurrently experiences periods of expansion and contraction, although the length and depth of these cycles can be irregular. These recurring patterns of recession and recovery are called **business cycles.** Figure 12.4 presents graphs of several measures of production and output. The production series all show clear variation around a generally rising trend. The bottom graph of capacity utilization also evidences a clear cyclical (although irregular) pattern.

business cycles
Recurring cycles of recession and recovery.

The transition points across cycles are called peaks and troughs, identified by the boundaries of the shaded areas of the graph. A **peak** is the transition from the end of an expansion to the start of a contraction. A **trough** occurs at the bottom of a recession just as the economy enters a recovery. The shaded areas in Figure 12.4 all represent periods of recession.

peak
The transition from the end of an expansion to the start of a contraction.

trough
The transition point between recession and recovery.

As the economy passes through different stages of the business cycle, the relative profitability of different industry groups might be expected to vary. For example, at a trough, just before the economy begins to recover from a recession, one would expect that **cyclical industries,** those with above-average sensitivity to the state of the economy, would tend to outperform other industries. Examples of cyclical industries are producers of durable goods, such as automobiles or washing machines. Because purchases of these goods can be deferred during a recession, sales are particularly sensitive to macroeconomic conditions. Other cyclical industries are producers of capital goods, that is, goods used by other firms to produce their own products. When demand is slack, few companies will be expanding and purchasing capital goods. Therefore, the capital goods industry bears the brunt of a slowdown but does well in an expansion.

cyclical industries
Industries with above-average sensitivity to the state of the economy.

In contrast to cyclical firms, **defensive industries** have little sensitivity to the business cycle. These are industries that produce goods for which sales and profits are least sensitive to the state of the economy. Defensive industries include food producers and processors, pharmaceutical firms, and public utilities. These industries will outperform others when the economy enters a recession.

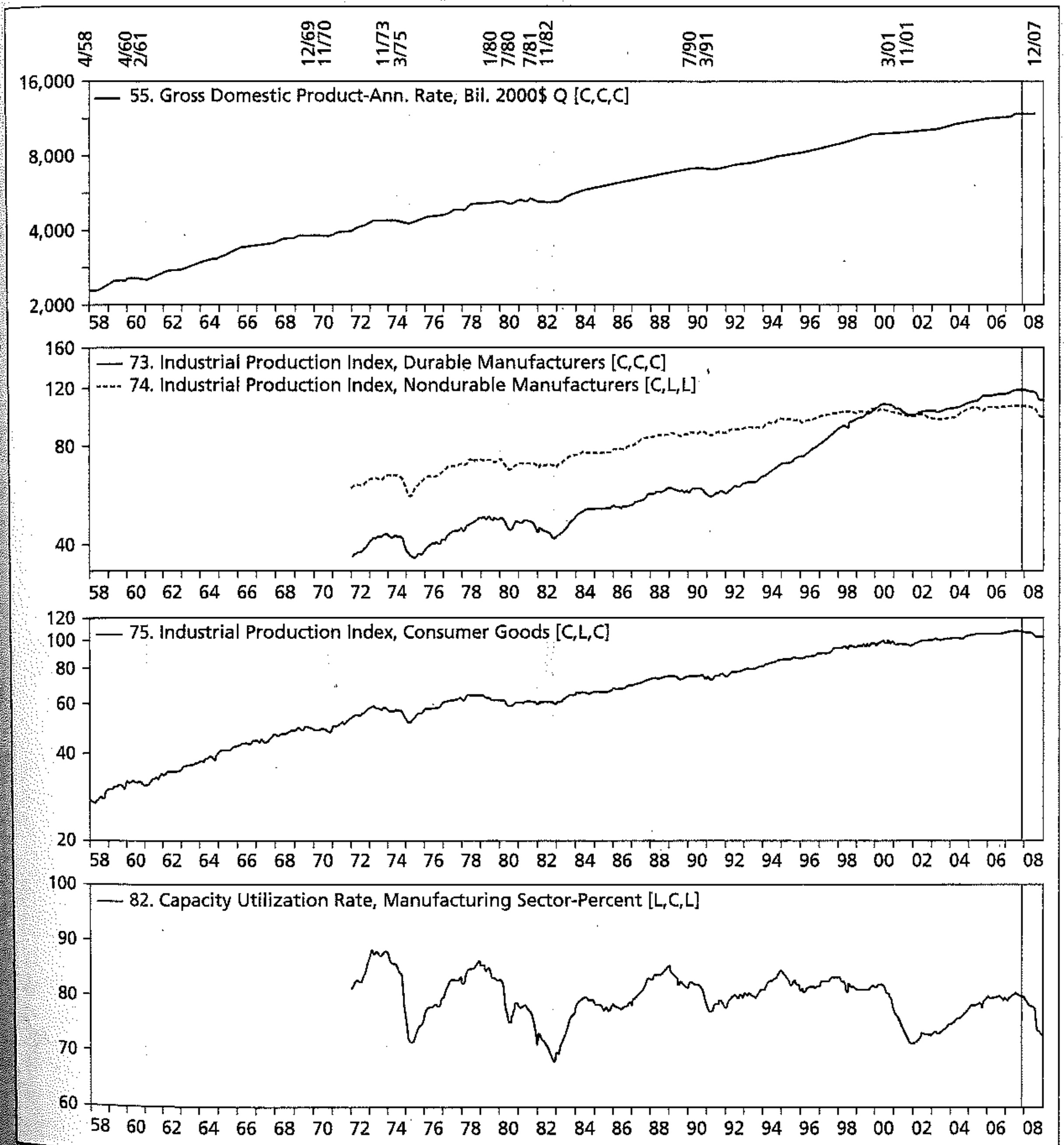
defensive industries
Industries with below-average sensitivity to the state of the economy.

The cyclical/defensive classification corresponds well to the notion of systematic or market risk introduced in our discussion of portfolio theory. When perceptions about the health of the economy become more optimistic, for example, the prices of most stocks will increase as forecasts of profitability rise. Because the cyclical firms are most sensitive to such developments,

FIGURE 12.4

Cyclical indicators

Source: The Conference Board, *Business Cycle Indicators*, December 2008. Used with permission of The Conference Board, Inc.



their stock prices will rise the most. Thus, firms in cyclical industries will tend to have high-beta stocks. In general, then, stocks of cyclical firms will show the best results when economic news is positive, but they will also show the worst results when that news is bad. Conversely, defensive firms will have low betas and performance that is comparatively unaffected by overall market conditions.

If your assessments of the state of the business cycle were reliably more accurate than those of other investors, choosing between cyclical and defensive industries would be easy. You

5. *Turnarounds.* These are firms that are in bankruptcy or soon might be. If they can recover from what might appear to be imminent disaster, they can offer tremendous investment returns. A good example of this type of firm would be Chrysler in 1982, when it required a government guarantee on its debt to avoid bankruptcy. The stock price rose 15-fold in the next five years.
6. *Asset plays.* These are firms that have valuable assets not currently reflected in the stock price. For example, a company may own or be located on valuable real estate that is worth as much or more than the company's business enterprises. Sometimes the hidden asset can be tax-loss carryforwards. Other times the assets may be intangible. For example, a cable company might have a valuable list of cable subscribers. These assets do not immediately generate cash flow and so may be more easily overlooked by other analysts attempting to value the firm.

Industry Structure and Performance

The maturation of an industry involves regular changes in the firm's competitive environment. As a final topic, we examine the relationship between industry structure, competitive strategy, and profitability. Michael Porter (1980, 1985) has highlighted these five determinants of competition: threat of entry from new competitors, rivalry between existing competitors, price pressure from substitute products, the bargaining power of buyers, and the bargaining power of suppliers.

Threat of entry New entrants to an industry put pressure on price and profits. Even if a firm has not yet entered an industry, the potential for it to do so places pressure on prices, since high prices and profit margins will encourage entry by new competitors. Therefore, barriers to entry can be a key determinant of industry profitability. Barriers can take many forms. For example, existing firms may already have secure distribution channels for their products based on long-standing relationships with customers or suppliers that would be costly for a new entrant to duplicate. Brand loyalty also makes it difficult for new entrants to penetrate a market and gives firms more pricing discretion. Proprietary knowledge or patent protection also may give firms advantages in serving a market. Finally, an existing firm's experience in a market may give it cost advantages due to the learning that takes place over time.

Rivalry between existing competitors When there are several competitors in an industry, there will generally be more price competition and lower profit margins as competitors seek to expand their share of the market. Slow industry growth contributes to this competition since expansion must come at the expense of a rival's market share. High fixed costs also create pressure to reduce prices since fixed costs put greater pressure on firms to operate near full capacity. Industries producing relatively homogeneous goods also are subject to considerable price pressure since firms cannot compete on the basis of product differentiation.

Pressure from substitute products Substitute products mean that the industry faces competition from firms in related industries. For example, sugar producers compete with corn syrup producers. Wool producers compete with synthetic fiber producers. The availability of substitutes limits the prices that can be charged to customers.

Bargaining power of buyers If a buyer purchases a large fraction of an industry's output, it will have considerable bargaining power and can demand price concessions. For example, auto producers can put pressure on suppliers of auto parts. This reduces the profitability of the auto parts industry.

Bargaining power of suppliers If a supplier of a key input has monopolistic control over the product, it can demand higher prices for the good and squeeze profits out of the industry. One special case of this issue pertains to organized labor as a supplier of a key

$$V_0 = \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + \cdots + \frac{D_H + P_H}{(1+k)^H} \quad \text{(13.2)}$$

Note the similarity between this formula and the bond valuation formula developed in Chapter 10. Each relates price to the present value of a stream of payments (coupons in the case of bonds, dividends in the case of stocks) and a final payment (the face value of the bond or the sales price of the stock). The key differences in the case of stocks are the uncertainty of dividends, the lack of a fixed maturity date, and the unknown sales price at the horizon date. Indeed, one can continue to substitute for price indefinitely to conclude

$$V_0 = \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \cdots \quad \text{(13.3)}$$

dividend discount model (DDM)

A formula for the intrinsic value of a firm equal to the present value of all expected future dividends.

Equation 13.3 states the stock price should equal the present value of all expected future dividends into perpetuity. This formula is called the **dividend discount model (DDM)** of stock prices.

It is tempting, but incorrect, to conclude from Equation 13.3 that the DDM focuses exclusively on dividends and ignores capital gains as a motive for investing in stock. Indeed, we assume explicitly in Equation 13.1 that capital gains (as reflected in the expected sales price, P_1) are part of the stock's value. At the same time, the price at which you can sell a stock in the future depends on dividend forecasts at that time.

The reason only dividends appear in Equation 13.3 is not that investors ignore capital gains. It is instead that those capital gains will be determined by dividend forecasts at the time the stock is sold. That is why in Equation 13.2 we can write the stock price as the present value of dividends plus sales price for *any* horizon date. P_H is the present value at time H of all dividends expected to be paid after the horizon date. That value is then discounted back to today, time 0. The DDM asserts that stock prices are determined ultimately by the cash flows accruing to stockholders, and those are dividends.

The Constant-Growth DDM

Equation 13.3 as it stands is still not very useful in valuing a stock because it requires dividend forecasts for every year into the indefinite future. To make the DDM practical, we need to introduce some simplifying assumptions. A useful and common first pass at the problem is to assume that dividends are trending upward at a stable growth rate that we will call g. For example, if $g = .05$ and the most recently paid dividend was $D_0 = 3.81$, expected future dividends are

$$D_1 = D_0(1+g) = 3.81 \times 1.05 = 4.00$$
$$D_2 = D_0(1+g)^2 = 3.81 \times (1.05)^2 = 4.20$$
$$D_3 = D_0(1+g)^3 = 3.81 \times (1.05)^3 = 4.41 \text{ etc.}$$

Using these dividend forecasts in Equation 13.3, we solve for intrinsic value as

$$V_0 = \frac{D_0(1+g)}{1+k} + \frac{D_0(1+g)^2}{(1+k)^2} + \frac{D_0(1+g)^3}{(1+k)^3} + \cdots$$

This equation can be simplified to

$$V_0 = \frac{D_0(1+g)}{k-g} = \frac{D_1}{k-g} \quad \text{(13.4)}$$

Note in Equation 13.4 that we divide D_1 (not D_0) by $k - g$ to calculate intrinsic value. If the market capitalization rate for Steady State is 12%, we can use Equation 13.4 to show that the intrinsic value of a share of Steady State stock is

CONCEPT check 13.3

a. Calculate the price of a firm with a plowback ratio of .60 if its ROE is 20%. Current earnings, E_1, will be $5 per share, and $k = 12.5\%$.

b. What if ROE is 10%, which is less than the market capitalization rate? Compare the firm's price in this instance to that of a firm with the same ROE and E_1 but a plowback ratio of $b = 0$.

Life Cycles and Multistage Growth Models

As useful as the constant-growth DDM formula is, you need to remember that it is based on a simplifying assumption, namely, that the dividend growth rate will be constant forever. In fact, firms typically pass through life cycles with very different dividend profiles in different phases. In early years, there are ample opportunities for profitable reinvestment in the company. Payout ratios are low, and growth is correspondingly rapid. In later years, the firm matures, production capacity is sufficient to meet market demand, competitors enter the market, and attractive opportunities for reinvestment may become harder to find. In this mature phase, the firm may choose to increase the dividend payout ratio, rather than retain earnings. The dividend level increases, but thereafter it grows at a slower rate because the company has fewer growth opportunities.

Table 13.2 illustrates this profile. It gives Value Line's forecasts of return on capital, dividend payout ratio, and projected three-year growth rate in earnings per share of a sample of the firms included in the computer software and services industry versus those of East Coast electric utilities. (We compare return on capital rather than return on equity because the latter is affected by leverage, which tends to be far greater in the electric utility industry than in the software industry. Return on capital measures operating income per dollar of total long-term

TABLE 13.2 Financial ratios in two industries

	Return on Capital	Payout Ratio	Growth Rate 2012–2015
Computer Software			
Adobe Systems	13.0%	0.0%	15.4%
Cognizant	19.0	0.0	21.0
Compuware	16.5	0.0	18.6
Intuit	21.0	21.0	13.3
Microsoft	31.5	30.0	10.2
Oracle	20.0	14.0	10.3
Red Hat	14.0	0.0	17.9
Parametric Tech	15.5	0.0	9.6
SAP	18.5	28.0	6.7
Median	18.5%	0.0%	13.3%
Electric Utilities			
Central Hudson G&E	6.0%	67.0%	2.6%
Central Vermont	6.0	54.0	1.9
Consolidated Edison	6.0	63.0	2.7
Duke Energy	5.5	65.0	4.4
Northeast Utilities	6.5	47.0	6.3
NStar	9.0	60.0	8.4
Pennsylvania Power (PPL Corp.)	7.0	55.0	3.6
Public Services Enter.	6.5	45.0	8.4
United Illuminating	5.0	73.0	2.2
Median	6.0%	60.0%	3.6%

Source: From *Value Line Investment Survey*, November and December 2011. Reprinted with permission of Value Line Investment Survey © 2012 Value Line, Inc. All Rights Reserved Worldwide. "Value Line" is a registered trademark of Value Line Inc.

financing, regardless of whether the source of the capital supplied is debt or equity. We will return to this issue in the next chapter.)

By and large, software firms have attractive investment opportunities. The median return on capital of these firms is forecast to be 18.5%, and the firms have responded with quite high plowback ratios. Most of these firms pay no dividends at all. The high returns on capital and high plowback ratios result in rapid growth. The median growth rate of earnings per share in this group is projected at 13.3%.

In contrast, the electric utilities are more representative of mature firms. Their median return on capital is lower, 6%; dividend payout is higher, 60%; and average growth rate is lower, 3.6%. We conclude that the higher payouts of the electric utilities reflect their more limited opportunities to reinvest earnings at attractive rates of return.

To value companies with temporarily high growth, analysts use a multistage version of the dividend discount model. Dividends in the early high-growth period are forecast and their combined present value is calculated. Then, once the firm is projected to settle down to a steady growth phase, the constant-growth DDM is applied to value the remaining stream of dividends.

two-stage DDM
Dividend discount model in which dividend growth is assumed to level off only at some future date.

We can illustrate this with a real-life example using a **two-stage DDM.** Figure 13.2 is a *Value Line Investment Survey* report on Honda Motor Co. Some of Honda's relevant information of the end of 2011 is highlighted.

Honda's beta appears at the circled A, its recent stock price at the B, the per-share dividend payments at the C, the ROE (referred to as "return on shareholder equity") at the D, and the dividend payout ratio (referred to as "all dividends to net profits") at the E.[4] The rows ending at C, D, and E are historical time series. The boldfaced italicized entries under 2012 are estimates for that year. Similarly, the entries in the far right column (labeled 14–16) are forecasts for some time between 2014 and 2016, which we will take to be 2015.

Value Line provides explicit dividend forecasts over the relative short term, with dividends rising from \$.72 in 2012 to \$1 in 2015. We can obtain dividend inputs for this initial period by using the explicit forecasts for 2012–2015 and linear interpolation for the years between:

2012	\$ .72
2013	\$ .81
2014	\$ .90
2015	\$1.00

Now let us assume the dividend growth rate will be steady beyond 2015. What is a reasonable guess for that steady-state growth rate? Value Line forecasts a dividend payout ratio of .25 and an ROE of 10%, implying long-term growth will be

$$g = \text{ROE} \times b = 10\% \times (1 - .25) = 7.5\%$$

Our estimate of Honda's intrinsic value using an investment horizon of 2015 is therefore obtained from Equation 13.2, which we restate here:

$$V_{2011} = \frac{D_{2012}}{(1+k)} + \frac{D_{2013}}{(1+k)^2} + \frac{D_{2014}}{(1+k)^3} + \frac{D_{2015} + P_{2015}}{(1+k)^4}$$

$$= \frac{.72}{(1+k)} + \frac{.81}{(1+k)^2} + \frac{.90}{(1+k)^3} + \frac{1.00 + P_{2015}}{(1+k)^4}$$

Here, P_{2015} represents the forecast price at which we can sell our shares of Honda at the end of 2015, when dividends enter their constant-growth phase. That price, according to the constant-growth DDM, should be

[4] Because Honda is a Japanese firm, Americans would hold its shares via ADRs, or American Depository Receipts. ADRs are not shares of the firm but are *claims* to shares of the underlying foreign stock that are then traded in U.S. security markets. Value Line notes that each Honda ADR is a claim on one common share, but in other cases, each ADR may represent a claim to either multiple shares or even fractional shares.

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

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AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-13

John Graham et al.: *Corporate Finance* (Excerpt)

October 3, 2019

GRAHAM
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CORPORATE FINANCE

LINKING THEORY TO WHAT COMPANIES DO

equal to $\overline{\sigma}^2$ and that, across any pair of stocks (say, stock *i* and stock *j*), the average covariance is $\overline{\sigma}_{ij}$. Then the portfolio variance equation can be written as shown at the bottom of Figure 5.7.

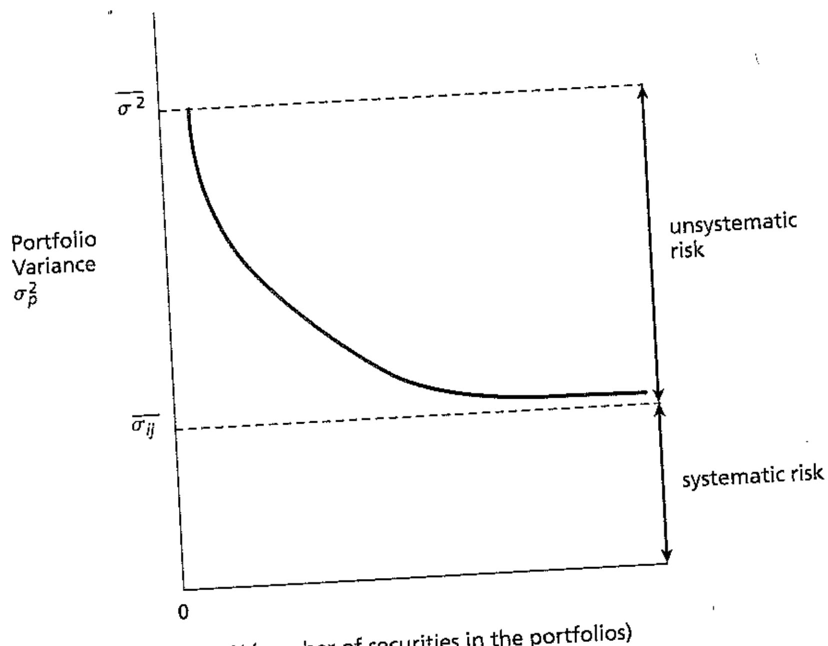
As the number *N* of stocks in the portfolio becomes very large, the variance term $N(1/N)^2\,\overline{\sigma}^2$ approaches zero. This means the average variance of individual stocks has no impact on portfolio variance. As *N* increases, the second term in the equation converges to $\overline{\sigma}_{ij}$, indicating that what really determines the risk of a large portfolio is the average covariance between all pairs of securities. A large portfolio consisting of securities that are, on average, only weakly correlated with each other will have a lower variance than a portfolio that consists of highly correlated securities.

Figure 5.8 plots the relationship between the number of securities in a portfolio and the portfolio's variance given by this equation. For investors, the figure contains both good and bad news. The good news is that as the number of securities in the portfolio increases, the portfolio's variance declines. Given the proliferation of low-cost mutual funds available today, investors can construct portfolios containing hundreds of securities, thereby reducing the variance of their investment portfolio to some degree. The bad news is that the marginal risk reduction benefit of adding more securities to the portfolio decreases as the number of securities in the portfolio increases. Not even a very well diversified portfolio can eliminate all risk.

FIGURE 5.8

Effect of Diversification on Portfolio Variance

Adding more securities to a portfolio lowers the portfolio's volatility, but the incremental benefit of adding more securities declines as the number of securities rises.



Because some risks systematically affect almost all securities, there is a limit to the risk reduction achievable by adding more securities to a portfolio. The average covariance term $\overline{\sigma}_{ij}$ represents this limit. No matter how diversified a portfolio becomes, its variance cannot fall below the average covariance of securities in the portfolio. Financial economists give this type of risk special names: undiversifiable risk, **systematic risk**, or market risk. Similarly, the risk that diversification eliminates is called diversifiable risk, **unsystematic risk**, idiosyncratic risk, or unique risk.

JOB INTERVIEW QUESTION

What is the difference between systematic and unsystematic risk?

In real-world terms, what exactly is systematic risk? This is a difficult question to answer, and we explore it in more depth in the next chapter. For now, we just say that systematic risks are those that are common across all types of securities. Fluctuations in gross domestic product, inflation, oil prices, or interest rates can be thought of as systematic risks, and so might certain political factors. For example, the legal system governing investors and markets in a given country can influence systematic risk because that system determines the level of protection given to minority shareholders, creditors, and ordinary investors. When investors perceive that the legal system protects their interests, their willingness to trade and invest in securities increases and so the returns they require for bearing risk decline.

Smart Ethics Video

Utpal Bhattacharya, Indiana University

"The cost of equity goes up if insider trading laws are not enforced."

See the entire interview at **SMARTFinance**

If investors can cheaply eliminate some risks through diversification, then we should not expect a security to earn higher returns for risks that can be eliminated through diversification. Investors can expect compensation only for bearing systematic risk (i.e., risk that cannot be diversified away). Refer back to the Example following Equation 5.4, which showed that the average return on Merck stock was about the same over 10 years as the average return on the S&P 500 *even though* Merck stock was much more volatile than the index. An undiversified investor who held only Merck stock had to bear twice as much volatility as an investor who owned the S&P 500, even though both investors earned the same reward. This is not to say that Merck was or is a bad investment. The point is that holding Merck (or any other individual company's stock) *in isolation* is a poor investment strategy. Undiversified portfolios are generally suboptimal because they expose investors to unsystematic risk without offering higher returns.

Measuring the Systematic Risk of an Individual Security

The previous section demonstrated two important facts. First, the formula for portfolio variance shows that each security contributes to a portfolio's risk through two channels, the security's own variance and its covariance with all other securities in the portfolio. In diversified portfolios, only the second channel matters. This implies that an individual stock's variance may be a poor measure of its risk. The variance of a stock captures its total volatility, some of which is unsystematic and some of which is systematic. Second, because diversification eliminates unsystematic risk, the market provides no reward for bearing it. As a consequence, though we still expect to see a positive relationship in the market between risk and return, we can no longer be confident that a positive relationship will exist between returns on an individual asset and its variance. Again, a stock's variance captures both its systematic and unsystematic fluctuations, but only the systematic component should be correlated with returns.

We need a new measure for an individual asset's risk, one that captures only the systematic component of its volatility. Remember, the primary contribution to portfolio risk from a single asset comes from its covariance with all the other assets in the portfolio. Imagine that an investor holds a fully diversified portfolio—literally, a portfolio containing every asset available in the economy. How would this investor determine the contribution of a single security to the portfolio's risk? One way to do that would be to measure the covariance between a single asset and the portfolio. Recall, though, the difficulty that nonstandard units cause for interpreting covariance calculations. A standardized measure would be preferable, and finance theory gives us just such a measure in the concept of *beta*:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \qquad \text{(Eq. 5.1}$$

The **beta** of asset i (β_i) equals the covariance of the asset's returns with the returns on the overall portfolio, divided by the portfolio's variance. As you will see in the next chapter, the portfolio we refer to here is known as "the market portfolio," a value-weighted portfolio of all available assets.[14] A security's beta gives us a standardized measure of its covariance with all other assets, or a measure of its systematic risk. If the market rewards only systematic risk and if beta captures the systematic risk of an individual asset, then we should observe a positive relationship between values of beta and returns in the market.

Observe that the formula for an asset's beta closely resembles that of the correlation coefficient:

$$\beta_i = \frac{\sigma_{im}}{(\sigma_m)(\sigma_m)};$$

$$\rho_i = \frac{\sigma_{im}}{(\sigma_i)(\sigma_m)}$$

The equations are identical except in one respect: The denominator of the correlation coefficient multiplies the standard deviations of the asset and the market, whereas the denominator of the beta formula squares the standard deviation of the market. This small adjustment to the denominator makes the interpretation of beta a little different from that of the correlation coefficient. First, unlike ρ, beta has no maximum or minimum value. Second, beta indicates how much the individual asset's return moves, on average, when the market moves by 1%. For example, if a stock has a beta of 1.5, then, when the market return increases by 1%, the stock return will (on average) increase by 1.5%.

EXAMPLE

Now that we understand the beta measure of a stock's risk, how does it compare to the measure we started with, standard deviation? Comparing the monthly returns on each of the four stocks listed in Table 5.3 to returns on the overall stock market, suppose you calculate the following statistics:

Stock	Covariance with Market
Mead	0.0031
Boise	0.0026
Nike	0.0011
Arrow	−0.0003

If the variance of market returns were 0.0028, then the betas of the four stocks would be as follows:

Mead 1.11 Boise 0.93 Nike 0.39 Arrow −0.11

These betas contain several surprises. First, based on comparison of the standard deviations of each stock in Table 5.3, we concluded that Nike was the riskiest security. Comparing the betas, however, suggests that Nike is less risky than either Mead or Boise Cascade. Recall

(continued)

[14]The modifier "value-weighted" means that the fraction invested in a particular security is equal to that security's total market value as a percentage of the market value of all securities. For example, if the total market value of all securities in the market is $10 trillion and if the total market value of a certain company's stock equals $100 billion, then the fraction of that stock in a value-weighted portfolio would be 0.01, or 1%.

6.4 The Capital Asset Pricing Model (CAPM)

The Security Market Line

The basic CAPM was developed almost simultaneously during the mid-1960s by William Sharpe (1964), John Lintner, and Jan Mossin (1966); it was quickly embraced by academic researchers and, in time, by practitioners as well. The reason for the CAPM's widespread acceptance is not hard to understand—for the first time, researchers and practitioners had a model that generated specific predictions about the risk–return characteristics of individual assets, and this relation was driven by how each asset *covaries* with the market portfolio.

The formal development of the CAPM requires several assumptions about investors and markets. Rather than present a detailed list of these assumptions, we present the logic of the CAPM as it flows from the material we have covered so far.

1. Investors are risk averse and require higher returns on riskier investments.
2. Because investors can diversify, they care only about the systematic (or undiversifiable) risk of any investment.
3. The market offers no reward for bearing unsystematic risk because it can be diversified away.
4. Some portfolios are better than others. Portfolios that maximize expected return for any level of risk are efficient portfolios.
5. If investors can borrow and lend at the risk-free rate, then there exists a single risky portfolio that dominates all others. Only portfolios consisting of the risk-free asset and the optimal risky portfolio are efficient.
6. If investors have homogeneous expectations then they will agree on the composition of the optimal portfolio. In equilibrium, the optimal portfolio will be the market portfolio.
7. The central insight of the CAPM is that if all investors hold the market portfolio then—when evaluating the risk of any specific asset—they will be concerned with the covariance of that asset with the overall market. The implication is that any measure of an asset's systematic risk exposure must capture how it covaries with the rest of the market. An asset's beta provides a quantitative measure of this risk, and therefore the CAPM predicts a positive, linear relationship between expected return and beta. In the CAPM, beta risk (or market risk) is the only risk that is priced.

The **capital asset pricing model (CAPM)** indicates that the expected return on a specific asset, $E(R_i)$, equals the risk-free rate plus a premium that depends on the asset's beta, β_i, and the expected risk premium on the market portfolio, $E(R_m) - R_f$:

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right]$$

Recall that beta measures an asset's correlation with a broader portfolio—in this case, the market portfolio. The higher the beta of a security, the greater the security's exposure to systematic risk and the higher the expected return it must offer investors. Although there are three variables (R_f, β_i, and $E(R_m)$) on the right-hand side of the CAPM equation, only beta changes from one security to the next. For that reason, analysts classify the CAPM as a **single-factor model**, meaning that just one variable explains differences in returns across securities.

JOB INTERVIEW QUESTION

How would you estimate the expected return of a stock?

Figure 6.8 plots the CAPM equation on a diagram with the expected return on the y-axis and beta on the x-axis. The intercept of this line is R_f, and its slope is $E(R_m) - R_f$. According to the CAPM, the equilibrium expected returns of all securities must plot on

In the CAPM, you recall, the market portfolio is a value-weighted combination of all assets in the economy. At present, we are unaware of any market index that attempts to incorporate every type of asset. When using the CAPM, most practitioners and academics use the returns on a broad-based stock index as a proxy for the true market portfolio. Accordingly, rather than try to estimate the expected risk premium on the market portfolio, analysts usually focus on the expected equity risk premium: the difference in expected returns between a well-diversified portfolio of common stocks and a risk-free asset such as a U.S. Treasury bill.

Since 1900, the average real return on stocks outpaced the average real return on U.S. Treasury bills by about 5.4% per year. But in the CAPM, what matters is not the actual equity risk premium from the past but rather the expected equity risk premium looking forward. Though many analysts trust the historical evidence and simply plug in a figure close to 6% for the term $E(R_m - R_f)$, a naive reliance on long-run historical averages is not the only approach for estimating the expected risk premium. Using an unbiased estimate is important because an error in the risk premium translates directly into an error in a project's discount rate and thus in its NPV.

One variable that analysts can use to obtain a forward-looking estimate of the risk premium is the market's aggregate earnings yield, which is the reciprocal of the price-to-earnings ratios. For example, to calculate the earnings yield for the S&P 500, add up the earnings of all 500 companies and divide by the aggregate market value of these firms. Corporate earnings fluctuate with the business cycle, so analysts usually try to smooth out, or *normalize*, these temporary effects before using the earnings yield to estimate the risk premium. In the United States, the long-run average value of the earnings yield is about 7%, a little less than the average real return on stocks. It should come as no surprise that the earnings yield is closely related to the real return on stocks. After all, stocks represent a claim on corporate earnings.

A second forward-looking method for estimating the equity risk premium uses the dividend growth model. Recall that this model calculates the present value of a perpetual dividend stream growing at a constant rate, g:

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

Rearranging this equation shows that the required return on the stock equals the sum of the dividend yield and the dividend growth rate:

$$r = \frac{D_1}{P_0} + g$$

To use this model when estimating the equity risk premium, we must think of the equation in aggregate, macroeconomic terms. In other words, r represents the required return on the stock market rather than the required return on a given stock. The ratio D_1/P_0 represents the aggregate dividend yield, and g represents the (real) growth rate of aggregate dividends. From 1872 to 1950, the expected equity premium derived from this model almost exactly matched the actual risk premium measured using average historical returns (a little more than 4%). From 1950 to 2000, however, the average real return on equities was much higher than predicted by the dividend growth model.[8]

[8]The opposite has been true since 2000: real equity returns have been *lower* on average than the dividend growth model would predict.

efficiency is more important because efficient capital markets incorporate all relevant information into financial asset prices, which in turn helps ensure that promising investments receive funding.

The concept of efficient capital markets is one of the most influential contributions that financial economics has made to modern economic thought. The **efficient markets hypothesis (EMH)**, as formally presented by Eugene Fama in 1970, has revolutionized financial thought, practice, and regulation. The EMH asserts that financial asset prices fully reflect all available information. What do we mean by "all available information"? The answer to this question varies, and we discuss three distinct versions of the efficient markets hypothesis.

The Three Forms of Market Efficiency

The EMH presents three increasingly stringent definitions of efficiency based on the information that market prices reflect: weak-form, semistrong-form, and strong-form efficiency.

Weak-Form Efficiency In markets characterized by **weak-form efficiency**, asset prices incorporate all information from the historical record—that is, all information about price trends or repeating patterns that occurred in the past. This implies that trading strategies based on analyses of historical pricing trends or relationships cannot consistently yield market-beating returns.

Prices in a weak-form efficient market will be unpredictable and will change only in response to the arrival of new information. In technical terms, this means that prices follow a **random walk**: they wander aimlessly, with no connection to past price changes and no tendency to return to a mean value over time.

Semistrong-Form Efficiency The second form of market efficiency, **semistrong-form efficiency**, asserts that asset prices incorporate *all publicly available information.* The key point about this form of efficiency is that the prices need only reflect information from *public* sources (e.g., newspapers, press releases, computer databases).

There is both a "stock" and a "flow" aspect to the information processing capabilities of semistrong-form efficient markets: First, the *level* of asset prices should correctly reflect all pertinent historical, current, and predictable future information that investors can obtain from public sources. Second, asset prices should *change* fully and instantaneously in response to relevant new information.

Strong-Form Efficiency In markets characterized by **strong-form efficiency**, asset prices reflect *all* information, both public and private. This extreme form of market efficiency implies that important company-specific information will be fully incorporated in asset prices with the very first trade after the information is generated.

In strong-form efficient markets, most insider trading would be unprofitable and there would be no benefit to ferreting out information on publicly traded companies. Any data morsel so obtained would already be reflected in stock and bond prices.

Table 10.1 on page 358 describes the three forms of market efficiency and summarizes the key implications of each form.

Malcolm Baker, Harvard University

"There is increasing evidence that stock markets aren't perfectly efficient."

See the entire interview at SMARTFinance

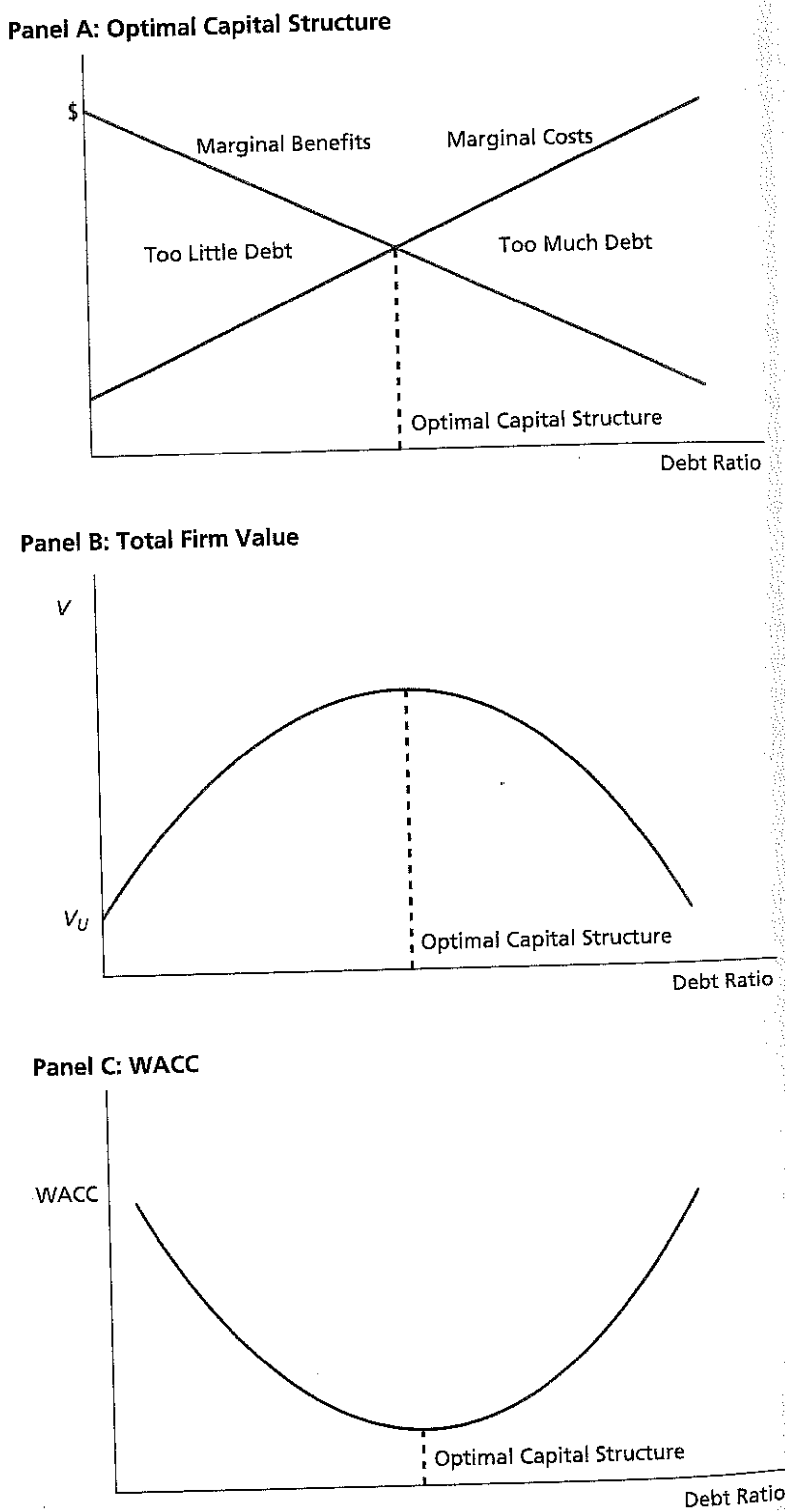
Does Empirical Evidence Support Market Efficiency?

Ultimately, whether financial markets are efficient is an empirical question. For more than a quarter of a century, the efficient market hypothesis enjoyed overwhelming support among financial economists. However, in recent years a large body of empirical evidence challenging the EMH has caused many former "true believers" to take a fresh look at the efficiency question. It also seems likely that the paralysis and near-collapse of global

FIGURE 13.2

Weighing Debt's Benefits and Costs to Find Optimal Capital Structure

The optimal amount of debt occurs where the marginal cost and marginal benefit curves intersect. At that point, total firm value is at its peak, and the weighted average cost of capital (WACC) is at its minimum.



combination of equity and debt, with the debt interest sheltering cash flows from taxes. Even so, most firms do not finance their activities exclusively with debt. This suggests that managers see debt as having costs that at some point offset debt's tax advantages. Based on observing what companies actually do, the optimal capital structure for most firms is apparently one that contains some debt, but not too much.

Duke University
"... managers ... benefits of debt ... of debt."
... entire interview at
Finance

How do managers trade-off the benefits and costs of debt to establish a target capital structure that maximizes firm value? Figure 13.2 offers a conceptual answer to this question. The blue line in Panel A shows that the marginal benefit of borrowing an additional dollar falls as the firm's overall debt ratio rises. The red line indicates that costs associated with using debt rise as leverage increases. We will explain in the next section why marginal benefits fall and marginal costs rise as debt increases, but for now you can just take the benefits and costs in Figure 13.2 as given. As in any cost–benefit analysis, the optimum occurs when marginal benefits and marginal costs are equal. Therefore, a manager facing these cost and benefit curves would choose a debt level where the two curves intersect. To the left of that point, the firm has too little debt in the sense that marginal benefits exceed marginal costs, so adding more debt would increase firm value. At higher debt levels, debt's marginal costs exceed its benefits, so adding leverage decreases firm value.

Panel B shows the relation between total firm value and leverage. If a firm has no debt, its value equals *Vu*. From that point, if the firm adds debt to its capital structure, its value begins to rise. At some point, firm value reaches a peak, and from that point, adding more debt decreases the value of the firm. The graph shows that, at the same point where the marginal benefit and cost curves in Panel A intersect, firm value reaches its peak. The point at which firm value begins to fall as leverage rises is exactly when debt's marginal costs first exceed its marginal benefits.

At the end of this chapter, we will demonstrate how to find the optimal debt ratio. But how much difference does finding the right capital structure really make in the overall value of the firm? In a recent study, van Binsbergen, Graham, and Yang (2008) estimate that, for the average firm, appropriate debt choices can increase firm value by about 5%. In some companies, like the one described at the beginning of Chapter 14, the increase in value may be 10% or more.

Panel C of Figure 13.2 demonstrates how a firm's weighted-average-cost of capital (WACC) changes as leverage rises. Here, the relation is U-shaped. A firm with no leverage can reduce its WACC by substituting debt for equity, but, eventually, the firm reaches a point where further increases in debt cause the WACC to increase. Naturally, managers want to find the debt ratio that minimizes the cost of capital because doing so maximizes firm value. Therefore, the optimum point in Panel C is the same optimum debt ratio in Panels A and B.

In the next section, we explore in more detail why debt's marginal benefits fall and its marginal costs rise as a firm uses more debt in its capital structure. To begin, we revisit the tax advantage of debt, taking into account some important features of the tax code that we have neglected thus far.

Concept Review Questions

1. How large would the costs of debt have to be in order to justify a firm's decision to operate with 100% equity?
2. If a firm is operating well below its optimum debt level, then what market forces might prompt it to use more debt?

Co-head of M&A ... Sachs in the

"... at the ... of industry and ... markets."

... entire interview at ... Finance

The Investment Banker's Role in Equity Issues

We now turn to the services that investment banks provide to issuing companies, with particular attention to U.S. practices.[1] We focus on common stock offerings, though the procedures for selling bonds and preferred stocks are similar. Investment banks play several different roles throughout the securities offering process, and this section describes the evolution of these roles over the course of an issue. We also describe how issuers compensate IBs for the services they provide.

Although firms can issue stock without the assistance of investment bankers, in practice almost all firms hire IBs to help issue equity. Firms can choose an investment banker in one of two ways. The most common approach is a **negotiated offer**, where the issuing firm negotiates the terms of the offer directly with one investment bank. Alternatively, in a **competitively bid offer**, the firm announces the terms of its intended equity sale and then investment banks bid for the business. Intuition suggests that competitive bidding should be cheaper, but the empirical evidence is mixed. One clear sign that competitive offers are not better and cheaper is that the vast majority of equity sales are negotiated. If the costs of negotiated deals were truly higher, then why would so many firms choose that approach?

Firms issuing securities often hire more than one investment bank. In these cases, one of the banks is usually named the **lead underwriter**, or *book-runner*, while the other leading banks are called **co-managers**. Chen and Ritter (2000) argue that firms often prefer to issue securities with several co-managers because doing so increases the number of stock analysts that will follow the firm after the offering. Firms believe that a larger analyst following leads to greater liquidity and higher stock values. Cliff and Denis (2004) verify the importance of attracting the coverage of top-rated analysts by showing that issuing firms willingly allow their IPO share price to be set low enough to attract excess demand and high trading volume, since this will indirectly compensate the underwriters' star analysts.

Investment bankers sell equity under two types of contracts. In a **best-efforts offering**, the investment bank merely promises to give its best effort to sell the firm's securities at the agreed-upon price but makes no guarantee about the ultimate success of the offering. If there is insufficient demand, the firm withdraws the issue from the market. Best-efforts offerings are most commonly used for small, high-risk companies, and the IB receives a commission based on the number of shares sold.

In contrast, in a **firm-commitment offering** the investment bank agrees to underwrite the issue, meaning that the bank guarantees (**underwrites**) the offering price. The IB actually purchases the shares from the firm and resells them to investors. This arrangement requires the investment bank to bear the risk of inadequate demand for the issuer's shares, but banks mitigate this risk in two ways. First, the lead underwriter forms an **underwriting syndicate** consisting of many investment banks. These banks collectively purchase the firm's shares and market them, thus spreading the risk across the syndicate. Second, underwriters go to great lengths to determine the demand for a new issue before it comes to market, and they generally set the issue's *offer price* and take possession of the securities no more than a day or two before the issue date. These steps help ensure that the investment bank faces only a small risk of being unable to sell the shares that it underwrites.

In firm-commitment offerings, investment banks receive compensation for their services via the **underwriting spread**, the difference between the price at which the banks purchase shares from firms (the **net price**) and the price at which they sell the shares to institutional and individual investors (the **offer price**). In some offerings, underwriters receive additional compensation in the form of warrants that grant the right to buy shares

[1]Ljungqvist, Jenkinson, and Wilhelm (2003) and DeGeorge, Derrien, and Womack (2007) document an increasing tendency for security issues around the world to conform to U.S. standards.

BEFORE THE WASHINGTON

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-14

DCF Stock Prices

October 3, 2019

DCF Stock and Index Prices

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1																								
2																								
3	Ticker	^GSPC	AQN	AEE	AGR	AVA	BKH	CNP	CMS	D	DTE	EIX	EE	EMA	ETR	EXC	FE	HE	IDA	NWE	OGE	OTTR	PNM	SRE
4																								
5	30-day Average	2956	12.64	76.25	49.73	45.73	78.11	28.30	58.91	76.11	129.03	71.70	66.29	54.57	105.30	46.08	43.67	44.45	103.51	70.85	42.86	51.96	49.82	138.20
6	Standard Deviation	58.9	0.21	0.56	0.80	0.44	1.51	0.49	1.12	1.30	1.39	1.74	0.20	1.21	2.01	1.68	0.55	0.36	1.84	1.61	0.35	0.73	0.61	2.25
7																								
8	07/09/19	2980	12.35	76.61	50.80	44.89	79.35	28.79	58.49	78.22	131.22	69.72	65.81	53.79	103.35	48.59	43.16	44.30	103.79	73.18	43.16	52.62	50.36	139.05
9	07/10/19	2993	12.41	76.65	51.20	44.87	79.68	28.71	58.53	78.13	131.56	69.62	66.03	54.11	103.78	48.98	43.11	44.46	103.45	73.25	43.05	52.51	50.31	139.66
10	07/11/19	3000	12.45	76.68	51.05	45.26	80.05	28.76	58.61	77.91	131.62	69.95	66.10	54.03	103.56	49.14	43.21	44.62	103.76	73.29	43.37	52.08	50.10	140.39
11	07/12/19	3014	12.46	76.16	49.93	45.33	79.44	28.57	58.19	77.50	130.40	70.64	66.05	53.37	102.98	48.67	43.03	44.58	103.06	72.69	43.17	51.87	49.22	139.89
12	07/15/19	3014	12.40	76.29	49.60	45.20	79.24	28.69	58.23	78.09	129.99	70.56	66.05	53.69	103.94	48.49	43.48	44.57	102.91	72.53	43.10	51.72	49.01	139.99
13	07/16/19	3004	12.43	76.23	49.40	45.57	79.43	28.60	58.02	77.48	129.55	70.10	66.20	53.22	103.98	48.01	43.17	44.51	103.80	72.85	43.03	52.18	49.12	139.26
14	07/17/19	2984	12.54	76.74	49.56	45.81	79.88	28.71	58.28	77.37	130.08	69.68	66.15	53.40	104.64	48.21	43.35	44.62	103.53	72.82	43.13	52.11	49.50	139.95
15	07/18/19	2995	12.64	77.16	49.78	46.46	80.59	28.95	58.74	77.42	131.36	70.78	66.29	53.61	105.84	48.37	43.64	45.08	103.95	73.27	43.54	52.38	50.01	141.17
16	07/19/19	2977	12.54	75.98	49.17	45.83	79.04	28.35	57.88	76.85	128.79	70.17	66.32	53.44	104.70	47.19	43.11	44.31	101.88	71.59	42.74	51.57	49.33	140.05
17	07/22/19	2985	12.50	76.28	48.85	45.68	78.77	28.39	57.91	76.26	128.61	69.68	66.09	53.24	104.50	46.90	43.22	44.26	102.02	71.13	42.66	51.33	49.46	140.57
18	07/23/19	3005	12.50	76.23	48.50	45.88	78.22	28.39	57.89	75.43	128.17	70.27	66.09	53.38	103.96	45.99	42.94	44.15	101.97	70.81	42.57	51.47	49.65	138.95
19	07/24/19	3020	12.43	76.43	48.59	45.62	77.76	28.14	57.63	75.18	127.71	71.02	66.12	53.30	103.77	45.12	43.24	44.39	101.52	71.30	42.65	52.04	49.87	139.76
20	07/25/19	3004	12.46	76.25	48.98	45.46	77.95	28.26	57.58	74.86	128.06	70.03	66.10	53.49	103.13	45.76	43.49	44.35	100.85	70.71	42.31	51.92	49.71	140.46
21	07/26/19	3026	12.51	76.59	48.97	45.73	79.00	28.50	58.30	75.15	129.37	70.95	66.31	53.57	102.80	45.45	43.67	44.56	101.65	71.17	42.56	52.85	50.20	140.26
22	07/29/19	3021	12.58	76.85	49.62	45.68	79.58	28.46	58.79	75.05	128.98	70.60	66.21	54.07	104.04	45.68	44.08	44.96	102.02	70.99	43.05	52.88	50.21	139.50
23	07/30/19	3013	12.54	76.21	50.31	46.02	78.72	28.54	58.17	75.03	127.95	70.27	66.43	53.91	102.99	45.68	44.09	44.73	101.60	70.19	43.01	53.15	50.02	136.47
24	07/31/19	2980	12.45	75.69	50.55	46.03	78.63	28.71	57.84	74.29	127.11	74.54	66.26	54.80	104.72	44.70	43.59	44.80	101.44	69.92	42.95	53.02	49.38	135.43
25	08/01/19	2954	12.63	76.64	51.02	46.14	79.40	28.79	58.99	75.91	129.05	73.88	66.60	54.75	106.05	44.05	43.99	44.61	103.03	69.92	43.16	53.15	50.17	135.68
26	08/02/19	2932	12.76	75.74	50.17	45.49	78.07	29.03	58.70	76.02	128.66	73.75	66.56	54.96	105.81	44.39	43.86	44.36	102.84	69.46	43.10	52.67	48.85	135.68
27	08/05/19	2845	12.61	75.05	49.22	45.18	76.57	28.26	58.22	74.67	126.92	72.51	66.54	NR	104.01	44.07	43.06	43.32	102.18	68.21	41.96	50.93	48.62	132.12
28	08/06/19	2882	12.80	75.00	50.37	45.10	76.16	28.56	58.90	75.22	127.82	73.37	66.42	55.34	105.64	44.85	43.42	43.78	103.33	68.44	42.49	51.32	49.04	133.93
29	08/07/19	2884	12.88	75.22	50.08	45.68	76.84	27.77	59.11	74.43	128.18	74.19	66.53	55.25	105.92	44.65	43.57	44.06	103.63	68.96	42.36	51.79	49.52	135.16
30	08/08/19	2938	12.94	76.32	50.79	46.25	77.52	27.54	60.07	75.33	129.29	75.12	66.58	55.82	107.04	45.06	44.25	45.05	105.70	69.83	42.99	52.63	50.53	136.71
31	08/09/19	2919	12.97	76.69	50.37	46.13	75.90	27.34	60.32	74.84	129.37	74.38	66.47	55.53	107.43	44.84	44.20	44.40	104.32	69.39	42.87	52.22	50.46	137.68
32	08/12/19	2883	12.90	76.64	49.53	46.11	75.59	27.47	59.94	74.37	128.09	73.07	66.34	55.94	107.74	44.84	44.51	44.15	104.11	68.79	42.69	50.84	50.46	137.14
33	08/13/19	2926	12.98	76.51	49.36	46.26	76.03	27.71	60.09	75.38	128.23	73.21	66.39	56.15	107.82	45.16	44.18	44.31	105.15	69.15	42.89	51.38	50.38	137.35
34	08/14/19	2841	12.91	75.25	48.42	45.67	75.15	27.50	59.77	75.33	126.16	71.82	66.41	56.15	107.00	44.48	43.53	44.26	104.95	68.60	42.49	50.67	49.30	136.75
35	08/15/19	2848	12.90	75.81	48.89	45.84	76.10	27.57	61.27	77.05	128.66	72.07	66.38	56.32	109.00	44.65	44.12	44.43	106.48	70.25	42.53	50.89	50.31	138.54
36	08/16/19	2889	12.88	76.64	49.27	46.48	77.17	27.87	61.20	76.86	129.29	72.50	66.41	56.59	109.19	45.13	44.68	44.71	108.03	71.09	43.10	51.23	51.00	138.88
37	08/19/19	2924	12.93	76.97	49.46	46.35	77.47	28.11	61.57	77.79	130.79	72.65	66.43	57.19	109.79	45.28	45.13	44.67	108.26	71.76	43.16	51.24	50.64	139.64
38																								
39																								
40																								
41	All prices are adjusted closing prices reported by Yahoo! Finance, http://finance.yahoo.com																							

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-15

Eugene Fama: Efficient Capital Markets

October 3, 2019

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SESSION TOPIC: STOCK MARKET PRICE BEHAVIOR

SESSION CHAIRMAN: BURTON G. MALKIEL

EFFICIENT CAPITAL MARKETS: A REVIEW OF THEORY AND EMPIRICAL WORK*

EUGENE F. FAMA**

I. INTRODUCTION

THE PRIMARY ROLE of the capital market is allocation of ownership of the economy's capital stock. In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information. A market in which prices always "fully reflect" available information is called "efficient."

This paper reviews the theoretical and empirical literature on the efficient markets model. After a discussion of the theory, empirical work concerned with the adjustment of security prices to three relevant information subsets is considered. First, *weak form* tests, in which the information set is just historical prices, are discussed. Then *semi-strong form* tests, in which the concern is whether prices efficiently adjust to other information that is obviously publicly available (e.g., announcements of annual earnings, stock splits, etc.) are considered. Finally, *strong form* tests concerned with whether given investors or groups have monopolistic access to any information relevant for price formation are reviewed.[1] We shall conclude that, with but a few exceptions, the efficient markets model stands up well.

Though we proceed from theory to empirical work, to keep the proper historical perspective we should note to a large extent the empirical work in this area preceded the development of the theory. The theory is presented first here in order to more easily judge which of the empirical results are most relevant from the viewpoint of the theory. The empirical work itself, however, will then be reviewed in more or less historical sequence.

Finally, the perceptive reader will surely recognize instances in this paper where relevant studies are not specifically discussed. In such cases my apologies should be taken for granted. The area is so bountiful that some such injustices are unavoidable. But the primary goal here will have been accomplished if a coherent picture of the main lines of the work on efficient markets is presented, along with an accurate picture of the current state of the arts.

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1. The distinction between weak and strong form tests was first suggested by Harry Roberts.

II. The Theory of Efficient Markets

A. *Expected Return or "Fair Game" Models*

The definitional statement that in an efficient market prices "fully reflect" available information is so general that it has no empirically testable implications. To make the model testable, the process of price formation must be specified in more detail. In essence we must define somewhat more exactly what is meant by the term "fully reflect."

One possibility would be to posit that equilibrium prices (or expected returns) on securities are generated as in the "two parameter" Sharpe [40]-Lintner [24, 25] world. In general, however, the theoretical models and especially the empirical tests of capital market efficiency have not been this specific. Most of the available work is based only on the assumption that the conditions of market equilibrium can (somehow) be stated in terms of expected returns. In general terms, like the two parameter model such theories would posit that conditional on some relevant information set, the equilibrium expected return on a security is a function of its "risk." And different theories would differ primarily in how "risk" is defined.

All members of the class of such "expected return theories" can, however, be described notationally as follows:

$$E(\tilde{p}_{j,t+1}|\Phi_t) = [1 + E(\tilde{r}_{j,t+1}|\Phi_t)]p_{jt}, \tag{1}$$

where E is the expected value operator; p_{jt} is the price of security j at time t; $p_{j,t+1}$ is its price at $t + 1$ (with reinvestment of any intermediate cash income from the security); $r_{j,t+1}$ is the one-period percentage return $(p_{j,t+1} - p_{jt})/p_{jt}$; Φ_t is a general symbol for whatever set of information is assumed to be "fully reflected" in the price at t; and the tildes indicate that $p_{j,t+1}$ and $r_{j,t+1}$ are random variables at t.

The value of the equilibrium expected return $E(\tilde{r}_{j,t+1}|\Phi_t)$ projected on the basis of the information Φ_t would be determined from the particular expected return theory at hand. The conditional expectation notation of (1) is meant to imply, however, that whatever expected return model is assumed to apply, the information in Φ_t is fully utilized in determining equilibrium expected returns. And this is the sense in which Φ_t is "fully reflected" in the formation of the price p_{jt}.

But we should note right off that, simple as it is, the assumption that the conditions of market equilibrium can be stated in terms of expected returns elevates the purely mathematical concept of expected value to a status not necessarily implied by the general notion of market efficiency. The expected value is just one of many possible summary measures of a distribution of returns, and market efficiency per se (i.e., the general notion that prices "fully reflect" available information) does not imbue it with any special importance. Thus, the results of tests based on this assumption depend to some extent on its validity as well as on the efficiency of the market. But some such assumption is the unavoidable price one must pay to give the theory of efficient markets empirical content.

The assumptions that the conditions of market equilibrium can be stated in terms of expected returns and that equilibrium expected returns are formed on the basis of (and thus "fully reflect") the information set Φ_t have a major empirical implication—they rule out the possibility of trading systems based only on information in Φ_t that have expected profits or returns in excess of equilibrium expected profits or returns. Thus let

$$x_{j,t+1} = p_{j,t+1} - E(p_{j,t+1}|\Phi_t). \tag{2}$$

Then

$$E(\tilde{x}_{j,t+1}|\Phi_t) = 0 \tag{3}$$

which, *by definition,* says that the sequence $\{x_{jt}\}$ is a "fair game" with respect to the information sequence $\{\phi_t\}$. Or, equivalently, let

$$z_{j,t+1} = r_{j,t+1} - E(\tilde{r}_{j,t+1}|\Phi_t), \tag{4}$$

then

$$E(\tilde{z}_{j,t+1}|\Phi_t) = 0, \tag{5}$$

so that the sequence $\{z_{jt}\}$ is also a "fair game" with respect to the information sequence $\{\Phi\}$.

In economic terms, $x_{j,t+1}$ is the excess market value of security j at time $t + 1$: it is the difference between the observed price and the expected value of the price that was projected at t on the basis of the information Φ_t. And similarly, $z_{j,t+1}$ is the return at $t + 1$ in excess of the equilibrium expected return projected at t. Let

$$\alpha(\Phi_t) = [\alpha_1(\Phi_t), \alpha_2(\Phi_t), \ldots, \alpha_n(\Phi_t)]$$

be any trading system based on Φ_t which tells the investor the amounts $\alpha_j(\Phi_t)$ of funds available at t that are to be invested in each of the n available securities. The total excess market value at $t + 1$ that will be generated by such a system is

$$V_{t+1} = \sum_{j=1}^{n} \alpha_j(\Phi_t)[r_{j,t+1} - E(\tilde{r}_{j,t+1}|\Phi_t)],$$

which, from the "fair game" property of (5) has expectation,

$$E(\tilde{V}_{t+1}|\Phi_t) = \sum_{j=1}^{n} \alpha_j(\Phi_t)E(\tilde{z}_{j,t+1}|\Phi_t) = 0.$$

The expected return or "fair game" efficient markets model[2] has other important testable implications, but these are better saved for the later discussion of the empirical work. Now we turn to two special cases of the model, the submartingale and the random walk, that (as we shall see later) play an important role in the empirical literature.

2. Though we shall sometimes refer to the model summarized by (1) as the "fair game" model, keep in mind that the "fair game" properties of the model are *implications* of the assumptions that (i) the conditions of market equilibrium can be stated in terms of expected returns, and (ii) the information Φ_t is fully utilized by the market in forming equilibrium expected returns and thus current prices.

The role of "fair game" models in the theory of efficient markets was first recognized and studied rigorously by Mandelbrot [27] and Samuelson [38]. Their work will be discussed in more detail later.

B. *The Submartingale Model*

Suppose we assume in (1) that for all t and Φ_t

$$E(\tilde{p}_{j,t+1}|\Phi_t) \geqslant p_{jt}, \quad \text{or equivalently,} \quad E(\tilde{r}_{j,t+1}|\Phi_t) \geqslant 0. \tag{6}$$

This is a statement that the price sequence $\{p_{jt}\}$ for security j follows a submartingale with respect to the information sequence $\{\Phi_t\}$, which is to say nothing more than that the expected value of next period's price, as projected on the basis of the information Φ_t, is equal to or greater than the current price. If (6) holds as an equality (so that expected returns and price changes are zero), then the price sequence follows a martingale.

A submartingale in prices has one important empirical implication. Consider the set of "one security and cash" mechanical trading rules by which we mean systems that concentrate on individual securities and that define the conditions under which the investor would hold a given security, sell it short, or simply hold cash at any time t. Then the assumption of (6) that expected returns conditional on Φ_t are non-negative directly implies that such trading rules based only on the information in Φ_t cannot have greater expected profits than a policy of always buying-and-holding the security during the future period in question. Tests of such rules will be an important part of the empirical evidence on the efficient markets model.[3]

C. *The Random Walk Model*

In the early treatments of the efficient markets model, the statement that the current price of a security "fully reflects" available information was assumed to imply that successive price changes (or more usually, successive one-period returns) are independent. In addition, it was usually assumed that successive changes (or returns) are identically distributed. Together the two hypotheses constitute the random walk model. Formally, the model says

$$f(r_{j,t+1}|\Phi_t) = f(r_{j,t+1}), \tag{7}$$

which is the usual statement that the conditional and marginal probability distributions of an independent random variable are identical. In addition, the density function f must be the same for all t.[4]

3. Note that the expected profitability of "one security and cash" trading systems vis-à-vis buy-and-hold is not ruled out by the general expected return or "fair game" efficient markets model. The latter rules out systems with expected profits in excess of equilibrium expected returns, but since in principle it allows equilibrium expected returns to be negative, holding cash (which always has zero actual and thus expected return) may have higher expected return than holding some security.

And negative equilibrium expected returns for some securities are quite possible. For example, in the Sharpe [40]-Lintner [24, 25] model (which is in turn a natural extension of the portfolio models of Markowitz [30] and Tobin [43]) the equilibrium expected return on a security depends on the extent to which the dispersion in the security's return distribution is related to dispersion in the returns on all other securities. A security whose returns on average move opposite to the general market is particularly valuable in reducing dispersion of portfolio returns, and so its equilibrium expected return may well be negative.

4. The terminology is loose. Prices will only follow a random walk if price changes are independent, identically distributed; and even then we should say "random walk with drift" since expected price changes can be non-zero. If one-period returns are independent, identically distributed, prices will not follow a random walk since the distribution of price changes will depend

Expression (7) of course says much more than the general expected return model summarized by (1). For example, if we restrict (1) by assuming that the expected return on security j is constant over time, then we have

$$E(\tilde{r}_{j,t+1}|\Phi_t) = E(\tilde{r}_{j,t+1}). \qquad (8)$$

This says that the mean of the distribution of $r_{j,t+1}$ is independent of the information available at t, Φ_t, whereas the random walk model of (7) in addition says that the entire distribution is independent of Φ_t.[5]

We argue later that it is best to regard the random walk model as an extension of the general expected return or "fair game" efficient markets model in the sense of making a more detailed statement about the economic environment. The "fair game" model just says that the conditions of market equilibrium can be stated in terms of expected returns, and thus it says little about the details of the stochastic process generating returns. A random walk arises within the context of such a model when the environment is (fortuitously) such that the evolution of investor tastes and the process generating new information combine to produce equilibria in which return distributions repeat themselves through time.

Thus it is not surprising that empirical tests of the "random walk" model that are in fact tests of "fair game" properties are more strongly in support of the model than tests of the additional (and, from the viewpoint of expected return market efficiency, superfluous) pure independence assumption. (But it is perhaps equally surprising that, as we shall soon see, the evidence against the independence of returns over time is as weak as it is.)

D. *Market Conditions Consistent with Efficiency*

Before turning to the empirical work, however, a few words about the market conditions that might help or hinder efficient adjustment of prices to information are in order. First, it is easy to determine *sufficient* conditions for capital market efficiency. For example, consider a market in which (i) there are no transactions costs in trading securities, (ii) all available information is costlessly available to all market participants, and (iii) all agree on the implications of current information for the current price and distributions of future prices of each security. In such a market, the current price of a security obviously "fully reflects" all available information.

But a frictionless market in which all information is freely available and investors agree on its implications is, of course, not descriptive of markets met in practice. Fortunately, these conditions are sufficient for market efficiency, but not necessary. For example, as long as transactors take account of all

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on the price level. But though rigorous terminology is usually desirable, our loose use of terms should not cause confusion; and our usage follows that of the efficient markets literature.

Note also that in the random walk literature, the information set Φ_t in (7) is usually assumed to include only the past return history, $r_{j,t}, r_{j,t-1}, \ldots$

5. The random walk model does not say, however, that past information is of no value in *assessing* distributions of future returns. Indeed since return distributions are assumed to be stationary through time, past returns are the best source of such information. The random walk model does say, however, that the *sequence* (or the order) of the past returns is of no consequence in assessing distributions of future returns.

available information, even large transactions costs that inhibit the flow of transactions do not in themselves imply that when transactions do take place, prices will not "fully reflect" available information. Similarly (and speaking, as above, somewhat loosely), the market may be efficient if "sufficient numbers" of investors have ready access to available information. And disagreement among investors about the implications of given information does not in itself imply market inefficiency unless there are investors who can consistently make better evaluations of available information than are implicit in market prices.

But though transactions costs, information that is not freely available to all investors, and disagreement among investors about the implications of given information are not necessarily sources of market inefficiency, they are potential sources. And all three exist to some extent in real world markets. Measuring their effects on the process of price formation is, of course, the major goal of empirical work in this area.

III. The Evidence

All the empirical research on the theory of efficient markets has been concerned with whether prices "fully reflect" particular subsets of available information. Historically, the empirical work evolved more or less as follows. The initial studies were concerned with what we call *weak form* tests in which the information subset of interest is just past price (or return) histories. Most of the results here come from the random walk literature. When extensive tests seemed to support the efficiency hypothesis at this level, attention was turned to *semi-strong form* tests in which the concern is the speed of price adjustment to other obviously publicly available information (e.g., announcements of stock splits, annual reports, new security issues, etc.). Finally, *strong form* tests in which the concern is whether any investor or groups (e.g., managements of mutual funds) have monopolistic access to any information relevant for the formation of prices have recently appeared. We review the empirical research in more or less this historical sequence.

First, however, we should note that what we have called *the* efficient markets model in the discussions of earlier sections is the hypothesis that security prices at any point in time "fully reflect" *all* available information. Though we shall argue that the model stands up rather well to the data, it is obviously an extreme null hypothesis. And, like any other extreme null hyposthesis, we do not expect it to be literally true. The categorization of the tests into weak, semi-strong, and strong form will serve the useful purpose of allowing us to pinpoint the level of information at which the hypothesis breaks down. And we shall contend that there is no important evidence against the hypothesis in the weak and semi-strong form tests (i.e., prices seem to efficiently adjust to obviously publicly available information), and only limited evidence against the hypothesis in the strong form tests (i.e., monopolistic access to information about prices does not seem to be a prevalent phenomenon in the investment community).

A. *Weak Form Tests of the Efficient Markets Model*

1. Random Walks and Fair Games: A Little Historical Background

As noted earlier, all of the empirical work on efficient markets can be considered within the context of the general expected return or "fair game" model, and much of the evidence bears directly on the special submartingale expected return model of (6). Indeed, in the early literature, discussions of the efficient markets model were phrased in terms of the even more special random walk model, though we shall argue that most of the early authors were in fact concerned with more general versions of the "fair game" model.

Some of the confusion in the early random walk writings is understandable. Research on security prices did not begin with the development of a theory of price formation which was then subjected to empirical tests. Rather, the impetus for the development of a theory came from the accumulation of evidence in the middle 1950's and early 1960's that the behavior of common stock and other speculative prices could be well approximated by a random walk. Faced with the evidence, economists felt compelled to offer some rationalization. What resulted was a theory of efficient markets stated in terms of random walks, but usually implying some more general "fair game" model.

It was not until the work of Samuelson [38] and Mandelbrot [27] in 1965 and 1966 that the role of "fair game" expected return models in the theory of efficient markets and the relationships between these models and the theory of random walks were rigorously studied.[6] And these papers came somewhat after the major empirical work on random walks. In the earlier work, "theoretical" discussions, though usually intuitively appealing, were always lacking in rigor and often either vague or *ad hoc*. In short, until the Mandelbrot-Samuelson models appeared, there existed a large body of empirical results in search of a rigorous theory.

Thus, though his contributions were ignored for sixty years, the first statement and test of the random walk model was that of Bachelier [3] in 1900. But his "fundamental principle" for the behavior of prices was that speculation should be a "fair game"; in particular, the expected profits to the speculator should be zero. With the benefit of the modern theory of stochastic processes, we know now that the process implied by this fundamental principle is a martingale.

After Bachelier, research on the behavior of security prices lagged until the

6. Basing their analyses on futures contracts in commodity markets, Mandelbrot and Samuelson show that if the price of such a contract at time t is the expected value at t (given information Φ_t) of the spot price at the termination of the contract, then the futures price will follow a martingale with respect to the information sequence $\{\Phi_t\}$; that is, the expected price change from period to period will be zero, and the price changes will be a "fair game." If the equilibrium expected return is not assumed to be zero, our more general "fair game" model, summarized by (1), is obtained.

But though the Mandelbrot-Samuelson approach certainly illuminates the process of price formation in commodity markets, we have seen that "fair game" expected return models can be derived in much simpler fashion. In particular, (1) is just a formalization of the assumptions that the conditions of market equilibrium can be stated in terms of expected returns and that the information Φ_t is used in forming market prices at t.

coming of the computer. In 1953 Kendall [21] examined the behavior of weekly changes in nineteen indices of British industrial share prices and in spot prices for cotton (New York) and wheat (Chicago). After extensive analysis of serial correlations, he suggests, in quite graphic terms:

> The series looks like a wandering one, almost as if once a week the Demon of Chance drew a random number from a symetrical population of fixed dispersion and added it to the current price to determine the next week's price [21, p. 13].

Kendall's conclusion had in fact been suggested earlier by Working [47], though his suggestion lacked the force provided by Kendall's empirical results. And the implications of the conclusion for stock market research and financial analysis were later underlined by Roberts [36].

But the suggestion by Kendall, Working, and Roberts that series of speculative prices may be well described by random walks was based on observation. None of these authors attempted to provide much economic rationale for the hypothesis, and, indeed, Kendall felt that economists would generally reject it. Osborne [33] suggested market conditions, similar to those assumed by Bachelier, that would lead to a random walk. But in his model, independence of successive price changes derives from the assumption that the decisions of investors in an individual security are independent from transaction to transaction—which is little in the way of an economic model.

Whenever economists (prior to Mandelbrot and Samuelson) tried to provide economic justification for the random walk, their arguments usually implied a "fair game." For example, Alexander [8, p. 200] states:

> If one were to start out with the assumption that a stock or commodity speculation is a "fair game" with equal expectation of gain or loss or, more accurately, with an expectation of zero gain, one would be well on the way to picturing the behavior of speculative prices as a random walk.

There is an awareness here that the "fair game" assumption is not sufficient to lead to a random walk, but Alexander never expands on the comment. Similarly, Cootner [8, p. 232] states:

> If any substantial group of buyers thought prices were too low, their buying would force up the prices. The reverse would be true for sellers. Except for appreciation due to earnings retention, the conditional expectation of tomorrow's price, given today's price, is today's price.
>
> In such a world, the only price changes that would occur are those that result from new information. Since there is no reason to expect that information to be non-random in appearance, the period-to-period price changes of a stock should be random movements, statistically independent of one another.

Though somewhat imprecise, the last sentence of the first paragraph seems to point to a "fair game" model rather than a random walk.[7] In this light, the second paragraph can be viewed as an attempt to describe environmental conditions that would reduce a "fair game" to a random walk. But the specification imposed on the information generating process is insufficient for this purpose; one would, for example, also have to say something about investor

7. The appropriate conditioning statement would be "Given the sequence of historical prices."

tastes. Finally, lest I be accused of criticizing others too severely for ambiguity, lack of rigor and incorrect conclusions,

> By contrast, the stock market trader has a much more practical criterion for judging what constitutes important dependence in successive price changes. For his purposes the random walk model is valid as long as knowledge of the past behavior of the series of price changes cannot be used to increase expected gains. More specifically, the independence assumption is an adequate description of reality as long as the actual degree of dependence in the series of price changes is not sufficient to allow the past history of the series to be used to predict the future in a way which makes expected profits greater than they would be under a naive buy-and hold model [10, p 35].

We know now, of course, that this last condition hardly requires a random walk. It will in fact be met by the submartingale model of (6).

But one should not be too hard on the theoretical efforts of the early empirical random walk literature. The arguments were usually appealing; where they fell short was in awareness of developments in the theory of stochastic processes. Moreover, we shall now see that most of the empirical evidence in the random walk literature can easily be interpreted as tests of more general expected return or "fair game" models.[8]

2. Tests of Market Efficiency in the Random Walk Literature

As discussed earlier, "fair game" models imply the "impossibility" of various sorts of trading systems. Some of the random walk literature has been concerned with testing the profitability of such systems. More of the literature has, however, been concerned with tests of serial covariances of returns. We shall now show that, like a random walk, the serial covariances of a "fair game" are zero, so that these tests are also relevant for the expected return models.

If x_t is a "fair game," its unconditional expectation is zero and its serial covariance can be written in general form as:

$$E(\tilde{x}_{t+\tau}\,\tilde{x}_t) = \int_{x_t} x_t E(\tilde{x}_{t+\tau}|x_t) f(x_t)\,dx_t,$$

where f indicates a density function. But if x_t is a "fair game,"

$$E(\tilde{x}_{t+\tau}|x_t) = 0.^{9}$$

8. Our brief historical review is meant only to provide perspective, and it is, of course, somewhat incomplete. For example, we have ignored the important contributions to the early random walk literature in studies of warrants and other options by Sprenkle, Kruizenga, Boness, and others. Much of this early work on options is summarized in [8].

9. More generally, if the sequence $\{x_t\}$ is a fair game with respect to the information sequence $\{\Phi_t\}$, (i.e., $E(\tilde{x}_{t+1}|\Phi_t) = 0$ for all Φ_t); then x_t is a fair game with respect to any Φ'_t that is a subset of Φ_t (i.e., $E(\tilde{x}_{t+1}|\Phi'_t) = 0$ for all Φ'_t). To show this, let $\Phi_t = (\Phi'_t, \Phi''_t)$. Then, using Stieltjes integrals and the symbol F to denote cumulative distinction functions, the conditional expectation

$$E(\tilde{x}_{t+1}|\Phi'_t) = \int_{\Phi''_t}\int_{x_{t+1}} x_{t+1}\,dF(x_{t+1}, \Phi''_t|\Phi'_t) = \int_{\Phi''_t}\left[\int_{x_{t+1}} x_{t+1}\,dF(x_{t+1}|\Phi'_t, \Phi''_t)\right] dF(\Phi''_t|\Phi'_t).$$

From this it follows that for all lags, the serial covariances between lagged values of a "fair game" variable are zero. Thus, observations of a "fair game" variable are linearly independent.[10]

But the "fair game" model does not necessarily imply that the serial covariances of *one-period returns* are zero. In the weak form tests of this model the "fair game" variable is

$$z_{j,t} = r_{j,t} - E(\tilde{r}_{j,t}|r_{j,t-1}, r_{j,t-2}, \ldots). \quad \text{(Cf. fn. 9)} \tag{9}$$

But the covariance between, for example, r_{jt} and $r_{j,t+1}$ is

$$E([\tilde{r}_{j,t+1} - E(\tilde{r}_{j,t+1})]\,[\tilde{r}_{jt} - E(\tilde{r}_{jt})])$$
$$= \int_{r_{jt}} [r_{jt} - E(\tilde{r}_{jt})]\,[E(\tilde{r}_{j,t+1}|r_{jt}) - E(\tilde{r}_{j,t+1})]f(r_{jt})dr_{jt},$$

and (9) does not imply that $E(\tilde{r}_{j,t+1}|r_{jt}) = E(\tilde{r}_{j,t+1})$: In the "fair game" efficient markets model, the deviation of the return for $t+1$ from its conditional expectation is a "fair game" variable, but the conditional expectation itself can depend on the return observed for t.[11]

In the random walk literature, this problem is not recognized, since it is assumed that the expected return (and indeed the entire distribution of returns) is stationary through time. In practice, this implies estimating serial covariances by taking cross products of deviations of observed returns from the overall sample mean return. It is somewhat fortuitous, then, that this procedure, which represents a rather gross approximation from the viewpoint of the general expected return efficient markets model, does not seem to greatly affect the results of the covariance tests, at least for common stocks.[12]

But the integral in brackets is just $E(\tilde{x}_{t+1}|\Phi_t)$ which by the "fair game" assumption is 0, so that

$$E(x_{t+1}|\Phi'_t) = 0 \text{ for all } \Phi'_t \subset \Phi_t.$$

10. But though zero serial covariances are consistent with a "fair game," they do not imply such a process. A "fair game" also rules out many types of non linear dependence. Thus using arguments similar to those above, it can be shown that if x is a "fair game," $E(\tilde{x}_t\tilde{x}_{t+1} \ldots \tilde{x}_{t+\tau}) = 0$ for all τ, which is not implied by $E(\tilde{x}_t\tilde{x}_{t+\tau}) = 0$ for all τ. For example, consider a three-period case where x must be either ± 1. Suppose the process is $x_{t+2} = \text{sign}\,(x_t x_{t+1})$, i.e.,

x_t	x_{t+1}	$\rightarrow$	x_{t+2}
+	+	$\rightarrow$	+
+	−	$\rightarrow$	−
−	+	$\rightarrow$	−
−	−	$\rightarrow$	+.

If probabilities are uniformly distributed across events,

$$E(\tilde{x}_{t+2}|x_{t+1}) = E(\tilde{x}_{t+2}|x_t) = E(\tilde{x}_{t+1}|x_t) = E(\tilde{x}_{t+2}) = E(\tilde{x}_{t+1}) = E(\tilde{x}_t) = 0,$$

so that all pairwise serial covariances are zero. But the process is not a "fair game," since $E(\tilde{x}_{t+2}|x_{t+1}, x_t) \neq 0$, and knowledge of (x_{t+1}, x_t) can be used as the basis of a simple "system" with positive expected profit.

11. For example, suppose the level of one-period returns follows a martingale so that

$$E(\tilde{r}_{j,t+1}|r_{jt}, r_{j,t-1} \ldots) = r_{jt}.$$

Then covariances between successive returns will be nonzero (though in this special case first differences of returns will be uncorrelated).

12. The reason is probably that for stocks, changes in equilibrium expected returns for the

TABLE 1 (from [10])
First-order Serial Correlation Coefficients for One-, Four-, Nine-, and Sixteen-Day Changes in Log_e Price

Stock	Differencing Interval (Days) One	Four	Nine	Sixteen
Allied Chemical	.017	.029	−.091	−.118
Alcoa	.118*	.095	−.112	−.044
American Can	−.087*	−.124*	−.060	.031
A. T. & T.	−.039	−.010	−.009	−.003
American Tobacco	.111*	−.175*	.033	.007
Anaconda	.067*	−.068	−.125	.202
Bethlehem Steel	.013	−.122	−.148	.112
Chrysler	.012	.060	−.026	.040
Du Pont	.013	.069	−.043	−.055
Eastman Kodak	.025	−.006	−.053	−.023
General Electric	.011	.020	−.004	.000
General Foods	.061*	−.005	−.140	−.098
General Motors	−.004	−.128*	.009	−.028
Goodyear	−.123*	.001	−.037	.033
International Harvester	−.017	−.068	−.244*	.116
International Nickel	.096*	.038	.124	.041
International Paper	.046	.060	−.004	−.010
Johns Manville	.006	−.068	−.002	.002
Owens Illinois	−.021	−.006	.003	−.022
Procter & Gamble	.099*	−.006	.098	.076
Sears	.097*	−.070	−.113	.041
Standard Oil (Calif.)	.025	−.143*	−.046	.040
Standard Oil (N.J.)	.008	−.109	−.082	−.121
Swift & Co.	−.004	−.072	.118	−.197
Texaco	.094*	−.053	−.047	−.178
Union Carbide	.107*	.049	−.101	.124
United Aircraft	.014	−.190*	−.192*	−.040
U.S. Steel	.040	−.006	−.056	.236*
Westinghouse	−.027	−.097	−.137	.067
Woolworth	.028	−.033	−.112	.040

* Coefficient is twice its computed standard error.

For example, Table 1 (taken from [10]) shows the serial correlations between successive changes in the natural log of price for each of the thirty stocks of the Dow Jones Industrial Average, for time periods that vary slightly from stock to stock, but usually run from about the end of 1957 to September 26, 1962. The serial correlations of successive changes in log_e price are shown for differencing intervals of one, four, nine, and sixteen days.[13]

common differencing intervals of a day, a week, or a month, are trivial relative to other sources of variation in returns. Later, when we consider Roll's work [37], we shall see that this is not true for one week returns on U.S. Government Treasury Bills.

13. The use of changes in log_e price as the measure of return is common in the random walk literature. It can be justified in several ways. But for current purposes, it is sufficient to note that for price changes less than fifteen per cent, the change in log_e price is approximately the percentage price change or one-period return. And for differencing intervals shorter than one month, returns in excess of fifteen per cent are unusual. Thus [10] reports that for the data of Table 1, tests carried out on percentage or one-period returns yielded results essentially identical to the tests based on changes in log_e price.

The results in Table 1 are typical of those reported by others for tests based on serial covariances. (Cf. Kendall [21], Moore [31], Alexander [1], and the results of Granger and Morgenstern [17] and Godfrey, Granger and Morgenstern [16] obtained by means of spectral analysis.) Specifically, there is no evidence of substantial linear dependence between lagged price changes or returns. In absolute terms the measured serial correlations are always close to zero.

Looking hard, though, one can probably find evidence of statistically "significant" linear dependence in Table 1 (and again this is true of results reported by others). For the daily returns eleven of the serial correlations are more than twice their computed standard errors, and twenty-two out of thirty are positive. On the other hand, twenty-one and twenty-four of the coefficients for the four and nine day differences are negative. But with samples of the size underlying Table 1 (N = 1200-1700 observations per stock on a daily basis) statistically "significant" deviations from zero covariance are not necessarily a basis for rejecting the efficient markets model. For the results in Table 1, the standard errors of the serial correlations were approximated as $(1/(N-1))^{1/2}$, which for the daily data implies that a correlation as small as .06 is more than twice its standard error. But a coefficient this size implies that a linear relationship with the lagged price change can be used to explain about .36% of the variation in the current price change, which is probably insignificant from an economic viewpoint. In particular, it is unlikely that the small absolute levels of serial correlation that are always observed can be used as the basis of substantially profitable trading systems.[14]

It is, of course, difficult to judge what degree of serial correlation would imply the existence of trading rules with substantial expected profits. (And indeed we shall soon have to be a little more precise about what is implied by "substantial" profits.) Moreover, zero serial covariances are consistent with a "fair game" model, but as noted earlier (fn. 10), there are types of nonlinear dependence that imply the existence of profitable trading systems, and yet do not imply nonzero serial covariances. Thus, for many reasons it is desirable to directly test the profitability of various trading rules.

The first major evidence on trading rules was Alexander's [1, 2]. He tests a variety of systems, but the most thoroughly examined can be decribed as follows: If the price of a security moves up at least y%, buy and hold the security until its price moves down at least y% from a subsequent high, at which time simultaneously sell and go short. The short position is maintained until the price rises at least y% above a subsequent low, at which time one covers the short position and buys. Moves less than y% in either direction are

14. Given the evidence of Kendall [21], Mandelbrot [28], Fama [10] and others that large price changes occur much more frequently than would be expected if the generating process were Gaussian, the expression $(1/(N-1))^{1/2}$ understates the sampling dispersion of the serial correlation coefficient, and thus leads to an overstatement of significance levels. In addition, the fact that sample serial correlations are predominantly of one sign or the other is not in itself evidence of linear dependence. If, as the work of King [23] and Blume [7] indicates, there is a market factor whose behavior affects the returns on all securities, the sample behavior of this market factor may lead to a predominance of signs of one type in the serial correlations for individual securities, even though the population serial correlations for both the market factor and the returns on individual securities are zero. For a more extensive analysis of these issues see [10].

ignored. Such a system is called a y% filter. It is obviously a "one security and cash" trading rule, so that the results it produces are relevant for the submartingale expected return model of (6).

After extensive tests using daily data on price indices from 1897 to 1959 and filters from one to fifty per cent, and after correcting some incorrect presumptions in the initial results of [1] (see fn. 25), in his final paper on the subject, Alexander concludes:

> In fact, at this point I should advise any reader who is interested only in practical results, and who is not a floor trader and so must pay commissions, to turn to other sources on how to beat buy and hold. The rest of this article is devoted principally to a theoretical consideration of whether the observed results are consistent with a random walk hypothesis [8], p. 351).

Later in the paper Alexander concludes that there is some evidence in his results against the independence assumption of the random walk model. But market efficiency does not require a random walk, and from the viewpoint of the submartingale model of (6), the conclusion that the filters cannot beat buy-and-hold is support for the efficient markets hypothesis. Further support is provided by Fama and Blume [13] who compare the profitability of various filters to buy-and-hold for the individual stocks of the Dow-Jones Industrial Average. (The data are those underlying Table 1.)

But again, looking hard one can find evidence in the filter tests of both Alexander and Fama-Blume that is inconsistent with the submartingale efficient markets model, if that model is interpreted in a strict sense. In particular, the results for very small filters (1 per cent in Alexander's tests and .5, 1.0, and 1.5 per cent in the tests of Fama-Blume) indicate that it is possible to devise trading schemes based on very short-term (preferably intra-day but at most daily) price swings that will on average outperform buy-and-hold. The average profits on individual transactions from such schemes are miniscule, but they generate transactions so frequently that over longer periods and ignoring commissions they outperform buy-and-hold by a substantial margin. These results are evidence of persistence or positive dependence in very short-term price movements. And, interestingly, this is consistent with the evidence for slight positive linear dependence in successive daily price changes produced by the serial correlations.[15]

15. Though strictly speaking, such tests of pure independence are not directly relevant for expected return models, it is interesting that the conclusion that very short-term swings in prices persist slightly longer than would be expected under the martingale hypothesis is also supported by the results of non-parametric runs tests applied to the daily data of Table 1. (See [10], Tables 12-15.) For the daily price changes, the actual number of runs of price changes of the same sign is less than the expected number for 26 out of 30 stocks. Moreover, of the eight stocks for which the actual number of runs is more than two standard errors less than the expected number, five of the same stocks have positive daily, first order serial correlations in Table 1 that are more than twice their standard errors. But in both cases the statistical "significance" of the results is largely a reflection of the large sample sizes. Just as the serial correlations are small in absolute terms (the average is .026), the differences between the expected and actual number of runs on average are only three per cent of the total expected number.

On the other hand, it is also interesting that the runs tests do not support the suggestion of slight negative dependence in four and nine day changes that appeared in the serial correlations. In the runs tests such negative dependence would appear as a tendency for the actual number of runs to exceed the expected number. In fact, for the four and nine day price changes, for 17 and

But when one takes account of even the minimum trading costs that would be generated by small filters, their advantage over buy-and-hold disappears. For example, even a floor trader (i.e., a person who owns a seat) on the New York Stock Exchange must pay clearinghouse fees on his trades that amount to about .1 per cent per turnaround transaction (i.e., sales plus purchase). Fama-Blume show that because small filters produce such frequent trades, these minimum trading costs are sufficient to wipe out their advantage over buy-and-hold.

Thus the filter tests, like the serial correlations, produce empirically noticeable departures from the strict implications of the efficient markets model. But, in spite of any statistical significance they might have, from an economic viewpoint the departures are so small that it seems hardly justified to use them to declare the market inefficient.

3. Other Tests of Independence in the Random Walk Literature

It is probably best to regard the random walk model as a special case of the more general expected return model in the sense of making a more detailed specification of the economic environment. That is, the basic model of market equilibrium is the "fair game" expected return model, with a random walk arising when additional environmental conditions are such that distributions of one-period returns repeat themselves through time. From this viewpoint violations of the pure independence assumption of the random walk model are to be expected. But when judged relative to the benchmark provided by the random walk model, these violations can provide insights into the nature of the market environment.

For example, one departure from the pure independence assumption of the random walk model has been noted by Osborne [34], Fama ([10], Table 17 and Figure 8), and others. In particular, large daily price changes tend to be followed by large daily changes. The signs of the successor changes are apparently random, however, which indicates that the phenomenon represents a denial of the random walk model but not of the market efficiency hypothesis. Nevertheless, it is interesting to speculate why the phenomenon might arise. It may be that when important new information comes into the market it cannot always be immediately evaluated precisely. Thus, sometimes the initial price will overadjust to the information, and other times it will underadjust. But since the evidence indicates that the price changes on days following the initial large change are random in sign, the initial large change at least represents an unbiased adjustment to the ultimate price effects of the information, and this is sufficient for the expected return efficient markets model.

Niederhoffer and Osborne [32] document two departures from complete randomness in common stock price changes from transaction to transaction. First, their data indicate that reversals (pairs of consecutive price changes of opposite sign) are from two to three times as likely as continuations (pairs of consecutive price changes of the same sign). Second, a continuation is

18 of the 30 stocks in Table 1 the actual number of runs is less than the expected number. Indeed, runs tests in general show no consistent evidence of dependence for any differencing interval longer than a day, which seems especially pertinent in light of the comments in footnote 14.

slightly more frequent after a preceding continuation than after a reversal. That is, let (+|++) indicate the occurrence of a positive price change, given two preceding positive changes. Then the events (+|++) and (—|——) are slightly more frequent than (+|+—) or (—|—+).[16]

Niederhoffer and Osborne offer explanations for these phenomena based on the market structure of the New York Stock Exchange (N.Y.S.E.). In particular, there are three major types of orders that an investor might place in a given stock: (a) buy limit (buy at a specified price or lower), (b) sell limit (sell at a specified price or higher), and (c) buy or sell at market (at the lowest selling or highest buying price of another investor). A book of unexecuted limit orders in a given stock is kept by the specialist in that stock on the floor of the exchange. Unexecuted sell limit orders are, of course, at higher prices than unexecuted buy limit orders. On both exchanges, the smallest non-zero price change allowed is ⅛ point.

Suppose now that there is more than one unexecuted sell limit order at the lowest price of any such order. A transaction at this price (initiated by an order to buy at market[17]) can only be followed either by a transaction at the same price (if the next market order is to buy) or by a transaction at a lower price (if the next market order is to sell). Consecutive price increases can usually only occur when consecutive market orders to buy exhaust the sell limit orders at a given price.[18] In short, the excessive tendency toward reversal for consecutive non-zero price changes could result from bunching of unexecuted buy and sell limit orders.

The tendency for the events (+|++) and (—|——) to occur slightly more frequently than (+|+—) and (—|—+) requires a more involved explanation which we shall not attempt to reproduce in full here. In brief, Niederhoffer and Osborne contend that the higher frequency of (+|++) relative to (+|+—) arises from a tendency for limit orders "to be concentrated at integers (26, 43), halves (26½, 43½), quarters and odd eighths in descending order of preference."[19] The frequency of the event (+|++), which usually requires that sell limit orders be exhausted at at least two consecutively higher prices (the last of which is relatively more frequently at an odd eighth), more heavily reflects the absence of sell limit orders at odd eighths than the event (+|+—), which usually implies that sell limit orders at only one price have been exhausted and so more or less reflects the average bunching of limit orders at all eighths.

But though Niederhoffer and Osborne present convincing evidence of sta-

16. On a transaction to transaction basis, positive and negative price changes are about equally likely. Thus, under the assumption that price changes are random, any pair of non-zero changes should be as likely as any other, and likewise for triplets of consecutive non-zero changes.

17. A buy limit order for a price equal to or greater than the lowest available sell limit price is effectively an order to buy at market, and is treated as such by the broker.

18. The exception is when there is a gap of more than ⅛ between the highest unexecuted buy limit and the lowest unexecuted sell limit order, so that market orders (and new limit orders) can be crossed at intermediate prices.

19. Their empirical documentation for this claim is a few samples of specialists' books for selected days, plus the observation [34] that actual trading prices, at least for volatile high priced stocks, seem to be concentrated at integers, halves, quarters and odd eighths in descending order.

tistically significant departures from independence in price changes from transaction to transaction, and though their analysis of their findings presents interesting insights into the process of market making on the major exchanges, the types of dependence uncovered do not imply market inefficiency. The best documented source of dependence, the tendency toward excessive reversals in pairs of non-zero price changes, seems to be a direct result of the ability of investors to place limit orders as well as orders at market, and this negative dependence in itself does not imply the existence of profitable trading rules. Similarly, the apparent tendency for observed transactions (and, by implication, limit orders) to be concentrated at integers, halves, even eighths and odd eighths in descending order is an interesting fact about investor behavior, but in itself is not a basis on which to conclude that the market is inefficient.[20]

The Niederhoffer-Osborne analysis of market making does, however, point clearly to the existence of market inefficiency, but with respect to strong form tests of the efficient markets model. In particular, the list of unexecuted buy and sell limit orders in the specialist's book is important information about the likely future behavior of prices, and this information is only available to the specialist. When the specialist is asked for a quote, he gives the prices and can give the quantities of the highest buy limit and lowest sell limit orders on his book, but he is prevented by law from divulging the book's full contents. The interested reader can easily imagine situations where the structure of limit orders in the book could be used as the basis of a profitable trading rule.[21] But the record seems to speak for itself:

It should not be assumed that these transactions undertaken by the specialist, and in which he is involved as buyer or seller in 24 per cent of all market volume, are necessarily a burden to him. Typically, the specialist sells above his last purchase on 83 per cent of all his sales, and buys below his last sale on 81 per cent of all his purchases ([32], p. 908).

Thus it seems that the specialist has monopoly power over an important block of information, and, not unexpectedly, uses his monopoly to turn a profit. And this, of course, is evidence of market inefficiency in the strong form sense. The important economic question, of course, is whether the market making

20. Niederhoffer and Osborne offer little to refute this conclusion. For example ([32], p. 914):

Although the specific properties reported in this study have a significance from a statistical point of view, the reader may well ask whether or not they are helpful in a practical sense. Certain trading rules emerge as a result of our analysis. One is that limit and stop orders should be placed at odd eights, preferably at ⅞ for sell orders and at ⅛ for buy orders. Another is to buy when a stock advances through a barrier and to sell when it sinks through a barrier.

The first "trading rule" tells the investor to resist his innate inclination to place orders at integers, but rather to place sell orders ⅛ below an integer and buy orders ⅛ above. Successful execution of the orders is then more likely, since the congestion of orders that occur at integers is avoided. But the cost of this success is apparent. The second "trading rule" seems no more promising, if indeed it can even be translated into a concrete prescription for action.

21. See, for example, ([32], p. 908). But it is unlikely that anyone but the specialist could earn substantial profits from knowledge of the structure of unexecuted limit orders on the book. The specialist makes trading profits by engaging in many transactions, each of which has a small average profit; but for any other trader, including those with seats on the exchange, these profits would be eaten up by commissions to the specialist.

function of the specialist could be fulfilled more economically by some non-monopolistic mechanism.[22]

4. Distributional Evidence

At this date the weight of the empirical evidence is such that economists would generally agree that whatever dependence exists in series of historical returns cannot be used to make profitable predictions of the future. Indeed, for returns that cover periods of a day or longer, there is little in the evidence that would cause rejection of the stronger random walk model, at least as a good first approximation.

Rather, the last burning issue of the random walk literature has centered on the nature of the distribution of price changes (which, we should note immediately, is an important issue for the efficient markets hypothesis since the nature of the distribution affects both the types of statistical tools relevant for testing the hypothesis and the interpretation of any results obtained). A model implying normally distributed price changes was first proposed by Bachelier [3], who assumed that price changes from transaction to transaction are independent, identically distributed random variables with finite variances. If transactions are fairly uniformly spread across time, and if the number of transactions per day, week, or month is very large, then the Central Limit Theorem leads us to expect that these price changes will have normal or Gaussian distributions.

Osborne [33], Moore [31], and Kendall [21] all thought their empirical evidence supported the normality hypothesis, but all observed high tails (i.e., higher proportions of large observations) in their data distributions vis-à-vis what would be expected if the distributions were normal. Drawing on these findings and some empirical work of his own, Mandelbrot [28] then suggested that these departures from normality could be explained by a more general form of the Bachelier model. In particular, if one does not assume that distributions of price changes from transaction to transaction necessarily have finite variances, then the limiting distributions for price changes over longer differencing intervals could be any member of the stable class, which includes the normal as a special case. Non-normal stable distributions have higher tails than the normal, and so can account for this empirically observed feature of distributions of price changes. After extensive testing (involving the data from the stocks in Table 1), Fama [10] concludes that non-normal stable distributions are a better description of distributions of daily returns on common stocks than the normal. This conclusion is also supported by the empirical work of Blume [7] on common stocks, and it has been extended to U.S. Government Treasury Bills by Roll [37].

Economists have, however, been reluctant to accept these results,[23] primar-

22. With modern computers, it is hard to believe that a more competitive and economical system would not be feasible. It does not seem technologically impossible to replace the entire floor of the N.Y.S.E. with a computer, fed by many remote consoles, that kept all the books now kept by the specialists, that could easily make the entire book on any stock available to anybody (so that interested individuals could then compete to "make a market" in a stock) and that carried out transactions automatically.

23. Some have suggested that the long-tailed empirical distributions might result from processes

ily because of the wealth of statistical techniques available for dealing with normal variables and the relative paucity of such techniques for non-normal stable variables. But perhaps the biggest contribution of Mandelbrot's work has been to stimulate research on stable distributions and estimation procedures to be applied to stable variables. (See, for example, Wise [46], Fama and Roll [15], and Blattberg and Sargent [6], among others.) The advance of statistical sophistication (and the importance of examining distributional assumptions in testing the efficient markets model) is well illustrated in Roll [37], as compared, for example, with the early empirical work of Mandelbrot [28] and Fama [10].

5. "Fair Game" Models in the Treasury Bill Market

Roll's work is novel in other respects as well. Coming after the efficient markets models of Mandelbrot [27] and Samuelson [38], it is the first weak form empirical work that is consciously in the "fair game" rather than the random walk tradition.

More important, as we saw earlier, the "fair game" properties of the general expected return models apply to

$$z_{jt} = r_{jt} - E(\tilde{r}_{jt}|\Phi_{t-1}). \quad (10)$$

For data on common stocks, tests of "fair game" (and random walk) properties seem to go well when the conditional expected return is estimated as the average return for the sample of data at hand. Apparently the variation in common stock returns about their expected values is so large relative to any changes in the expected values that the latter can safely be ignored. But, as Roll demonstrates, this result does not hold for Treasury Bills. Thus, to test the "fair game" model on Treasury Bills requires explicit economic theory for the evolution of expected returns through time.

Roll uses three existing theories of the term structure (the pure expectations hypothesis of Lutz [26] and two market segmentation hypotheses, one of which is the familiar "liquidity preference" hypothesis of Hicks [18] and Kessel [22]) for this purpose.[24] In his models r_{jt} is the rate observed from the term structure at period t for one week loans to commence at $t + j - 1$, and can be thought of as a "futures" rate. Thus $r_{j+1, t-1}$ is likewise the rate on

that are mixtures of normal distributions with different variances. Press [35], for example, suggests a Poisson mixture of normals in which the resulting distributions of price changes have long tails but finite variances. On the other hand, Mandelbrot and Taylor [29] show that other mixtures of normals can still lead to non-normal stable distributions of price changes for finite differencing intervals.

If, as Press' model would imply, distributions of price changes are long-tailed but have finite variances, then distributions of price changes over longer and longer differencing intervals should be progressively closer to the normal. No such convergence to normality was observed in [10] (though admittedly the techniques used were somewhat rough). Rather, except for origin and scale, the distributions for longer differencing intervals seem to have the same "high-tailed" characteristics as distributins for shorter differencing intervals, which is as would be expected if the distributions are non-normal stable.

24. As noted early in our discussions, all available tests of market efficiency are implicitly also tests of expected return models of market equilibrium. But Roll formulates explicitly the economic models underlying his estimates of expected returns, and emphasizes that he is simultaneously testing economic models of the term structure as well as market efficiency.

one week loans to commence at $t + j - 1$, but observed in this case at $t - 1$. Similarly, L_{jt} is the so-called "liquidity premium" in r_{jt}; that is

$$r_{jt} = E(\tilde{r}_{0,t+j-1}|\Phi_t) + L_{jt}.$$

In words, the one-week "futures" rate for period $t + j - 1$ observed from the term structure at t is the expectation at t of the "spot" rate for $t + j - 1$ plus a "liquidity premium" (which could, however, be positive or negative).

In all three theories of the term structure considered by Roll, the conditional expectation required in (10) is of the form

$$E(\tilde{r}_{j,t}|\Phi_{t-1}) = r_{j+1,t-1} + E(\tilde{L}_{jt}|\Phi_{t-1}) - L_{j+1,t-1}.$$

The three theories differ only in the values assigned to the "liquidity premiums." For example, in the "liquidity preference" hypothesis, investors must always be paid a positive premium for bearing interest rate uncertainty, so that the L_{jt} are always positive. By contrast, in the "pure expectations" hypothesis, all liquidity premiums are assumed to be zero, so that

$$E(\tilde{r}_{jt}|\Phi_{t-1}) = r_{j+1,t-1}.$$

After extensive testing, Roll concludes (i) that the two market segmentation hypotheses fit the data better than the pure expectations hypothesis, with perhaps a slight advantage for the "liquidity preference" hypothesis, and (ii) that as far as his tests are concerned, the market for Treasury Bills is effcient. Indeed, it is interesting that when the best fitting term structure model is used to estimate the conditional expected "futures" rate in (10), the resulting variable z_{jt} seems to be serially independent! It is also interesting that if he simply assumed that his data distributions were normal, Roll's results would not be so strongly in support of the efficient markets model. In this case taking account of the observed high tails of the data distributions substantially affected the interpretation of the results.[25]

6. Tests of a Multiple Security Expected Return Model

Though the weak form tests support the "fair game" efficient markets model, all of the evidence examined so far consists of what we might call "single security tests." That is, the price or return histories of individual securities are examined for evidence of dependence that might be used as the basis of a trading system for *that* security. We have not discussed tests of whether securities are "appropriately priced" vis-à-vis one another.

But to judge whether differences between average returns are "appropriate" an economic theory of equilibrium expected returns is required. At the moment, the only fully developed theory is that of Sharpe [40] and Lintner [24,

25. The importance of distributional assumptions is also illustrated in Alexander's work on trading rules. In his initial tests of filter systems [1], Alexander assumed that purchases could always be executed exactly (rather than at least) y% above lows and sales exactly y% below highs. Mandelbrot [28] pointed out, however, that though this assumption would do little harm with normally distributed price changes (since price series are then essentially continuous), with non-normal stable distributions it would introduce substantial positive bias into the filter profits (since with such distributions price series will show many discontinuities). In his later tests [2], Alexander does indeed find that taking account of the discontinuities (i.e., the presence of large price changes) in his data substantially lowers the profitability of the filters.

25] referred to earlier. In this model (which is a direct outgrowth of the mean-standard deviation portfolio models of investor equilibrium of Markowitz [30] and Tobin [43]), the expected return on security j from time t to t + 1 is

$$E(\tilde{r}_{j,t+1}|\Phi_t) = r_{f,t+1} + \left[\frac{E(\tilde{r}_{m,t+1}|\Phi_t) - r_{f,t+1}}{\sigma(\tilde{r}_{m,t+1}|\Phi_t)}\right] \frac{\text{cov}\,(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)}{\sigma(\tilde{r}_{m,t+1}|\Phi_t)}, \quad (11)$$

where $r_{f,t+1}$ is the return from t to t + 1 on an asset that is riskless in money terms; $r_{m,t+1}$ is the return on the "market portfolio" m (a portfolio of all investment assets with each weighted in proportion to the total market value of all its outstanding units); $\sigma^2(\tilde{r}_{m,t+1}|\Phi_t)$ is the variance of the return on m; cov $(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)$ is the covariance between the returns on j and m; and the appearance of Φ_t indicates that the various expected returns, variance and covariance, could in principle depend on Φ_t. Though Sharpe and Lintner derive (11) as a one-period model, the result is given a multiperiod justification and interpretation in [11]. The model has also been extended in (12) to the case where the one-period returns could have stable distributions with infinite variances.

In words, (11) says that the expected one-period return on a security is the one-period riskless rate of interest $r_{f,t+1}$ plus a "risk premium" that is proportional to $\text{cov}(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)/\sigma(\tilde{r}_{m,t+1}|\Phi_t)$. In the Sharpe-Lintner model each investor holds some combination of the riskless asset and the market portfolio, so that, given a mean-standard deviation framework, the risk of an individual asset can be measured by its contribution to the standard deviation of the return on the market portfolio. This contribution is in fact cov $(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)/\sigma(\tilde{r}_{m,t+1}|\Phi_t)$.[26] The factor

$$[E(\tilde{r}_{m,t+1}|\Phi_t) - r_{f,t+1}]/\sigma(\tilde{r}_{m,t+1}|\Phi_t),$$

which is the same for all securities, is then regarded as the market price of risk.

Published empirical tests of the Sharpe-Lintner model are not yet available, though much work is in progress. There is some published work, however, which, though not directed at the Sharpe-Lintner model, is at least consistent with some of its implications. The stated goal of this work has been to determine the extent to which the returns on a given security are related to the returns on other securities. It started (again) with Kendall's [21] finding that though common stock price changes do not seem to be serially correlated, there is a high degree of cross-correlation between the *simultaneous* returns of different securities. This line of attack was continued by King [23] who (using factor analysis of a sample of monthly returns on sixty N.Y.S.E. stocks for the period 1926-60) found that on average about 50% of the variance of an individual stock's returns could be accounted for by a "market factor" which affects the returns on all stocks, with "industry factors" accounting for at most an additional 10% of the variance.

26. That is,

$$\sum_j \text{cov}\,(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)/\sigma(\tilde{r}_{m,t+1}|\Phi_t) = \sigma(\tilde{r}_{m,t+1}|\Phi_t).$$

For our purposes, however, the work of Fama, Fisher, Jensen, and Roll [14] (henceforth FFJR) and the more extensive work of Blume [7] on monthly return data is more relevant. They test the following "market model," originally suggested by Markowitz [30]:

$$\tilde{r}_{j,t+1} = \alpha_j + \beta_j \tilde{r}_{M,t+1} + \tilde{u}_{j,t+1} \tag{12}$$

where $r_{j,t+1}$ is the rate of return on security j for month t, $r_{M,t+1}$ is the corresponding return on a market index M, α_j and β_j are parameters that can vary from security to security, and $u_{j,t+1}$ is a random disturbance. The tests of FFJR and subsequently those of Blume indicate that (12) is well specified as a linear regression model in that (i) the estimated parameters $\hat{\alpha}_j$ and $\hat{\beta}_j$ remain fairly constant over long periods of time (e.g., the entire post-World War II period in the case of Blume), (ii) $r_{M,t+1}$ and the estimated $\hat{u}_{j,t+1}$, are close to serially independent, and (iii) the $\hat{u}_{j,t+1}$ seem to be independent of $r_{M,t+1}$.

Thus the observed properties of the "market model" are consistent with the expected return efficient markets model, and, in addition, the "market model" tells us something about the process generating expected returns from security to security. In particular,

$$E(\tilde{r}_{j,t+1}) = \alpha_j + \beta_j E(\tilde{r}_{M,t+1}). \tag{13}$$

The question now is to what extent (13) is consistent with the Sharpe-Lintner expected return model summarized by (11). Rearranging (11) we obtain

$$E(\tilde{r}_{j,t+1}|\Phi_t) = \alpha_j(\Phi_t) + \beta_j(\Phi_t)E(\tilde{r}_{m,t+1}|\Phi_t), \tag{14}$$

where, noting that the riskless rate $r_{f,t+1}$ is itself part of the information set Φ_t, we have

$$\alpha_j(\Phi_t) = r_{f,t+1}[1 - \beta_j(\Phi_t)], \tag{15}$$

and

$$\beta_j(\Phi_t) = \frac{\text{cov}\,(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)}{\sigma^2(\tilde{r}_{m,t+1}|\Phi_t)}. \tag{16}$$

With some simplifying assumptions, (14) can be reduced to (13). In particular, if the covariance and variance that determine $\beta_j(\Phi_t)$ in (16) are the same for all t and Φ_t, then $\beta_j(\Phi_t)$ in (16) corresponds to β_j in (12) and (13), and the least squares *estimate* of β_j in (12) is in fact just the ratio of the sample values of the covariance and variance in (16). If we also assume that $r_{f,t+1}$ is the same for all t, and that the behavior of the returns on the market portfolio m are closely approximated by the returns on some representative index M, we will have come a long way toward equating (13) and (11). Indeed, the only missing link is whether in the estimated parameters of (12)

$$\hat{\alpha}_j \cong r_f(1 - \hat{\beta}_j). \tag{17}$$

Neither FFJR nor Blume attack this question directly, though some of Blume's evidence is at least promising. In particular, the magnitudes of the estimated $\hat{\alpha}_j$ are roughly consistent with (17) in the sense that the estimates are always close to zero (as they should be with monthly return data).[27]

In a sense, though, in establishing the apparent empirical validity of the "market model" of (12), both too much and too little have been shown *vis-à-vis* the Sharpe-Lintner expected return model of (11). We know that during the post-World War II period one-month interest rates on riskless assets (e.g., government bills with one month to maturity) have not been constant. Thus, if expected security returns were generated by a version of the "market model" that is fully consistent with the Sharpe-Lintner model, we would, according to (15), expect to observe some non-stationarity in the estimates of α_j. On a monthly basis, however, variation through time in one-period riskless interest rates is probably trivial relative to variation in other factors affecting monthly common stock returns, so that more powerful statistical methods would be necessary to study the effects of changes in the riskless rate.

In any case, since the work of FFJR and Blume on the "market model" was not concerned with relating this model to the Sharpe-Lintner model, we can only say that the results for the former are somewhat consistent with the implications of the latter. But the results for the "market model" are, after all, just a statistical description of the return generating process, and they are probably somewhat consistent with other models of equilibrium expected returns. Thus the only way to generate strong empirical conclusions about the Sharpe-Lintner model is to test it directly. On the other hand, any alternative model of equilibrium expected returns must be somewhat consistent with the "market model," given the evidence in its support.

B. *Tests of Martingale Models of the Semi-strong Form*

In general, semi-strong form tests of efficient markets models are concerned with whether current prices "fully reflect" all obviously publicly available information. Each individual test, however, is concerned with the adjustment of security prices to one kind of information generating event (e.g., stock splits, announcements of financial reports by firms, new security issues, etc.). Thus each test only brings supporting evidence for the model, with the idea that by accumulating such evidence the validity of the model will be "established."

In fact, however, though the available evidence is in support of the efficient markets model, it is limited to a few major types of information generating events. The initial major work is apparently the study of stock splits by Fama,

27. With least squares applied to monthly return data, the estimate of α_j in (12) is

$$\hat{\alpha}_j = \bar{r}_{j,t} - \hat{\beta}_j \bar{r}_{M,t},$$

where the bars indicate sample mean returns. But, in fact, Blume applies the market model to the wealth relatives $R_{jt} = 1 + r_{jt}$ and $R_{Mt} = 1 + r_{Mt}$. This yields precisely the same estimate of β_j as least squares applied to (12), but the intercept is now

$$\hat{\alpha}'_j = \bar{R}_{jt} - \hat{\beta}_j \bar{R}_{Mt} = 1 + \bar{r}_{jt} - \hat{\beta}_j(1 + \bar{r}_{Mt}) = 1 - \hat{\beta}_j + \hat{\alpha}_j.$$

Thus what Blume in fact finds is that for almost all securities, $\hat{\alpha}'_j + \hat{\beta}_j \cong 1$, which implies that $\hat{\alpha}_j$ is close to 0.

Fisher, Jensen, and Roll (FFJR) [14], and all the subsequent studies summarized here are adaptations and extensions of the techniques developed in FFJR. Thus, this paper will first be reviewed in some detail, and then the other studies will be considered.

1. Splits and the Adjustment of Stock Prices to New Information

Since the only apparent result of a stock split is to multiply the number of shares per shareholder without increasing claims to real assets, splits in themselves are not necessarily sources of new information. The presumption of FFJR is that splits may often be associated with the appearance of more fundamentally important information. The idea is to examine security returns around split dates to see first if there is any "unusual" behavior, and, if so, to what extent it can be accounted for by relationships between splits and other more fundamental variables.

The approach of FFJR to the problem relies heavily on the "market model" of (12). In this model if a stock split is associated with abnormal behavior, this would be reflected in the estimated regression residuals for the months surrounding the split. For a given split, define month O as the month in which the effective date of a split occurs, month 1 as the month immediately following the split month, month -1 as the month preceding, etc. Now define the average residual over all split securities for month m (where for each security m is measured relative to the split month) as

$$u_m = \sum_{j=1}^{N} \frac{\hat{u}_{jm}}{N},$$

where $\hat{u}_{jm}$ is the sample regression residual for security j in month m and N is the number of splits. Next, define the cumulative average residual U_m as

$$U_m = \sum_{k=-29}^{m} u_k.$$

The average residual u_m can be interpreted as the average deviation (in month m relative to split months) of the returns of split stocks from their normal relationships with the market. Similarly, U_m can be interpreted as the cumulative deviation (from month -29 to month m). Finally, define u_m^+, u_m^-, U_m^+, and U_m^- as the average and cumulative average residuals for splits followed by "increased" (+) and "decreased" (−) dividends. An "increase" is a case where the percentage change in dividends on the split share in the year after the split is greater than the percentage change for the N.Y.S.E. as a whole, while a "decrease" is a case of relative dividend decline.

The essence of the results of FFJR are then summarized in Figure 1, which shows the cumulative average residuals U_m U_m^+, and U_m^- for $-29 \leq m \leq 30$. The sample includes all 940 stock splits on the N.Y.S.E. from 1927-59, where the exchange was at least five new shares for four old, and where the security was listed for at least twelve months before and after the split.

For all three dividend categories the cumulative average residuals rise in the 29 months prior to the split, and in fact the average residuals (not shown here) are uniformly positive. This cannot be attributed to the splitting process, since in only about ten per cent of the cases is the time between the announcement and effective dates of a split greater than four months. Rather, it seems that firms tend to split their shares during "abnormally" good times—that is, during periods when the prices of their shares have increased more than would

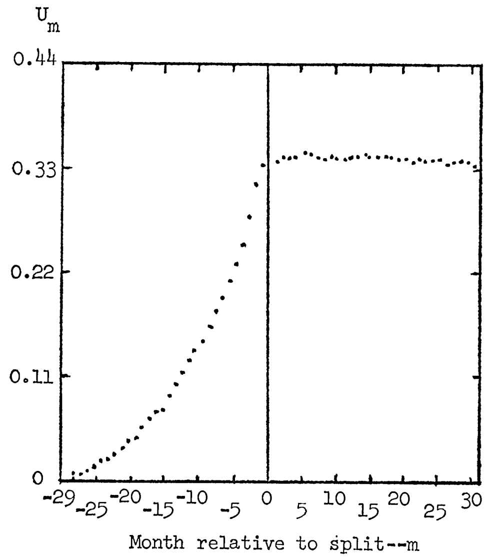

FIGURE 1a
Cumulative average residuals—all splits.

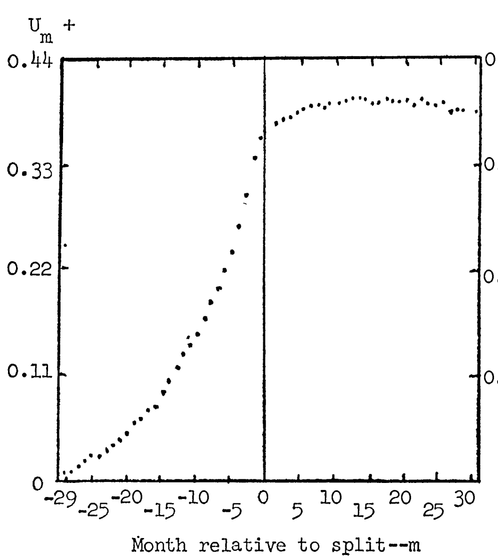

FIGURE 1b
Cumulative average residuals for dividend "increases."

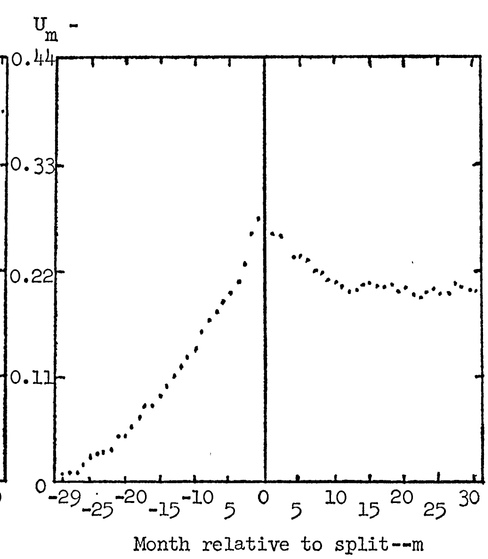

FIGURE 1c
Cumulative average residuals for dividend "decreases."

be implied by their normal relationships with general market prices, which itself probably reflects a sharp improvement, relative to the market, in the earnings prospects of these firms sometime during the years immediately preceding a split.[28]

After the split month there is almost no further movement in U_m, the cumulative average residual for all splits. This is striking, since 71.5 per cent (672 out of 940) of all splits experienced greater percentage dividend increases in the year after the split than the average for all securities on the N.Y.S.E. In light of this, FFJR suggest that when a split is announced the market interprets this (and correctly so) as a signal that the company's directors are probably confident that future earnings will be sufficient to maintain dividend payments at a higher level. Thus the large price increases in the months immediately preceding a split may be due to an alteration in expectations concerning the future earning potential of the firm, rather than to any intrinsic effects of the split itself.

If this hypothesis is correct, return behavior subsequent to splits should be substantially different for the cases where the dividend increase materializes than for the cases where it does not. FFJR argue that in fact the differences are in the directions that would be predicted. The fact that the cumulative average residuals for the "increased" dividends (Figure 1b) drift upward but only slightly in the year *after* the split is consistent with the hypothesis that when the split is *declared*, there is a price adjustment in anticipation of future dividend increases. But the behavior of the residuals for stock splits associated with "decreased" dividends offers even stronger evidence for the split hypothesis. The cumulative average residuals for these stocks (Figure 1c) rise in the few months before the split, but then fall dramatically in the few months after the split when the anticipated dividend increase is not forthcoming. When a year has passed after the split, the cumulative average residual has fallen to about where it was five months prior to the split, which is about the earliest time reliable information about a split is likely to reach the market. Thus by the time it becomes clear that the anticipated dividend increase is not forthcoming, the apparent effects of the split seem to have been wiped away, and the stock's returns have reverted to their normal relationship with market returns.

Finally, and most important, although the behavior of post-split returns will be very different depending on whether or not dividend "increases" occur, and in spite of the fact that a large majority of split securities do experience dividend "increases," when all splits are examined together (Figure 1a), subsequent to the split there is no net movement up or down in the cumulative

28. It is important to note, however, that as FFJR indicate, the persistent upward drift of the cumulative average residuals in the months preceding the split is not a phenomenon that could be used to increase expected trading profits. The reason is that the behavior of the average residuals is not representative of the behavior of the residuals for individual securities. In months prior to the split, successive sample residuals for individual securities seem to be independent. But in most cases, there are a few months in which the residuals are abnormally large and positive. The months of large residuals differ from security to security, however, and these differences in timing explain why the signs of the average residuals are uniformly positive for many months preceding the split.

average residuals. Thus, apparently the market makes unbiased forecasts of the implications of a split for future dividends, and these forecasts are fully reflected in the prices of the security by the end of the split month. After considerably more data analysis than can be summarized here, FFJR conclude that their results lend considerable support to the conclusion that the stock market is efficient, at least with respect to its abiliy to adjust to the information implicit in a split.

2. Other Studies of Public Announcements

Variants of the method of residual analysis developed in [14] have been used by others to study the effects of different kinds of public announcements, and all of these also support the efficient markets hypothesis.

Thus using data on 261 major firms for the period 1946-66, Ball and Brown [4] apply the method to study the effects of annual earnings announcements. They use the residuals from a time series regression of the annual earnings of a firm on the average earnings of all their firms to classify the firm's earnings for a given year as having "increased" or "decreased" relative to the market. Residuals from regressions of monthly common stock returns on an index of returns (i.e., the market model of (12)) are then used to compute cumulative average return residuals separately for the earnings that "increased," and those that "decreased." The cumulative average return residuals rise throughout the year in advance of the announcement for the earnings "increased" category, and fall for the earnings "decreased" category.[29] Ball and Brown [4, p. 175] conclude that in fact no more than about ten to fifteen percent of the information in the annual earnings announcement has not been anticipated by the month of the announcement.

On the macro level, Waud [45] has used the method of residual analysis to examine the effects of announcements of discount rate changes by Federal Reserve Banks. In this case the residuals are essentially just the deviations of the daily returns on the Standard and Poor's 500 Index from the average daily return. He finds evidence of a statistically significant "announcement effect" on stock returns for the first trading day following an announcement, but the magnitude of the adjustment is small, never exceeding .5%. More interesting from the viewpoint of the efficient markets hypothesis is his conclusion that, if anything, the market anticipates the announcements (or information is somehow leaked in advance). This conclusion is based on the non-random patterns of the signs of average return residuals on the days immediately preceding the announcement.

Further evidence in support of the efficient markets hypothesis is provided in the work of Scholes [39] on large secondary offerings of common stock (ie., large underwritten sales of existing common stocks by individuals and institutions) and on new issues of stock. He finds that on average secondary issues are associated with a decline of between one and two per cent in the cumulative average residual returns for the corresponding common stocks. Since the magnitude of the price adjustment is unrelated to the size of the

29. But the comment of footnote 28 is again relevant here.

issue, Scholes concludes that the adjustment is not due to "selling pressure" (as is commonly believed), but rather results from negative information implicit in the fact that somebody is trying to sell a large block of a firm's stock. Moreover, he presents evidence that the value of the information in a secondary depends to some extent on the vendor; somewhat as would be expected, by far the largest negative cumulative average residuals occur where the vendor is the corporation itself or one of its officers, with investment companies a distant second. But the identity of the vendor is not generally known at the time of the secondary, and corporate insiders need only report their transactions in their own company's stock to the S.E.C. within six days after a sale. By this time the market on average has fully adjusted to the information in the secondary, as indicated by the fact that the average residuals behave randomly thereafter.

Note, however, that though this is evidence that prices adjust efficiently to public information, it is also evidence that corporate insiders at least sometimes have important information about their firm that is not yet publicly known. Thus Scholes' evidence for secondary distributions provides support for the efficient markets model in the semi-strong form sense, but also some strong-form evidence against the model.

Though his results here are only preliminary, Scholes also reports on an application of the method of residual analysis to a sample of 696 new issues of common stock during the period 1926-66. As in the FFJR study of splits, the cumulative average residuals rise in the months preceding the new security offering (suggesting that new issues tend to come after favorable recent events)[30] but behave randomly in the months following the offering (indicating that whatever information is contained in the new issue is on average fully reflected in the price of the month of the offering).

In short, the available semi-strong form evidence on the effect of various sorts of public announcements on common stock returns is all consistent with the efficient markets model. The strong point of the evidence, however, is its consistency rather than its quantity; in fact, few different types of public information have been examined, though those treated are among the obviously most important. Moreover, as we shall now see, the amount of semi-strong form evidence is voluminous compared to the strong form tests that are available.

C. *Strong Form Tests of the Efficient Markets Models*

The strong form tests of the efficient markets model are concerned with whether all available information is fully reflected in prices in the sense that no individual has higher expected trading profits than others because he has monopolistic access to some information. We would not, of course, expect this model to be an exact description of reality, and indeed, the preceding discussions have already indicated the existence of contradictory evidence. In particular, Niederhoffer and Osborne [32] have pointed out that specialists on the N.Y.S.E. apparently use their monopolistic access to information concern-

30. Footnote 28 is again relevant here.

ing unfilled limit orders to generate monopoly profits, and Scholes' evidence [39] indicates that officers of corporations sometimes have monopolistic access to information about their firms.

Since we already have enough evidence to determine that the model is not strictly valid, we can now turn to other interesting questions. Specifically, how far down through the investment community do deviations from the model permeate? Does it pay for the average investor (or the average economist) to expend resources searching out little known information? Are such activities even generally profitable for various groups of market "professionals"? More generally, who are the people in the investment community that have access to "special information"?

Though this is a fascinating problem, only one group has been studied in any depth—the managements of open end mutual funds. Several studies are available (e.g., Sharpe [41, 42] and Treynor [44]), but the most thorough are Jensen's [19, 20], and our comments will be limited to his work. We shall first present the theoretical model underlying his tests, and then go on to his empirical results.

1. Theoretical Framework

In studying the performance of mutual funds the major goals are to determine (a) whether in general fund managers seem to have access to special information which allows them to generate "abnormal" expected returns, and (b) whether some funds are better at uncovering such special information than others. Since the criterion will simply be the ability of funds to produce higher returns than some norm with no attempt to determine what is responsible for the high returns, the "special information" that leads to high performance could be either keener insight into the implications of publicly available information than is implicit in market prices or monopolistic access to specific information. Thus the tests of the performance of the mutual fund industry are not strictly strong form tests of the efficient markets model.

The major theoretical (and practical) problem in using the mutual fund industry to test the efficient markets model is developing a "norm" against which performance can be judged. The norm must represent the results of an investment policy based on the assumption that prices fully reflect all available information. And if one believes that investors are generally risk averse and so on average must be compensated for any risks undertaken, then one has the problem of finding appropriate definitions of risk and evaluating each fund relative to a norm with its chosen level of risk.

Jensen uses the Sharpe [40]-Lintner [24, 25] model of equilibrium expected returns discussed above to derive a norm consistent with these goals. From (14)-(16), in this model the expected return on an asset or portfolio j from t to t + 1 is

$$E(\tilde{r}_{j,t+1}|\Phi_t) = r_{f,t+1}\,[1 - \beta_j(\Phi_t)] + E(\tilde{r}_{m,t+1}|\Phi_t)\beta_j(\Phi_t), \qquad (18)$$

where the various symbols are as defined in Section III. A. 6. But (18) is an *ex ante* relationship, and to evaluate performance an *ex post* norm is needed.

One way the latter can be obtained is to substitute the realized return on the market portfolio for the expected return in (18) with the result[31]

$$E(\tilde{r}_{j,t+1}|\Phi_t, r_{m,t+1}) = r_{f,t+1}\,[1 - \beta_j(\Phi_t)] + r_{m,t+1}\beta_j(\Phi_t). \qquad (19)$$

Geometrically, (19) says that within the context of the Sharpe-Lintner model, the expected return on j (given information Φ_t and the return $r_{m,t+1}$ on the market portfolio) is a linear function of its risk

$$\beta_j(\Phi_t) = \text{cov}\,(\tilde{r}_{j,t+1}, \tilde{r}_{m,t+1}|\Phi_t)/\sigma^2(\tilde{r}_{m,t+1}|\Phi_t),$$

as indicated in Figure 2. Assuming that the value of $\beta_j(\Phi_t)$ is somehow known, or can be reliably estimated, if j is a mutual fund, its *ex post* performance from t to t + 1 might now be evaluated by plotting its combination of realized return $r_{j,t+1}$ and risk in Figure 2. If (as for the point a) the combination falls above the expected return line (or, as it is more commonly called, the "market line"), it has done better than would be expected given its level of risk, while if (as for the point b) it falls below the line it has done worse.

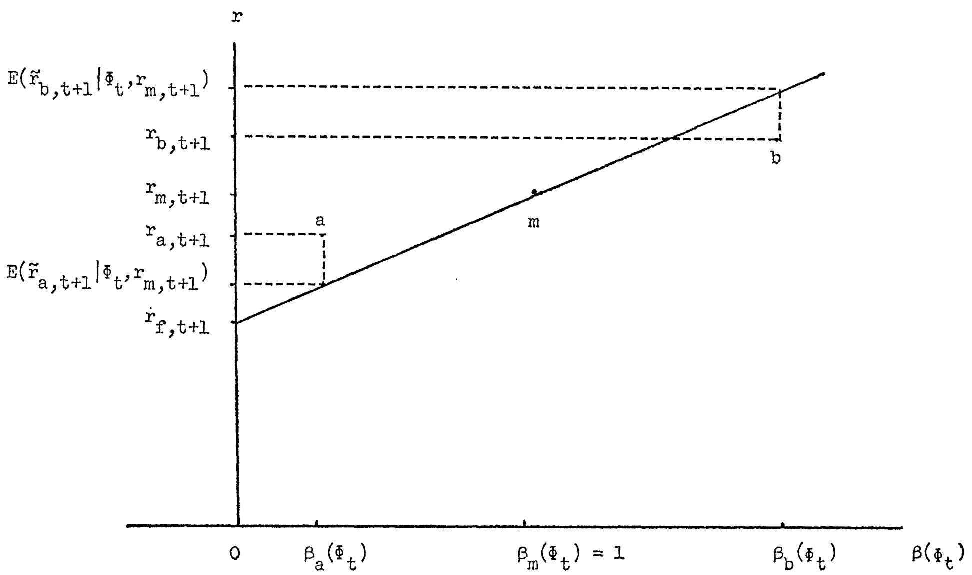

FIGURE 2
Performance Evaluation Graph

Alternatively, the market line shows the combinations of return and risk provided by portfolios that are simple mixtures of the riskless asset and the market portfolio m. The returns and risks for such portfolios (call them c) are

$$r_{c,t+1} = \alpha r_{f,t+1} + (1 - \alpha) r_{m,t+1}$$

$$\beta_c(\Phi_t) = \frac{\text{cov}\,(\tilde{r}_{c,t+1}, \tilde{r}_{m,t+1}|\Phi_t)}{\sigma^2(\tilde{r}_{m,t+1}|\Phi_t)} = \frac{\text{cov}\,((1-\alpha)\tilde{r}_{m,t+1}, \tilde{r}_{m,t+1}|\Phi_t)}{\sigma^2(\tilde{r}_{m,t+1}|\Phi_t)} = 1 - \alpha,$$

31. The assumption here is that the return $\tilde{r}_{j,t+1}$ is generated according to

$$\tilde{r}_{j,t+1} = r_{f,t+1}[1 - \beta_j(\Phi_t)] + r_{m,t+1}\beta_j(\Phi_t) + \tilde{u}_{j,t+1},$$

and

$$E(\tilde{u}_{j,t+1}|r_{m,t+1}) = 0 \text{ for all } r_{m,t+1}.$$

where α is the proportion of portfolio funds invested in the riskless asset. Thus, when $1 \geqslant \alpha \geqslant 0$ we obtain the combinations of return and risk along the market line from $r_{f,t+1}$ to m in Figure 2, while when $\alpha < 0$ (and under the assumption that investors can borrow at the same rate that they lend) we obtain the combinations of return and risk along the extension of the line through m. In this interpretation, the market line represents the results of a naive investment strategy, which the investor who thinks prices reflect all available information might follow. The performance of a mutual fund is then measured relative to this naive strategy.

2. Empirical Results

Jensen uses this risk-return framework to evaluate the performance of 115 mutual funds over the ten year period 1955-64. He argues at length for measuring return as the nominal ten year rate with continuous compounding (i.e., the natural log of the ratio of terminal wealth after ten years to initial wealth) and for using historical data on nominal one-year rates with continuous compounding to estimate risk. The Standard and Poor Index of 500 major common stocks is used as the proxy for the market portfolio.

The general question to be answered is whether mutual fund managements have any special insights or information which allows them to earn returns above the norm. But Jensen attacks the question on several levels. First, can the funds in general do well enough to compensate investors for loading charges, management fees, and other costs that might be avoided by simply choosing the combination of the riskless asset f and the market portfolio m with risk level comparable to that of the fund's actual portfolio? The answer seems to be an emphatic no. As far as net returns to investors are concerned, in 89 out of 115 cases, the fund's risk-return combination for the ten year period is below the market line for the period, and the average over all funds of the deviations of ten year returns from the market time is -14.6%. That is, on average the consumer's wealth after ten years of holding mutual funds is about fifteen per cent less than if he held the corresponding portfolios along the market line.

But the loading charge that an investor pays in buying into a fund is usually a pure salesman's commission that the fund itself never gets to invest. Thus one might ask whether, ignoring loading charges (i.e., assuming no such charges were paid by the investor), in general fund managements can earn returns sufficiently above the norm to cover all other expenses that are presumably more directly related to the management of the fund portfolios. Again, the answer seems to be no. Even when loading charges are ignored in computing returns, the risk-return combinations for 72 out of 115 funds are below the market line, and the average deviation of ten year returns from the market line is -8.9%.

Finally, as a somewhat stronger test of the efficient markets model, one would like to know if, ignoring all expenses, fund managements in general showed any ability to pick securities that outperformed the norm. Unfortunately, this question cannot be answered with precision for individual funds since, curiously, data on brokerage commissions are not published regularly.

But Jensen suggests the available evidence indicates that the answer to the question is again probably negative. Specifically, adding back all other published expenses of funds to their returns, the risk-return combinations for 58 out of 115 funds were below the market line, and the average deviation of ten year return from the line was −2.5%. But part of this result is due to the absence of a correction for brokerage commissions. Estimating these commissions from average portfolio turnover rates for all funds for the period 1953-58, and adding them back to returns for all funds increases the average deviation from the market line from −2.5% to .09%, which still is not indicative of the existence of special information among mutual fund managers.

But though mutual fund managers in general do not seem to have access to information not already fully reflected in prices, perhaps there are individual funds that consistently do better than the norm, and so provide at least some strong form evidence against the efficient markets model. If there are such funds, however, they escape Jensen's search. For example, for individual funds, returns above the norm in one subperiod do not seem to be associated with performance above the norm in other subperiods. And regardless of how returns are measured (i.e., net or gross of loading charges and other expenses), the number of funds with large positive deviations of returns from the market line of Figure 2 is less than the number that would be expected by chance with 115 funds under the assumption that fund managements have no special talents in predicting returns.[32]

Jensen argues that though his results apply to only one segment of the investment community, they are nevertheless striking evidence in favor of the efficient markets model:

> Although these results certainly do not imply that the strong form of the martingale hypothesis holds for all investors and for all time, they provide strong evidence in support of that hypothesis. One must realize that these analysts are extremely well endowed. Moreover, they operate in the securities markets every day and have wide-ranging contacts and associations in both the business and financial communities. Thus, the fact that they are apparently unable to forecast returns accurately enough to recover their research and transactions costs is a striking piece of evidence in favor of the strong form of the martingale hypothesis—at least as far as the extensive subset of information available to these analysts is concerned [20, p. 170].

IV. Summary and Conclusions

The preceding (rather lengthy) analysis can be summarized as follows. In general terms, the theory of efficient markets is concerned with whether prices at any point in time "fully reflect" available information. The theory only has empirical content, however, within the context of a more specific model of

32. On the other hand, there is some suggestion in Scholes' [39] work on secondary issues that mutual funds may occassionally have access to "special information." After corporate insiders, the next largest negative price changes occur when the secondary seller is an investment company (including mutual funds), though on average the price changes are much smaller (i.e., closer to 0) than when the seller is a corporate insider.

Moreover, Jensen's evidence itself, though not indicative of the existence of special information among mutual fund managers, is not sufficiently precise to conclude that such information never exists. This stronger conclusion would require exact data on unavoidable expenses (including brokerage commissions) of portfolio management incurred by funds.

market equilibrium, that is, a model that specifies the nature of market equilibrium when prices "fully reflect" available information. We have seen that all of the available empirical literature is implicitly or explicitly based on the assumption that the conditions of market equilibrium can be stated in terms of expected returns. This assumption is the basis of the expected return or "fair game" efficient markets models.

The empirical work itself can be divided into three categories depending on the nature of the information subset of interest. *Strong-form* tests are concerned with whether individual investors or groups have monopolistic access to any information relevant for price formation. One would not expect such an extreme model to be an exact description of the world, and it is probably best viewed as a benchmark against which the importance of deviations from market efficiency can be judged. In the less restrictive *semi-strong-form* tests the information subset of interest includes all obviously publicly available information, while in the *weak form* tests the information subset is just historical price or return sequences.

Weak form tests of the efficient market model are the most voluminous, and it seems fair to say that the results are strongly in support. Though statistically significant evidence for dependence in successive price changes or returns has been found, some of this is consistent with the "fair game" model and the rest does not appear to be sufficient to declare the market inefficient. Indeed, at least for price changes or returns covering a day or longer, there isn't much evidence against the "fair game" model's more ambitious offspring, the random walk.

Thus, there is consistent evidence of positive dependence in day-to-day price changes and returns on common stocks, and the dependence is of a form that can be used as the basis of marginally profitable trading rules. In Fama's data [10] the dependence shows up as serial correlations that are consistently positive but also consistently close to zero, and as a slight tendency for observed numbers of runs of positive and negative price changes to be less than the numbers that would be expected from a purely random process. More important, the dependence also shows up in the filter tests of Alexander [1, 2] and those of Fama and Blume [13] as a tendency for very small filters to produce profits in excess of buy-and-hold. But any systems (like the filters) that attempt to turn short-term dependence into trading profits of necessity generate so many transactions that their expected profits would be absorbed by even the minimum commissions (security handling fees) that floor traders on major exchanges must pay. Thus, using a less than completely strict interpretation of market efficiency, this positive dependence does not seem of sufficient importance to warrant rejection of the efficient markets model.

Evidence in contradiction of the "fair game" efficient markets model for price changes or returns covering periods longer than a single day is more difficult to find. Cootner [9], and Moore [31] report preponderantly negative (but again small) serial correlations in weekly common stock returns, and this result appears also in the four day returns analyzed by Fama [10]. But it does not appear in runs tests of [10], where, if anything, there is some slight indication of positive dependence, but actually not much evidence of any dependence at all. In any case, there is no indication that whatever dependence exists in weekly returns can be used as the basis of profitable trading rules.

Other existing evidence of dependence in returns provides interesting insights into the process of price formation in the stock market, but it is not relevant for testing the efficient markets model. For example, Fama [10] shows that large daily price changes tend to be folowed by large changes, but of unpredictable sign. This suggests that important information cannot be completely evaluated immediately, but that the initial first day's adjustment of prices to the information is unbiased, which is sufficient for the martingale model. More interesting and important, however, is the Niederhoffer-Osborne [32] finding of a tendency toward excessive reversals in common stock price changes from transaction to transaction. They explain this as a logical result of the mechanism whereby orders to buy and sell at market are matched against existing limit orders on the books of the specialist. Given the way this tendency toward excessive reversals arises, however, there seems to be no way it can be used as the basis of a profitable trading rule. As they rightly claim, their results are a strong refutation of the theory of random walks, at least as applied to price changes from transaction to transaction, but they do not constitute refutation of the economically more relevant "fair game" efficient markets model.

Semi-strong form tests, in which prices are assumed to fully reflect all obviously publicly available information, have also supported the efficient markets hypothesis. Thus Fama, Fisher, Jensen, and Roll [14] find that the information in stock splits concerning the firm's future dividend payments is on average fully reflected in the price of a split share at the time of the split. Ball and Brown [4] and Scholes [39] come to similar conclusions with respect to the information contained in (i) annual earning announcements by firms and (ii) new issues and large block secondary issues of common stock. Though only a few different types of information generating events are represented here, they are among the more important, and the results are probably indicative of what can be expected in future studies.

As noted earlier, the strong-form efficient markets model, in which prices are assumed to fully reflect all available information, is probably best viewed as a benchmark against which deviations from market efficiency (interpreted in its strictest sense) can be judged. Two such deviations have in fact been observed. First, Niederhoffer and Osborne [32] point out that specialists on major security exchanges have monopolistic access to information on unexecuted limit orders and they use this information to generate trading profits. This raises the question of whether the "market making" function of the specialist (if indeed this is a meaningful economic function) could not as effectively be carried out by some other mechanism that did not imply monopolistic access to information. Second, Scholes [39] finds that, not unexpectedly, corporate insiders often have monopolistic access to information about their firms.

At the moment, however, corporate insiders and specialists are the only two groups whose monopolistic access to information has been documented. There is no evidence that deviations from the strong form of the efficient markets model permeate down any further through the investment community. For the purposes of most investors the efficient markets model seems a good first (and second) approximation to reality.

In short, the evidence in support of the efficient markets model is extensive, and (somewhat uniquely in economics) contradictory evidence is sparse. Nevertheless, we certainly do not want to leave the impression that all issues are closed. The old saw, "much remains to be done," is relevant here as elsewhere. Indeed, as is often the case in successful scientific research, now that we know we've been in the past, we are able to pose and (hopefully) to answer an even more interesting set of questions for the future. In this case the most pressing field of future endeavor is the development and testing of models of market equilibrium under uncertainty. When the process generating equilibrium expected returns is better understood (and assuming that some expected return model turns out to be relevant), we will have a more substantial framework for more sophisticated intersecurity tests of market efficiency.

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BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-16

DCF Dividend Yields

October 3, 2019

DCF Dividend Yields

	A	B	C	D	E	F	G	H	I
1									
2									
3					[1]		[2]		[3]
4									
5							Stock		Dividend
6	Company		Ticker		Dividend		Price		Yield
7									
8	Algonquin Pwr & Util		AQN		0.141		12.64		1.12%
9	Ameren Corp.		AEE		0.475		76.25		0.62%
10	Avangrid, Inc.		AGR		0.440		49.73		0.88%
11	Avista Corp.		AVA		0.387		45.73		0.85%
12	Black Hills Corp.		BKH		0.505		78.11		0.65%
13	CenterPoint Energy		CNP		0.287		28.30		1.01%
14	CMS Energy Corp.		CMS		0.382		58.91		0.65%
15	Dominion Energy		D		0.918		76.11		1.21%
16	DTE Energy Co.		DTE		0.945		129.03		0.73%
17	Edison International		EIX		0.613		71.70		0.85%
18	El Paso Electric Co.		EE		0.385		66.29		0.58%
19	Emera Inc.		EMA		0.588		54.57		1.08%
20	Entergy Corp.		ETR		0.910		105.30		0.86%
21	Exelon Corp.		EXC		0.363		46.08		0.79%
22	FirstEnergy Corp.		FE		0.380		43.67		0.87%
23	Hawaiian Elec.		HE		0.320		44.45		0.72%
24	IDACORP, Inc.		IDA		0.630		103.51		0.61%
25	NorthWestern Corp.		NWE		0.575		70.85		0.81%
26	OGE Energy Corp.		OGE		0.365		42.86		0.85%
27	Otter Tail Corp.		OTTR		0.350		51.96		0.67%
28	PNM Resources		PNM		0.290		0.73		39.77%
29	Sempra Energy		SRE		0.967		138.20		0.70%
30									
31	**Average**				**$0.51**		**$63.41**		**2.59%**
32									
33									
34									
35	[1] Most recent reported quarterly dividends per share. Nasdaq.com								
36	[2] Average stock price from DJG stock price exhibit.								
37	[3] = [1] / [2] (quarterly)								
38									

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-17

DCF Growth Rates

October 3, 2019

DCF Terminal Growth Rate Determinants

	A	B	C	D
1				
2				
3	**Terminal Growth Determinants**		**Rate**	
4				
5	Nominal GDP		3.9%	[1]
6				
7	Inflation		2.0%	[2]
8				
9	Risk Free Rate		2.1%	[3]
10				
11	**Highest**		**3.9%**	
12				
13				
14	[1], [2] CBO Long-Term Budget Outlook 2019 - 2049 (p. 30)			
15	[3] I&M 2018-19 IRP Public Summary, p. 2.			
16	[4] From DJG risk-free rate exhibit			
17				
18				
19				
20				
21	**Company-Specific Qualitiative**			
22	**Growth Determinants**		**Rate**	
23				
24	Electric Customer Growth		0.8%	[4]
25				
26	Gas System Wide Growth		1.2%	[5]
27				
28	Population Growth		1.1%	[6]
29				
30	**Average**		**1.0%**	
31				
32				
33	[4] Company Electric IRP 2017, p. 3-14			
34	[5] Company Natural Gas IRP 2018, p. 25			
35	[4] Company Electric IRP 2017, p. 3-10			

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-18

DCF Final Results

October 3, 2019

DCF Final Results

	A	B	C	D	E	F	G	H
1								
2								
3	[1]		[2]		[3]			[4]
4								
5	Dividend		Stock Price		Growth Rate			**DCF**
6	(d_0)		(P_0)		(g)			**Result**
7								
8	$0.51		$63.41		3.90%			**7.3%**
9								
10								
11	[1] Average proxy dividend from DJG dividend exhibit							
12	[2] Average proxy stock price from DJG dividend exhibit							
13	[3] Highest growth rate from DJG growth determinant exhibit							
14	[4] Quarterly DCF Approximation = $[d_0(1 + g)^{0.25}/P_0 + (1 + g)^{0.25}]^4 - 1$							

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-19

Myron Gordon et al.: *Capital Equipment Analysis*

October 3, 2019

CAPITAL EQUIPMENT ANALYSIS: THE REQUIRED RATE OF PROFIT

MYRON J. GORDON AND ELI SHAPIRO

School of Industrial Management, Massachusetts Institute of Technology

The interest in capital equipment analysis that has been evident in the business literature of the past five years is the product of numerous social, economic, and business developments of the postwar period. No conclusive listing of these developments can be attempted here. However, four should be mentioned which are of particular importance in this search for a more systematic method for discovering, evaluating, and selecting investment opportunities. These are: (1) the high level of capital outlays (in absolute terms); (2) the growth in the size of business firms; (3) the delegation of responsibility for initiating recommendations from top management to the profit center, which has been part of the general movement toward decentralization; and (4) the growing use of "scientific management" in the operations of the business firm.

These developments have motivated the current attempt to develop objective criteria whereby the executive committee in a decentralized firm can arrive at a capital budget. Since each of its profit centers submits capital proposals, the executive committee must screen these and establish an allocation and a level of capital outlays that is consistent with top management's criteria for rationing the firm's funds. Capital budgeting affords the promise that this screening process can be made amenable to some established criteria that are understandable to all the component parts of the firm. Consequently, capital budgeting appeals to top management, for, in the first place, each plant manager can see his proposal in the light of all competing proposals for the funds of the enterprise. This may not completely eliminate irritation among the various parts of the firm, but a rational capital budgeting program can go a long way toward maintaining initiative on the part of a plant manager, even though the executive committee may veto one or all of his proposals. In the second place, the use of a capital budgeting program serves to satisfy top management that each accepted proposal meets adequate predetermined standards and that the budget as a whole is part of a sound, long-run plan for the firm.

What specifically does a capital budgeting program entail? The focal points of capital budgeting are: (1) ascertaining the profit abilities of the array of capital outlay alternatives, and (2) determining the least profitability required to make an investment, i.e., a cut-off point. Capital budgeting also involves administrative procedures and organization designed to discover investment opportunities, process information, and carry out the budget; however, these latter aspects of the subject have been discussed in detail by means of case studies that have appeared in publications of the American Management Association and the

National Industrial Conference Board and in periodicals such as the *N.A.C.A. Bulletin*.[1] Hence, we will not concern ourselves with them here.

There are at least four methods for establishing an order-preference array of the capital expenditure suggestions. They are: (1) the still popular "payoff period"; (2) the average investment formula; (3) the present value formula with the rate of interest given; and (4) the present value formula used to find the rate of profit. It is not our intention in this paper to discuss these various methods specifically, since critical analyses of these alternatives are to be found in papers by Dean, by Lorie and Savage, and by Gordon in a recent issue of the *Journal of Business*,[2] which is devoted exclusively to the subject of capital budgeting.

However, it is of interest to note that in each of these methods the future revenue streams generated by the proposed outlays must be amenable to measurement if the method is to be operational. However, improvements in quality, more pleasant working conditions, strategic advantages of integration, and other types of benefits from a capital outlay are still recognized only in qualitative terms, and there is a considerable hiatus in the literature of capital budgeting with respect to the solution of this problem. Hence, in the absence of satisfactory methods for quantifying these types of benefits, the evaluation of alternative proposals is still characterized by intuitive judgments on the part of management, and a general quantitative solution to the capital budgeting problem is not now feasible. It appears to us that this problem affords one of the most promising opportunities for the application of the methods of management science. In fact, we anticipate that techniques for the quantification of the more important factors now treated qualitatively will soon be found.

Given the rate of profit on each capital outlay proposal, the size of the budget and its allocation are automatically determined with the establishment of the rate of profit required for the inclusion of a proposal in the budget. In the balance of this paper, a method for determining this quantity is proposed and its use in capital budgeting is analyzed.

II

We state that the objective of a firm is the maximization of the value of the stockholders' equity. While there may be legitimate differences of opinion as to whether this is the sole motivation of management, we certainly feel that there can be no quarrel with the statement that it is a dominant variable in manage-

[1] American Management Association, *Tested Approaches to Capital Equipment Replacement*, Special Report No. 1, 1954; American Management Association, *Capital Equipment Replacement*; *AMA Special Conference*, May 3–4, 1954 (New York, 1954, American Management Association, 105 pp.); J. H. Watson, III, National Industrial Conference Board, *Controlling Capital Expenditures*, Studies in Business Policy, No. 62, April, 1953; C. I. Fellers, "Problems of Capital Expenditure Budgeting", *N.A.C.A. Bulletin*, 26 (May, 1955), 918–24; E. N. Martin, "Equipment Replacement Policy and Application", *N.A.C.A. Bulletin*, 35 (February, 1954), 715–30.

[2] *Journal of Business*, Vol. XXVIII, No. 3 (October, 1955).

ment's decisions. It has been shown by Lutz and Lutz in their *Theory of the Investment of the Firm*[3] and by others[4] that this objective is realized in capital budgeting when the budget is set so as to equate the marginal return on investment with the rate of return at which the corporation's stock is selling in the market. The logic and operation of this criterion will be discussed later. Now, we only wish to note the role assigned in capital budgeting to the rate of profit that is required by the market.

At the present time, the dividend yield (the current dividend divided by the price) and the earnings yield (the current income per share divided by the price) are used to measure the rate of profit at which a share is selling. However, both these yields fail to recognize that a share's payments can be expected to grow, and the earnings yield fails to recognize that the corporation's earnings per share are not the payments made to the stockholder.

The practical significance of these failures is evidenced by the qualifications with which these two rate-of-profit measures are used by investment analysts. In the comparative analysis of common stocks for the purpose of arriving at buy or sell recommendations, the conclusions indicated by the dividend and/or the earnings yield are invariably qualified by the presence or absence of the prospect of growth. If it is necessary to qualify a share's yield as a measure of the rate of profit one might expect to earn by buying the share, then it must follow that current yield, whether income or dividend, is inadequate for the purposes of capital budgeting, which is also concerned with the future. In short, it appears to us that the prospective growth in a share's revenue stream should be reflected in a measure of the rate of profit at which the share is selling. Otherwise, its usefulness as the required rate of profit in capital budgeting is questionable.

In his *Theory of Investment Value*[5], a classic on the subject, J. B. Williams tackled this problem of growth. However, the models he developed were arbitrary and complicated so that the problem of growth remained among the phenomena dealt with qualitatively. It is our belief that the following proposal for a definition of the rate of profit that takes cognizance of prospective growth has merit.

The accepted definition of the rate of profit on an asset is the rate of discount that equates the asset's expected future payments with its price. Let P_0 = a share's price at $t = 0$, let D_t = the dividend expected at time t, and let k = the rate of profit. Then, the rate of profit on a share of stock is the value of k that satisfies

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t}. \tag{1}$$

[3] Friedrich and Vera Lutz, *The Theory of Investment of the Firm* (Princeton, N. J., 1951, Princeton University Press, 253 pp.), 41–43.

[4] Joel Dean, *Capital Budgeting: Top Management Policy on Plant, Equipment, and Product Development* (New York, 1951, Columbia University Press, 174 pp.); Roland P. Soule, "Trends in the Cost of Capital", *Harvard Business Review*, 31 (March, April, 1953), 33–47.

[5] J. B. Williams, *The Theory of Investment Value*, (Cambridge, Massachusetts, 1938, Harvard University Press), 87–96.

It is mathematically convenient to assume that the dividend is paid and discounted continuously at the annual rates D_t and k, in which case

(2) $$P_0 = \int_0^\infty D_t e^{-kt} \, dt.$$

Since P_0 is known, estimating the rate of profit at which a share of stock is selling requires the determination of D_t, $t = 1, 2, \cdots, \infty$.

At the outset it should be made clear that our objective is not to find the rate of profit that *will actually be earned* by buying a share of stock. This requires knowledge of the dividends that will be paid in the future, the price at which the share will be sold, and when it will be sold. Unfortunately, such information is not available to us. The rate of profit of interest here is a relation between the present known price and the *expected future dividends*. The latter will vary among individuals with the information they have on a host of variables and with their personality. Therefore, by expected future dividends we mean an estimate that (1) is derivable from known data in an objective manner, (2) is derived by methods that appear reasonable, i.e., not in conflict with common sense knowledge of corporation financial behavior, and (3) can be used to arrive at a manageable measure of the rate of profit implicit in the expectation.

We arrive at D_t by means of two assumptions. One, a corporation is expected to retain a fraction b of its income after taxes; and two, a corporation is expected to earn a return of r on the book value of its common equity. Let Y_t equal a corporation's income per share of common after taxes at time t. Then the expected dividend at time t is

(3) $$D_t = (1 - b)Y_t$$

The income per share at time t is the income at $(t - 1)$ plus r percent of the income at $(t - 1)$ retained, or

(4) $$Y_t = Y_{t-1} + rbY_{t-1}$$

Equation (4) is simply a compound interest expression so that, if Y_t grows continuously at the rate $g = br$,

(5) $$Y_t = Y_0 e^{gt}.$$

From Equations (3) and (5)

(6) $$D_t = D_0 e^{gt}.$$

Substituting this expression for D_t in Equation (2) and integrating, yields

(7) $$\begin{aligned} P_0 &= \int_0^\infty D_0 e^{gt} e^{-kt} \, dt \\ &= D_0 \int_0^\infty e^{-t(k-g)} \, dt \\ &= \frac{D_0}{k - g}. \end{aligned}$$

The condition for a solution is $k > g$, a condition that is easily satisfied, for otherwise, P_0 would be infinite or negative.

Solving Equation (7) for k we find that

$$k = \frac{D_0}{P_0} + g. \tag{8}$$

Translated, this means that the rate of profit at which a share of common stock is selling is equal to the current dividend, divided by the current price (the dividend yield), plus the rate at which the dividend is expected to grow. Since there are other possible empirical definitions of the market rate of profit on a share of stock, we will refer to k as the growth rate of profit.

III

Let us now review and evaluate the rationale of the model we have just established. Estimating the rate of profit on a share of stock involves estimating the future dividend stream that it provides, and the fundamental difference between this model and the dividend yield is the assumption of growth. The latter, as can be seen, assumes that the dividend will remain constant. Since growth is generally recognized as a factor in the value of a share and since it is used to explain differences in dividend yield among shares, its explicit recognition appears desirable. Future dividends are uncertain, but the problem cannot be avoided by ignoring it. To assume a constant rate of growth and estimate it to be equal to the current rate appears to be a better alternative.

Under this model the dividend will grow at the rate br, which is the product of the fraction of income retained and the rate of return earned on net worth. It is mathematically true that the dividend will grow at this rate if the corporation retains b and earns r. While we can be most certain that the dividend will not grow uniformly and continuously at some rate, unless we believe that an alternative method for estimating the future dividend stream is superior, the restriction of the model to the assumption that it will grow uniformly at some rate is no handicap. Furthermore, the future is discounted; hence, an error in the estimated dividend for a year in the distant future results in a considerably smaller error in k than an error in estimating the dividend in a near year.

It should be noted that this measure of the rate of profit is suspect, when *both* income and dividend are zero, and it may also be questioned when either falls to very low (or negative) values. In such cases, the model yields a lower rate of profit than one might believe that the market requires on a corporation in such difficulties. It is evident that the dividend and the income yields are even more suspect under these conditions and, hence, are subject to the same limitations.

There are other approaches to the estimation of future dividends than the extrapolation of the current dividend on the basis of the growth rate implicit in b and r. In particular, one can arrive at g directly by taking some average of the past rate of growth in a corporation's dividend. Whether or not this or some other measure of the expected future dividends is superior to the one presented earlier will depend on their relative usefulness in such purposes as the analysis of variation in prices among shares and the preferences of those who want an objective measure of a share's rate of profit.

So far, we have compared the growth rate of profit with the income and dividend yields on theoretical grounds. Let us now consider how they differ in practice, using the same measurement rules for the variables in each case. The numerical difference between the growth rate of profit and the dividend yield is simply the growth rate. However, the income yield, which is the measure of the rate of profit commonly recommended for capital budgeting, differs from the growth rate of profit in a more complex manner, and to establish this difference we first note that

$$b = \frac{Y - D}{Y} \text{ and } r = \frac{Y}{B} \tag{9}$$

where B = the net worth or book value per share. The growth rate of profit, therefore, may be written as

$$k = \frac{D}{P} + br = \frac{D}{P} + \frac{Y - D}{B}. \tag{10}$$

Next, the income yield can be decomposed as follows:

$$y = \frac{Y}{P} = \frac{D}{P} + \frac{Y - D}{P}. \tag{11}$$

We see then that y and k will be equal when book and market values are equal. It can be argued that the income yield overstates a share's payment stream by assuming that each payment is equal to the income per share and understates the payment stream by assuming that it will not grow. Hence, in this special case where book and market values are equal, the two errors exactly compensate each other.

Commonly market and book values differ, and y will be above k when market is below book, and it will be below k when market is above book. Hence, a share of IBM, for example, that is priced far above book had had an earnings yield of two to three percent in 1955. We know that the market requires a higher rate of profit on a common stock, even on IBM, and its growth rate of profit, k, is more in accord with the value suggested by common sense. Conversely, when U. S. Steel was selling at one-half of book value in 1950, the high income yield grossly overstated the rate of profit that the market was, in fact, requiring on the stock.

Furthermore, the growth rate of profit will fluctuate in a narrower range than the earnings yield. For instance, during the last few years, income, dividends, and book value have gone up more or less together, but market price has gone up at a considerably higher rate. Consequently, the growth rate of profit, dependent in part on book value, has fallen less than the earnings yield. Conversely, in a declining market k would rise less rapidly than y.

There is a widespread feeling that many accounting figures, particularly book value per share, are insensitive to the realities of the world, and some may feel that the comparative stability of k is merely a consequence of the limitations of accounting data. This is not true! The behavior of k is not a consequence of the supposed lack of realism in accounting data. Rather, book value appears in the model because it, and not market value, is used to measure the rate of return the corporation earns on investment, which, we have seen, is the rate of return that enters into the determination of the rate at which the dividend will grow. The comparative stability of k follows from the simple fact that, when a revenue stream is expected to grow, a change in the required rate of profit will give rise to a more than proportional change in the asset's price. Conversely, a change in the price reflects a less than proportional change in the rate of profit.

IV

Given the rate of profit expected on each item in the schedule of available investment opportunities and given the rate of profit at which the corporation's stock is selling, what should the capital budget be? As stated earlier, the accepted theory is that the budget should be set so as to equate the marginal return on investment with the rate of profit at which the stock is selling. The reasoning is, if the market requires, let us say, a 10 percent return on investment in the corporation's stock, and if the corporation can earn 15 percent on additional investment, obtaining the funds and making the investment will increase the earnings per share. As the earnings and the dividend per share increase or as the market becomes persuaded that they will increase, the price of the stock will rise. The objective, it will be recalled, is the maximization of the value of the stockholder's equity.

The conclusion drawn implicitly assumes that the corporation can sell additional shares at or above the prevailing market, or if a new issue depresses the market, the fall will be slight, and the price will soon rise above the previous level. However, some other consideration may argue against a new stock issue; for example, the management may be concerned with dilution of control, or the costs of floating a new issue may be very high, or a new issue may be expected to depress the price severely and indefinitely for reasons not recognized in the theory. Hence, it does not automatically follow that a new issue should be floated when a firm's demand for funds exceeds, according to the above criterion, those that are internally available.

In determining whether the required rate of profit is above or below r', the marginal return on investment, one can use y, the earnings yield, or k, the growth rate of profit as the required rate of profit. If y and k differ and if the reasoning in support of k presented earlier is valid, using y to estimate the direction in which a new issue will change the price of the stock may result in a wrong conclusion.

In arriving at the optimum size of a stock issue, the objective is to equate r' and y or k, depending on which is used. Internal data may be used to estimate the marginal efficiency of capital schedule. If the required rate of profit is considered a constant, its definition, $y = Y/P$ or $k = D/P + br$, provides its value. However, the required rate of profit may vary with the size of the stock issue or with the variables that may change as a consequence of the issue. In this event,

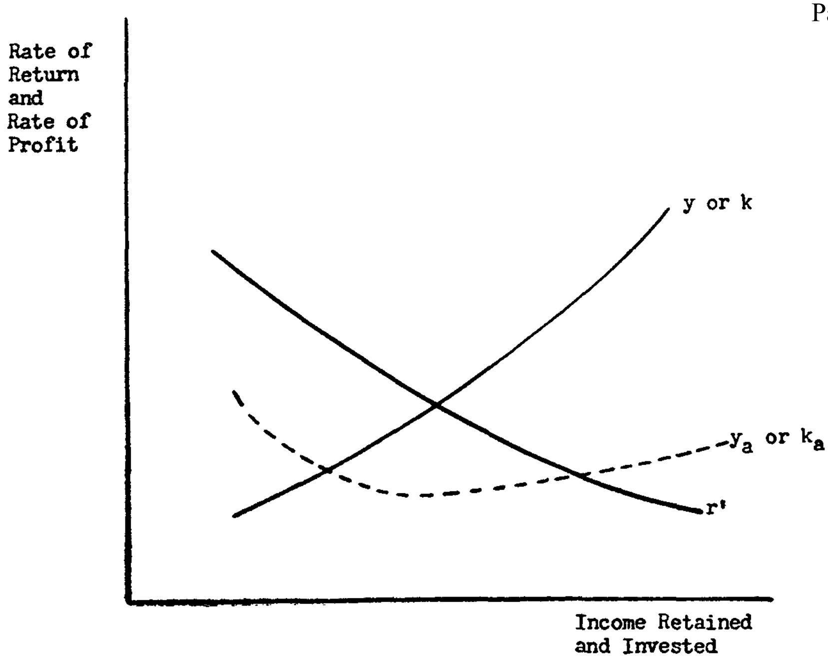

Fig. 1

finding the optimum size of a stock issue requires a model that predicts the variation in the required rate of profit with the relevant variables.

Borrowing is an alternative source of funds for investment. However, an analysis of this alternative requires the measurement of both (1) the variation in risk with debt, and (2) the difference between the rate of profit and the rate of interest needed to cover a given increase in risk. This has not been done as yet, which may explain the widespread practice of arbitrarily establishing a "satisfactory" financial structure and only borrowing to the extent allowed by it.

It has been stated by Dean[6] and Terborgh[7] that the long-term ceiling on a firm's capital outlays is the amount of its internally available funds. However, the share of its income a corporation retains is not beyond the control of its management; and, among the things we want from a capital budgeting model is guidance on whether the share of a corporation's income that is retained for investment should be raised or lowered.

Proceeding along traditional lines, the problem may be posed as follows. A firm estimates its earnings and depreciation allowances for the coming year and deducts the planned dividend to arrive at a preliminary figure for the capital budget. The marginal rate of return on investment in excess of this amount may be above or below the required rate of profit. We infer from theory that the two rates should be equated by (1) raising the budget and reducing the dividend

[6] Dean, *op. cit.*, 53–55.

[7] George Willard Terborgh, *Dynamic Equipment Policy* (New York, 1949, McGraw-Hill, 290 pp.), 228–29.

when the marginal return on investment is above the required rate of return, and (2) raising the dividend and reducing the budget when the reverse holds. The conditions under which this process yields an equilibrium are illustrated in Figure 1. The marginal return on investment, r', should fall as the budget is increased, and the required rate of profit, y or k, should increase or it should fall at a lower rate than r'. The latter case is illustrated by the line y_a or k_a.

Changing the dividend so as to equate r' and say y should maximize the price of the stock. For instance, if r' is above y, the company can earn a higher return on investment than stockholders require, and a dollar used this way is worth more to the stockholders than the dollar distributed in dividends. In other words, the price should go up by more than the income retained.

There are, of course, a number of problems connected with the use of this model for arriving at the optimum dividend rate. First, there is the question whether y or k should be used to measure the required rate of profit. Second, there is no question that the required rate of profit varies with the dividend rate. Hence, the current rate of profit given by the definition does not tell what profit rate will be required with a different dividend rate. This requires a model which predicts the variation in y or k with the dividend rate and other variables. Third, there is a very nasty problem of the short and the long run. It is widely believed, though the evidence has limitations, that the price of a share of stock varies with the dividend rate, in which case a corporation should distribute all of its income. However, it is quite possible that a change in the dividend gives rise to the expectation that earnings and future dividends are changing in the same direction. Further, in the short run, the market is not likely to be informed on a firm's marginal efficiency of capital schedule. For these and other reasons, it is likely that the dividend rate should not be made to vary with short-run changes in the marginal efficiency of capital, and more sophisticated methods than those now in use are needed to establish the variation in price or required rate of profit with the dividend rate.

V

The major points developed in this paper may be summarized as follows. We presented a definition of the rate of profit required by the market on a share of common stock, and we noted some of its advantages. It is theoretically superior to the income and dividend yields because it recognizes that the revenue stream provided by a share can be expected to grow. Furthermore, its empirical characteristics are also superior to those of the income and dividend yields since its value is generally in closer agreement with common sense notions concerning the prevailing rate of profit on a share of stock and since its value fluctuates in a narrower range over time. We next examined some of the problems involved in using this definition of the rate of profit and the earnings yield in capital budgeting models. Finally, we saw that, before capital budgeting theory can be made a reliable guide to action, we must improve our techniques for estimating the future revenue on a capital outlay proposal, and we must learn a good deal more about how the rate of profit the market requires on a share of stock varies with the dividend, the growth rate, and other variables that may influence it.

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-20

William Sharpe: *A Simplified Model for Portfolio Analysis*

October 3, 2019

A SIMPLIFIED MODEL FOR PORTFOLIO ANALYSIS*

WILLIAM F. SHARPE†

University of Washington

This paper describes the advantages of using a particular model of the relationships among securities for practical applications of the Markowitz portfolio analysis technique. A computer program has been developed to take full advantage of the model: 2,000 securities can be analyzed at an extremely low cost—as little as 2% of that associated with standard quadratic programming codes. Moreover, preliminary evidence suggests that the relatively few parameters used by the model can lead to very nearly the same results obtained with much larger sets of relationships among securities. The possibility of low-cost analysis, coupled with a likelihood that a relatively small amount of information need be sacrificed make the model an attractive candidate for initial practical applications of the Markowitz technique.

1. Introduction

Markowitz has suggested that the process of portfolio selection be approached by (1) making probabilistic estimates of the future performances of securities, (2) analyzing those estimates to determine an *efficient set* of portfolios and (3) selecting from that set the portfolios best suited to the investor's preferences [1, 2, 3]. This paper extends Markowitz' work on the second of these three stages —*portfolio analysis*. The preliminary sections state the problem in its general form and describe Markowitz' solution technique. The remainder of the paper presents a simplified model of the relationships among securities, indicates the manner in which it allows the portfolio analysis problem to be simplified, and provides evidence on the costs as well as the desirability of using the model for practical applications of the Markowitz technique.

2. The Portfolio Analysis Problem

A security analyst has provided the following predictions concerning the future returns from each of N securities:

$E_i \equiv$ the expected value of R_i (the return from security i)
C_{i1} through C_{in} ; C_{ij} represents the covariance between R_i and R_j (as usual, when $i = j$ the figure is the variance of R_i)

* Received December 1961.

† The author wishes to express his appreciation for the cooperation of the staffs of both the Western Data Processing Center at UCLA and the Pacific Northwest Research Computer Laboratory at the University of Washington where the program was tested. His greatest debt, however, is to Dr. Harry M. Markowitz of the RAND Corporation, with whom he was privileged to have a number of stimulating conversations during the past year. It is no longer possible to segregate the ideas in this paper into those which were his, those which were the author's, and those which were developed jointly. Suffice it to say that the only accomplishments which are unquestionably the property of the author are those of authorship—first of the computer program and then of this article.

The portfolio analysis problem is as follows. Given such a set of predictions, determine the set of *efficient portfolios*; a portfolio is efficient if none other gives either (a) a higher expected return and the same variance of return or (b) a lower variance of return and the same expected return.

Let X_i represent the proportion of a portfolio invested in security i. Then the expected return (E) and variance of return (V) of any portfolio can be expressed in terms of (a) the basic data (E_i-values and C_{ij}-values) and (b) the amounts invested in various securities:

$$E = \sum_i X_i E_i$$

$$V = \sum_i \sum_j X_i X_j C_{ij} .$$

Consider an objective function of the form:

$$\begin{aligned} \phi &= \lambda E - V \\ &= \lambda \sum_i X_i E_i - \sum_i \sum_j X_i X_j C_{ij} . \end{aligned}$$

Given a set of values for the parameters (λ, E_i's and C_{ij}'s), the value of ϕ can be changed by varying the X_i values as desired, as long as two basic restrictions are observed:

1. The entire portfolio must be invested:[1]

$$\sum_i X_i = 1$$

and 2. no security may be held in negative quantities:[2]

$$X_i \geqq 0 \quad \text{for all} \quad i.$$

A portfolio is described by the proportions invested in various securities—in our notation by the values of X_i. For each set of admissable values of the X_i variables there is a corresponding predicted combination of E and V and thus of ϕ. Figure 1 illustrates this relationship for a particular value of λ. The line ϕ_1 shows the combinations of E and V which give $\phi = \phi_1$, where $\phi = \lambda_k E - V$; the other lines refer to larger values of ϕ ($\phi_3 > \phi_2 > \phi_1$). Of all possible portfolios, one will maximize the value of ϕ;[3] in figure 1 it is portfolio C. The relationship between this solution and the portfolio analysis problem is obvious. The E, V combination obtained will be on the boundary of the set of attainable combinations; moreover, the objective function will be tangent to the set at that point. Since this function is of the form

$$\phi = \lambda E - V$$

[1] Since cash can be included as one of the securities (explicitly or implicitly) this assumption need cause no lack of realism.

[2] This is the standard formulation. Cases in which short sales are allowed require a different approach.

[3] This fact is crucial to the critical line computing procedure described in the next section.

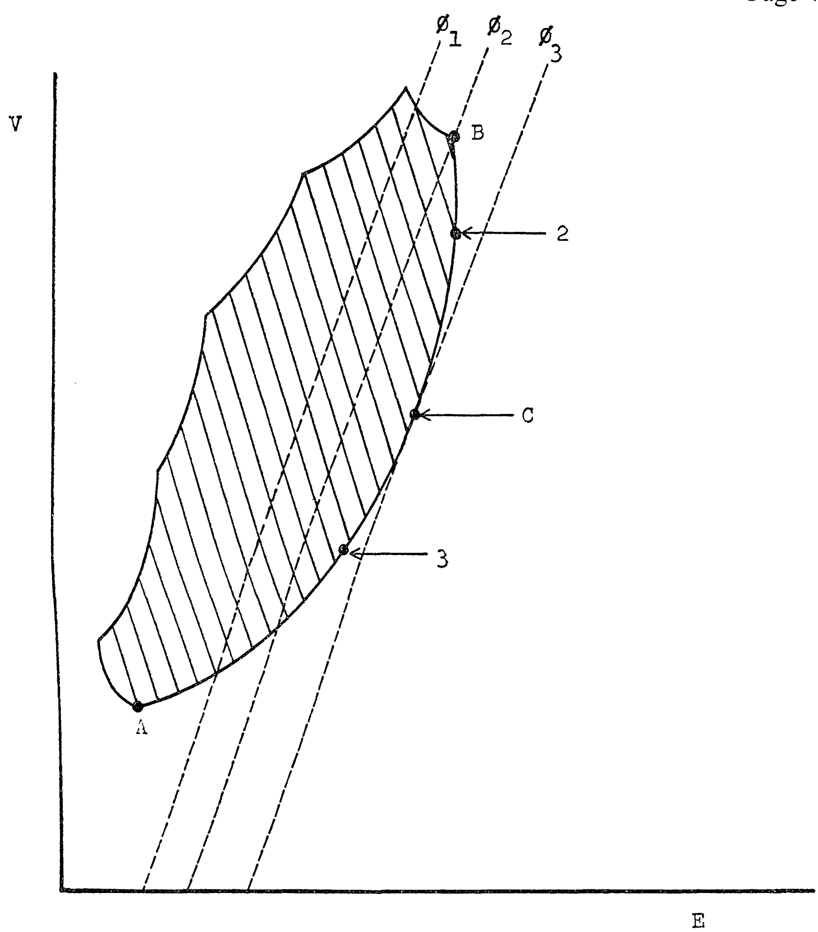

FIGURE 1

the slope of the boundary at the point must be λ; thus, by varying λ from $+\infty$ to 0, every solution of the portfolio analysis problem can be obtained.

For any given value of λ the problem described in this section requires the maximization of a quadratic function, ϕ (which is a function of X_i, X_i^2, and X_iX_j terms) subject to a linear constraint ($\sum_i X_i = 1$), with the variables restricted to non-negative values. A number of techniques have been developed to solve such *quadratic programming problems*. The critical line method, developed by Markowitz in conjunction with his work on portfolio analysis, is particularly suited to this problem and was used in the program described in this paper.

3. The Critical Line Method

Two important characteristics of the set of efficient portfolios make systematic solution of the portfolio analysis problem relatively straightforward. The first concerns the relationships among portfolios. Any set of efficient portfolios can be described in terms of a smaller set of *corner portfolios*. Any point on the E, V curve (other than the points associated with corner portfolios) can be obtained with a portfolio constructed by dividing the total investment between the two adjacent corner portfolios. For example, the portfolio which gives E, V combination C in Figure 1 might be some linear combination of the two corner portfolios with E, V combinations shown by points 2 and 3. This characteristic allows the analyst to restrict his attention to corner portfolios rather than the complete set of efficient portfolios; the latter can be readily derived from the former.

The second characteristic of the solution concerns the relationships among corner portfolios. Two corner portfolios which are adjacent on the E, V curve are related in the following manner: one portfolio will contain either (1) all the securities which appear in the other, plus one additional security or (2) all but one of the securities which appear in the other. Thus in moving down the E, V curve from one corner portfolio to the next, the quantities of the securities in efficient portfolios will vary until either one drops out of the portfolio or another enters. The point at which a change takes place marks a new corner portfolio.

The major steps in the critical line method for solving the portfolio analysis problem are:

1. The corner portfolio with $\lambda = \infty$ is determined. It is composed entirely of the one security with the highest expected return.[4]
2. Relationships between (a) the amounts of the various securities contained in efficient portfolios and (b) the value of λ are computed. It is possible to derive such relationships for any section of the E, V curve between adjacent corner portfolios. The relationships which apply to one section of the curve will not, however, apply to any other section.
3. Using the relationships computed in (2), each security is examined to determine the value of λ at which a change in the securities included in the portfolio would come about:
   a. securities presently in the portfolio are examined to determine the value of λ at which they would drop out, and
   b. securities not presently in the portfolio are examined to determine the value of λ at which they would enter the portfolio.
4. The next largest value of λ at which a security either enters or drops out of the portfolio is determined. This indicates the location of the next corner portfolio.
5. The composition of the new corner portfolio is computed, using the relationships derived in (2). However, since these relationships held only for the section of the curve between this corner portfolio and the preceding one, the solution process can only continue if new relationships are derived. The method thus returns to step (2) unless $\lambda = 0$, in which case the analysis is complete.

The amount of computation required to complete a portfolio analysis using

[4] In the event that two or more of the securities have the same (highest) expected return, the first efficient portfolio is the combination of such securities with the lowest variance.

this method is related to the following factors:

1. The number of securities analyzed
   This will affect the extent of the computation in step (2) and the number of computations in step (3).
2. The number of corner portfolios
   Steps (2) through (5) must be repeated once to find each corner portfolio.
3. The complexity of the variance-covariance matrix
   Step (2) requires a matrix be inverted and must be repeated once for each corner portfolio.

The amount of computer memory space required to perform a portfolio analysis will depend primarily on the size of the variance-covariance matrix. In the standard case, if N securities are analyzed this matrix will have $\frac{1}{2}(N^2 + N)$ elements.

4. The Diagonal Model

Portfolio analysis requires a large number of comparisons; obviously the practical application of the technique can be greatly facilitated by a set of assumptions which reduces the computational task involved in such comparisons. One such set of assumptions (to be called the diagonal model) is described in this article. This model has two virtues: it is one of the simplest which can be constructed without assuming away the existence of interrelationships among securities and there is considerable evidence that it can capture a large part of such interrelationships.

The major characteristic of the diagonal model is the assumption that the returns of various securities are related only through common relationships with some basic underlying factor. The return from any security is determined solely by random factors and this single outside element; more explicitly:

$$R_i = A_i + B_i I + C_i$$

where A_i and B_i are parameters, C_i is a random variable with an expected value of zero and variance Q_i, and I is the level of some index. The index, I, may be the level of the stock market as a whole, the Gross National Product, some price index or any other factor thought to be the most important single influence on the returns from securities. The future level of I is determined in part by random factors:

$$I = A_{n+1} + C_{n+1}$$

where A_{n+1} is a parameter and C_{n+1} is a random variable with an expected value of zero and a variance of Q_{n+1}. It is assumed that the covariance between C_i and C_j is zero for all values of i and j $(i \neq j)$.

Figure 2 provides a graphical representation of the model. A_i and B_i serve to locate the line which relates the expected value of R_i to the level of I. Q_i indicates the variance of R_i around the expected relationship (this variance is assumed to be the same at each point along the line). Finally, A_{n+1} indicates the expected value of I and Q_{n+1} the variance around that expected value.

The diagonal model requires the following predictions from a security analyst:

1) values of A_i, B_i and Q_i for each of N securities
2) values of A_{n+1} and Q_{n+1} for the index I.

The number of estimates required from the analyst is thus greatly reduced: from 5,150 to 302 for an analysis of 100 securities and from 2,003,000 to 6,002 for an analysis of 2,000 securities.

Once the parameters of the diagonal model have been specified all the inputs required for the standard portfolio analysis problem can be derived. The relationships are:

$$E_i = A_i + B_i(A_{n+1})$$

$$V_i = (B_i)^2(Q_{n+1}) + Q_i$$

$$C = (B_i)(B_j)(Q_{n+1})$$

A portfolio analysis could be performed by obtaining the values required by the diagonal model, calculating from them the full set of data required for the standard portfolio analysis problem and then performing the analysis with the derived values. However, additional advantages can be obtained if the portfolio analysis problem is restated directly in terms of the parameters of the diagonal model. The following section describes the manner in which such a restatement can be performed.

5. The Analogue

The return from a portfolio is the weighted average of the returns from its component securities:

$$R_p = \sum_{i=1}^{N} X_i R_i$$

The contribution of each security to the total return of a portfolio is simply X_iR_i or, under the assumptions of the diagonal model:

$$X_i(A_i + B_iI + C_i).$$

The total contribution of a security to the return of the portfolio can be broken into two components: (1) an investment in the "basic characteristics" of the security in question and (2) an "investment" in the index:

$$X_i(A_i + B_iI + C_i) = X_i(A_i + C_i) \quad (1)$$

$$+ X_iB_iI \quad (2)$$

The return of a portfolio can be considered to be the result of (1) a series of investments in N "basic securities" and (2) an investment in the index:

$$R_p = \sum_{i=1}^{N} X_i(A_i + C_i) + \left[\sum_{i=1}^{N} X_i B_i\right] I$$

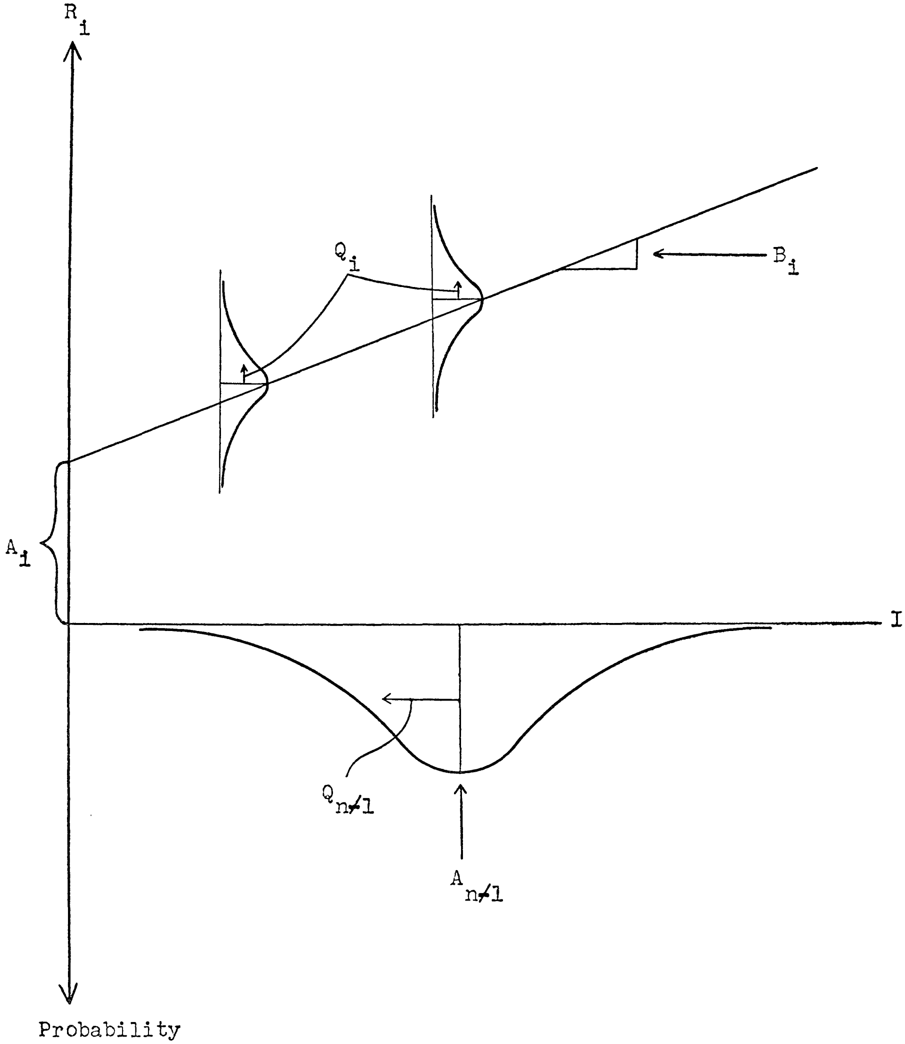

FIGURE 2

Defining X_{n+1} as the weighted average responsiveness of R_p to the level of I:

$$X_{n+1} \equiv \sum_{i=1}^{N} X_i B_i$$

and substituting this variable and the formula for the determinants of I, we obtain:

$$\begin{aligned} R_p &= \sum_{i=1}^{N} X_i(A_i + C_i) + X_{n+1}(A_{n+1} + C_{n+1}) \\ &= \sum_{i=1}^{N+1} X_i(A_i + C_i). \end{aligned}$$

The expected return of a portfolio is thus:

$$E = \sum_{i=1}^{N+1} X_i A_i$$

while the variance is:[5]

$$V = \sum_{i=1}^{N+1} X_i^2 Q_i$$

This formulation indicates the reason for the use of the parameters A_{n+1} and Q_{n+1} to describe the expected value and variance of the future value of I. It also indicates the reason for calling this the "diagonal model". The variance-covariance matrix, which is full when N securities are considered, can be expressed as a matrix with non-zero elements only along the diagonal by including an $(n + 1)$st security defined as indicated. This vastly reduces the number of computations required to solve the portfolio analysis problem (primarily in step 2 of the critical line method, when the variance-covariance matrix must be inverted) and allows the problem to be stated directly in terms of the basic parameters of the diagonal model:

$$\text{Maximize: } \lambda E - V$$

$$\text{Where: } E = \sum_{i=1}^{N+1} X_i A_i$$

$$V = \sum_{i=1}^{N+1} X_i^2 Q_i$$

$$\text{Subject to: } X_i \geqq 0 \text{ for all } i \text{ from 1 to } N$$

$$\sum_{i=1}^{N} X_i = 1$$

$$\sum_{i=1}^{N} X_i B_i = X_{n+1}\,.$$

6. The Diagonal Model Portfolio Analysis Code

As indicated in the previous section, if the portfolio analysis problem is expressed in terms of the basic parameters of the diagonal model, computing time and memory space required for solution can be greatly reduced. This section describes a machine code, written in the FØRTRAN language, which takes full advantage of the characteristics of the diagonal model. It uses the critical line method to solve the problem stated in the previous section.

The computing time required by the diagonal code is considerably smaller than that required by standard quadratic programming codes. The RAND QP

[5] Recall that the diagonal model assumes $\text{cov}(C_i, C_j) = 0$ for all i and j $(i \neq j)$.

code[6] required 33 minutes to solve a 100-security example on an IBM 7090 computer; the same problem was solved in 30 seconds with the diagonal code. Moreover, the reduced storage requirements allow many more securities to be analyzed: with the IBM 709 or 7090 the RAND QP code can be used for no more than 249 securities, while the diagonal code can analyze up to 2,000 securities.

Although the diagonal code allows the total computing time to be greatly reduced, the cost of a large analysis is still far from insignificant. Thus there is every incentive to limit the computations to those essential for the final selection of a portfolio. By taking into account the possibilities of borrowing and lending money, the diagonal code restricts the computations to those absolutely necessary for determination of the final set of efficient portfolios. The importance of these alternatives, their effect on the portfolio analysis problem and the manner in which they are taken into account in the diagonal code are described in the remainder of this section.

A. The "lending portfolio"

There is some interest rate (r_l) at which money can be lent with virtual assurance that both principal and interest will be returned; at the least, money can be buried in the ground ($r_l = 0$). Such an alternative could be included as one possible security ($A_i = 1 + r_l$, $B_i = 0$, $Q_i = 0$) but this would necessitate some needless computation.[7] In order to minimize computing time, lending at some pure interest rate is taken into account explicitly in the diagonal code.

The relationship between lending and efficient portfolios can best be seen in terms of an E, σ curve showing the combinations of expected return and standard deviation of return ($= \sqrt{V}$) associated with efficient portfolios. Such a curve is shown in Figure 3 (FBCG); point A indicates the E, σ combination attained if all funds are lent. The relationship between lending money and purchasing portfolios can be illustrated with the portfolio which has the E, σ combination shown by point Z. Consider a portfolio with X_z invested in portfolio Z and the remainder $(1 - X_z)$ lent at the rate r_l. The expected return from such a portfolio would be:

$$E = X_z E_z + (1 - X_z)(1 + r_l)$$

and the variance of return would be:

$$V = X_z^2 V_z + (1 - X_z)^2 V_l + 2X_z(1 - X_z)(\text{cov}_{zl})$$

[6] The program is described in [4]. Several alternative quadratic programming codes are available. A recent code, developed by IBM, which uses the critical line method is likely to prove considerably more efficient for the portfolio analysis problem. The RAND code is used for comparison since it is the only standard program with which the author has had experience.

[7] Actually, the diagonal code cannot accept non-positive values of Q_i; thus if the lending alternative is to be included as simply another security, it must be assigned a very small value of Q_i. This procedure will give virtually the correct solution but is inefficient.

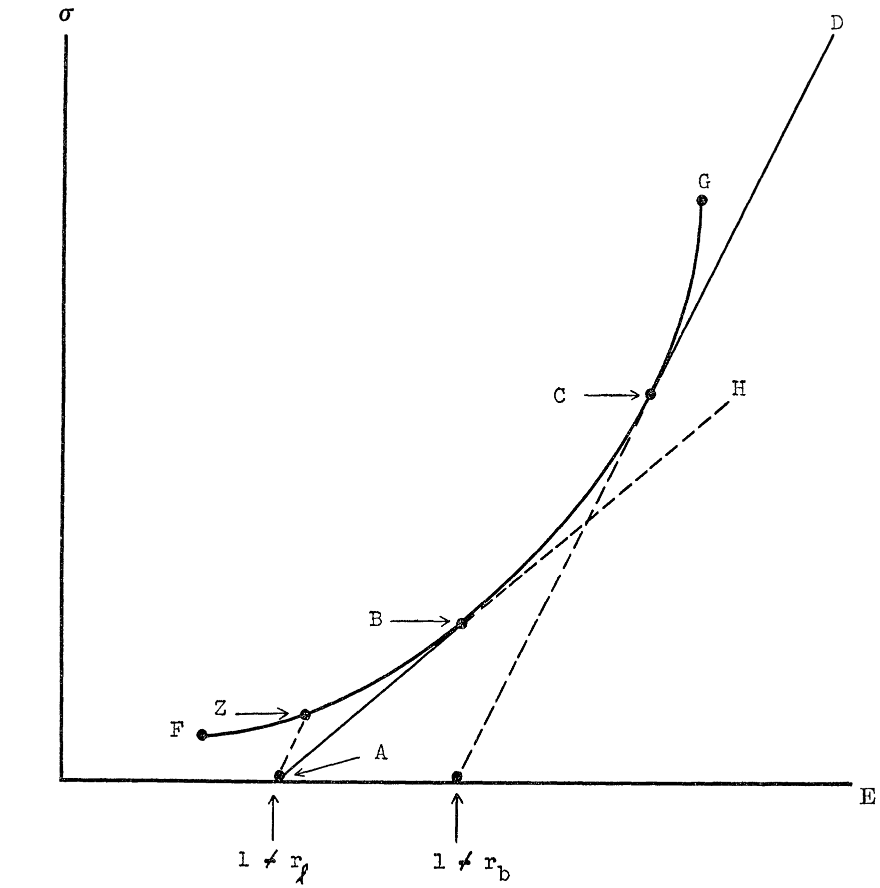

FIGURE 3

But, since V_l and cov_{zl} are both zero:

$$V = X_z^2 V_z$$

and the standard deviation of return is:

$$\sigma = X_z \sigma_z .$$

Since both E and σ are linear functions of X_z, the E, σ combinations of all portfolios made up of portfolio Z plus lending must lie on a straight line connecting points Z and A. In general, by splitting his investment between a portfolio and lending, an investor can attain any E, σ combination on the line connecting the E, σ combinations of the two components.

Many portfolios which are efficient in the absence of the lending alternative becomes inefficient when it is introduced. In Figure 3, for example, the possibility of attaining E, σ combinations along the line AB makes all portfolios along the original E, σ curve from point F to point B inefficient. For any desired level of

E below that associated with portfolio B, the most efficient portfolio will be some combination of portfolio B and lending. Portfolio B can be termed the "lending portfolio" since it is the appropriate portfolio whenever some of the investor's funds are to be lent at the rate r_l. This portfolio can be found readily once the E, σ curve is known. It lies at the point on the curve at which a ray from ($E = 1 + r_l$, $\sigma = 0$) is tangent to the curve. If the E, σ curve is not known in its entirety it is still possible to determine whether or not a particular portfolio is the lending portfolio by computing the rate of interest which *would* make the portfolio in question the lending portfolio. For example, the rate of interest associated in this manner with portfolio C is r_b, found by extending a tangent to the curve down to the E-axis. The diagonal code computes such a rate of interest for each corner portfolio as the analysis proceeds; when it falls below the previously stated lending rate the code computes the composition of the lending portfolio and terminates the analysis.

B. The "borrowing portfolio"

In some cases an investor may be able to borrow funds in order to purchase even greater amounts of a portfolio than his own funds will allow. If the appropriate rate for such borrowing were r_b, illustrated in figure 3, the E, σ combinations attainable by purchasing portfolio C with both the investor's funds and with borrowed funds would lie along the line CD, depending on the amount borrowed. Inclusion of the borrowing alternative makes certain portfolios inefficient which are efficient in the absence of the alternative; in this case the affected portfolios are those with E, σ combinations along the segment of the original E, σ curve from C to G. Just as there is a single appropriate portfolio if any lending is contemplated, there is a single appropriate portfolio if borrowing is contemplated. This "borrowing portfolio" is related to the rate of interest at which funds can be borrowed in exactly the same manner as the "lending portfolio" is related to the rate at which funds can be lent.

The diagonal code does not take account of the borrowing alternative in the manner used for the lending alternative since it is necessary to compute all previous corner portfolios in order to derive the portion of the E, σ curve below the borrowing portfolio. For this reason all computations required to derive the full E, σ curve above the lending portfolio must be made. However, the code does allow the user to specify the rate of interest at which funds can be borrowed. If this alternative is chosen, none of the corner portfolios which will be inefficient when borrowing is considered will be printed. Since as much as 65% of the total computer time can be spent recording (on tape) the results of the analysis this is not an insignificant saving.

7. The Cost of Portfolio Analysis with the Diagonal Code

The total time (and thus cost) required to perform a portfolio analysis with the diagonal code will depend upon the number of securities analyzed, the number of corner portfolios and, to some extent, the composition of the corner portfolios. A formula which gives quite an accurate estimate of the time required to perform an analysis on an IBM 709 computer was obtained by analyzing a series of runs during which the time required to complete each major segment of the program was recorded. The approximate time required for the analysis will be:[8]

$$\begin{aligned}\text{Number of seconds} = {} & .6 \\ & + .114 \times \text{number of securities analyzed} \\ & + .54 \times \text{number of corner portfolios} \\ & + .0024 \times \text{number of securities analyzed} \times \text{number of corner portfolios.}\end{aligned}$$

Unfortunately only the number of securities analyzed is known before the analysis is begun. In order to estimate the cost of portfolio analysis before it is performed, some relationship between the number of corner portfolios and the number of securities analyzed must be assumed. Since no theoretical relationship can be derived and since the total number of corner portfolios could be several times the number of securities analysed, it seemed desirable to obtain some crude notion of the typical relationship when "reasonable" inputs are used. To accomplish this, a series of portfolio analyses was performed using inputs generated by a Monte Carlo model.

Data were gathered on the annual returns during the period 1940–1951 for 96 industrial common stocks chosen randomly from the New York Stock Exchange. The returns of each security were then related to the level of a stock market index and estimates of the parameters of the diagonal model obtained. These parameters were assumed to be samples from a population of A_i, B_i and Q_i triplets related as follows:

$$A_i = \bar{A} + r_1$$

$$B_i = \bar{B} + \psi A_i + r_2$$

$$Q_i = \bar{Q} + \theta A_i + \gamma B_i + r_3$$

where r_1, r_2 and r_3 are random variables with zero means. Estimates for the parameters of these three equations were obtained by regression analysis and estimates of the variances of the random variables determined.[9] With this information the characteristics of any desired number of securities could be generated. A random number generator was used to select a value for A_i; this value, together with an additional random number determined the value of B_i; the value of Q_i was then determined with a third random number and the previously obtained values of A_i and B_i.

Figure 4 shows the relationship between the number of securities analyzed

[8] The computations in this section are based on the assumption that no corner portfolios prior to the lending portfolio are printed. If the analyst chooses to print all preceding portfolios, the estimates given in this section should be multiplied by 2.9; intermediate cases can be estimated by interpolation.

[9] The random variables were considered normally distributed; in one case, to better approximate the data, two variances were used for the distribution—one for the portion above the mean and another for the portion below the mean.

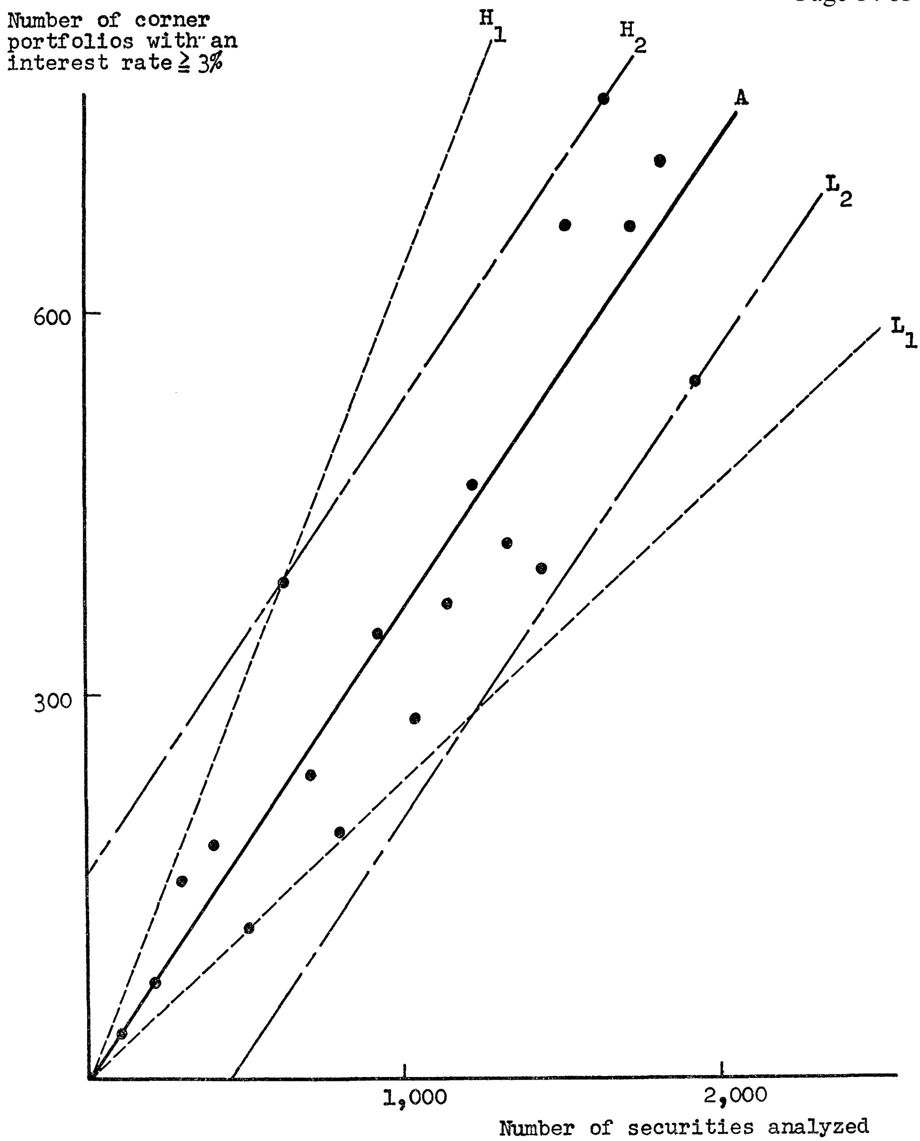

FIGURE 4

and the number of corner portfolios with interest rates greater than 3% (an approximation to the "lending rate"). Rather than perform a sophisticated analysis of these data, several lines have been used to bracket the results in various ways. These will be used subsequently as extreme cases, on the presumption that most practical cases will lie within these extremes (but with no presumption that these limits will never be exceeded). Curve A indicates the average relationship between the number of portfolios and the number of securities:

average $(N_p/N_s) = .37$. Curve H_1 indicates the highest such relationship: maximum $(N_p/N_s) = .63$; the line L_1 indicates the lowest: minimum $(N_p/N_s) = .24$. The other two curves, H_2 and L_2, indicate respectively the maximum deviation above (155) and below (173) the number of corner portfolios indicated by the average relationship $N_p = .37\ N_s$.

In Figure 5 the total time required for a portfolio analysis is related to the number of securities analyzed under various assumptions about the relationship

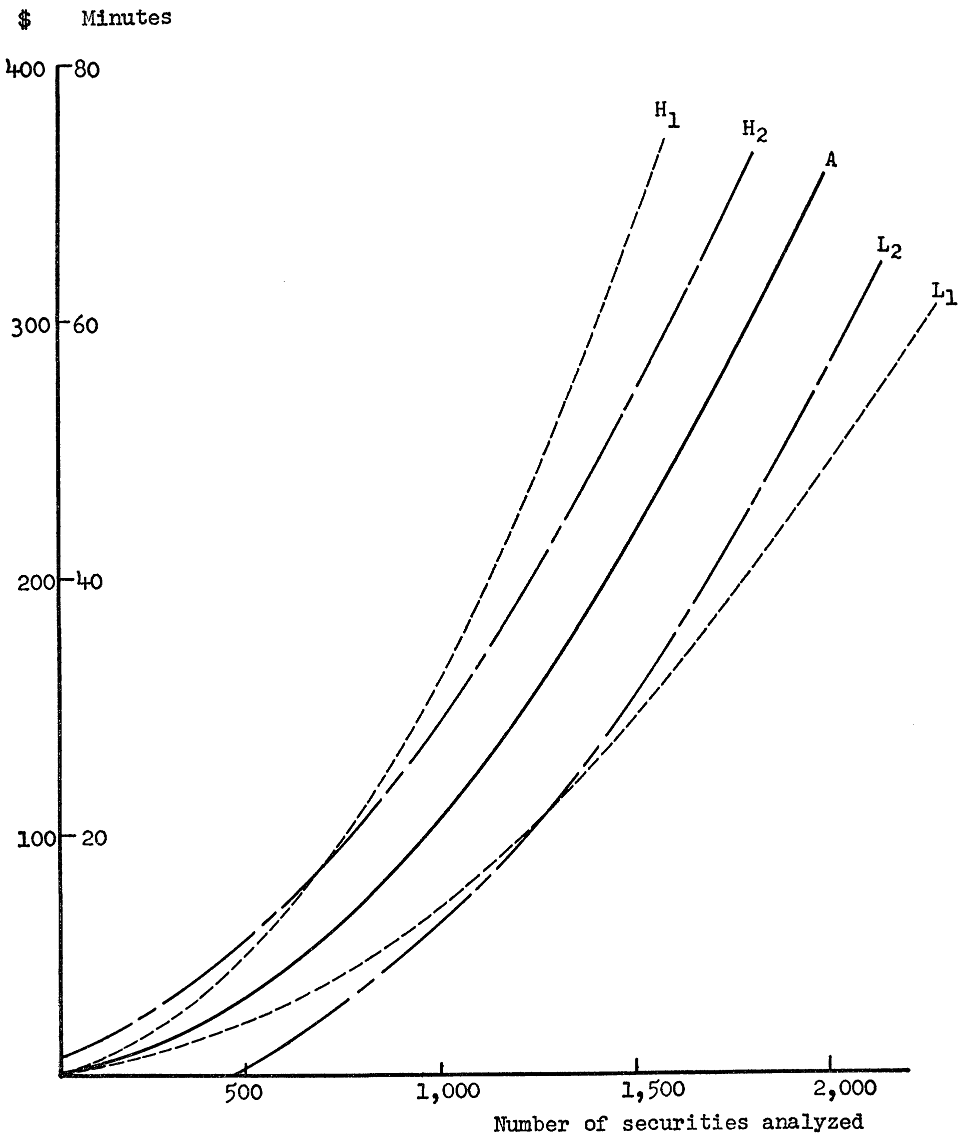

FIGURE 5

between the number of corner portfolios and the number of securities analyzed. Each of the curves shown in Figure 5 is based on the corresponding curve in Figure 4; for example, curve *A* in Figure 5 indicates the relationship between total time and number of securities analyzed on the assumption that the relationship between the number of corner portfolios and the number of securities is that shown by curve *A* in Figure 4. For convenience a second scale has been provided in Figure 5, showing the total cost of the analysis on the assumption that an IBM 709 computer can be obtained at a cost of $300 per hour.

8. The Value of Portfolio Analysis Based on the Diagonal Model

The assumptions of the diagonal model lie near one end of the spectrum of possible assumptions about the relationships among securities. The model's extreme simplicity enables the investigator to perform a portfolio analysis at a very small cost, as we have shown. However, it is entirely possible that this simplicity so restricts the security analyst in making his predictions that the value of the resulting portfolio analysis is also very small.

In order to estimate the ability of the diagonal model to summarize information concerning the performance of securities a simple test was performed. Twenty securities were chosen randomly from the New York Stock Exchange and their performance during the period 1940–1951 used to obtain two sets of

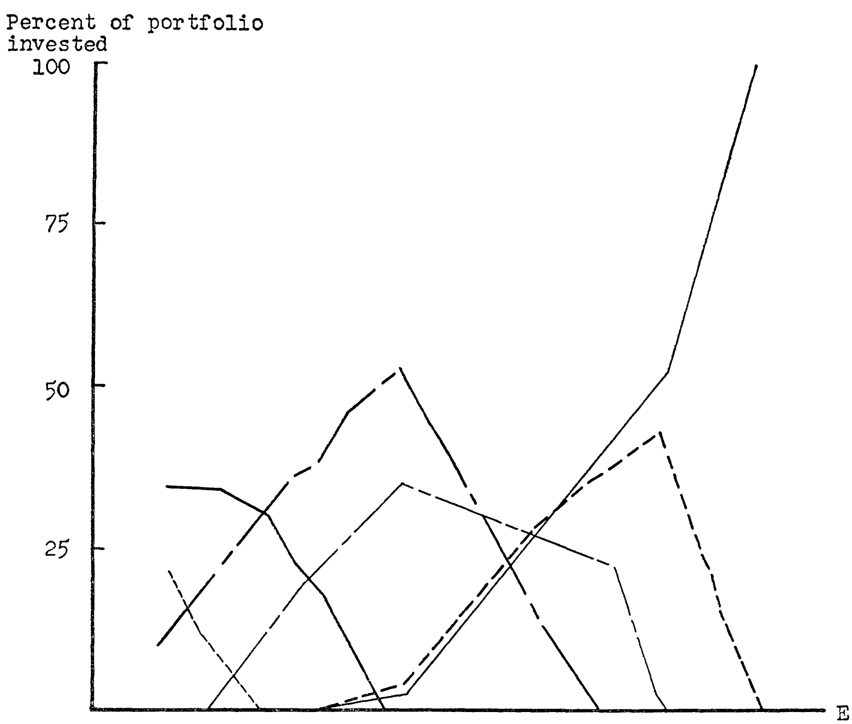

FIG. 6a. Composition of efficient portfolios derived from the analysis of the parameters of the diagonal model.

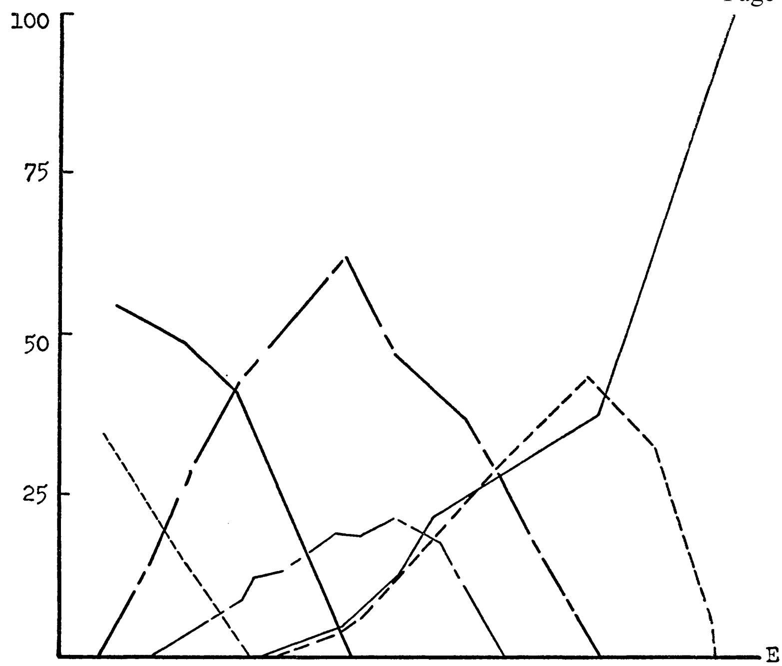

FIG. 6b. Composition of efficient portfolios derived from the analysis of historical data

data: (1) the actual mean returns, variances of returns and covariances of returns during the period and (2) the parameters of the diagonal model, estimated by regression techniques from the performance of the securities during the period. A portfolio analysis was then performed on each set of data. The results are summarized in Figures 6a and 6b. Each security which entered any of the efficient portfolios in significant amounts is represented by a particular type of line; the height of each line above any given value of E indicates the percentage of the efficient portfolio with that particular E composed of the security in question. The two figures thus indicate the compositions of all the efficient portfolios chosen from the analysis of the historical data (Figure 6b) and the compositions of all the portfolios chosen from the analysis of the parameters of the diagonal model (Figure 6a). The similarity of the two figures indicates that the 62 parameters of the diagonal model were able to capture a great deal of the information contained in the complete set of 230 historical relationships. An additional test, using a second set of 20 securities, gave similar results.

These results are, of course, far too fragmentary to be considered conclusive but they do suggest that the diagonal model may be able to represent the relationships among securities rather well and thus that the value of portfolio analyses based on the model will exceed their rather nominal cost. For these reasons it appears to be an excellent choice for the initial practical applications of the Markowitz technique.

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BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-21

CAPM Risk-Free Rate

October 3, 2019

CAPM Risk-Free Rate

	A	B	C	D	E	F	G
1							
2							
3			Date		Rate		
4			07/09/19		2.54%		
5			07/10/19		2.57%		
6			07/11/19		2.65%		
7			07/12/19		2.64%		
8			07/15/19		2.61%		
9			07/16/19		2.63%		
10			07/17/19		2.57%		
11			07/18/19		2.56%		
12			07/19/19		2.57%		
13			07/22/19		2.58%		
14			07/23/19		2.61%		
15			07/24/19		2.58%		
16			07/25/19		2.60%		
17			07/26/19		2.59%		
18			07/29/19		2.59%		
19			07/30/19		2.58%		
20			07/31/19		2.53%		
21			08/01/19		2.44%		
22			08/02/19		2.39%		
23			08/05/19		2.30%		
24			08/06/19		2.25%		
25			08/07/19		2.22%		
26			08/08/19		2.25%		
27			08/09/19		2.26%		
28			08/12/19		2.14%		
29			08/13/19		2.15%		
30			08/14/19		2.03%		
31			08/15/19		1.98%		
32			08/16/19		2.01%		
33			08/19/19		2.08%		
34							
35			**Average**		**2.42%**		
36							
37							
38							
39	*Daily Treasury Yield Curve Rates on 30-year T-bonds, http://www.treasury.gov/resources-center/data-chart-center/interest-rates/.						
40							

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DAVID J. GARRETT

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EXHIBIT DJG-22

CAPM Betas

October 3, 2019

CAPM Beta Coefficient

	A	B	C	D	E
1					
2					
3	Company		Ticker		Beta
4					
5	Algonquin Pwr & Util		AQN		NR
6	Ameren Corp.		AEE		0.60
7	Avangrid, Inc.		AGR		0.40
8	Avista Corp.		AVA		0.60
9	Black Hills Corp.		BKH		0.75
10	CenterPoint Energy		CNP		0.80
11	CMS Energy Corp.		CMS		0.55
12	Dominion Energy		D		0.55
13	DTE Energy Co.		DTE		0.55
14	Edison International		EIX		0.60
15	El Paso Electric Co.		EE		0.70
16	Emera Inc.		EMA		0.55
17	Entergy Corp.		ETR		0.60
18	Exelon Corp.		EXC		0.70
19	FirstEnergy Corp.		FE		0.60
20	Hawaiian Elec.		HE		0.55
21	IDACORP, Inc.		IDA		0.60
22	NorthWestern Corp.		NWE		0.60
23	OGE Energy Corp.		OGE		0.80
24	Otter Tail Corp.		OTTR		0.70
25	PNM Resources		PNM		0.60
26	Sempra Energy		SRE		0.75
27					
28	Average				0.63
29					
30					
31					
32	Betas from Value Line Investment Survey				
33					

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-23

Elroy Dimson et al.: *Triumph of the Optimists* (Excerpt)

October 3, 2019

ELROY DIMSON • PAUL MARSH • MIKE STAUNTON

Triumph of the Optimists

101 YEARS OF GLOBAL INVESTMENT RETURNS

countries, over the whole of the 101-year period from 1900–2000. We also have century-long evidence on the small-firm and value/growth phenomena. We have put significant effort into compiling complete financial market histories, so that we can present consistent and comparable records for different countries. But *Triumph of the Optimists* is about much more than just data, since it has description and analysis at its core.

There is an obvious need for a reliable and truly international dataset for the investment industry as it continues relentlessly toward full market globalization. One of the many changes taking place in the investment business is the increasing demand for locally sourced research placed in a global context. Another innovation is the growing number of truly global mandates being given to fund managers. Globalization may be a cliché, but for portfolio managers it is fast becoming a reality. Access to a properly constituted and rigorously maintained international database is a sine qua non for the start of any investment process.

The period since spring 2000 has come as a shock to those who had become used to the bull market conditions of previous years. The bursting of the technology bubble, the rapid decline in economic growth rates, especially in the United States, and the advent of international terrorism raised questions about what we can expect for the future. We assert in this book that the single most important variable for making investment decisions is the equity risk premium, and we argue that high long-term returns on equities, relative to bonds, are unlikely to persist. Even after the setbacks of 2000–01, it is necessary to justify the relatively high rating of today's stock markets in terms of a historically low forward-looking equity risk premium. For the investment strategist this raises the most fundamental question of all: Do investors realize that returns are likely to revert to more normal levels, or do current valuations embody exaggerated expectations based on an imperfect understanding of history?

Good data is the key to understanding history. With this as our guiding principle, assembling the data for this book was a major task. For the United Kingdom, ABN AMRO supported us in compiling an authoritative record of UK equity market performance over the last 101 years. We did this because we were not satisfied with the data that previously existed, and there was anyway no comprehensive record of equity returns extending back to 1900. To construct our UK indexes, we devoted intensive efforts to financial archaeology. This involved transcribing original source data from dusty newspaper archives and ancient reference books into our database. A resulting benefit is that we have not simply assembled an index, but we also have the underlying stock-by-stock data, so we can now study the performance of segments of the market, such as industry sectors and market-capitalization bands. We also compiled a series of UK government bond indexes especially for this study.

For the other fifteen countries covered in this book, we have linked together the best quality indexes and returns data available from previous studies and other sources, a number of which are previously unpublished, and some of which are still work in progress. In addition to the United Kingdom, we cover two North American markets, the United States and Canada; ten other European markets, namely, Belgium, Denmark, France, Germany, Ireland, Italy, The Netherlands, Spain, Sweden and Switzerland; two Asia-Pacific markets, Australia

Chapter 3 Measuring long-term returns

Good measures of long-run returns should accurately reflect the outcome of an implementable investment strategy. The strategy should be one that could have been set up in advance, and followed in real life, and which is representative of the asset class and country in question. It is only too easy for researchers to fail to meet these criteria.

This chapter begins in section 3.1 by setting out the principles that need to be followed in constructing long-run return indexes. These provide a benchmark for assessing previous studies, and have been the guiding framework for this book. Given that our data goes back to the beginning of the last century and covers sixteen countries, we have not always been able to adhere to every principle, especially in the earliest years. Nevertheless, these standards have guided our choices, and we indicate where compromises have been necessary.

Next, in section 3.2 we take a closer look at equity index construction and at a bias that has afflicted some previous studies. When an index is compiled retrospectively, a crucial issue is how to avoid tilting its composition toward companies that, with hindsight, are known to have survived and/or to have been successful. In section 3.3, we review other issues that arise in index design, such as dividend reinvestment, index coverage, and index weighting.

In section 3.4 we consider how best to assemble a sample of international indexes. We show that reliance on data that is easy to acquire, such as indexes that start after the end of a war, tends to result in overstated performance. Both success bias and easy-data bias arise from a focus on assets that have survived or prospered over a particular period, and both can lead to overestimates of index returns and risk premia.

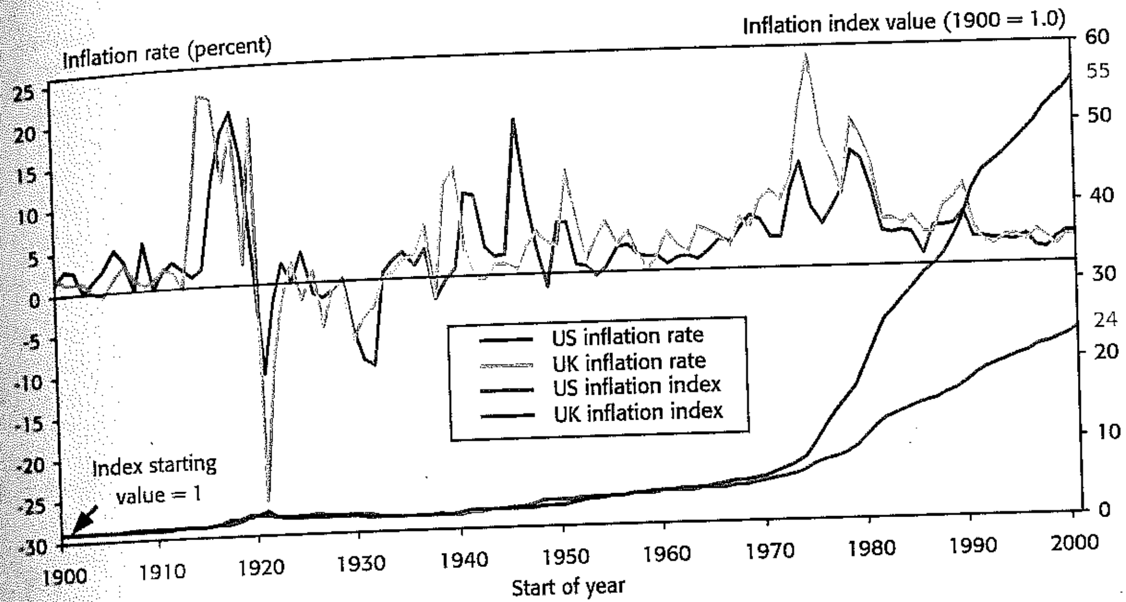
In section 3.5, we focus on the special problems that can arise when measuring inflation rates, as well as long-term returns on bonds, bills and currencies. We conclude in section 3.6 with a summary of the chapter.

3.1 Good indexes and bad

There are five guiding principles that underpin our measures of long-term performance. They are to avoid bias in index construction, to focus on total returns, to ensure the widest possible coverage within each market, to apply appropriate methods of weighting and averaging, and to maximize the extent to which comparisons can be made across national boundaries.

First, equity indexes should avoid bias. Good indexes follow an investment strategy that could be followed in real life. Apart from dealing costs, an investor should in principle have been able to replicate index performance. Indexes, especially when they are constructed retrospectively, must therefore be free of any look-ahead bias. They must be constructed solely from information that would have been available at the time of investment. Serious bias can arise if index constituents are tilted toward companies that subsequently survived or

Figure 5-2: US and UK annual inflation rates and cumulative inflation, 1900–2000



much higher than in the United States, peaking at 25 percent in 1975. The cumulative impact of these higher rates can be seen by comparing the two inflation indexes, which are plotted against the right-hand axis in Figure 5-2. The red line for the United Kingdom and the blue line for the United States are virtually coincident until the mid-1960s. From that point onward, the UK index rises to a value of fifty-five by end-2000, compared with twenty-four for the United States. From 1900–2000, UK consumer prices thus rose 55-fold, a factor of 2.3 times more than in the United States, with the difference almost entirely attributable to the last thirty-five years. Over the full 101-year period, the average annualized UK inflation rate was 4.1 percent per year, versus 3.2 percent for the United States.

5.2 Inflation around the world

While inflation was fairly similar in the United States and the United Kingdom, a number of other countries had quite different experiences. Table 5-1 provides international inflation rate comparisons across all sixteen countries covered in this book, showing the mean inflation rates from 1900–2000. Clearly, there were large differences between countries. At the same time, the standard deviations for each country show that there was also considerable variation in inflation rates over time. Taking the full 101-year period as a whole, there have been four high inflation rate countries, France, Germany, Italy, and Japan; two runner-ups, Belgium and Spain; and one low inflation country, Switzerland. The other countries fall in between, with inflation rates in the region of 3–4 percent per year. Note that the true 101-year means and standard deviations for inflation in Germany are much higher than shown in Table 5-1 since the statistics in the table omit the hyper-inflationary years of 1922–23.

and some of the studies span periods as brief as five years. These differences in research periods, methodologies, and definitions of "smallness" mean that the premia shown in Figure 9-5 are not directly comparable. In particular, it would be unwise to make inferences about the magnitudes or significance of any apparent size premium differences between countries.

In spite of this caveat, Figure 9-5 paints a very clear picture, namely, that the size premium was not restricted to the United States but was present in almost every country studied by the researchers. The sole exception was Korea, where a negative premium was reported, although this study used just five years of data. Furthermore, in most countries, researchers also looked at risk differences. They concluded, like Banz (1981), that the size premium could not be explained away by risk.

The pervasiveness and magnitude of the size effect, and the striking outperformance of smaller companies in most countries around the world, meant that the size effect rapidly became recognized as the premier stock market anomaly.

9.4 The reversal of the size premium

The "discovery" of the size effect in the United States by Banz (1981) and Reinganum (1981), and the publication and dissemination of their research, led to considerable interest in small-caps among investors in the United States. This spurred the launch of significant new small-cap investment vehicles led by Dimensional Fund Advisors, who raised several billion dollars within a couple of years of their 1981 launch. This honeymoon period lasted for approximately two years, until the end of 1983, and during this period, US small-caps continued to outperform. But subsequently, and over much of the period since, US small-caps have underperformed.

The UK experience was remarkably similar. When the HGSC was launched in 1987, its back-history showed that smaller companies had outperformed the UK market by 5.2 percent per year. This dramatic outperformance attracted substantial media attention, and there were over two hundred follow-up articles in the UK press. By the end of 1988, at least thirty open- and closed-end funds had been launched to exploit the perceived outperformance of small-caps, and numerous investment institutions developed a strategy of investing in smaller companies as a distinct asset class. Again, the honeymoon lasted just two years. In the decade that followed, smaller companies were to underperform by a large margin.

This reversal in the fortunes of US and UK small-cap stocks led us to write an article in 1999 entitled "Murphy's Law and Market Anomalies." Murphy's Law is often summarized as "bread always falls with the buttered side down." Figure 9-6 shows the performance record of US and UK small-caps at the time of our article, and shows why this appeared like a classic case of Murphy's Law. The left-hand side of Figure 9-6 shows the historical small- and micro-cap premia for the United States and the United Kingdom from the start date of the original research studies until the end of the post publication honeymoon period (i.e., 1926–

Our subsequent research has shown that the small-cap reversal extended beyond the United Kingdom and United States, and was a worldwide phenomenon. The line of investigation we followed here was to revisit all of the research studies that have been conducted into the size effect in different countries, and to estimate the size premium over the years since the research was published. These studies were discussed earlier in section 9.3 and their findings were summarized in Figure 9-5. We found that they showed evidence of a significant size premium in every country examined, with the sole exception of Korea, where the research covered just a five-year period. Most of these research studies were published in the 1980s.

To update these studies, we estimated the size premium in each country over the period since each study was published. For consistency, we again measured the size premium as the difference between the average monthly returns on the smallest and the largest stocks. For the United States, we use the CRSP NYSE Decile 10 and Decile 1 returns as our respective measures of small and large stock returns, as this most closely approximates Banz's (1981) earlier research, and gives results close to his over his earlier period. Similarly, for the United Kingdom we adopt the same definition as was used in Figure 9-5, namely, the difference between HGSC returns and overall UK equity returns.

For all other countries, we use the size-based indexes published by either Independence International Associates (IIA) or by FTSE International. IIA publish large- and small-cap indexes for a number of countries starting in 1975. They define small as the bottom 30 percent by capitalization of their universe, and large as the top 70 percent. FTSE publish a similar set of large and medium-small-cap indexes for a larger population of countries, but only from 1987, with some countries starting even later. FTSE define medium/small-cap as the bottom 25 percent by capitalization, and large-cap as the balancing 75 percent. For countries where we had a choice between both IIA and FTSE Indexes, we have used the IIA series since they provide a longer time series and generally have somewhat wider coverage.

The results of our research are shown in Figure 9-7. Countries are listed in alphabetical order, and for each country, the size premium reported by the original research studies and plotted earlier in Figure 9-5 in shown in green. Alongside this, the yellow bar shows the size premium calculated over the period since the original research was published, that is, over the period starting at the beginning of the year immediately following publication and ending at New Year 2001. No size-based indexes were available for Korea or Taiwan, so we omitted these countries. We have, however, included the four countries covered in this book, but which did not feature in Figure 9-5 due to the absence of any research study on the size premium. For these countries, we have omitted the "initial research" bars in Figure 9-7, while the "subsequent period" bars show the size premium over the period from 1990–2000.

It is clear from Figure 9-7 that there was a global reversal of the size effect in virtually every country, with the size premium not just disappearing but going into reverse. Researchers around the world universally fell victim to Murphy's Law, with the very effect they were documenting—and inventing explanations for—promptly reversing itself shortly after their studies were published. The only country experiencing a size premium, as opposed to a size discount, in the period subsequent to the original research was Switzerland. However, the Swiss size premium was statistically insignificant, and its magnitude was just 0.05 percent.

Table 12-2: Worldwide equity risk premia relative to long bond returns, 1900–2000

Country	Annual equity risk premium relative to long-term bonds: Geometric mean	Arithmetic mean	Standard error	Standard deviation	Minimum premium	Maximum premium	Ten year risk premium: Geometric mean	Arithmetic mean	Standard deviation
Australia	6.3	8.0	1.9	18.9	-30.6	66.3	6.3	6.4	4.6
Belgium	2.9	4.8	2.1	20.7	-35.1	76.6	3.0	3.2	5.1
Canada	4.5	6.0	1.8	17.8	-36.8	54.7	4.6	4.7	5.4
Denmark	2.0	3.3	1.7	16.9	-35.9	74.9	1.8	1.9	4.1
France	4.9	7.0	2.1	21.6	-32.7	83.7	4.9	5.1	6.8
Germany*	6.7	9.9	2.9	28.4	-38.6	117.6	8.2	8.5	9.1
Ireland	3.2	4.6	1.7	17.4	-37.0	73.3	3.0	3.2	4.8
Italy	5.0	8.4	3.0	30.0	-39.6	152.2	5.0	5.4	9.2
Japan	6.2	10.3	3.3	33.2	-43.3	193.0	6.7	7.2	11.5
The Netherlands	4.7	6.7	2.1	21.4	-43.9	107.6	4.3	4.5	6.5
South Africa	5.4	7.1	2.0	19.7	-29.2	70.9	6.2	6.3	5.0
Spain	2.3	4.2	2.0	20.3	-34.0	69.1	2.2	2.3	5.5
Sweden	5.2	7.4	2.2	22.1	-38.3	87.8	4.8	5.0	7.7
Switzerland†	2.7	4.2	1.9	17.9	-34.4	52.2	2.0	2.1	5.1
United Kingdom	4.4	5.6	1.7	16.7	-38.0	80.8	4.8	4.9	4.5
United States	5.0	7.0	2.0	20.0	-40.8	57.7	4.9	5.0	5.2
World	4.6	5.6	1.4	14.5	-31.2	37.4	4.6	4.7	4.8

* All statistics for Germany exclude 1922–23. † Premia for Switzerland are from 1911.

In this table, the first six columns give summary statistics for the annual premia, while the last three columns relate to rolling ten-year premia. The first column shows the geometric means that were plotted as bars in Figure 12-6. The fourth column shows the standard deviations. The 20.0 percent figure for the United States is close to the 19.6 percent standard deviation for the premia relative to bills shown earlier in Table 12-1. For some countries, however, the distribution of premia relative to bonds is narrower than relative to bills. For the United Kingdom, for example, the standard deviation is 16.7 percent, compared with 19.9 percent relative to bills. This is because, in the United Kingdom, there was a fairly high correlation between annual equity returns and long bond returns (0.56), while the correlation between equities and bills was lower (0.29). This propensity for good bond years to coincide with good equity years, and vice versa, has tended to lower the annual difference between equity and bond returns in the United Kingdom. This was particularly marked in the best and worst years on record for UK equities, namely, 1975 and 1974 respectively.

12.5 Summary

In this chapter, we have used 101 years of stock market history for sixteen different countries and for the world index to take a fresh look at the equity risk premium. In the past, the historical evidence for the US market, and to a lesser extent for the United Kingdom, has heavily influenced views about the magnitude of the risk premium. For the United States, the most widely cited source is Ibbotson Associates (2000), who estimate a geometric risk premium of

The chapter addresses four questions: Which historical equity risk premium should one use as the starting point? Why has it typically been so high? What is a good forward-looking predictor for the future? How can one use variables such as the dividend yield to improve forecasts of the risk premium?

We stress the central role in finance of the equity premium. The historical premium is often summarized in the form of an annualized rate of return. This is a geometric mean. It provides information on past performance. For the future, what is required is the arithmetic mean of the distribution of equity premia, which is larger than the geometric mean. For markets that have been particularly volatile, the arithmetic mean of past equity premia may exceed the geometric mean premium by several percentage points. We adjust the arithmetic mean for (i) the differences between the variability of the stock market over the last 101 years, and the variability that we might anticipate today, and (ii) the impact of unanticipated cash flows and of declines in the required risk premium. The result is a forward-looking, *geometric* mean risk premium for the United States, United Kingdom and world of around 2½ to 4 percent and an *arithmetic* mean risk premium for US, UK, and world equities that falls within a range from a little below 4 to a little above 5 percent.

These equity risk premia are lower than those cited in surveys of finance academics. They are also lower than frequently quoted historical averages, such as those from Ibbotson Associates, which cover a somewhat briefer interval. We show that the historical risk premium, even if it embraces countries that have been less successful than the United States, is supported by two factors. Over the second half of the last century, equity cash flows almost certainly exceeded expectations, and the required rate of return doubtless fell as investment risk declined and the scope for diversification increased. Stock markets rose, in both the United States and other countries, for reasons that are unlikely to be repeated. Even after the setbacks of 2001, the prospective risk premium is markedly lower than the historical risk premium.

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-24

Aswath Damodaran: *Equity Risk Premiums (2015 Edition)* (Excerpt)

October 3, 2019

Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2015 Edition

Updated: March 2015

Aswath Damodaran
Stern School of Business
adamodar@stern.nyu.edu

coefficients to demand these premiums.[30] In the years since, there have been many attempts to provide explanations for this puzzle:

1. Statistical artifact: The historical risk premium obtained by looking at U.S. data is biased upwards because of a survivor bias (induced by picking one of the most successful equity markets of the twentieth century). The true premium, it is argued, is much lower. This view is backed up by a study of large equity markets over the twentieth century, which concluded that the historical risk premium is closer to 4% than the 6% cited by Mehra and Prescott.[31] However, even the lower risk premium would still be too high, if we assumed reasonable risk aversion coefficients.
2. Disaster Insurance: A variation on the statistical artifact theme, albeit with a theoretical twist, is that the observed volatility in an equity market does not fully capture the potential volatility, which could include rare but disastrous events that reduce consumption and wealth substantially. Reitz, referenced earlier, argues that investments that have dividends that are proportional to consumption (as stocks do) should earn much higher returns than riskless investments to compensate for the possibility of a disastrous drop in consumption. Prescott and Mehra (1988) counter than the required drops in consumption would have to be of such a large magnitude to explain observed premiums that this solution is not viable. [32] Berkman, Jacobsen and Lee (2011) use data from 447 international political crises between 1918 and 2006 to create a crisis index and note that increases in the index increase equity risk premiums, with disproportionately large impacts on the industries most exposed to the crisis.[33]
3. Taxes: One possible explanation for the high equity returns in the period after the Second World War is the declining marginal tax rate during that period. McGrattan and Prescott (2001), for instance, provide a hypothetical illustration where a drop in the tax rate on dividends from 50% to 0% over 40 years would cause equity prices to rise about 1.8% more than the growth rate in GDP; adding the dividend yield to this expected price appreciation generates returns similar to

[30] Mehra, Rajnish, and Edward C.Prescott, 1985, *The Equity Premium: A Puzzle*, Journal of Monetary Economics, v15, 145–61. Using a constant relative risk aversion utility function and plausible risk aversion coefficients, they demonstrate the equity risk premiums should be much lower (less than 1%).

[31] Dimson, E., P. March and M. Staunton, 2002, *Triumph of the Optimists*, Princeton University Press.

[32] Mehra, R. and E.C. Prescott, 1988, *The Equity Risk Premium: A Solution?* Journal of Monetary Economics, v22, 133-136.

[33] Berkman, H., B. Jacobsen and J. Lee, 2011, *Time-varying Disaster Risk and Stock Returns*, Journal of Financial Economics, v101, 313-332

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

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AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-25

John Graham et al.: *The Equity Risk Premium in 2016*

October 3, 2019

The Equity Risk Premium in 2016

John R. Graham
Fuqua School of Business, Duke University, Durham, NC 27708, USA
National Bureau of Economic Research, Cambridge, MA 02912, USA

Campbell R. Harvey*
Fuqua School of Business, Duke University, Durham, NC 27708, USA
National Bureau of Economic Research, Cambridge, MA 02912, USA

ABSTRACT

We analyze the history of the equity risk premium from surveys of U.S. Chief Financial Officers (CFOs) conducted every quarter from June 2000 to June 2016. The risk premium is the expected 10-year S&P 500 return relative to a 10-year U.S. Treasury bond yield. The average risk premium in 2016, 4.02%, is slightly higher than the average observed over the past 16 years. We also provide results on the risk premium disagreement among respondents as well as asymmetry or skewness of risk premium estimates. We also link our risk premium results to survey-based measures of the weighted average cost of capital and investment hurdle rates. The hurdle rates are significantly higher than the cost of capital implied by the market risk premium estimates.

JEL Classification: *G11, G31, G12, G14*

Keywords: *Cost of capital, financial crisis, equity premium, WACC, hurdle rate, long-term market returns, stock return forecasts, long-term equity returns, expected excess returns, disagreement, individual uncertainty, skewness, asymmetry, survey methods, TIPs, VIX, credit spreads*

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*Corresponding author, Telephone: +1 919.660.7768, E-mail: cam.harvey@duke.edu. We appreciate the research assistance of Joy Tong. Version: August 2, 2016

Introduction

We analyze the results of the most recent survey of Chief Financial Officers (CFOs) conducted by Duke University and *CFO* Magazine. The survey closed on June 2, 2016 and measures expectations beginning in the second quarter of 2016. In particular, we poll CFOs about their long-term expected return on the S&P 500. Given the current U.S. 10-year Treasury bond yield, we provide estimates of the equity risk premium and show how the premium changes through time. We also provide information on the disagreement over the risk premium as well as average confidence intervals. Finally, we link the equity risk premium to measures used to evaluate firm's investments: the weighted average cost of capital (WACC) and the investment hurdle rate.

1. Method

2.1 Design

The quarterly survey of CFOs was initiated in the third quarter of 1996.[1] Every quarter, Duke University polls financial officers with a short survey on important topical issues (Graham and Harvey, 2009). The usual response rate for the quarterly survey is 5%-8%. Starting in June of 2000, a question on expected stock market returns was added to the survey. Fig. 1 summarizes the results from the risk premium question. While the survey asks for both the one-year and ten-year expected returns, we focus on the ten-year expected returns herein, as a proxy for the market risk premium.

The executives have the job title of CFO, Chief Accounting Officer, Treasurer, Assistant Treasurer, Controller, Assistant Controller, or Vice President (VP), Senior VP or Executive VP of Finance. Given that the majority of survey respondents hold the CFO title, for simplicity we refer to the entire group as CFOs.

[1] The surveys from 1996Q3-2004Q2 were partnered with a national organization of financial executives. The 2004Q3 and 2004Q4 surveys were solely Duke University surveys, which used Duke mailing lists (previous survey respondents who volunteered their email addresses) and purchased email lists. The surveys from 2005Q1 to present are partnered with *CFO magazine*. The sample includes both the Duke mailing lists and the *CFO* subscribers that meet the criteria for policy-making positions.

2.2 Delivery and response

In the early years of the survey, the surveys were faxed to executives. The delivery mechanism was changed to the Internet starting with the December 4, 2001 survey. Respondents are given four business days to fill out the survey, and then a reminder is sent allowing another four days. Usually, two-thirds of the surveys are returned within two business days.

The response rate of 5-8% could potentially lead to a non-response bias. There are six reasons why we are not overly concerned with the response rate. First, we do not manage our email list. If we deleted the email addresses that had not responded to the survey in the past 12 quarters, our response rate would be in the 15-20% range – which is a good response rate. Second, Graham and Harvey (2001) conduct a standard test for non-response biases (which involves comparing the results of those that fill out the survey early to the ones that fill it out late) and find no evidence of bias. Third, Brav, Graham, Harvey and Michaely (2005) conduct a captured sample survey at a national conference in addition to an Internet survey. The captured survey responses (to which over two-thirds participated) are qualitatively identical to those for the Internet survey (to which 8% responded), indicating that non-response bias does not significantly affect their results. Fourth, Brav et al. contrast survey responses to archival data from Compustat and find archival evidence for the universe of Compustat firms that is consistent with the responses from the survey sample. Fifth, Campello, Graham, and Harvey (2011) show that the December 2008 response sample is fairly representative of the firms included in the commonly used Compustat database. Sixth, Graham, Harvey, Popadak and Rajgopal (2016) update the non-response bias test in a survey of 1,900 CFOs and find no evidence of non-response bias.

2.3 Data integrity

In each quarter, implement a series of rules to ensure the integrity of the data. We have, on average, 355 responses each quarter. However, in recent years the average number of responses has exceeded 400. There are a total of 23,086 survey observations. There are six key pieces of data: 1) the 10-year forecast (LT); 2) lower 10% of 10-year forecast (LLT); and 3) upper 10% of the

10-year forecast (ULT). We collect the analogous information for the one-year S&P 500 forecasts too (ST). This paper focuses on the 10-year forecasts but the short-term forecasts factor into our data filters.

Our exclusion rules are the following:

1. Delete all missing forecasts, LT, ST
2. Delete all negative LT forecasts (not ST forecasts)
3. Delete all observations that failed to use percentages (forecasts<1.0 for both ST and LT)
4. Delete observations where they failed to annualize, i.e. delete if LT>30% (does not apply to ST)
5. Delete is ST>100%.
6. Delete if lower intervals inconsistent, i.e. LST>=ST or LLT>=LT.
7. Delete if upper intervals inconsistent, i.e. UST<=ST or ULT<=LT.
8. Delete if ST-LST and UST-ST both equal 1 (we call this a lazy answer)
9. Delete if LT-LLT and ULT-LT both equal 1 (again, a lazy answer)

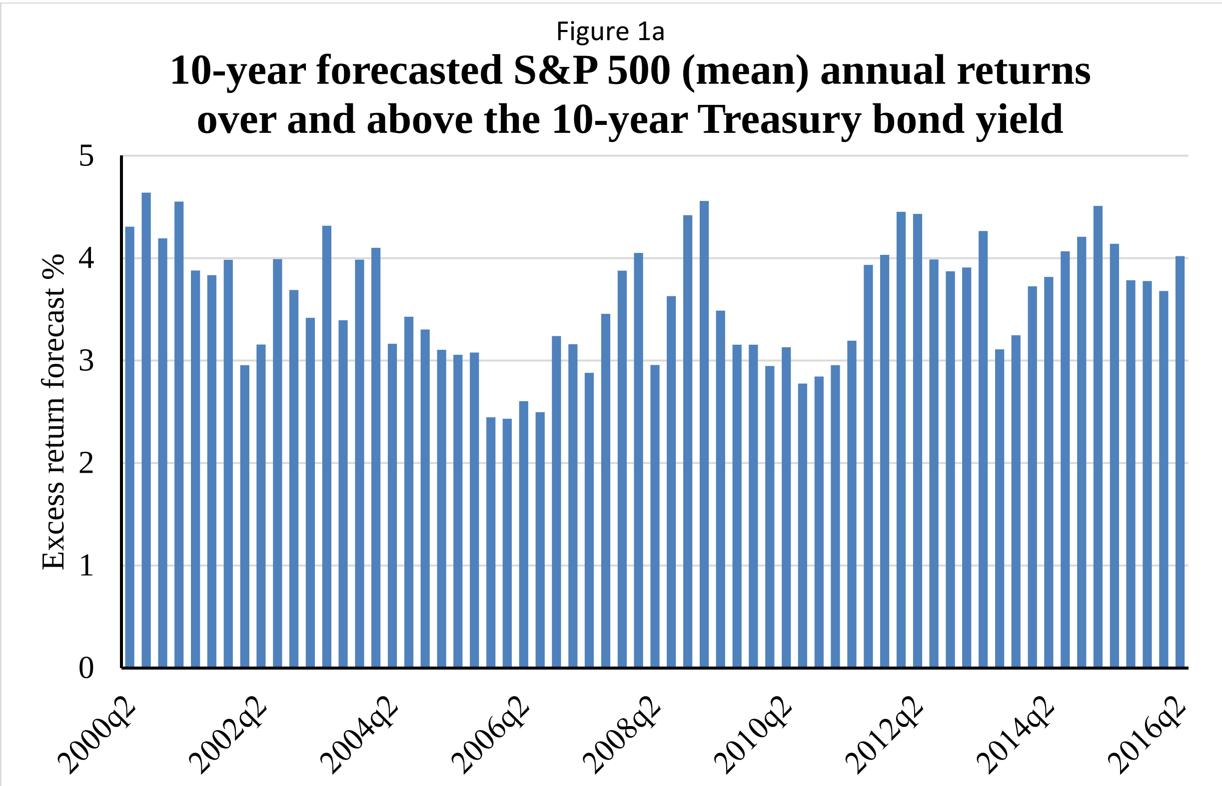
2.4 The 2016 results

The expected market return questions are a subset of a larger set of questions in the quarterly survey of CFOs. The survey usually contains between eight and ten questions. Some of the questions are repeated every quarter and some change through time depending on economic conditions. The historical surveys can be accessed at http://www.cfosurvey.org. Appendix 1 shows the risk premium question in the most recent survey.

While the survey is anonymous, we collect demographic information on seven firm characteristics, including industry, sales revenue, number of employees, headquarters location, ownership (public or private), and proportion of foreign sales.

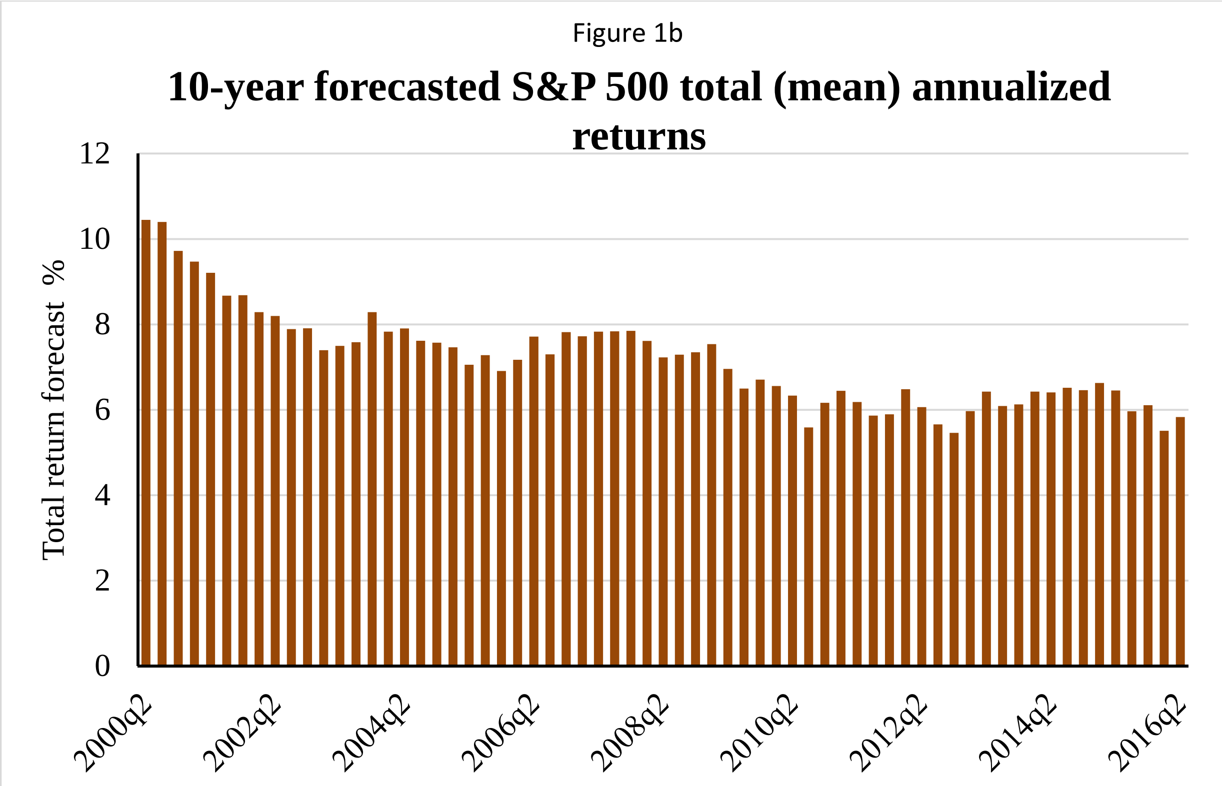
During the past 16 years, we have collected over 23,000 responses to the survey. Panel A of Table 1 presents the date that the survey window opened, the number of responses for each survey, the 10-year Treasury bond rate, as well as the average and median expected excess returns. There is relatively little time variation in the risk premium. This is confirmed in Fig. 1a, which displays the historical risk premiums contained in Table 1. The current premium, 4.02%, is close to the historical average. The June 2016 survey shows that the expected annual S&P 500 return is 5.83% (=4.02%+1.81%) which is below the overall average of 7.19%. The total return forecasts are presented in Fig. 1b.[2]

Panel B of Table 1 presents some summary statistics that pool all responses through the 16 year history of the survey. The overall average ten-year risk premium return is 3.58%.[3] The standard deviation of the individual responses is 2.91% (see Panel B). The standard deviation of the quarterly risk premium estimates is 0.58% (not reported in the Table).



[2] See, for example, Ghysels (1998), Welch (2000, 2001, 2009), Ghysels (1998), Fraser (2001), Harris and Marston (2001), Pástor and Stambaugh (2001), Fama and French (2002), Goyal and Welch (2003), Graham and Harvey (2003), Ang and Bekaert (2005), Fernandez (2004, 2006, 2009) for studies of the risk premium.

[3] Using the Ibbotson Associates data from January 1926 through July 2010, the arithmetic (geometric) average return on the S&P 500 over and above the 30-day U.S. Treasury bill is 7.75% (5.80%). Using data from April 1953-July 2010, the arithmetic (geometric) risk premium is 6.27% (5.12%). The risk premium over the 10 year bond should be reduced by 212 basis points for the arithmetic premium and 174 basis points for the geometric premium. Fama and French (2002) study the risk premium on the S&P 500 from 1872-2000 using fundamental data. They argue that the ex ante risk premia is between 2.55% and 4.32% for 1951-2000 period. Ibbotson and Chen (2001) estimate a long-term risk premium between 4 and 6%. Also see Siegel (1999), Asness (2000), Heaton and Lucas (2000) and Jagannathan, McGratten and Scherbina (2001). A recent treatment is Sharpe and Suarez (2013).



The cross-sectional standard deviation across the individual CFO forecasts in a quarter is a measure of the disagreement or dispersion of the participants in each survey. Dispersion sharply increased during the global financial crisis. The average disagreement in 2005 was 2.39%. Disagreement increased in 2006 to 2.64%. As the crisis began in 2007, disagreement increased to 2.98 by March 2008. The peak disagreement was recorded in February 2009 (4.13%). The most recent observation is 3.24%.

We also report information on the average of the CFOs' assessments of the one in ten chance that the market will exceed or fall below a certain level. In the most recent survey, the worst case total return is +0.39% which is lower than the historic average of 1.52%. The best-case return is 9.71% which is also slightly lower than the average of 10.97%.

With information on the 10% tails, we construct a probability distribution for each respondent. We use Davidson and Cooper's (1976) method to recover each respondent's probability distribution:

$$\text{Variance} = ([x(0.90)-x(0.10)]/2.65)^2$$

where *x*(0.90) and *x*(0.10) represent the 90th and 10th percentiles of the respondent's distribution, ULT and LLT. Keefer and Bodily (1983) show that this simple approximation is the preferred method of estimating the variance of a probability distribution of random variables, given information about the 10th and 90th percentiles. Like disagreement, the average of individual volatilities peaked in February 2009 at 4.29%. The current level, 3.52%, is very close to the overall average.

There is also a natural measure of asymmetry in each respondent's response. We look at the difference between each individual's 90% tail and the mean forecast and the mean minus the 10% tail. Hence, if the respondent's forecast of the excess return is 6% and the tails are -8% and +11%, then the distribution is negatively skewed with a value of -9% (=5%-14%). As with the usual measure of skewness, we cube this quantity and standardize by dividing by the cube of the individual standard deviation. In every quarter's survey, there is on average negative skewness in the individual forecasts. The average asymmetry -0.63 which is slightly lower than the average of -0.47.

Table 1

Summary statistics based on the responses from the
65 CFO Outlook Surveys from June 2000 to June 2016 (Maximums in red, minimums in green)

A. By quarter

#	Survey date	Survey quarter	Number of survey responses	10-year bond yield	Total market return forecast	Average risk premium	Median risk premium	Disagreement (standard deviation of risk premium estimates)	Average of individual standard deviations	Average of individuals' worst 10% market return scenario	Average of individuals' best 10% market return scenario	Skewness of risk premium estimates	Average of individuals' asymmetry	% who forecast negative excess return
1	6/6/2000	2000Q2	209	**6.14**	**10.45**	4.31	3.86	3.22				0.95		9.09
2	9/7/2000	2000Q3	188	5.76	10.40	**4.64**	4.24	3.03				0.83		4.79
3	12/4/2000	2000Q4	243	5.53	9.72	4.19	4.47	2.52				0.53		4.12
4	3/12/2001	2001Q1	140	4.92	9.47	4.55	4.58	2.91				0.78		3.57
5	6/7/2001	2001Q2	208	5.33	9.21	3.88	3.67	2.64				0.58		5.77
6	9/10/2001	2001Q3	199	4.84	8.67	3.83	3.16	2.53				**0.13**		3.52
7	12/4/2001	2001Q4	279	4.70	8.68	3.98	3.30	2.43				0.61		2.15
8	3/11/2002	2002Q1	233	5.33	8.29	2.96	2.67	2.43	3.28	**3.68**	12.42	1.06	-0.28	11.16
9	6/4/2002	2002Q2	316	5.04	8.20	3.16	2.96	2.61	3.50	3.00	12.28	1.86	-0.39	10.44
10	9/16/2002	2002Q3	361	3.90	7.89	3.99	4.10	2.31	3.39	3.05	12.03	0.86	-0.25	2.77
11	12/2/2002	2002Q4	285	4.22	7.91	3.69	3.78	2.56	3.23	3.32	11.87	1.24	-0.28	4.91
12	3/19/2003	2003Q1	184	3.98	7.40	3.42	3.02	2.37	3.59	1.95	11.47	0.83	-0.62	4.35
13	6/16/2003	2003Q2	366	3.18	7.50	4.32	**4.82**	2.34	3.74	2.16	12.07	0.90	-0.33	3.28
14	9/18/2003	2003Q3	167	4.19	7.58	3.39	3.81	**2.07**	**2.83**	3.31	10.83	0.35	-0.43	6.59
15	12/10/2003	2003Q4	220	4.30	8.29	3.98	3.70	2.66	3.29	3.40	12.10	1.74	-0.45	2.27
16	3/24/2004	2004Q1	206	3.73	7.83	4.10	4.27	2.37	3.46	2.85	12.02	0.50	-0.29	3.88
17	6/16/2004	2004Q2	177	4.74	7.90	3.16	3.26	2.61	3.10	3.14	11.34	2.14	-0.40	6.21
18	9/10/2004	2004Q3	179	4.19	7.62	3.43	3.31	2.92	3.27	2.61	11.29	2.02	-0.52	8.94
19	12/3/2004	2004Q4	287	4.27	7.57	3.30	3.23	2.66	3.05	3.10	11.17	1.89	-0.37	5.92
20	2/28/2005	2005Q1	272	4.36	7.46	3.10	3.39	2.52	3.06	3.13	11.23	1.29	-0.33	6.62
21	5/31/2005	2005Q2	316	4.00	7.06	3.06	3.00	2.22	3.22	2.39	10.93	0.46	-0.26	6.65
22	8/29/2005	2005Q3	321	4.20	7.28	3.08	2.80	2.61	3.36	2.15	11.06	2.42	-0.52	7.48
23	11/21/2005	2005Q4	338	4.46	6.91	2.45	2.54	2.20	3.48	2.23	11.44	0.41	**-0.23**	9.76
24	3/6/2006	2006Q1	276	4.74	7.17	**2.43**	2.26	2.40	3.44	2.07	11.18	1.02	-0.37	8.70
25	6/1/2006	2006Q2	494	5.11	7.72	2.61	2.89	2.74	3.29	3.00	11.70	1.84	-0.24	**18.02**
26	9/11/2006	2006Q3	460	4.80	7.30	2.50	2.20	2.49	3.32	2.53	11.33	1.32	-0.33	7.83
27	11/21/2006	2006Q4	386	4.58	7.82	3.24	3.42	2.93	3.36	2.94	11.82	1.91	-0.30	6.99
28	3/1/2007	2007Q1	380	4.56	7.72	3.16	3.44	2.39	3.38	2.73	11.67	1.80	-0.39	5.53
29	6/1/2007	2007Q2	419	4.95	7.83	2.88	3.05	2.14	3.21	3.08	11.58	0.56	-0.37	3.58
30	9/7/2007	2007Q3	479	4.38	7.84	3.46	3.62	2.82	3.12	3.33	11.59	1.80	-0.34	5.22
31	11/30/2007	2007Q4	458	3.97	7.85	3.88	4.03	2.75	3.31	2.93	11.70	1.38	-0.32	3.28
32	3/7/2008	2008Q1	381	3.56	7.61	4.05	4.44	2.99	3.21	3.08	11.58	2.23	-0.30	3.94
33	6/13/2008	2008Q2	384	4.27	7.23	2.96	2.73	2.60	3.32	2.44	11.24	1.50	-0.41	9.38
34	9/5/2008	2008Q3	432	3.66	7.29	3.63	3.34	2.79	3.31	2.30	11.06	1.71	-0.42	4.63
35	11/28/2008	2008Q4	534	2.93	7.35	4.42	4.07	3.19	3.73	1.77	11.64	1.94	-0.37	2.81
36	2/26/2009	2009Q1	443	2.98	7.54	4.56	4.02	**4.13**	**4.29**	1.18	**12.54**	1.80	-0.47	5.87
37	5/29/2009	2009Q2	427	3.47	6.96	3.49	3.53	3.12	3.73	1.37	11.26	1.79	-0.42	6.56
38	9/11/2009	2009Q3	536	3.34	6.50	3.16	2.66	2.88	3.87	0.62	10.86	1.82	-0.46	10.82
39	12/11/2009	2009Q4	457	3.55	6.71	3.16	2.45	3.56	3.86	0.64	10.88	2.38	-0.52	9.85
40	2/26/2010	2010Q1	478	3.61	6.56	2.95	2.39	3.28	3.96	0.39	10.86	2.31	-0.68	9.41
41	6/4/2010	2010Q2	444	3.20	6.33	3.13	2.80	3.08	3.90	0.33	10.64	**2.61**	-0.64	9.91
42	9/10/2010	2010Q3	451	2.81	5.59	2.78	**2.19**	2.53	4.21	**-1.16**	9.99	0.77	-0.67	8.65
43	12/10/2010	2010Q4	402	3.32	6.17	2.85	2.68	2.62	3.91	0.26	10.63	1.89	-0.55	10.70
44	3/4/2011	2011Q1	429	3.49	6.45	2.96	2.51	2.92	4.16	-0.27	10.76	2.44	**-0.70**	8.16
45	6/3/2011	2011Q2	406	2.99	6.18	3.19	3.01	2.90	3.90	0.12	10.45	2.09	-0.68	5.17
46	9/9/2011	2011Q3	397	1.93	5.86	3.93	3.07	3.11	3.79	0.04	10.09	2.41	-0.54	**2.02**
47	12/16/2011	2011Q4	439	1.86	5.89	4.03	3.14	2.98	4.07	-0.11	10.68	1.91	-0.36	3.42
48	3/1/2012	2012Q1	406	2.03	6.48	4.45	3.97	2.97	4.07	0.30	11.08	2.25	-0.59	2.71
49	5/30/2012	2012Q2	338	1.63	6.06	4.43	4.37	2.96	3.94	0.00	10.42	1.96	-0.59	2.37
50	9/7/2012	2012Q3	675	1.67	5.66	3.99	3.33	3.00	3.66	-0.01	9.67	2.04	-0.58	2.37
51	12/6/2012	2012Q4	325	**1.59**	**5.46**	3.87	3.41	2.59	3.69	-0.49	**9.25**	1.42	-0.62	3.08
52	3/8/2013	2013Q1	418	2.06	5.97	3.91	3.94	2.73	3.84	-0.14	10.02	2.01	-0.64	4.55
53	5/31/2013	2013Q2	300	2.16	6.43	4.27	3.84	2.91	4.02	0.10	10.76	1.63	-0.67	2.67
54	9/5/2013	2013Q3	404	2.98	6.09	3.11	3.02	2.73	3.41	0.75	9.77	1.71	-0.53	6.68
55	12/5/2013	2013Q4	320	2.88	6.13	3.25	3.12	2.95	3.81	0.18	10.26	1.69	-0.50	7.19
56	3/4/2014	2014Q1	291	2.70	6.43	3.73	3.30	2.63	3.32	1.35	10.13	0.64	-0.69	5.15
57	6/5/2014	2014Q2	325	2.59	6.41	3.82	3.41	3.23	3.76	0.50	10.46	1.89	-0.64	7.08
58	9/4/2014	2014Q3	316	2.45	6.52	4.07	3.55	3.33	3.69	0.90	10.68	2.56	-0.60	3.16
59	12/4/2014	2014Q4	398	2.25	6.46	4.21	4.50	2.51	3.79	0.46	10.51	1.22	-0.59	2.26
60	3/3/2015	2015Q1	414	2.12	6.63	4.51	3.88	3.50	3.72	0.81	10.68	1.92	-0.55	5.80
61	6/4/2015	2015Q2	399	2.31	6.45	4.14	3.69	3.03	3.96	0.20	10.68	1.93	-0.72	4.26
62	9/3/2015	2015Q3	376	2.18	5.96	3.78	2.82	3.17	3.48	0.28	9.49	2.72	-0.72	3.99
63	12/3/2015	2015Q4	347	2.33	6.11	3.78	2.67	3.58	3.55	0.54	9.94	1.92	-0.52	9.22
64	3/3/2016	2016Q1	476	1.83	5.51	3.68	3.17	2.55	3.12	1.04	9.29	0.99	-0.34	3.15
65	6/2/2016	2016Q2	472	1.81	5.83	4.02	3.19	3.24	3.52	0.39	9.71	2.14	-0.63	2.54
	Average of quarters		355	**3.58**	**7.19**	**3.61**	**3.37**	**2.80**	**3.57**	**1.52**	**10.97**	**1.54**	**-0.47**	**5.89**
	Standard deviation			1.18	1.13	0.58	0.63	0.38	0.34	1.33	0.80	0.66	0.15	3.05

B. By individual responses

Survey for		Number of survey responses	10-year bond yield	Total market return forecast	Average risk premium	Median risk premium	Disagreement	Average of individual standard deviations	Average of individuals' worst 10%	Average of individuals' best 10%	Skewness	Average of individuals' asymmetry	% who forecast negative excess return
All dates		23,086	**3.41**	**6.99**	**3.58**	**3.30**	**2.91**	**3.60**	**1.37**	**10.91**	**1.64**	**-0.48**	**5.95**

2.5 Risk premia, weighted average cost of capital and hurdle rates

The risk premia that we measure can be used in the calculation of the cost of capital. In a simple capital asset pricing model, the cost of equity capital would be the product of the company's beta times the risk premium along with the risk free rate. The average firm's cost of equity capital would be 6.63% (assuming a beta=1). Assuming the Baa bond yield is the borrowing rate and a 25% marginal tax rate, the weighted average cost of capital would be about 5.67%.

In previous surveys, we have asked CFOs about their weighted average cost of capital. For example, in March of 2011, companies told us that their internally calculated weighted average cost of capital was 10% (averaged across respondents). At the time, the cost of equity capital was similar to today, 6.45%. The bond yields were higher, with the Baa yielding 6.09%. The average firm (assuming average beta is 1.0) without any debt would have a WACC of 6.45%. When debt is introduced, the WACC would be less than 6.45% -- which is sharply lower than the reported 10%.

Why is there such a divergence? One possible reason is that companies consider other factors in calculating the WACC – perhaps a multifactor model.[4] However, there is no evidence supporting this hypothesis. For example, consultants often add a premium for smaller firms based on the results in many research papers of a size premium. However, in our survey the average WACC for firms with less than $25 million in revenue is 10.6% and the WACC for the largest firms with annual revenue greater than $10 billion is 10.5%.

This analysis was replicated in June of 2012 with similar results. Given the same assumptions, the WACC is 5.37%. However, the average self-reported WACC is 9.3%. Again, there is no evidence of a size premium. The smallest firms reported a WACC of 9.3% and the largest firms 9.7%.

The WACC should not be confused with the investment hurdle rate. The WACC is an analytical calculation that combines a model-based cost of equity (such as the CAPM) and the after-tax cost of debt (reflected in current borrowing rates). Given capital constraints, firms often impose a higher hurdle rate on their investments. For example, to allocate capital to an investment that

[4] Graham and Harvey (2001) find that most companies use a 1-factor model for cost of capital calculations.

promises a projected return exactly at the firm's WACC is equivalent to accepting a zero net present value project.

The June 2012 survey also asked for the investment hurdle rates. They are much higher than the WACCs. The average rate was 13.5% (compared to the survey-reported WACC of 9.3% and the implied WACC from the survey based risk premium of 5.7%. Similar to the WACC results, there is no evidence that the hurdle rates are higher for small firms. Our evidence shows that the reported average hurdle rate for the smallest firms is 13.1% and for the largest firms the rate is 14.2%.

Even though we know from Graham and Harvey (2001) that three quarters of companies use the capital asset pricing model, there is a large gap between an imputed WACC and the WACC that people use. One way to reconcile this is that companies use very long term averages of equity and bond premia in their calculations. For example, suppose the cost of capital is being calculated with averages from 1926. Ibbotson (2013) reports an arithmetic average return of 11.8% over the 1926-2012 period. The average return on corporate bonds is 6.4%. Using the same parameters, we get an imputed WACC of 9.7%. This is very close to the average reported WACC and, indeed, identical to the WACC reported by the largest firms in our survey.

We learn the following: 1) the equity risk premium is much lower today than averages used over long-periods (e.g. from 1926) such as reported in Morningstar (2013) and Duff and Phelps (2015); 2) the survey questions asking directly about a company's WACC is consistent with companies routinely using long-horizon averages for inputs; and 3) WACCs should be thought as lower bounds – the Hurdle Rates used for actual investment decisions are 400bp higher than the stated WACCs.[5]

2.6 Recessions, the financial crisis and risk premia

Our survey spans two recessions: March 2001-September 2001 as well as the recession that begins in December 2007 and ends in June 2009. Financial theory would suggest that risk premia should vary with the business cycle. Premiums should be highest during recessions and lowest

[5] Also see Sharpe and Suarez (2013) and Jagannathan et al. (2016) who analyze our CFO survey data.

during recoveries. Previous research has used a variety of methods including looking at ex post realized returns to investigate whether there is business-cycle like variation in risk premia.

While we only have 60 observations and this limits our statistical analysis, we do see important differences. During recessions, the risk premium is 3.92% and during non-recessions, the premium falls to 3.46%.

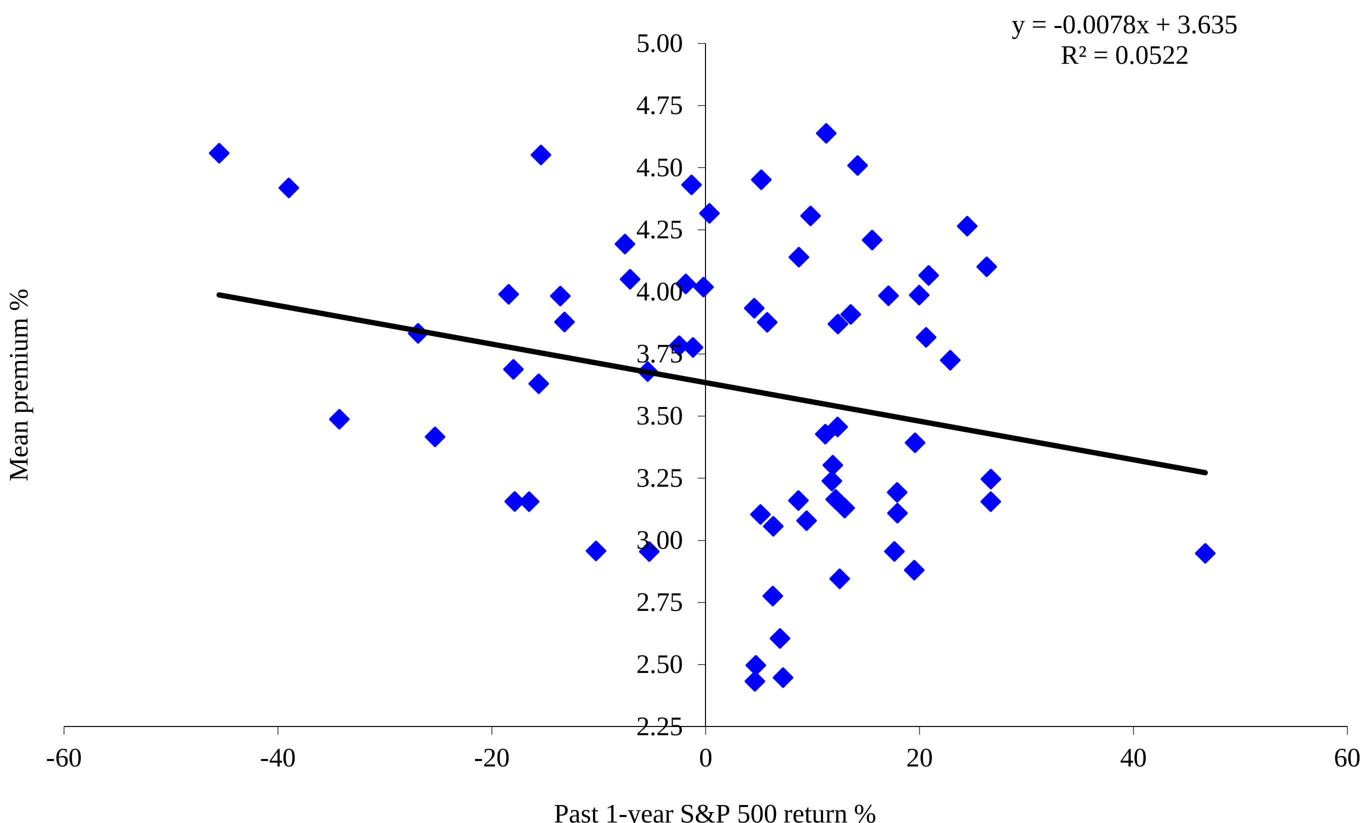
2.7 Explaining variation in the risk premium

While we document the level and a limited time-series of the long-run risk premium, statistical inference is complicated by the fact that the forecasting horizons are overlapping. First, we have no way of measuring the accuracy of the risk premiums as forecasts of equity returns. Second, any inference based on regression analysis is confounded by the fact that from one quarter to the next, there are 36 common quarters being forecasted. This naturally induces a moving-average process.

We do, however, try to characterize the time-variation in the risk premium without formal statistical tests. Figure 2 examines the relation between the mean premium and previous one-year returns on the S&P 500.

Figure 2

The ten-year equity risk premium and past 1-year returns on the S&P 500 index

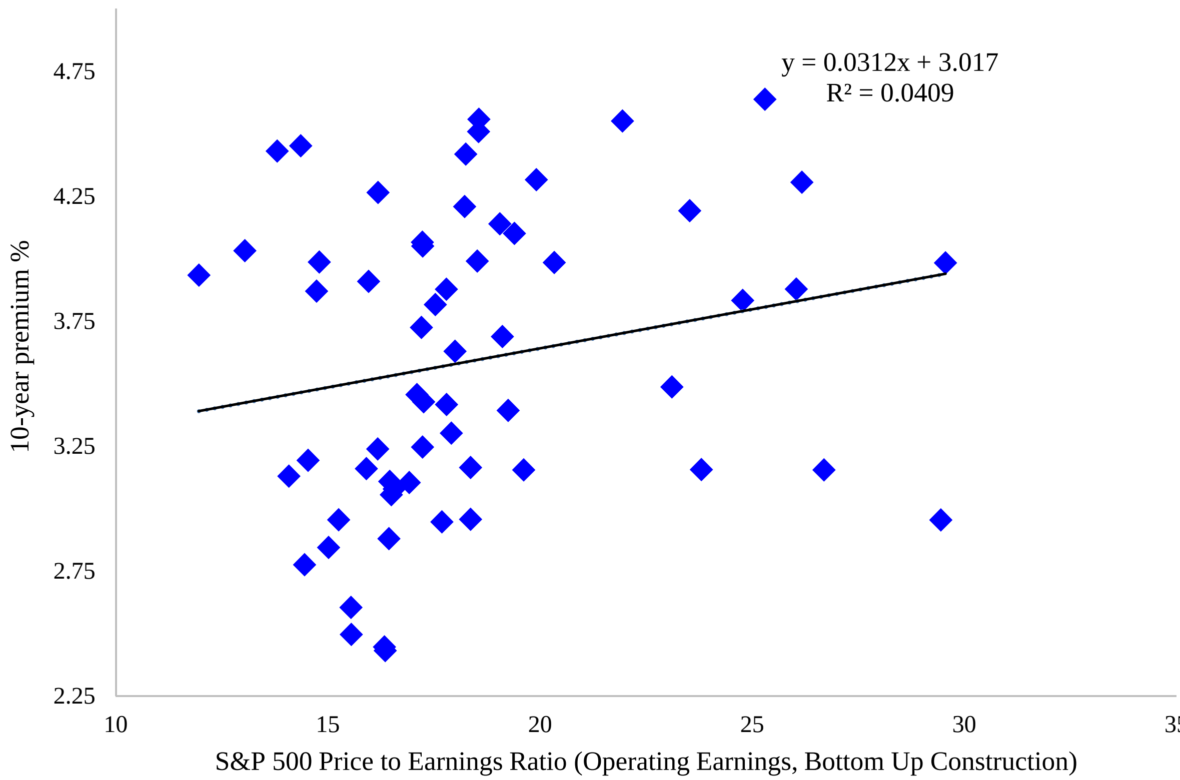


The evidence suggests that there is a weak negative correlation between past returns and the level of the long-run risk premium. This makes economic sense. When prices are low (after negative returns), expected return increase.

An alternative to using past-returns is to examine a measure of valuation. Figure 3 examines a scatter of the mean premium versus the forward price-to-earnings ratio of the S&P 500.

Figure 3

The equity risk premium and the S&P 500 forward price-to-earnings ratio

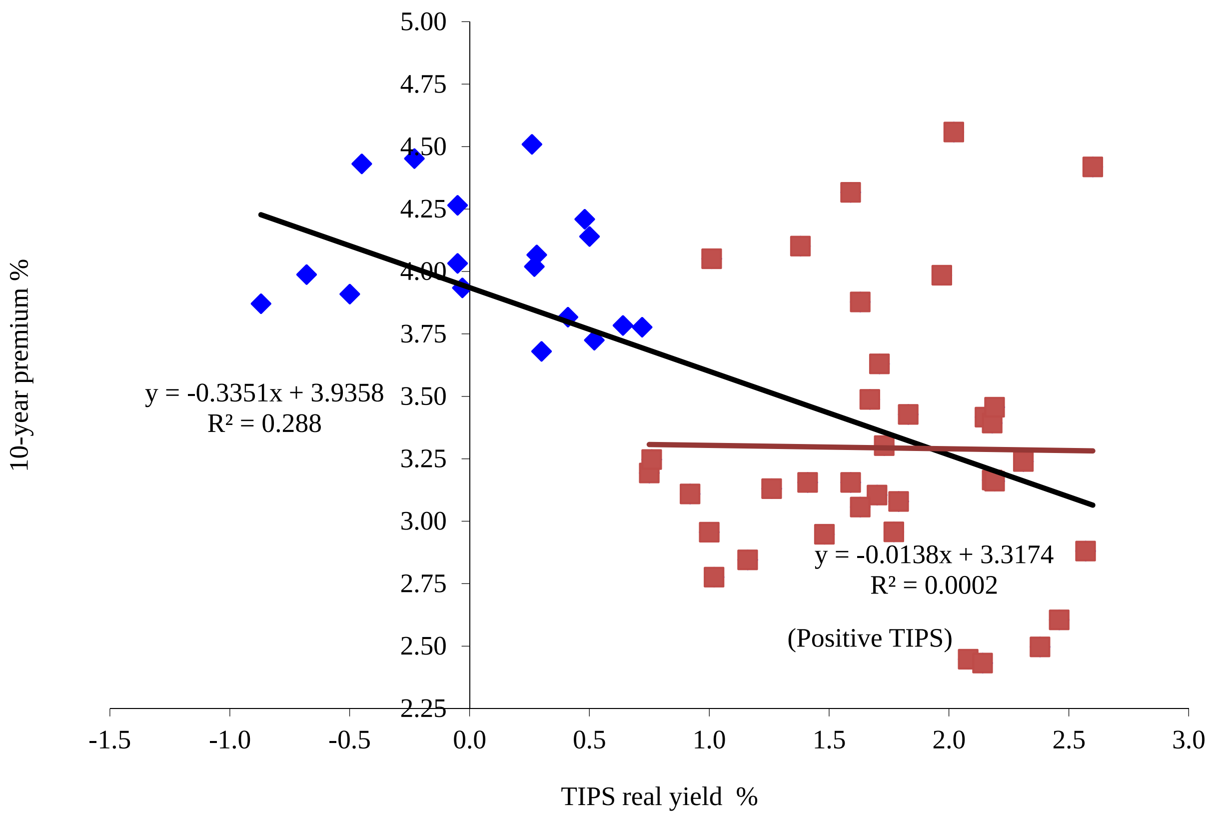


Looking at the data in Figure 3, it appears that the inference may be complicated by a non-linear relation. At very high levels of valuation, the expected return (the risk premium) was low.

We also examine the real yield on Treasury Inflation Indexed Notes. The risk premium is like an expected real return on the equity market. It seems reasonable that there could be a correlation between expected real rates of return stocks and bonds. Figure 4 examines the 10-year on the run yield on the Treasury Inflation Indexed Notes.

Figure 4

The equity risk premium and the real yield on Treasury Inflation Indexed Notes

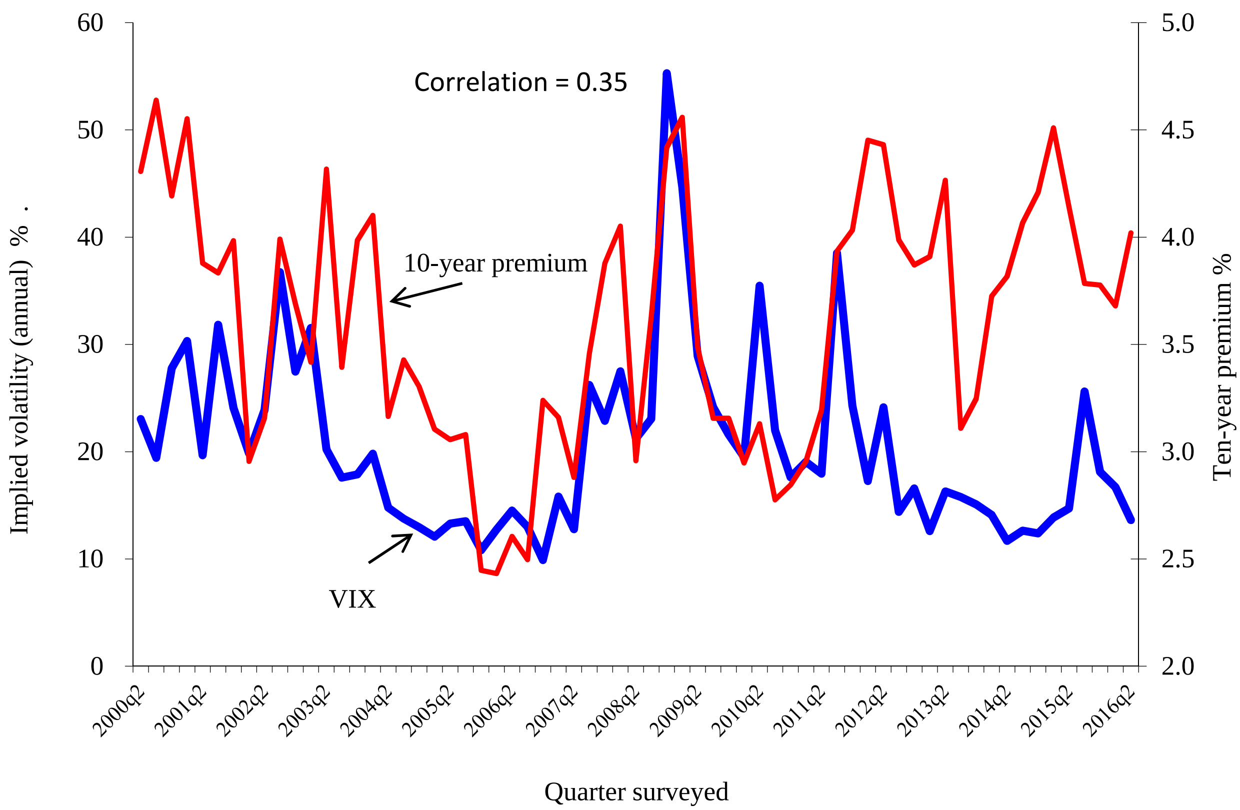


Overall, there is a negative correlation of -0.517. However, this correlation is driven by the negative TIPS yields. This is consistent with the idea that in periods of heightened uncertainty, investors engage in a flight to safety and accept low or negative TIPS yields – and at the same time demand a high risk premium for investing in the equity market.

Finally, we consider two alternative measures of risk and the risk premium. Figure 5 shows that over our sample there is evidence of a strong positive correlation between market volatility and the long-term risk premium. We use a five-day moving average of the implied volatility on the S&P index option (VIX) as our volatility proxy. The correlation between the risk premium and volatility is 0.35. If the closing day of the survey is used, the correlation is roughly the same. Asset pricing theory suggests that there is a positive relation between risk and expected return. While our volatility proxy doesn't match the horizon of the risk premium, the evidence, nevertheless, is suggestive of a positive relation. Figure 5 also highlights a strong recent divergence between the risk premium and the VIX.

Figure 5

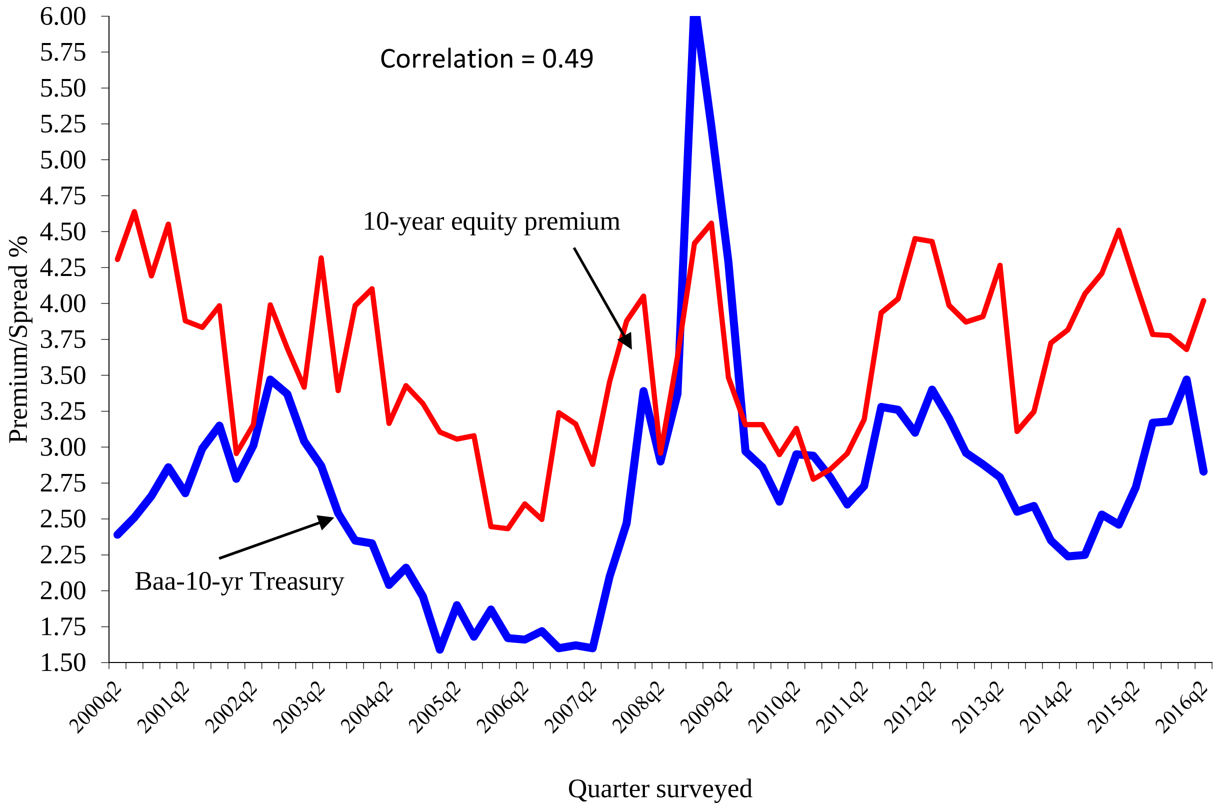
The equity risk premium and the implied volatility on the S&P 500 index option (VIX)



We also consider an alternative risk measure, the credit spread. We look at the correlation between Moody's Baa rated bond yields less the 10-year Treasury bond yield and the risk premium. Figure 6 shows a highly significant relation between the time-series with a correlation of 0.49. Similar to Figure 5, there is a strong recent divergence.

Figure 6

The equity risk premium and credit spreads



2.8 Other survey questions

The June 2016 survey contains a number of other questions. http://www.cfosurvey.org presents the full results of these questions. The site also presents results conditional on demographic firm characteristics. For example, one can examine the CFOs views of the risk premium conditional on the industry in which the CFO works.

2.9 Risk premium data and corporate policies

Research by Ben-David, Graham and Harvey (2013) uses the one-year risk premium forecasts as a measure of optimism and the 80% confidence intervals as a direct measure of overconfidence. By linking email addresses that respondents provide to archival corporate data, Ben-David et al. find that the tightness of the confidence intervals is correlated with corporate investment. Overconfident managers invest more.

Campello, Graham and Harvey (2010) use the survey during the financial crisis and the higher risk premiums to examine the implications of financial constraints on the real activities of the firm. They provide new evidence on the negative impact of financial constraints on firms' investment plans.

Campello, Giambona, Graham and Harvey (2011) use the survey during the financial crisis to study how firms managed liquidity during the financial crisis.

Graham, Harvey and Puri (2013) administer a psychometric test using the survey instrument and link CEO optimism and risk aversion to corporate financial policies.

Graham, Harvey and Puri (2015) use survey data to study how capital is allocated within the firm and the degree to which CEOs delegate decision making to CFOs.

Graham, Harvey and Rajgopal (2005) use survey data to study how managers manipulate earnings. Dichev, Graham, Harvey, and Rajgopal (2013) study earnings quality.

Graham, Harvey, Popadak and Rajgopal (2016) use a similar survey sample to study corporate culture.

2.10 CFO Survey compared to other surveys

Table 2 compares the predictive ability of the Duke-CFO survey with other popular surveys. The table reports the correlations between the current quarter Duke-CFO survey of either optimism about the economy or optimism about the firm's prospects with the subsequent quarter's realization for five surveys: UBS-Gallup, CEO Survey, Conference Board Consumer Confidence, University of Michigan Consumer Confidence and ISM Purchasing Manager's Index. Both of the Duke-CFO optimism measures significantly predict all five of these popular barometers of economic confidence. Related analysis shows that our CFO survey anticipates economic activity sooner (usually one quarter sooner) than do the other surveys.

Table 2
The ability of the Duke CFO survey to predict other surveys

	Predictive correlations	
Survey	Optimism about economy	Optimism about firm's prospects
UBS-Gallup	0.289	0.380
CEO Survey	0.814	0.824
Conference Board Consumer Confidence	0.513	0.767
University of Michigan Consumer Confidence	0.341	0.253
ISM Purchasing Managers Index	0.694	0.497

3. Conclusions

We provide a direct measure of ten-year market returns based on a multi-year survey of Chief Financial Officers. Importantly, we have a 'measure' of expectations. We do not claim it is the true market expectation. Nevertheless, the CFO measure has not been studied before.

While there is relatively little time-variation in the risk premium, premia are higher during recessions and higher during periods of uncertainty. We also link our analysis to the actual investment decisions of financial managers. We are able to impute the weighted average cost of capital given the CFO estimates of equity risk premia, current corporate bond yields and marginal tax rates. This imputed measure is significantly less than the WACCs that CFOs report using in project evaluation. One way to reconcile this is that CFOs use very long-term averages of equity premia and bond rates when calculating WACCs. We provide evidence on the actual hurdle rates used by companies. These hurdle rates are, on average, 400bp higher than the reported WACCs.

While we have over 23,000 survey responses in 16 years, much of our analysis uses summary statistics for each survey. As such, with only 65 unique quarters of predictions and a variable of interest that has a 10-year horizon, it is impossible to evaluate the accuracy of the market excess return forecasts. For example, the June 4, 2007 10-year annual forecast was 7.83% and the realized annual S&P 500 return through June 2, 2016 is 3.2%. Our analysis shows some weak correlation between past returns, real interest rates and the risk premium. In contrast, there is significant evidence on the relation between two common measures of economic risk and the risk premium. We find that both the implied volatility on the S&P index as well as a commonly used measure of credit spreads are correlated with our measured equity risk premium.

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Appendix A

Excerpt from the Survey Instrument

9. On May 17, 2016 the annual yield on 10-yr treasury bonds was 1.8%. Please complete the following:

a. Over the next 10 years, I expect the average annual S&P 500 return will be:

Worst Case: There is a 1-in-10 chance the actual average return will be less than:	**Best Guess**: I expect the return to be:	Best Case: There is a 1-in-10 chance the actual average return will be greater than:
____ %	____ %	____ %

b. During the next year, I expect the S&P 500 return will be:

Worst Case: There is a 1-in-10 chance the actual return will be less than:	**Best Guess**: I expect the return to be:	Best Case: There is a 1-in-10 chance the actual return will be greater than:
____ %	____ %	____ %

Please check one from each category that best describes your company:

a. Industry (choose best option)

- Retail/Wholesale
- Banking/Finance/Insurance/Real Estate
- Mining/Construction
- Transportation & Public Utilities
- Energy
- Services, Consulting
- Agriculture, Forestry, & Fishing
- Public Administration
- Communication/Media
- Tech [software/biotech/hardware]
- Manufacturing
- Healthcare/Pharmaceutical
- Other: ____

b. Sales Revenue

- Less than $25 million
- $25-$99 million
- $100-$499 million
- $500-$999 million
- $1-$4.9 billion
- $5-$9.9 billion
- More than $10 billion

c. Number of Employees

- Fewer than 100
- 100-499
- 500-999
- 1,000-2,499
- 2,500-4,999
- 5,000-9,999
- More than 10,000

d. Where are you personally located?

- Northeast U.S.
- Mountain U.S.
- Midwest U.S.
- South Central U.S.
- South Atlantic U.S.
- Pacific U.S.
- Canada
- Latin America
- Europe
- Asia
- Africa
- Other ____

e. Ownership

- Public, NYSE
- Public, NASDAQ/AMEX
- Private
- Government
- Nonprofit

f. Foreign Sales

- 0%
- 1-24%
- 25-50%
- More than 50%

g. What is your company's credit rating?

[▼] Check here if you do not have a rating, and please estimate what your rating would be.

h. Return on assets (ROA=operating earnings/assets) (e.g., -5%, 6.2%)

____ % Approximate ROA in 2015
____ % Expected ROA in 2016

i. Your job title (e.g., CFO, Asst. Treasurer, etc.)

____

BEFORE THE WASHINGTON

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-26

Pablo Fernandez et al.: *Market Risk Premium used in 71 countries in 2016* (Excerpt)

October 3, 2019

Market Risk Premium used in 71 countries in 2016:
a survey with 6,932 answers

Pablo Fernandez*, Alberto Ortiz** and Isabel Fernandez Acín***
IESE Business School. University of Navarra

ABSTRACT

This paper contains the statistics of the Equity Premium or Market Risk Premium (MRP) used in 2016 for **71 countries**. We got answers for more countries, but we only report the results for 71 countries with more than 8 answers.

54% of the MRP used in 2016 decreased (vs. 2015) and 38% increased.

Most previous surveys have been interested in the Expected MRP, but this survey asks about the Required MRP. The paper also contains the references used to justify the MRP, and comments from 46 persons.

JEL Classification: G12, G31, M21

Keywords: equity premium; required equity premium; expected equity premium; historical equity premium

May 9, 2016

* Professor of Corporate Finance. e-mail: fernandezpa@iese.edu
** Research Assistant. e-mail: AOrtiz@iese.edu
*** Independent Researcher. e-mail: ifernandez.28@alumni.unav.es

xLhMTPPP

IESE Business School
Camino del Cerro del Aguila 3. 28023 Madrid, Spain

Table 2. Market Risk Premium (%) used for 71 countries in 2016

		Average	Median	St Dev	Max	min	Q1	Q3	N
1	USA	5,3%	5,0%	1,3%	20,0%	1,5%	4,5%	6,0%	2536
2	Spain	6,2%	6,0%	1,4%	12,0%	1,5%	5,0%	6,8%	817
3	Germany	5,3%	5,0%	1,7%	12,4%	1,2%	4,0%	6,0%	360
4	UK	5,3%	5,0%	1,4%	12,8%	1,5%	4,5%	6,0%	221
5	Italy	5,6%	5,5%	1,5%	10,1%	2,0%	4,8%	6,0%	152
6	Canada	5,4%	5,2%	1,3%	10,5%	3,0%	4,6%	6,0%	127
7	Brazil	8,2%	7,0%	4,9%	30,0%	1,8%	5,5%	8,7%	107
8	France	5,8%	5,5%	1,6%	11,4%	2,0%	5,0%	6,7%	105
9	Mexico	7,4%	7,0%	2,3%	15,0%	3,0%	6,0%	9,0%	103
10	South Africa	6,3%	6,0%	1,5%	11,8%	3,0%	5,5%	7,0%	99
11	China	8,3%	7,0%	4,4%	30,0%	3,8%	6,0%	10,0%	96
12	Netherlands	5,1%	5,0%	1,2%	11,6%	2,5%	4,5%	5,9%	93
13	Switzerland	5,1%	5,0%	1,1%	9,6%	3,0%	4,5%	5,6%	88
14	Australia	6,0%	6,0%	1,6%	15,0%	3,0%	5,0%	6,2%	87
15	India	8,1%	8,0%	2,4%	16,0%	2,3%	6,6%	9,0%	82
16	Russia	7,9%	7,0%	3,5%	25,0%	2,7%	6,0%	9,0%	81
17	Chile	6,1%	6,0%	1,6%	15,0%	3,0%	5,5%	7,0%	72
18	Sweden	5,2%	5,0%	1,0%	9,0%	3,0%	4,5%	5,9%	72
19	Austria	5,4%	5,3%	1,4%	14,3%	2,5%	5,0%	6,0%	71
20	Belgium	5,6%	5,5%	1,1%	8,1%	3,6%	5,0%	6,4%	71
21	Norway	5,5%	5,0%	1,8%	14,0%	3,0%	4,5%	6,0%	70
22	Denmark	5,3%	5,0%	1,7%	14,0%	2,0%	4,4%	6,0%	63
23	Japan	5,4%	5,0%	2,3%	16,7%	2,0%	4,0%	6,8%	58
24	Argentina	11,8%	11,0%	4,4%	28,7%	5,0%	9,0%	14,0%	57
25	Colombia	8,1%	7,8%	3,9%	20,5%	2,0%	6,5%	9,0%	56
26	Portugal	7,9%	8,0%	2,1%	14,0%	4,0%	6,6%	9,0%	55
27	Finland	5,5%	5,0%	1,6%	12,0%	3,0%	4,7%	6,0%	51
28	Poland	6,2%	5,8%	1,5%	10,0%	4,4%	5,0%	7,6%	50
29	Peru	7,8%	7,5%	2,6%	15,0%	3,5%	6,3%	8,3%	44
30	New Zealand	5,8%	6,0%	1,4%	8,0%	2,0%	5,0%	7,0%	42
31	Greece	13,0%	12,4%	5,2%	23,0%	6,5%	8,5%	17,9%	41
32	Luxembourg	4,7%	5,0%	1,1%	7,0%	2,0%	4,0%	5,4%	38
33	Israel	5,9%	6,0%	2,2%	15,0%	2,5%	5,0%	7,0%	37
34	Turkey	8,1%	8,0%	3,4%	18,0%	2,5%	5,5%	10,5%	37
35	Czech Republic	6,3%	6,5%	1,0%	8,0%	4,3%	5,5%	7,3%	32
36	Egypt	13,8%	13,0%	6,2%	30,3%	3,5%	9,0%	16,4%	32
37	Indonesia	8,0%	8,0%	2,1%	14,5%	4,5%	6,1%	9,3%	29
38	Ireland	6,6%	5,8%	2,2%	12,3%	4,0%	5,0%	8,2%	28
39	Pakistan	9,8%	6,5%	5,4%	18,0%	2,5%	6,0%	16,0%	26
40	Taiwan	7,9%	7,2%	2,1%	15,0%	4,3%	7,0%	8,4%	26
41	Korea	6,7%	7,0%	1,8%	11,1%	2,0%	6,0%	7,3%	25
42	Singapore	5,9%	6,0%	1,3%	9,6%	3,9%	5,5%	6,3%	25
43	Liechtenstein	4,8%	5,0%	1,0%	7,3%	3,0%	4,4%	5,0%	24
44	Hong Kong	7,6%	6,9%	2,6%	12,0%	3,5%	5,5%	10,0%	21

BEFORE THE WASHINGTON

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EXHIBIT DJG-27

CAPM Implied Equity Risk Premium Calculation

October 3, 2019

CAPM Implied Equity Risk Premium Estimate

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Year	Market Value	Operating Earnings	Dividends	Buybacks	Earnings Yield	Dividend Yield	Buyback Yield	Gross Cash Yield
2013	16,495	956	312	476	5.80%	1.89%	2.88%	4.77%
2014	18,245	1,004	350	553	5.50%	1.92%	3.03%	4.95%
2015	17,900	885	382	572	4.95%	2.14%	3.20%	5.33%
2016	19,268	920	397	536	4.77%	2.06%	2.78%	4.85%
2017	22,821	1,066	420	519	4.67%	1.84%	2.28%	4.12%
2018	21,033	1,282	456	806	6.09%	2.17%	3.83%	6.00%

Cash Yield	4.98%	[9]
Growth Rate	6.04%	[10]
Risk-free Rate	2.42%	[11]
Current Index Value	2,956	[12]

	[13]	[14]	[15]	[16]	[17]
Year	1	2	3	4	5
Expected Dividends	156	165	175	186	197
Expected Terminal Value					3389
Present Value	144	141	138	135	2399

Intrinsic Index Value	2956	[18]
Required Return on Market	8.38%	[19]
Implied Equity Risk Premium	**6.0%**	[20]

[1-4] S&P Quarterly Press Releases, data found at https://us.spindices.com/indices/equity/sp-500 (additional info tab) (all dollar figures are in $ billions)
[1] Market value of S&P 500
[5] = [2] / [1]
[6] = [3] / [1]
[7] = [4] / [1]
[8] = [6] + [7]
[9] = Average of [8]
[10] = Compund annual growth rate of [2] = (end value / beginning value)$^{1/4}$-1
[11] Risk-free rate from DJG risk-free rate exhibit
[12] 30-day average of closing index prices from DJG stock price exhibit
[13-16] Expected dividends = [9]*[12]*(1+[10])^n ; Present value = expected dividend / (1+[11]+[19])^n
[17] Expected terminal value = expected dividend * (1+[11]) / [19] ; Present value = (expected dividend + expected terminal value) / (1+[11]+[19]^n)
[18] = Sum([13-17]) present values.
[19] = [20] + [11]
[20] Internal rate of return calculation setting [18] equal to [12] and solving for the discount rate

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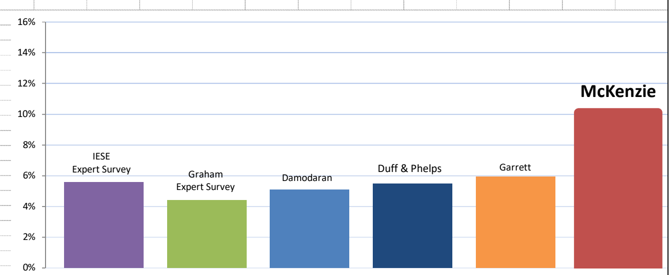
EXHIBIT DJG-28

CAPM Equity Risk Premium Results

October 3, 2019

CAPM Equity Risk Premium Results

	A	B	C	D	E	F	G	H	I
1									
2									
3								Company ERP	10.10%
4	IESE Business School Survey		5.6%		[1]				AMM-8
5									
6	Graham & Harvey Survey		4.4%		[2]				
7									
8	Duff & Phelps Report		5.5%		[3]				
9									
10	Damodaran		5.1%		[4]				
11									
12	Garrett		6.0%		[5]				
13									
14	**Average**		**5.3%**						
15									
16	**Highest**		**6.0%**						
17									
18									
19									
20	[1] IESE Business School Survey 2019								
21	[2] Graham and Harvey Survey 2018								
22	[3] Duff & Phelps 2018								
23	[4] Avg ERP, http://pages.stern.nyu.edu/~adamodar/ , 9-1-19								
24	[5] From DJG implied ERP exhibit								



BEFORE THE WASHINGTON

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-29

CAPM Final Results

October 3, 2019

CAPM Final Results

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3					[1]		[2]		[3]			[4]
4												
5					Risk-Free		Value Line		Risk			CAPM
6	Company		Ticker		Rate		Beta		Premium			Results
7												
8	Algonquin Pwr & Util		AQN		2.42%		NR		5.96%			NA
9	Ameren Corp.		AEE		2.42%		0.600		5.96%			6.0%
10	Avangrid, Inc.		AGR		2.42%		0.400		5.96%			4.8%
11	Avista Corp.		AVA		2.42%		0.600		5.96%			6.0%
12	Black Hills Corp.		BKH		2.42%		0.750		5.96%			6.9%
13	CenterPoint Energy		CNP		2.42%		0.800		5.96%			7.2%
14	CMS Energy Corp.		CMS		2.42%		0.550		5.96%			5.7%
15	Dominion Energy		D		2.42%		0.550		5.96%			5.7%
16	DTE Energy Co.		DTE		2.42%		0.550		5.96%			5.7%
17	Edison International		EIX		2.42%		0.600		5.96%			6.0%
18	El Paso Electric Co.		EE		2.42%		0.700		5.96%			6.6%
19	Emera Inc.		EMA		2.42%		0.550		5.96%			5.7%
20	Entergy Corp.		ETR		2.42%		0.600		5.96%			6.0%
21	Exelon Corp.		EXC		2.42%		0.700		5.96%			6.6%
22	FirstEnergy Corp.		FE		2.42%		0.600		5.96%			6.0%
23	Hawaiian Elec.		HE		2.42%		0.550		5.96%			5.7%
24	IDACORP, Inc.		IDA		2.42%		0.600		5.96%			6.0%
25	NorthWestern Corp.		NWE		2.42%		0.600		5.96%			6.0%
26	OGE Energy Corp.		OGE		2.42%		0.800		5.96%			7.2%
27	Otter Tail Corp.		OTTR		2.42%		0.700		5.96%			6.6%
28	PNM Resources		PNM		2.42%		0.600		5.96%			6.0%
29	Sempra Energy		SRE		2.42%		0.750		5.96%			6.9%
30												
31	**Average**						0.626					**6.1%**
32												
33												
34												
35	[1] From DJG risk-free rate exhibit											
36	[2] From DJG beta exhibit											
37	[3] From DJG equity risk premium exhibit											
38	[6] = [1] + [2] * [3]											

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EXHIBIT DJG-30

Michael Gombola: *Time-Series Processes of Utility Betas* (Excerpt)

October 3, 2019

Time-Series Processes of Utility Betas: Implications for Forecasting Systematic Risk

Michael J. Gombola and Douglas R. Kahl

Michael J. Gombola is an Associate Professor of Finance at Drexel University, Philadelphia, PA. Douglas R. Kahl is an Associate Professor of Finance at the University of Akron, Akron, OH.

■ Brigham and Crum [5] describe difficulties with the Capital Asset Pricing Model (CAPM) in estimating utility cost of capital. This controversial article elicited six comments [7, 15, 17, 21, 22, 24], a reply [6], and one extension [11]. Examining the dividend omission by Consolidated Edison (Con Ed), Brigham and Crum note that this information release could confound estimation of Con Ed's beta. Although the Ordinary Least Squares (OLS) beta estimate decreased concurrent with the dividend omission, Brigham and Crum contend that Con Ed's risk had not decreased.

An OLS estimate of beta requires an estimation period during which the relationship between stock return and market return is stable. Without this stability, the forecaster needs alternatives for forecasting a time-varying relationship, such as the general Bayesian adjustment process [25] or its specific variations employed by Merrill Lynch [18]. The appropriateness of a given procedure depends on the particular time-series properties of the beta being forecast.

Information on the time-series properties of utility betas, including the variability of beta and the tendency of utility betas to auto-regress toward an underlying mean, is presented here. The degree of difficulty in forecasting beta depends on both of these properties. Since the basis of Bayesian adjustment lies in beta's tendency to return to an underlying mean, if betas follow a random walk process then Bayesian adjustment will be fruitless.

Collins, Ledolter, and Rayburn [10] explain that random variation in beta leads to severe forecasting difficulties, unlike variability due to auto-regression in beta. To the extent that beta instability is auto-correlated, an unstable beta can be forecasted accurately. Estimating that about 25% of beta variability in their sample is due to auto-correlated beta changes, Collins, Ledolter, and Rayburn suggest that recognition of auto-correlation can improve forecasting accuracy by 15%.

Auto-correlated beta changes allow use of beta adjustment models to improve beta forecasts. A general Bayesian adjustment model would adjust the short-term (transient) beta estimate towards a long-term underlying mean. An example of such an application is the Merrill Lynch [18] adjustment process:

$$B_t = 0.65(B_{t-1}) + 0.35(1.0)\,. \qquad (1)$$

Here, the transient beta estimate obtained by OLS is presumed to return to an underlying mean of 1.0 slowly, since more weight is placed on the transient beta than on the underlying mean.

Studying the time-series properties of utility betas—including their tendency to return to an underlying mean, the speed of this return, and the underlying mean itself—should prove helpful in formulating Bayesian adjustments of beta forecasts. Carleton [7] suggests that Bayesian-adjusted beta forecasts have been applied, often inappropriately, to beta forecasts in regulatory proceedings. This study strives to determine whether such Bayesian adjustment processes are appropriate at all.

I. Beta Coefficient Instability and the Rate-Setting Process

Cooley [12] points out the widespread, albeit controversial, use of the Capital Asset Pricing Model in estimating required return for utility equity. Exchanges published by two journals dealing with the CAPM for rate setting ([7, 15, 17, 21, 22, 24] and [4, 19, 20]) center not on the validity of the theory but on the reliability and usefulness of beta estimates.

Concern over empirical estimates of systematic risk is based on a substantial body of empirical literature pointing to beta instability. From the early descriptive work of Blume [2] through later tests by Fabozzi and Francis [13] and Collins, Ledolter, and Rayburn [10], the evidence supports instability in security betas. Studying specifically the behavior of utility betas, Bey [1], Chen [8], and Pettway [23] all demonstrate instability.

Although the size of beta instability has been extensively investigated, comparatively little attention has been focused on the form of that instability, particularly for utilities. Beta instability does not necessarily preclude application of the CAPM unless combined with a random walk process for beta.

The simplest case, a constant coefficient process for beta, may be expressed as:

$$B_{it} = B_{i,t-1} = B_i^m \text{ for all } t\,. \qquad (2)$$

In Equation (2), the beta at any point in time remains equal to the previous beta and also to a constant underlying mean beta, B_i^m. This constant coefficient process is assumed in OLS estimation of a beta and serves as the null hypothesis in tests of beta variability [3, 13].

When the transient beta for a particular company (B_{it}) is distributed around an underlying mean beta for that company B_i^m, the resulting time-series process may be described as:

$$B_{it} = B_i^m + u_{it}\,. \qquad (3)$$

Equation (3) describes the random coefficient model tested by Fabozzi and Francis [13] and assumed in a beta forecasting model by Chen and Keown [9]. Since the deviations of beta from its underlying mean (u_{it}) are limited to a single period and are serially uncorrelated, the transient beta (B_{it}) tends to return quickly to the underlying mean.

If the transient beta takes more than one period to return to its underlying mean, then an auto-regressive process describes the time-series behavior of beta:

$$B_{it} = a_i B_{i,t-1} + (1 - a_i)B_i^m + u_{it}\,. \qquad (4)$$

This process is very similar to the random coefficient process, except for the strength of the tendency for mean-reversion. A value of 0.9 for $1 - a_i$ would cause the process to be classified as auto-regressive, whereas a value of 1.0 would label it random coefficient. Otherwise, there is little difference.

The auto-regressive model described in Equation (4) is the same one studied by Bos and Newbold [3] and Collins, Ledolter, and Rayburn [10]. The process considers a tendency to return to an underlying mean beta, where the tendency is measured by $1 - a_i$. The Merrill Lynch adjustment process [18] describes a special case in which the underlying mean beta (B_i^m) is 1.0 and the adjustment factor to the mean, also called the regression rate ($1 - a_i$), is 0.35. Vasicek's adjustment model [25] is a less restrictive case in which the underlying mean beta is unity and no restriction is made on the adjustment rate toward the underlying mean.

If all beta variation is random, then there will be no tendency for beta to return to an underlying mean, resulting in a random walk process:

$$B_{it} = B_{i,t-1} + u_{it}. \qquad (5)$$

This model has been suggested as a time-varying model for beta in a stability test described by Garbade and Rentzler [14]. Since there are no bounds on the value that beta can assume, the process is difficult to forecast, especially in the long run. If beta follows a random walk process then the best long-term forecast is the short-term beta, and a Bayesian adjustment process will not improve the forecast. Notably, Brigham and Crum's [6] original criticism of the CAPM was based on unadjusted OLS estimates of Con Ed's beta, which implicitly assumes that an unstable beta follows a random walk.

II. The Beta Coefficient as an Auto-Regressive Variable

Any of the four beta-generating processes can be represented as a special case of a general auto-regressive process. The general model has a measurement equation,

$$R_{it} = B_{it} R_{mt} + e_{it}, \qquad (6)$$

and state equation,

$$B_{it} = a_i B_{i,t-1} + (1 - a_i)B_i^m + u_{it}, \qquad (6')$$

where R_{it} is the excess return on the ith security during time t, R_{mt} is the return on the market index during time t, B_i^m is the underlying mean beta for the ith stock, and B_{it} is the transient beta for the ith stock at time t.

Equation (6') specifies a first-order auto-regressive process for beta. If the value for $1 - a_i$ is 0.0, then (6') reverts to the random walk process described in Equation (5). If the value for $1 - a_i$ is 1.0, then (6') reverts to the random coefficient process described in Equation (3). If the residual variance is 0.0, then $1 - a_i$ becomes 0.0 and the underlying mean and error terms in Equation (6') drop out, leaving the constant beta process in Equation (2).

III. Estimating Parameters of the Model

The parameters of the model in Equations (6) and (6') were estimated using monthly stock return data from the Compustat PDE file for 109 utility companies. 61 electric and 48 electric and gas. The 15-year sample period is from January 1967–December 1981. The period contains both the dividend omission by Consolidated Edison [5] and the Three Mile Island incident.

The model in Equations (6) can be expressed in matrix format as:

$$R_{it} = \underline{h}_t \underline{B}_{mt} + \underline{e}_{it}, \qquad (7)$$

$$\underline{B}_{it} = \underline{A}_i \underline{B}_{i,t-1} + \underline{U}_{it}, \qquad (7')$$

where

$\underline{h}_t = (R_{mt}, 0)$;
$\underline{B}'_{it} = (B_{it}, B_i^m)$;
$\underline{U}'_{it} = (u_{it}, 0)$ and is distributed as $N(0, W_i S_i^2)$,

$$\underline{W} = \begin{bmatrix} w_i & 0 \\ 0 & 0 \end{bmatrix}, \qquad (8)$$

$$\underline{A} = \begin{bmatrix} a_i & 1 - a_i \\ 0 & 1 \end{bmatrix}. \qquad (9)$$

The recursive Kalman filtering approach described by Kahl and Ledolter [16] is used to estimate simultaneously the three parameters of the market model in Equations (6). These parameters are: the underlying mean beta (B_i^m), the regression rate toward the underlying mean ($1 - a_i$), and the variance of beta over time.

Simultaneous estimation of three parameters requires considerable data and computer resources which might explain why studies using broad samples and large numbers of stocks formulate the problem somewhat differently. Bos and Newbold estimated a Kalman filtering model with a two-pass process. Decreasing the number of parameters from three to two reduces the computation time to only a fraction of that required for a full model. Collins, Ledolter, and Rayburn [10] suggest that the procedure followed by Bos and Newbold [3] creates a downward bias in the estimate of beta's regression rate. They were able to eliminate the estimate of the underlying mean beta in the model and focus on beta regression tendencies.

The model used in this study produces independent variance estimates like the model used by Collins, Ledolter, and Rayburn. In addition, this model estimates the underlying mean beta. Maximum likelihood estimates of elements in the transition matrix (a_i), the variance ratio (w_i), and the variance of the measurement equa-

Exhibit 1. Maximum Likelihood Estimates of Model Parameters

Regression Rate	Standard Deviation of Beta 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0.0			2[a]	3[a]	4[a]	6[a]	12[a]	5[a]	3[a]		
0.1				1	2	5	1				
0.2					1	7	2	5	2		
0.3				1	1	2	5	1	3		
0.4				1	2	1	3	1			
0.5											
0.6						1					
0.7						1					
0.8											
0.9		1	1								
1.0	6[b]	17[c]									

[a]These firms display characteristics of firms whose betas follow a random coefficient process.
[b]These firms display characteristics of firms whose betas are constant.
[c]These firms display characteristics of firms whose betas follow a random walk process.

tion (S_i^2), were all concurrently estimated using a grid search procedure.

IV. Results

The particular time-series process followed by a beta can be indicated by two parameters: the standard deviation of this beta over time, u_{it} in Equation (6'); and its adjustment rate to the mean, $(1 - a_i)$ in Equation (6'). Consequently, the cross-tabulation of these two parameters in Exhibit 1 is also a tabulation of the process followed by the beta. The most common process shown in Exhibit 1 is the auto-regressive process. Nearly half of the companies in the sample, 51 out of 109, show a nonzero standard deviation of beta together with a value for the regression rate between zero and unity.

The next most common process is the random coefficient process, indicated by a nonzero value for the standard deviation of beta together with an estimate of 1.0 for $1 - a_i$. These estimates are shown by 35 of the sample companies. The firms with auto-regressive betas and those with very similar random coefficient betas jointly comprise 86 of the 109 sample firms.

A nonzero estimate of the standard deviation of beta combined with a regression rate of zero indicates a beta following a random walk process. Parameter estimates consistent with a random walk process are shown for only 17 companies.

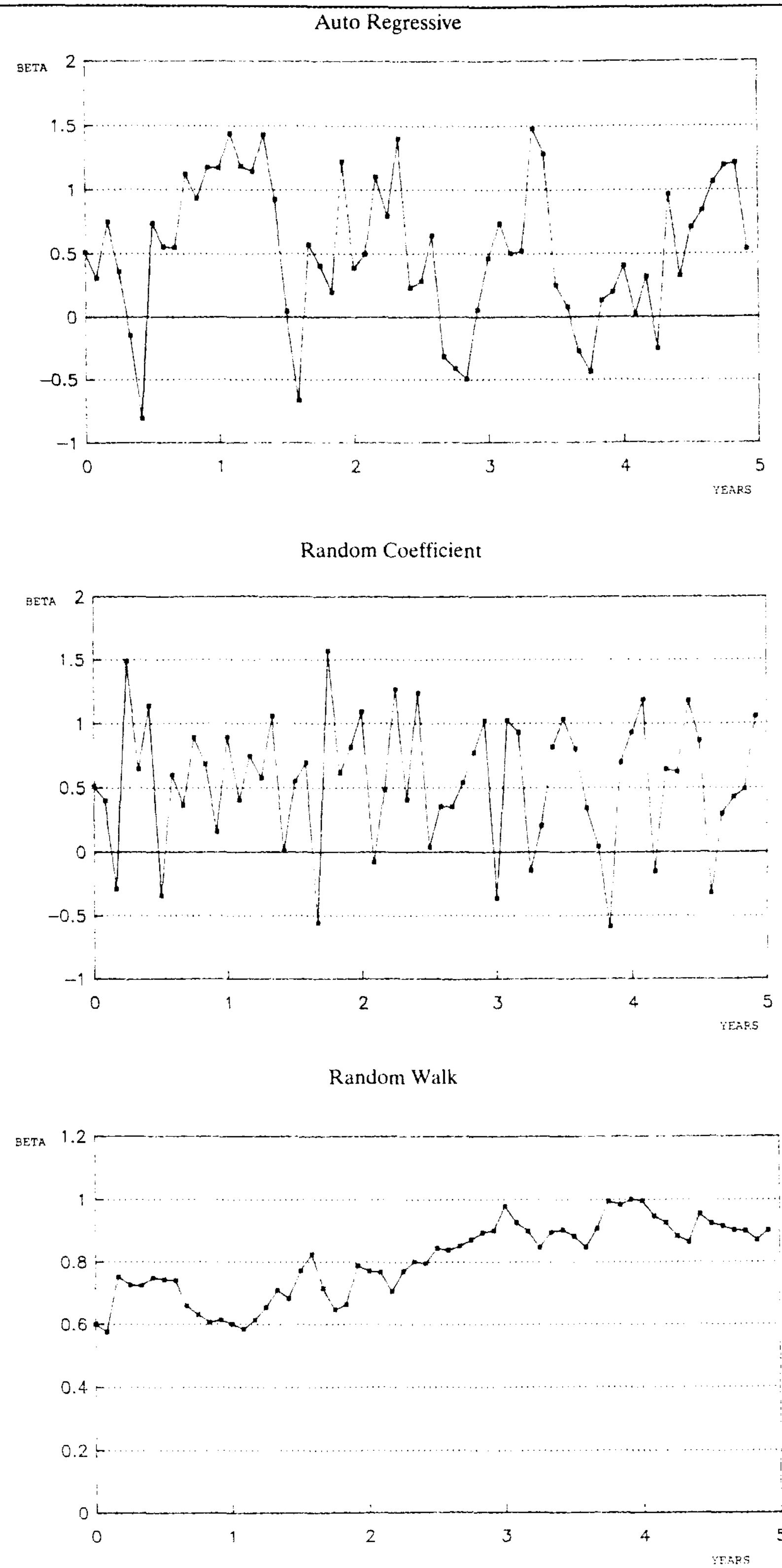
The least common process indicated by companies in the sample is the constant coefficient process, shown by only 6 companies. A constant beta coefficient is indicated by a zero estimate for the standard deviation of beta.

Since the estimation period covers 15 years (180 months), many companies could not maintain a constant beta coefficient. The long estimation period allows management, regulators, and the markets to react to any exogenous changes affecting systematic risk so as to bring risk back to reasonable levels. Such reaction is consistent with a beta that follows an auto-regressive process. Consequently, the preponderance of companies with auto-regressive betas in Exhibit 1 conforms to expected long-term behavior of management and markets.

Internal consistency of parameter estimates in Exhibit 1 is just as important as reasonableness. All companies having a zero estimate for the standard deviation of beta also show a value of 0.0 for the adjustment rate estimate. Any other estimate would be ambiguous for classifying the process. A positive association between the estimate of the standard deviation of beta and the estimate of $1 - a_i$ further points to the lack of ambiguity and helps in interpreting the process for all of the sample companies.

The positive association between beta variability and the regression rate is also consistent with boundaries upon beta values. Companies with high beta variability tend to have betas that return quickly to an underlying mean. Companies with low or zero return rates have low beta variability. High variability to-

Exhibit 2. Three Time-Series Processes for Beta



gether with a low or zero return rate would lead to extreme beta instability and preclude application of the CAPM. The results show no evidence of this type of beta instability.

A. Behavior of Transient Betas

To illustrate the implications of different processes and parameters, plots of betas following an auto-regressive process, a random coefficient process, and a random walk process are presented in Exhibit 2. Each of these processes behaves according to average coefficient values of companies with that process in Exhibit 1. For the auto-regressive process, the coefficients are an underlying mean of 0.51, a standard deviation of transient beta of 0.50, and a return rate toward the underlying mean of 0.52. For the random coefficient process, the underlying mean is 0.52 and its standard deviation is 0.53. For the random walk process the standard deviation of beta is 0.05.

The auto-regressive beta depicted in Exhibit 2 shows considerable variability and ranges between a minimum value of -0.8 and a maximum value of 1.50. Although the variability in the short run is rather large, the beta at no time takes longer than 9 months to return to its underlying mean, usually returning in three or four months. However, upon returning to its underlying mean it often strays on the opposite side, requiring several additional months to return.

Over the 60-month period shown for the auto-regressive process in Exhibit 2, only 36 of the transient beta values fall between a low of 0.0 and a high of 1.0. These bounds might be considered reasonable for a utility. Nine of the 60 beta observations lie below 0.0. The presence of such outliers might frustrate, but not obviate, application of OLS techniques for beta estimation. Although Exhibit 2 indicates that extreme beta values, such as those discussed by Brigham and Crum [5], might be common in the short run, the forecaster should not be deterred by the presence of short-run instability. In the long run, beta will return to its mean.

The similarity between the auto-regressive process and the random coefficient process, also shown in Exhibit 2, is obvious. Even if rather extreme values are encountered, the random coefficient beta reverts back to the mean within the next two observations. The upper and lower bounds on beta as well as the proportion of betas less than zero are very similar for the two processes.

Exhibit 2 also contains a plot of the time-series behavior of a beta following a random walk process. Although the beta behavior for the random walk process seems more stable than the auto-regressive or random coefficient process, such apparent short-run stability is misleading. Over the 60 months depicted in Exhibit 2, the beta wanders from a value of 0.6 to a value of about 0.9. Over the next 60 months, the beta could potentially rise by another 0.3, fall back to 0.6, or be anywhere in between. In the longer run, the beta becomes even more difficult to forecast, due to the lack of any tendency to revert to an underlying mean.

B. Focusing on the Consolidated Edison Dividend Omission

A plot during the period from January 1970–December 1984 of the behavior of the transient beta for Consolidated Edison is presented in Exhibit 3. The transient beta behaves much like the typical beta for any utility with an auto-regressive beta, except for the period immediately following the dividend omission. During this period, the transient beta becomes very erratic for about 9 months. Once it settles down, it continues to behave like any other utility with a typical auto-regressive beta. The plot of the transient beta for Con Ed over the last 60 months, if placed on the same scale as Exhibit 2, would be visually indistinguishable from the auto-regressive process depicted in that exhibit.

The plot of Con Ed's transient beta shown in Exhibit 3 depicts the transitory effect of economic disturbances on beta estimates. Even in this dramatic case of a dividend omission, the relationship between the stock and the market returned to normal within less than one year. This strong tendency to return to the mean beta gives empirical support to forecaster-supplied prior values in Bayesian adjustment models that place more weight on the underlying mean beta and less weight on the transient beta than the Merrill Lynch model would imply.

Some additional information on the behavior of Con Ed's beta is presented in Exhibit 4. During the overall period, which extends from January 1970–June 1984, its OLS beta estimate was 0.61 and the estimate of its underlying mean beta was 0.58. Since this overall period contains the dividend omission, a null hypothesis of a constant coefficient process for beta can be easily rejected. The regression rate of 0.70 toward the underlying mean indicates a strong mean-reversion tendency.

Exhibit 3. Transient Beta for Consolidated Edison, 1970–1984

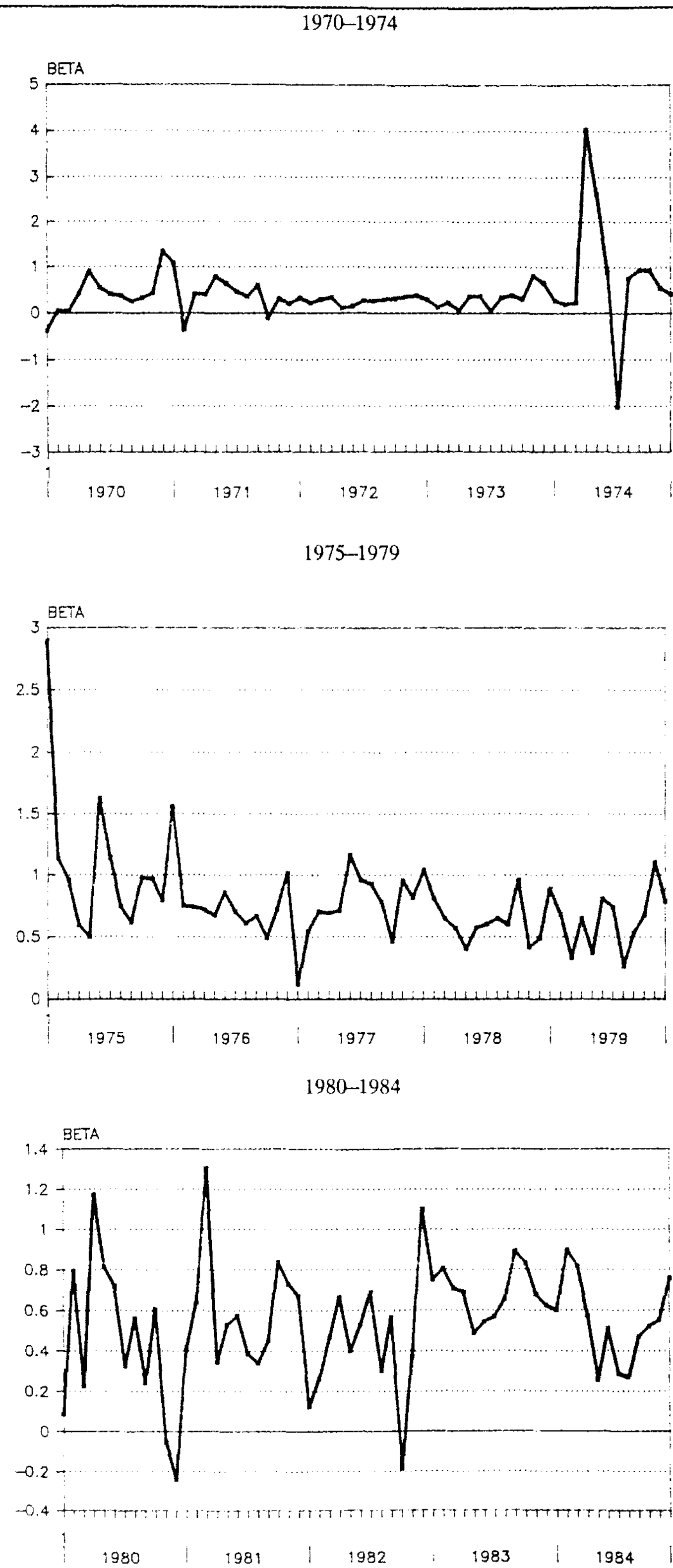


Exhibit 4. Parameter Estimates for Consolidated Edison Beta

Parameter	Overall Period 1970–1984	Before Dividend Omission 1970–1973	After Dividend Omission 1978–1981
Ordinary Least Squares Beta	0.61	0.39	0.62
Standard Error of OLS Beta	0.08	0.04	0.05
$K-F$ Underlying Mean Beta	0.58	0.34	0.47
$K-F$ Regression Rate to Mean	0.70	1.00	1.00
$K-F$ Standard Deviation of Beta	0.74	0.62	0.78
$K-F$ Residual Error in Market Model	0.05	0.03	0.04
$K-F$ Beta Stability Test	58.80*	20.30*	7.00*

*Significant at the 0.05 level.

Exhibit 4 also contains Kalman filtering and OLS estimates of beta for both a four-year period prior to the divided omission and a four-year period after the dividend omission. Forty-eight monthly observations is not sufficient to estimate reliably the underlying mean beta, since by nature this parameter reveals itself only over the long run. Likewise, the estimate of $1 - a_i$ may also be unreliable when estimated by only a few observations over a short time period. However, the subperiods do depict the variability that is characteristic of short-term estimates, whether those estimates are obtained by OLS or by Kalman filtering.

Although these short-term estimates should be approached with caution, some effects of the dividend omission on Con Ed's risk might be inferred. First, estimates for the long-term period or either of the short-term periods do not appear contaminated by the dividend omission but appear quite reasonable for a utility. Second, no indication of a decline in the beta estimate due to inclusion of the dividend omission period is evident. The indication is to the contrary. The estimate of the underlying mean beta for the overall period is higher than either the four- year period prior to the omission or the four years following the omission.

V. Implications for Beta Forecasting and Rate Setting

A partial resolution to the beta measurement problem is outlined by Peseau and Zepp [22], who show that the effect of the dividend omission was transitory and could be diagnosed from examination of OLS statistics. Although the dividend omission produces beta estimation problems for Consolidated Edison, subsequent estimates using data after the omission become much more reasonable.

The primary difference between the Brigham and Crum [5] forecast using an OLS beta and the Peseau and Zepp comment lies in the assumption of the time-series process followed by beta. The OLS estimate for five years of return data is only a good beta forecast if beta follows a constant coefficient process. This assumption is untenable for an estimation period containing a major information release.

When beta is time-varying, a short-term unadjusted OLS estimate may not be the best estimate of beta. Instead, the forecaster, taking advantage of auto-regressive properties of beta, should adjust that short-term estimate toward an underlying mean beta. When beta is unstable but reverts to an underlying mean, beta instability would not preclude application of the CAPM, but might preclude use of an OLS beta.

Reliance on a short-term beta forecast, whether from an OLS estimate or the transient beta estimate in the Kalman filtering model, is appropriate only if the firm's beta follows a random walk process. This research shows little evidence suggesting the typical utility beta follows a random walk and no evidence that, specifically, Con Ed's beta follows a random walk.

Due to the preponderance of auto-regressive or random coefficient betas, the results of this study strongly support the use of Bayesian-type adjustment processes such as the one employed by Merrill Lynch. The results also suggest that the behavior of utility betas may differ from the behavior of large diversified samples of stocks. For example, since Blume [2] finds an underlying mean beta of 1.0 for a large sample of stocks, many Bayesian models will adjust the OLS beta estimate toward 1.0. The results of this study, however, indicate that 1.0 is too high an underlying mean for most utilities. Instead, they should be adjusted toward a value that is less than one. For Consolidated Edison, an underlying mean of 0.7 would be more appropriate.

VI. Conclusions

Understanding beta behavior requires more information than whether or not betas are stable. Development of statistical procedures admitting a continuously time-varying beta now allows forecasters to understand how beta may behave over the short run and how that short-run behavior can differ from long-run behavior. Measuring continuously time-varying betas also frees the forecaster from the limitations imposed by assuming a constant coefficient beta. Instead, like most economic variables, beta can be modeled as a coefficient that is always changing. From the time series process followed by betas, the forecaster also gains an understanding of the difficult problem of forecasting beta. The beta for the majority of utility companies in this sample follows either an auto-regressive process or a constant coefficient process. Very few appear to follow a random walk process, which would produce betas that are not only unstable but very difficult to forecast. On the other hand, with an auto-regressive process, a patient forecaster using relatively simple diagnostic procedures should be able to obtain a reasonable long-run estimate of systematic risk. A reasonable forecast of beta then admits application of the CAPM for utilities even if beta is time varying.

The strong evidence of auto-regressive tendencies in utility betas lends support to the application of adjustment procedures such as the Bayesian adjustment procedure presented by Vasicek [25]. This procedure depends upon beta following an auto-regressive process. In addition, the Kalman filtering methodology also provides objective prior estimates of the underlying mean beta and the adjustment rate toward that underlying mean.

Typical adjustment models use a prior estimate of about 0.35 for the adjustment rate toward the underlying mean and a prior estimate of 1.0 as the underlying mean. The results of this study indicate that an underlying mean of 1.0 is too high for most utilities and an adjustment rate of 0.35 is too low.

Although considerable variability in adjustment rates and underlying mean betas can be observed in the sample, it may not be necessary for a forecaster to apply the Kalman filtering approach in order to obtain these estimates. A reasonable estimate of the underlying mean may be obtained by OLS if applied to a very long time period. The prior estimate of the adjustment rate toward the mean can be obtained by considering the positive relationship between the adjustment rate and beta variability. Estimates of the prior adjustments in the Bayesian adjustment models could be applied without relying blindly on large-sample estimates that may not be applicable to utilities.

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BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-31

Rolf Banz: *The Relationship Between Return and Market Value of Common Stocks*

October 3, 2019

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THE RELATIONSHIP BETWEEN RETURN AND MARKET VALUE OF COMMON STOCKS*

Rolf W. BANZ

Northwestern University, Evanston, IL 60201, USA

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This study examines the empirical relationship between the return and the total market value of NYSE common stocks. It is found that smaller firms have had higher risk adjusted returns, on average, than larger firms. This 'size effect' has been in existence for at least forty years and is evidence that the capital asset pricing model is misspecified. The size effect is not linear in the market value; the main effect occurs for very small firms while there is little difference in return between average sized and large firms. It is not known whether size *per se* is responsible for the effect or whether size is just a proxy for one or more true unknown factors correlated with size.

1. Introduction

The single-period capital asset pricing model (henceforth CAPM) postulates a simple linear relationship between the expected return and the market risk of a security. While the results of direct tests have been inconclusive, recent evidence suggests the existence of additional factors which are relevant for asset pricing. Litzenberger and Ramaswamy (1979) show a significant positive relationship between dividend yield and return of common stocks for the 1936-1977 period. Basu (1977) finds that price-earnings ratios and risk adjusted returns are related. He chooses to interpret his findings as evidence of market inefficiency but as Ball (1978) points out, market efficiency tests are often joint tests of the efficient market hypothesis and a particular equilibrium relationship. Thus, some of the anomalies that have been attributed to a lack of market efficiency might well be the result of a misspecification of the pricing model.

This study contributes another piece to the emerging puzzle. It examines the relationship between the total market value of the common stock of a firm and its return. The results show that, in the 1936-1975 period, the common stock of small firms had, on average, higher risk-adjusted returns

*This study is based on part of my dissertation and was completed while I was at the University of Chicago. I am grateful to my committee, Myron Scholes (chairman), John Gould, Roger Ibbotson, Jonathan Ingersoll, and especially Eugene Fama and and Merton Miller, for their advice and comments I wish to acknowledge the valuable comments of Bill Schwert on earlier drafts of this paper

than the common stock of large firms. This result will henceforth be referred to as the 'size effect'. Since the results of the study are not based on a particular theoretical equilibrium model, it is not possible to determine conclusively whether market value *per se* matters or whether it is only a proxy for unknown true additional factors correlated with market value. The last section of this paper will address this question in greater detail.

The various methods currently available for the type of empirical research presented in this study are discussed in section 2. Since there is a considerable amount of confusion about their relative merit, more than one technique is used. Section 3 discusses the data. The empirical results are presented in section 4. A discussion of the relationship between the size effect and other factors, as well as some speculative comments on possible explanations of the results, constitute section 5.

2. Methodologies

The empirical tests are based on a generalized asset pricing model which allows the expected return of a common stock to be a function of risk β and an additional factor ϕ, the market value of the equity.[1] A simple linear relationship of the form

$$E(R_i)=\gamma_0+\gamma_1\beta_i+\gamma_2[(\phi_i-\phi_m)/\phi_m], \qquad (1)$$

is assumed, where

$E(R_i)$ = expected return on security i,
γ_0 = expected return on a zero-beta portfolio,
γ_1 = expected market risk premium,
ϕ_i = market value of security i,
ϕ_m = average market value, and
γ_2 = constant measuring the contribution of ϕ_i to the expected return of a security.

If there is no relationship between ϕ_i and the expected return, i.e., $\gamma_2=0$, (1) reduces to the Black (1972) version of the CAPM.

Since expectations are not observable, the parameters in (1) must be estimated from historical data. Several methods are available for this purpose. They all involve the use of pooled cross-sectional and time series regressions to estimate γ_0, γ_1, and γ_2. They differ primarily in (a) the assumption concerning the residual variance of the stock returns (homoscedastic or heteroscedastic in the cross-sectional), and (b) the treatment of the

[1]In the empirical tests, Φ_i and Φ_m are defined as the market proportion of security i and average market proportion, respectively. The two specifications are, of course, equivalent.

errors-in-variables problem introduced by the use of estimated betas in (1). All methods use a constrained optimization procedure, described in Fama (1976, ch. 9), to generate minimum variance (m.v.) portfolios with mean returns γ_i, $i=0,\ldots,2$. This imposes certain constraints on the portfolio weights, since from (1)

$$E(R_p)\equiv\gamma_i=\gamma_0\sum_j w_j+\gamma_1\sum_j w_j\beta_j + \gamma_2\left[\left(\sum_j w_j\phi_j-\phi_m\sum_j w_j\right)\Big/\phi_m\right], \qquad i=0,\ldots,2, \tag{2}$$

where the w_j are the portfolio proportions of each asset j, $j=1,\ldots,N$. An examination of (2) shows that $\hat{\gamma}_0$ is the mean return of a standard m.v. portfolio ($\sum_j w_j=1$) with zero beta and $\phi_p\equiv\sum_j w_j\phi_j=\phi_m$ [to make the second and third terms of the right-hand side of (2) vanish]. Similarly, $\hat{\gamma}_1$ is the mean return on a zero-investment m.v. portfolio with beta of one and $\phi_p=0$, and $\hat{\gamma}_2$ is the mean return on a m.v. zero-investment, zero-beta portfolio with $\phi_p=\phi_m$. As shown by Fama (1976, ch. 9), this constrained optimization can be performed by running a cross-sectional regression of the form

$$R_{it}=\gamma_{0t}+\gamma_{1t}\beta_{it}+\gamma_{2t}[(\phi_{it}-\phi_{mt})/\phi_{mt}]+\varepsilon_{it}, \qquad i=1,\ldots,N, \tag{3}$$

on a period-by-period basis, using estimated betas $\hat{\beta}_{it}$ and allowing for either homoscedastic or heteroscedastic error terms. Invoking the usual stationarity arguments the final estimates of the gammas are calculated as the averages of the T estimates.

One basic approach involves grouping individual securities into portfolios on the basis of market value and security beta, reestimating the relevant parameters (beta, residual variance) of the portfolios in a subsequent period, and finally performing either an ordinary least squares (OLS) regression [Fama and MacBeth (1973)] which assumes homoscedastic errors, or a generalized least squares (GLS) regression [Black and Scholes (1974)] which allows for heteroscedastic errors, on the portfolios in each time period.[2] Grouping reduces the errors-in-variables problem, but is not very efficient because it does not make use of all information. The errors-in-variables problem should not be a factor as long as the portfolios contain a reasonable number of securities.[3]

Litzenberger and Ramaswamy (1979) have suggested an alternative method which avoids grouping. They allow for heteroscedastic errors in the cross-section and use the estimates of the standard errors of the security

[2]Black and Scholes (1974) do not take account of heteroscedasticity, even though their method was designed to do so.

[3]Black, Jensen and Scholes (1972, p. 116).

betas as estimates of the measurement errors. As Theil (1971, p. 610) has pointed out, this method leads to unbiased maximum likelihood estimators for the gammas as long as the error in the standard error of beta is small and the standard assumptions of the simple errors-in-variables model are met. Thus, it is very important that the diagonal model is the correct specification of the return-generating process, since the residual variance assumes a critical position in this procedure. The Litzenberger–Ramaswamy method is superior from a theoretical viewpoint; however, preliminary work has shown that it leads to serious problems when applied to the model of this study and is not pursued any further.[4]

Instead of estimating equation (3) with data for all securities, it is also possible to construct arbitrage portfolios containing stocks of very large and very small firms, by combining long positions in small firms with short positions in large firms. A simple time series regression is run to determine the difference in risk-adjusted returns between small and large firms. This approach, long familiar in the efficient markets and option pricing literature, has the advantage that no assumptions about the exact functional relationships between market value and expected return need to be made, and it will therefore be used in this study.

3. Data

The sample includes all common stocks quoted on the NYSE for at least five years between 1926 and 1975. Monthly price and return data and the number of shares outstanding at the end of each month are available in the monthly returns file of the Center for Research in Security Prices (CRSP) of the University of Chicago. Three different market indices are used; this is in response to Roll's (1977) critique of empirical tests of the CAPM. Two of the three are pure common stock indices — the CRSP equally- and value-weighted indices. The third is more comprehensive: a value-weighted combination of the CRSP value-weighted index and return data on corporate and government bonds from Ibbotson and Sinquefield (1977) (henceforth 'market index').[5] The weights of the components of this index are derived from information on the total market value of corporate and government bonds in various issues of the *Survey of Current Business* (updated annually) and from the market value of common stocks in the CRSP monthly index file. The stock indices, made up of riskier assets, have both higher returns

[4]If the diagonal model (or market model) is an incomplete specification of the return generating process, the estimate of the standard error of beta is likely to have an upward bias, since the residual variance estimate is too large The error in the residual variance estimate appears to be related to the second factor. Therefore, the resulting gamma estimates are biased.

[5]No pretense is made that this index is complete, thus, the use of quotation marks It ignores real estate, foreign assets, etc ; it should be considered a first step toward a comprehensive index. See Ibbotson and Fall (1979)

and higher risk than the bond indices and the 'market index'.[6] A time series of commercial paper returns is used as the risk-free rate.[7] While not actually constant through time, its variation is very small when compared to that of the other series, and it is not significantly correlated with any of the three indices used as market proxies.

4. Empirical results

4.1. Results for methods based on grouped data

The portfolio selection procedure used in this study is identical to the one described at length in Black and Scholes (1974). The securities are assigned to one of twenty-five portfolios containing similar numbers of securities, first to one of five on the basis of the market value of the stock, then the securities in each of those five are in turn assigned to one of five portfolios on the basis of their beta. Five years of data are used for the estimation of the security beta; the next five years' data are used for the reestimation of the portfolio betas. Stock price and number of shares outstanding at the end of the five year periods are used for the calculation of the market proportions. The portfolios are updated every year. The cross-sectional regression (3) is then performed in each month and the means of the resulting time series of the gammas could be (and have been in the past) interpreted as the final estimators. However, having used estimated parameters, it is not certain that the series have the theoretical properties, in particular, the hypothesized beta. Black and Scholes (1974, p. 17) suggest that the time series of the gammas be regressed once more on the excess return of the market index. This correction involves running the time series regression (for $\hat{\gamma}_2$)

$$\hat{\gamma}_{2t} - R_{Ft} = \hat{\alpha}_2 + \hat{\beta}_2(R_{mt} - R_{Ft}) + \hat{\varepsilon}_{2t}. \qquad (4)$$

It has been shows earlier that the theoretical β_2 is zero. (4) removes the effects of a non-zero $\hat{\beta}_2$ on the return estimate $\hat{\gamma}_2$ and $\hat{\alpha}_2$ is used as the final estimator for $\widehat{\gamma_2 - R_F}$. Similar corrections are performed for γ_0 and γ_1. The

[6]Mean monthly returns and standard deviations for the 1926–1975 period are.

	Mean return	Standard deviation
'Market index'	0 0046	0.0178
CRSP value-weighted index	0 0085	0 0588
CRSP equally-weighted index	0.0120	0.0830
Government bond index	0.0027	0.0157
Corporate bond index	0 0032	0 0142

[7]I am grateful to Myron Scholes for making this series available The mean monthly return for the 1926–1975 period is 0.0026 and the standard deviation is 0 0021.

derivations of the $\hat{\beta}_i$, $i=0,\ldots,2$, in (4) from their theoretical values also allow us to check whether the grouping procedure is an effective means to eliminate the errors-in-beta problem.

The results are essentially identical for both OLS and GLS and for all three indices. Thus, only one set of results, those for the 'market index' with GLS, is presented in table 1. For each of the gammas, three numbers are reported: the mean of that time series of returns which is relevant for the test of the hypothesis of interest (i.e., whether or not $\hat{\gamma}_0$ and $\hat{\gamma}_1$ are different from the risk-free rate and the risk premium, respectively), the associated t-statistic, and finally, the estimated beta of the time series of the gamma from (4). Note that the means are corrected for the deviation from the theoretical beta as discussed above.

The table shows a significantly negative estimate for γ_2 for the overall time period. Thus, shares of firms with large market values have had smaller returns, on average, than similar small firms. The CAPM appears to be misspecified. The table also shows that γ_0 is different from the risk-free rate. As both Fama (1976, ch. 9) and Roll (1977) have pointed out, if a test does not use the true market portfolio, the Sharpe–Lintner model might be wrongly rejected. The estimates for γ_0 are of the same magnitude as those reported by Fama and MacBeth (1973) and others. The choice of a market index and the econometric method does not affect the results. Thus, at least within the context of this study, the choice of a proxy for the market portfolio does not seem to affect the results and allowing for heteroscedastic disturbances does not lead to significantly more efficient estimators.

Before looking at the results in more detail, some comments on econometric problems are in order. The results in table 1 are based on the 'market index' which is likely to be superior to pure stock indices from a theoretical viewpoint since it includes more assets [Roll (1977)]. This superiority has its price. The actual betas of the time series of the gammas are reported in table 1 in the columns labeled $\hat{\beta}_i$. Recall that the theoretical values of β_0 and β_1 are zero and one, respectively. The standard zero-beta portfolio with return $\hat{\gamma}_0$ contains high beta stocks in short positions and low beta stocks in long positions, while the opposite is the case for the zero-investment portfolio with return $\hat{\gamma}_1$. The actual betas are all significantly different from the theoretical values. This suggests a regression effect, i.e., the past betas of high beta securities are overestimated and the betas of low beta securities are underestimated.[8] Past beta is not completely uncorrelated with the error of the current beta and the instrumental variable approach to the error-in-variables problem is not entirely successful.[9]

[8]There is no such effect for β_2 because that portfolio has both zero beta and zero investment, i.e., net holdings of both high and low beta securities are, on average, zero.

[9]This result is first documented in Brenner (1976) who examines the original Fama–McBeth (1973) time series of $\hat{\gamma}_{0t}$

Table 1

Portfolio estimators for γ_0, γ_1 and γ_2 based on the 'market index' with generalized least squares estimation [a]

$$R_{it} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t}\hat{\beta}_{it} + \hat{\gamma}_{2t}[(\phi_{it} - \phi_{mt})/\phi_{mt}]$$

Period	$\hat{\gamma}_0 - R_F$	$t(\hat{\gamma}_0 - R_F)$	$\hat{\beta}_0$	$\hat{\gamma}_1 - (R_M - R_F)$	$t(\hat{\gamma}_1 - (R_M - R_F))$	$\hat{\beta}_1$	$\hat{\gamma}_2$	$t(\hat{\gamma}_2)$	$\hat{\beta}_2$
1936–1975	0 00450	2.76	0 45	−0.00092	−1.00	0.75	−0.00052	−2.92	0.01
1936–1955	0.00377	1 66	0.43	−0.00060	−0 80	0.80	−0 00043	−2.12	0.01
1956–1975	0.00531	2.22	0.46	−0.00138	−0.82	0.73	−0.00062	−2.09	0.01
1936–1945	0.00121	0.30	0.63	−0.00098	−0 77	0.82	−0.00075	−2.32	−0.01
1946 1955	0 00650	2.89	0 03	−0.00021	−0 26	0 75	−0.00015	−0.65	0.06
1956–1965	0 00494	2 02	0 34	−0.00098	−0.56	0 96	−0.00039	−1.27	−0.01
1966–1975	0.00596	1 43	0.49	−0.00232	−0.80	0 69	−0.00080	−1.55	0.01

[a] $\hat{\gamma}_0 - R_F$ = mean difference between return on zero beta portfolio and risk-free rate, $\hat{\gamma}_1 - (R_M - R_F)$ = mean difference between actual risk premium ($\hat{\gamma}_1$) and risk premium stipulated by Sharpe–Lintner model $(R_M - R_F)$ $\hat{\gamma}_2$ = size premium. $\hat{\beta}_i$ = actual estimated market risk of $\hat{\gamma}_i$ (theoretical values. $\beta_0 = 0$, $\beta_1 = 1$, $\beta_2 = 0$), all β_0, β_1 are significantly different from the theoretical values. $t(\ )$ = t-statistic.

The deviations from the theoretical betas are largest for the 'market index', smaller for the CRSP value-weighted index, and smallest for the CRSP equally-weighted index. This is due to two factors: first, even if the true covariance structure is stationary, betas with respect to a value-weighted index change whenever the weights change, since the weighted average of the betas is constrained to be equal to one. Second, the betas and their standard errors with respect to the 'market index' are much larger than for the stock indices (a typical stock beta is between two and three), which leads to larger deviations -- a kind of 'leverage' effect. Thus, the results in table 1 show that the final correction for the deviation of $\hat{\beta}_0$ and $\hat{\beta}_1$ from their theoretical values is of crucial importance for maket proxies with changing weights.

Estimated portfolio betas and portfolio market proportions are (negatively) correlated. It is therefore possible that the errors in beta induce an error in the coefficient of the market proportion. According to Levi (1973), the probability limit of $\hat{\gamma}_1$ in the standard errors-in-the-variables model is

$$\text{plim } \hat{\gamma}_1 = \gamma_1/(1+(\sigma_u^2 \cdot \sigma_2^2)/D) < \gamma_1,$$

with

$$D = (\sigma_1^2 + \sigma_u^2) \cdot \sigma_2^2 - \sigma_{12}^2 > 0,$$

where σ_1^2, σ_2^2 are the variances of the true factors β and ϕ, respectively, σ_u^2 is the variance of the error in beta and σ_{12} is the covariance of β and ϕ. Thus, the bias in $\hat{\gamma}_1$ is unambiguously towards zero for positive γ_1. The probability limit of $\hat{\gamma}_2 - \gamma_2$ is [Levi (1973)]

$$\text{plim } (\hat{\gamma}_2 - \gamma_2) = (\sigma_u^2 \cdot \sigma_{12} \cdot \gamma_1)/D.$$

We find that the bias in $\hat{\gamma}_2$ depends on the covariance between β and ϕ and the sign of γ_1. If σ_{12} has the same sign as the covariance between $\hat{\beta}$ and ϕ, i.e., $\sigma_{12} < 0$, and if $\gamma_1 > 0$, then $\text{plim}(\hat{\gamma}_2 - \gamma_2) < 0$, i.e., $\text{plim}\,\hat{\gamma}_2 < \gamma_2$. If the grouping procedure is not successful in removing the error in beta, then it is likely that the reported $\hat{\gamma}_2$ overstates the true magnitude of the size effect. If this was a serious problem in this study, the results for the different market indices should reflect the problem. In particular, using the equally-weighted stock index should then lead to the smallest size effect since, as was pointed out earlier, the error in beta problem is apparently less serious for that kind of index. In fact, we find that there is little difference between the estimates.[10]

[10]For the overall time period, $\hat{\gamma}_2$ with the equally-weighted CRSP index is −0.00044, with the value weighted CRSP index −0.00044 as well as opposed to the −0.00052 for the 'market index' reported in table 1 The estimated betas of $\hat{\gamma}_0$ and $\hat{\gamma}_1$ which reflect the degree of the error in beta problems are 0 07 and 0 91, respectively, for the equally-weighted CRSP index and 0 13 and 0.87 for the value-weighted CRSP index.

Thus, it does not appear that the size effect is just a proxy for the unobservable true beta even though the market proportion and the beta of securities are negatively correlated.

The correlation coefficient between the mean market values of the twenty-five portfolios and their betas is significantly negative, which might have introduced a multicollinearity problem. One of its possible consequences is coefficients that are very sensitive to addition or deletion of data. This effect does not appear to occur in this case: the results do not change significantly when five portfolios are dropped from the sample. Revising the grouping procedure — ranking on the basis of beta first, then ranking on the basis of market proportion — also does not lead to substantially different results.

4.2. A closer look at the results

An additional factor relevant for asset pricing — the market value of the equity of a firm — has been found. The results are based on a linear model. Linearity was assumed only for convenience and there is no theoretical reason (since there is no model) why the relationship should be linear. If it is nonlinear, the particular form of the relationship might give us a starting point for the discussion of possible causes of the size effect in the next section. An analysis of the residuals of the twenty-five portfolios is the easiest way to look at the linearity question. For each month t, the estimated residual return

$$\hat{\varepsilon}_{it} = R_{it} - \hat{\gamma}_{0t} - \hat{\gamma}_{1t}\hat{\beta}_{it} - \hat{\gamma}_{2t}[(\phi_{it} - \phi_{mt})/\phi_{mt}], \qquad i = 1, \ldots, 25, \tag{5}$$

is calculated for all portfolios. The mean residuals over the forty-five year sample period are plotted as a function of the mean market proportion in fig. 1. Since the distribution of the market proportions is very skewed, a logarithmic scale is used. The solid line connects the mean residual returns of each size group. The numbers identify the individual portfolios within each group according to beta, '1' being the one with the largest beta, '5' being the one with the smallest beta.

The figure shows clearly that the linear model is misspecified.[11] The residuals are not randomly distributed around zero. The residuals of the portfolios containing the smallest firms are all positive; the remaining ones are close to zero. As a consequence, it is impossible to use $\hat{\gamma}_2$ as a simple size premium in the cross-section. The plot also shows, however, that the misspecification is not responsible for the significance of $\hat{\gamma}_2$ since the linear model underestimates the true size effect present for very small firms. To illustrate this point, the five portfolios containing the smaller firms are

[11]The nonlinearity cannot be eliminated by defining ϕ_i as the log of the market proportion

deleted from the sample and the parameters reestimated. The results, summarized in table 2, show that the $\hat{\gamma}_2$ remain essentially the same. The relationship is still not linear; the new $\hat{\gamma}_2$ still cannot be used as a size premium.

Fig. 1 suggests that the main effect occurs for very small firms. Further support for this conclusion can be obtained from a simple test. We can regress the returns of the twenty-five portfolios in each result on beta alone and examine the residuals. The regression is misspecified and the residuals contain information about the size effect. Fig. 2 shows the plot of those residuals in the same format as fig. 1. The smallest firms have, on average, very large unexplained mean returns. There is no significant difference between the residuals of the remaining portfolios.

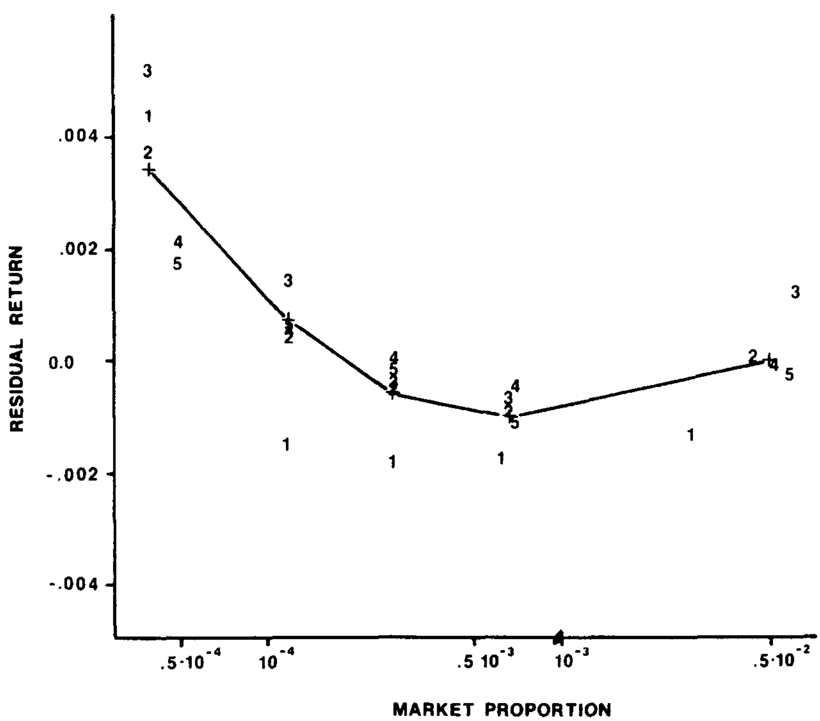

Fig. 1. Mean residual returns of portfolios (1936–1975) with equally-weighted CRSP index as market proxy. The residual is calculated with the three-factor model [eq. (3)]. The numbers 1,...,5 represent the mean residual return for the five portfolios within each size group (1: portfolio with largest beta,. .,5· portfolio with smallest beta) + represents the mean of the mean residuals of the five portfolios with similar market values.

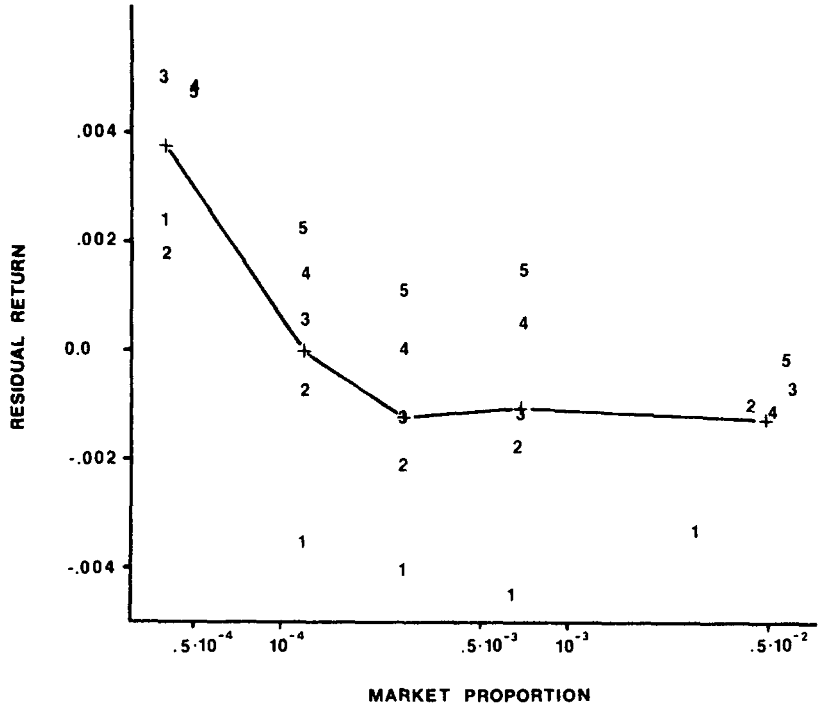

Fig. 2. Mean residual returns of portfolios (1936–1975) with equally-weighted CRSP index as market proxy. The residual is calculated with the two-factor model ($\hat{\varepsilon}_{it} = R_{it} - \hat{\gamma}_{0t} - \hat{\gamma}_{1t}\hat{\beta}_{it}$) The symbols are as defined for fig. 1.

4.3. 'Arbitrage' portfolio returns

One important empirical question still remains: How important is the size effect from a practical point of view? Fig. 2 suggests that the difference in returns between the smallest firms and the remaining ones is, on average, about 0.4 percent per month. A more dramatic result can be obtained when the securities are chosen solely on the basis of their market value.

As an illustration, consider putting equal dollar amounts into portfolios containing the smallest, largest and median-sized firms at the beginning of a year. These portfolios are to be equally weighted and contain, say, ten, twenty or fifty securities. They are to be held for five years and are rebalanced every month. They are levered or unlevered to have the same beta. We are then interested in the differences in their returns,

$$R_{1t} = R_{st} - R_{lt}, \qquad R_{2t} = R_{st} - R_{at}, \qquad R_{3t} = R_{at} - R_{lt}, \tag{6}$$

Table 2
Portfolio estimators for γ_2 for all 25 portfolios and for 20 portfolios (portfolios containing smallest firms deleted) based on CRSP equally weighted index with generalized least-squares estimation.[a]

	Size premium $\hat{\gamma}_2$ with	
Period	25 portfolios	20 portfolios
1936–1975	−0.00044 (−2.42)	−0 00043 (−2.54)
1936–1955	−0.00037 (−1 72)	−0.00041 (−1.88)
1956–1975	−0.00056 (−1.91)	−0.00050 (−1.91)
1936–1945	−0.00085 (−2.81)	−0.00083 (−2.48)
1946–1955	0.00003 (0.12)	−0.00003 (−0 13)
1956–1965	−0.00023) (−0.81)	−0.00017 (−0.65)
1966–1975	−0.00091 (−1.78)	−0.00085 (−1.84)

[a]t-statistic in parentheses

where R_{st}, R_{at} and R_{lt} are the returns on the portfolios containing the smallest, median-sized and largest firms at portfolio formation time (and $R_{1t} = R_{2t} + R_{3t}$). The procedure involves (a) the calculation of the three differences in raw returns in each month and (b) running time series regressions of the differences on the excess returns of the market proxy. The intercept terms of these regressions are then interpreted as the $\bar{R}_i$, $i = 1,\ldots,3$. Thus, the differences can be interpreted as 'arbitrage' returns, since, e.g., R_{1t} is the return obtained from holding the smallest firms long and the largest firms short, representing zero net investment in a zero-beta portfolio.[12] Simple equally weighted portfolios are used rather than more sophisticated minimum variance portfolios to demonstrate that the size effect is not due to some quirk in the covariance matrix.

Table 3 shows that the results of the earlier tests are fully confirmed. $\bar{R}_2$, the difference in returns between very small firms and median-size firms, is typically considerably larger than $\bar{R}_3$, the difference in returns between median-sized and very large firms. The average excess return from holding very small firms long and very large firms short is, on average, 1.52 percent

[12]No *ex post* sample bias is introduced, since monthly rebalancing includes stocks delisted during the five years. Thus, the portfolio size is generally accurate only for the first month of each period

Table 3
Mean monthly returns on 'arbitrage' portfolios.[a]
$R_j - R_k = \hat{\alpha}_i + \hat{\beta}_i(R_m - R_F)$

	$\bar{\alpha}_1$[b]			$\bar{\alpha}_2$[c]			$\bar{\alpha}_3$[d]		
	$n=10$	$n=20$	$n=50$	$n=10$	$n=20$	$n=50$	$n=10$	$n=20$	$n=50$
Overall period									
1931–1975	0.0152 (2.99)	0.0148 (3.53)	0.0101 (3.07)	0.0130 (2.90)	0.0124 (3.56)	0.0089 (3.64)	0.0021 (1.06)	0.0024 (1.41)	0.0012 (0.85)
Five-year subperiods									
1931–1935	0.0589 (2.25)	0.0597 (2.81)	0.0427 (2.35)	0.0462 (1.92)	0.0462 (2.55)	0.0326 (2.46)	0.0127 (1.09)	0.0134 (1.49)	0.0101 (1.42)
1936–1940	0.0201 (0.82)	0.0182 (0.97)	0.0089 (0.67)	0.0118 (0.55)	0.0145 (0.90)	0.0064 (0.65)	0.0084 (1.20)	0.0037 (0.62)	0.0025 (0.49)
1941–1945	0.0430 (2.29)	0.0408 (2.46)	0.0269 (2.17)	0.0381 (2.29)	0.0367 (2.54)	0.0228 (2.02)	0.0049 (1.25)	0.0038 (1.09)	0.0041 (1.68)
1946–1950	−0.0060 (−1.17)	−0.0046 (−0.97)	−0.0036 (−0.97)	−0.0058 (−1.03)	−0.0059 (−1.29)	−0.0029 (−0.83)	−0.0002 (−0.07)	−0.0104 (−0.50)	−0.0007 (−0.38)
1951–1955	−0.0067 (−0.89)	−0.0011 (−0.21)	0.0013 (0.32)	−0.0004 (−0.07)	0.0026 (0.72)	0.0010 (0.39)	−0.0062 (−1.29)	−0.0037 (−0.99)	0.0003 (0.11)
1956–1960	0.0039 (0.67)	0.0008 (0.15)	0.0037 (0.89)	0.0007 (0.14)	−0.0027 (−0.64)	0.0011 (0.45)	0.0031 (0.88)	0.0035 (1.16)	0.0026 (0.97)
1961–1965	0.0131 (1.38)	0.0060 (0.67)	0.0024 (0.31)	0.0096 (1.11)	0.0046 (0.72)	0.0036 (0.77)	0.0035 (0.59)	0.0014 (0.24)	−0.0012 (−0.24)
1966–1970	0.0121 (1.64)	0.0117 (2.26)	0.0077 (1.91)	0.0129 (1.93)	0.0110 (2.71)	0.0071 (2.43)	0.0008 (0.23)	0.0007 (0.22)	0.0006 (0.27)
1971–1975	0.0063 (0.60)	0.0108 (1.23)	0.0098 (1.45)	0.0033 (0.39)	0.0077 (1.18)	0.0083 (1.79)	0.0030 (0.64)	0.0031 (0.72)	0.0015 (0.43)

[a]Equally-weighted portfolios with n securities, adjusted for differences in market risk with respect to CRSP value-weighted index, t-statistics in parentheses.
[b]Small firms held long, large firms held short.
[c]Small firms held long, median-size firms held short.
[d]Median-size firms held long, large firms held short.

per month or 19.8 percent on an annualized basis. This strategy, which suggests very large 'profit opportunities', leaves the investor with a poorly diversified portfolio. A portfolio of small firms has typically much larger residual risk with respect to a value-weighted index than a portfolio of very large firms with the same number of securities [Banz (1978, ch. 3)]. Since the fifty largest firms make up more than 25 percent of the total market value of NYSE stocks, it is not surprising that a larger part of the variation of the return of a portfolio of those large firms can be explained by its relation with the value-weighted market index. Table 3 also shows that the strategy would not have been successful in every five year subperiod. Nevertheless, the magnitude of the size effect during the past forty-five years is such that it is of more than just academic interest.

5. Conclusions

The evidence presented in this study suggests that the CAPM is misspecified. On average, small NYSE firms have had significantly larger risk adjusted returns than large NYSE firms over a forty year period. This size effect is not linear in the market proportion (or the log of the market proportion) but is most pronounced for the smallest firms in the sample. The effect is also not very stable through time. An analysis of the ten year subperiods show substantial differences in the magnitude of the coefficient of the size factor (table 1).

There is no theoretical foundation for such an effect. We do not even know whether the factor is size itself or whether size is just a proxy for one or more true but unknown factors correlated with size. It is possible, however, to offer some conjectures and even discuss some factors for which size is suspected to proxy. Recent work by Reinganum (1980) has eliminated one obvious candidate: the price–earnings (*P*/*E*) ratio.[13] He finds that the *P*/*E*-effect, as reported by Basu (1977), disappears for both NYSE and AMEX stocks when he controls for size but that there is a significant size effect even when he controls for the *P*/*E*-ratio, i.e., the *P*/*E*-ratio effect is a proxy for the size effect and not vice versa. Stattman (1980), who found a significant negative relationship between the ratio of book value and market value of equity and its return, also reports that this relationship is just a proxy for the size effect. Naturally, a large number of possible factors remain to be tested.[14] But the Reinganum results point out a potential problem with some of the existing negative evidence of the efficient market hypothesis. Basu believed to have identified a market inefficiency but his *P*/*E*-effect is

[13]The average correlation coefficient between *P*/*E*-ratio and market value is only 0.16 for individual stocks for thirty-eight quarters ending in 1978. But for the portfolios formed on the basis of *P*/*E*-ratio, it rises to 0.82. Recall that Basu (1977) used ten portfolios in his study.

[14]E.g., debt–equity ratios, skewness of the return distribution [Kraus and Litzenberger (1976)].

just a proxy for the size effect. Given its longevity, it is not likely that it is due to a market inefficiency but it is rather evidence of a pricing model misspecification. To the extent that tests of market efficiency use data of firms of different sizes and are based on the CAPM, their results might be at least contaminated by the size effect.

One possible explanation involving the size of the firm directly is based on a model by Klein and Bawa (1977). They find that if insufficient information is available about a subset of securities, investors will not hold these securities because of estimation risk, i.e., uncertainty about the true parameters of the return distribution. If investors differ in the amount of information available, they will limit their diversification to different subsets of all securities in the market.[15] It is likely that the amount of information generated is related to the size of the firm. Therefore, many investors would not desire to hold the common stock of very small firms. I have shown elsewhere [Banz (1978, ch. 2)] that securities sought by only a subset of the investors have higher risk-adjusted returns than those considered by all investors. Thus, lack of information about small firms leads to limited diversification and therefore to higher returns for the 'undesirable' stocks of small firms.[16] While this informal model is consistent with the empirical results, it is, nevertheless, just conjecture.

To summarize, the size effect exists but it is not at all clear why it exists. Until we find an answer, it should be interpreted with caution. It might be tempting to use the size effect, e.g., as the basis for a theory of mergers — large firms are able to pay a premium for the stock of small firms since they will be able to discount the same cash flows at a smaller discount rate. Naturally, this might turn out to be complete nonsense if size were to be shown to be just a proxy.

The preceding discussion suggests that the results of this study leave many questions unanswered. Further research should consider the relationship between size and other factors such as the dividend yield effect, and the tests should be expanded to include OTC stocks as well.

[15]Klein and Bawa (1977, p 102)

[16]A similar result can be obtained with the introduction of fixed holding costs which lead to limited diversification as well. See Brennan (1975), Banz (1978, ch. 2) and Mayshar (1979)

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BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

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Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-32

Morningstar: *2015 Ibbotson Stocks, Bonds, Bills, and Inflation Classic Yearbook Cost of Equity Summary* (Excerpt)

October 3, 2019

Ibbotson® SBBI®
2015 Classic Yearbook

Market Results for Stocks, Bonds, Bills, and Inflation 1926–2014

SBBI

MORNINGSTAR®

Chapter 7

Company Size and Return

One of the most remarkable discoveries of modern finance is the finding of a relationship between company size and return.[1] Historically on average, small companies have higher returns than those of large ones. Earlier chapters of this book document this phenomenon for the smallest stocks on the New York Stock Exchange, or NYSE. The relationship between company size and return cuts across the entire size spectrum; it is not restricted to the smallest stocks. This chapter examines returns across the entire range of company size.

Construction of the Size Decile Portfolios

The portfolios used in this chapter are those created by the Center for Research in Security Prices, or CRSP, at the University of Chicago's Booth School of Business. CRSP has refined the methodology of creating size-based portfolios and has applied this methodology to the entire universe of NYSE/AMEX/NASDAQ-listed securities going back to 1926.

The NYSE universe excludes closed-end mutual funds, preferred stocks, real estate investment trusts, foreign stocks, American Depository Receipts, unit investment trusts, and Americus Trusts. All companies on the NYSE are ranked by the combined market capitalization of all their eligible equity securities. The companies are then split into 10 equally populated groups or deciles. Eligible companies traded on the NYSE, the NYSE MKT LLC (formerly known as the American Stock Exchange, or AMEX), and the NASDAQ Stock Market (formerly the NASDAQ National Market) are then assigned to the appropriate deciles according to their capitalization in relation to the NYSE breakpoints. The portfolios are rebalanced using closing prices for the last trading day of March, June, September, and December. Securities added during the quarter are assigned to the appropriate portfolio when two consecutive month-end prices are available. If the final NYSE price of a security that becomes delisted is a month-end price, then that month's return is included in the quarterly return of the portfolio. When a month-end NYSE price is missing, the month-end value is derived from merger terms, quotations on regional exchanges, and other sources. If a month-end value is not available, the last available daily price is used.

In October 2008, NYSE Euronext acquired the American Stock Exchange and rebranded the index as NYSE Amex. Later, in May 2012, it was renamed NYSE MKT LLC. For the sake of continuity, we refer to this index as AMEX, its historical name.

Base security returns are monthly holding period returns. All distributions are added to the month-end prices. Appropriate adjustments are made to prices to account for stock splits and dividends. The return on a portfolio for one month is calculated as the value weighted average of the returns for the individual stocks in the portfolio. Annual portfolio returns are calculated by compounding the monthly portfolio returns.

Aspects of the Company Size Effect

The company size phenomenon is remarkable in several ways. First, the greater risk of small-cap does not, in the context of the capital asset pricing model, fully account for their higher returns over the long term. In the CAPM only systematic, or beta risk, is rewarded; small-cap stock returns have exceeded those implied by their betas.

Second, the calendar annual return differences between small- and large-cap companies are serially correlated. This suggests that past annual returns may be of some value in predicting future annual returns. Such serial correlation, or autocorrelation, is practically unknown in the market for large-cap stocks and in most other equity markets but is evident in the size premium series.

Table 7-8: Size-Decile Portfolios of the NYSE/AMEX/NASDAQ Returns in Excess of Decile 1 (%)

Decile	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	[illegible]
2	0.86	0.52	-0.04	-0.17	0.09	-0.09	-0.11	0.18	0.02	-0.30	0.12	0.39	[illegible]
	68	60	42	34	45	44	38	47	46	42	51	49	
3	1.16	0.39	-0.04	-0.03	-0.12	-0.14	-0.13	0.36	-0.12	-0.33	0.45	0.34	[illegible]
	65	58	42	33	40	38	44	54	42	38	49	52	
4	1.38	0.60	0.06	-0.20	0.09	-0.07	-0.19	0.28	0.03	-0.77	0.31	0.55	[illegible]
	66	56	43	37	43	43	38	52	45	32	47	52	
5	2.11	0.62	-0.04	-0.15	-0.15	0.05	-0.14	0.28	0.02	-0.71	0.29	0.40	[illegible]
	66	55	43	38	39	43	44	51	46	37	51	50	
6	2.39	0.46	-0.05	-0.04	0.30	-0.05	-0.24	0.47	0.11	-1.11	0.18	0.33	[illegible]
	66	57	41	37	43	41	44	51	47	38	46	48	
7	2.99	0.61	-0.05	-0.09	0.16	-0.23	-0.17	0.21	0.23	-0.99	0.12	0.15	[illegible]
	67	56	47	37	38	37	39	44	49	32	47	44	
8	4.06	0.64	-0.05	-0.34	0.36	-0.32	-0.01	0.13	0.05	-0.98	0.12	-0.05	[illegible]
	66	51	46	34	37	41	41	41	47	37	41	41	
9	5.21	0.82	-0.24	-0.15	0.26	-0.30	-0.08	0.05	-0.05	-1.14	0.00	-0.64	[illegible]
	65	48	41	34	38	37	38	46	43	36	39	39	
10	8.53	0.84	-0.05	-0.03	0.57	-0.47	0.45	-0.19	0.53	-1.38	-0.59	-1.33	[illegible]
	81	45	46	36	38	38	41	34	44	32	33	35	

First row: Average excess return in percent Second row: Number of times excess return was positive (in 89 years)

Data from 1926–2014. Source: Morningstar and CRSP. Calculated (or Derived) based on data from CRSP US Stock Database and CRSP US Indices Database ©2015 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business. Used with permission.

Table 7-8 shows the returns of capitalization deciles 2-10 in excess of the return on decile 1; the excess returns are segregated into months. For each decile and for each month, the exhibit shows both the average excess return and the number of times the excess return was positive. These two statistics measure the seasonality of the excess return in different ways—the average excess return illustrates the size of the seasonality effect, while the number of positive excess returns shows its reliability.

Virtually all of the small-cap effect occurs in January, as the excess outcomes for small-company stocks are mostly negative in the other months of the year. Excess returns in January relate to size in a precisely rank-ordered fashion, and the January effect seems to pervade all size groups. Yet, simply demonstrating that the size premium is largely produced by the January effect does not refute the existence of such a premium.

Small-Cap Returns Are Unpredictable

Because investors cannot predict when small-cap returns will be higher than large-cap returns, it has been argued that they do not expect higher rates of return for small stocks. As was illustrated earlier in this chapter, even over periods of many years, investors in small stocks do not always earn returns that are higher than those of investors in large stocks. By simple definition, one cannot expect risky companies to always outperform less-risky companies; otherwise they would not be risky. Over the long-term, however, investors do expect small stocks to outperform large stocks.

The unpredictability of small-cap returns has given rise to another argument against the existence of a size premium: that markets have changed so that the size premium no longer exists. As evidence, one might observe the last 20 years of market data to see that the performance of large-cap stocks was basically equal to that of small-cap stocks. In fact, large-cap stocks have outperformed small-cap stocks in five of the last 10 years.

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Respondent.

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-33

Cost of Equity Summary

October 3, 2019

Cost of Equity Summary

	A	B	C
1			
2			
3	**Model**		**Cost of Equity**
4			
5	Discounted Cash Flow Model		7.3%
6			
7	Capital Asset Pricing Model		6.1%
8			
9	**Average**		**6.7%**
10			

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DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-34

Market Cost of Equity

October 3, 2019

Market Cost of Equity

	A	B	C	D
1				
2				
3	**Source**		**Estimate**	
4				
5	IESE Survey		8.0%	[1]
6				
7	Graham Harvey Survey		6.8%	[2]
8				
9	Damodaran		7.5%	[3]
10				
11	Garrett		8.4%	[4]
12				
13	**Average**		7.7%	
14				
15				
16				
17	[1] Average reported ERP + riskfree rate			
18	[2] Average reported ERP + risk-free rate			
19	[3] Recent highest reported ERP + risk-free rate			
20	[4] From Implied ERP exhibit			

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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-35

Optimal Capital Structure Estimate

October 3, 2019

Optimal Capital Structure

	A		E	G	Q	S	U	W
3					[14]	[15]	[16]	[17]
5	**Inputs**				**Ratings Table**			
6					Coverage	Bond		Interest
7	EBIT		261,113	[1]	Ratio	Rating	Spread	Rate
8	Interest Expense		100,936	[2]	8.5 - 10.00	Aaa/AAA	0.75%	3.17%
9	Book Debt		1,863,174	[3]	6.5 - 8.49	Aa2/AA	1.00%	3.42%
10	Book Equity		1,773,220	[4]	5.5 - 6.49	A1/A+	1.25%	3.67%
11	Debt / Capital		51.24%	[5]	4.25 - 5.49	A2/A	1.38%	3.80%
12	Debt / Equity		105%	[6]	3.0 - 4.24	A3/A-	1.56%	3.98%
13	Debt Cost		5.33%	[7]	2.5 - 2.99	Baa2/BBB	2.00%	4.42%
14	Corporate Tax Rate		21%	[8]	2.25 - 2.49	Ba1/BB+	3.00%	5.42%
15	Unlevered Beta		0.34	[9]	2.0 - 2.24	Ba2/BB	3.60%	6.02%
16	Risk-free Rate		2.42%	[10]	1.75 - 1.99	B1/B+	4.50%	6.92%
17	Equity Risk Premium		5.96%	[11]	1.5 - 1.74	B2/B	5.40%	7.82%
18	Coverage Ratio		2.59	[12]	1.25 - 1.49	B3/B-	6.60%	9.02%
19	Bond Rating		Baa2	[13]	0.8 - 1.24	Caa/CCC	9.00%	11.42%

Optimal Capital Structure Calculation

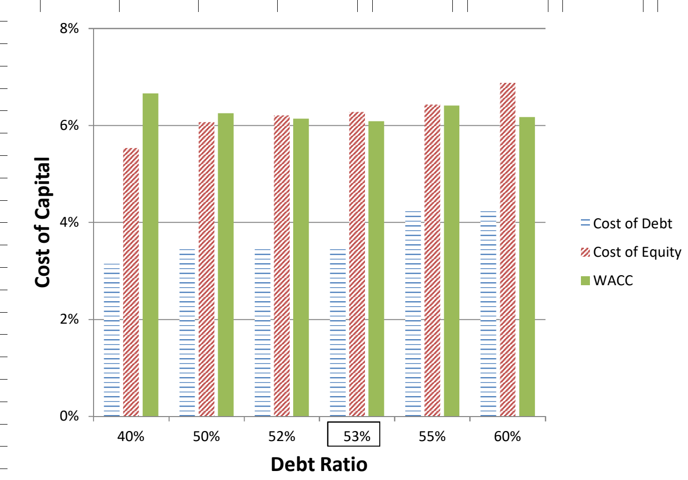
	A	C	E	G	I	K	M	O	Q	S	U	W
22	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]
26	Debt	D/E	Levered	Cost	Proposed	Debt	Interest	Coverage	Pre-tax	After-tax	Optimal	WACC at
27	Ratio	Ratio	Beta	of Equity	ROE	Level	Expense	Ratio	Debt Cost	Debt Cost	WACC	9.0% ROE
28	0%	0%	0.342	4.46%	9.00%	0	0	∞	3.17%	2.50%	4.46%	9.00%
29	20%	25%	0.410	4.86%	9.00%	727,279	38,764	6.74	3.42%	2.70%	4.43%	7.74%
30	30%	43%	0.458	5.15%	9.00%	1,090,918	58,146	4.49	3.80%	3.00%	4.50%	7.20%
31	40%	67%	0.522	5.53%	9.00%	1,454,558	77,528	3.37	3.98%	3.14%	4.58%	6.66%
32	50%	100%	0.612	6.07%	9.00%	1,818,197	96,910	2.69	4.42%	3.49%	4.78%	6.25%
33	52%	108%	0.635	6.20%	9.00%	1,890,925	100,786	2.59	4.42%	3.49%	4.79%	6.14%
34	53%	113%	0.647	6.27%	9.00%	1,927,289	102,724	2.54	4.42%	3.49%	4.80%	6.08%
35	55%	122%	0.673	6.42%	9.00%	2,000,017	106,601	2.45	5.42%	4.28%	5.25%	6.40%
36	60%	150%	0.748	6.87%	9.00%	2,181,836	116,292	2.25	5.42%	4.28%	5.32%	6.17%

40	[1], [2] Company 2018 Annual Report (000s)	[12] = [1] / [2]	[21] = [10] + [20] * [11]
41	[3], [4] Company 2018 Annual Report (000s)	[13] Company bond rating	[22] Recommended awarded ROE
42	[5] = [3] / ([3] + [4])	[14] Ranges of coverage ratios	[23] = [18] * ([3] + [4]); (000's)
43	[6] = [3] / [4]	[15] Moody's / S&P bond ratings	[24] = [22] * [7]; (000's)
44	[7] Company 2018 Annual Report	[16] NYU spread over risk-free rate	[25] = [1] / [23]
45	[8] Estimated corporate tax rate	[17] = [16] + [10] = est. debt cost	[26] Debt cost given coverage ratio per Ratings Table
46	[9] Average beta / (1+(1 - [8])*[6])	[18] = debt / total capital	[27] = [25] * (1 - [8])
47	[10] From DJG risk-free rate exhibit	[19] = [18] / (1 - [18])	[28] = ([18] * [26]) + ((1 - [18]) * [21])
48	[11] From DJG equity risk premium exhibit	[20] = [9] * (1 + (1 - [8]) * [6]	[29] = ([18] * [26]) + ((1 - [18]) * [22])

Optimal Capital Structure

Figure

Debt Ratio	Levered Beta	Cost of Equity	Proposed ROE	Coverage Ratio	After-tax Debt Cost	Optimal WACC	WACC at 9.0% ROE
0%	0.342	4.46%	9.00%	∞	2.50%	4.46%	9.00%
20%	0.410	4.86%	9.00%	6.74	2.70%	4.43%	7.74%
30%	0.458	5.15%	9.00%	4.49	3.00%	4.50%	7.20%
40%	0.522	5.53%	9.00%	3.37	3.14%	4.58%	6.66%
50%	0.612	6.07%	9.00%	2.69	3.49%	4.78%	6.25%
52%	0.635	6.20%	9.00%	2.59	3.49%	4.79%	6.14%
53%	0.647	6.27%	9.00%	2.54	3.49%	4.80%	6.08%
55%	0.673	6.42%	9.00%	2.45	4.28%	5.25%	6.40%
60%	0.748	6.87%	9.00%	2.25	4.28%	5.32%	6.17%



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ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-36

Competitive Industry Debt Ratios

October 3, 2019

Competitive Industry Debt Ratios

	A	B	C	D	E	F	G	H	I	J	K	L	M
3	**Industry**		**# Firms**		**Debt Ratio**				**Industry**		**# Firms**		**Debt Ratio**
4	Hospitals/Healthcare Facilities		34		88%				Hospitals/Healthcare Facilities		34		88%
5	Tobacco		17		88%				Tobacco		17		88%
6	Broadcasting		24		83%				Broadcasting		24		83%
7	Brokerage & Investment Banking		38		77%				Brokerage & Investment Banking		38		77%
8	Auto & Truck		14		76%				Auto & Truck		14		76%
9	Retail (Building Supply)		17		76%				Retail (Building Supply)		17		76%
10	Advertising		48		75%				Advertising		48		75%
11	Retail (Automotive)		24		74%				Retail (Automotive)		24		74%
12	Software (Internet)		44		74%				Software (Internet)		44		74%
13	Bank (Money Center)		10		67%				Bank (Money Center)		10		67%
14	Trucking		28		65%				Trucking		28		65%
15	Food Wholesalers		18		64%				Food Wholesalers		18		64%
16	Hotel/Gaming		70		63%				Hotel/Gaming		70		63%
17	Beverage (Soft)		37		63%				Beverage (Soft)		37		63%
18	Packaging & Container		27		62%				Packaging & Container		27		62%
19	R.E.I.T.		238		62%				R.E.I.T.		238		62%
20	Retail (Grocery and Food)		12		61%				Retail (Grocery and Food)		12		61%
21	Green & Renewable Energy		21		60%				**Green & Renewable Energy**		21		**60%**
22	Transportation		19		59%				Transportation		19		59%
23	Retail (Distributors)		88		59%				Retail (Distributors)		88		59%
24	Telecom. Services		67		58%				**Telecom. Services**		67		**58%**
25	Utility (General)		18		58%				Aerospace/Defense		85		58%
26	Aerospace/Defense		85		58%				Air Transport		18		58%
27	Air Transport		18		58%				Oil/Gas Distribution		20		58%
28	Oil/Gas Distribution		20		58%				Farming/Agriculture		33		57%
29	Farming/Agriculture		33		57%				Construction Supplies		48		56%
30	Construction Supplies		48		56%				**Utility (Water)**		19		**56%**
31	Utility (Water)		19		56%				**Power**		51		**56%**
32	Power		51		56%				**Cable TV**		14		**56%**
33	Cable TV		14		56%				Office Equipment & Services		24		56%
34	Office Equipment & Services		24		56%				**Telecom (Wireless)**		21		**55%**
35	Telecom (Wireless)		21		55%				Computers/Peripherals		57		55%
36	Computers/Peripherals		57		55%				Business & Consumer Services		168		55%
37	Business & Consumer Services		168		55%				Recreation		72		55%
38	Recreation		72		55%								
39	Real Estate (Operations & Services)		59		53%				**Total / Average**		**1,525**		**64%**
40	Drugs (Biotechnology)		481		53%								
41	Rubber& Tires		4		52%								
42	Environmental & Waste Services		91		52%								
43	Household Products		141		52%								
44	Chemical (Basic)		39		52%								
45	Information Services		71		52%								
46	Computer Services		119		51%								
47	Healthcare Support Services		111		50%								
48	Chemical (Specialty)		89		49%								
49	Software (System & Application)		355		48%								
50	Retail (General)		19		47%								
51	Transportation (Railroads)		10		47%								
52	Food Processing		83		47%								
53													
54	**Total / Average**		**3,215**		**60%**								
55													
56													
57													
58	http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/dbtfund.htm												

BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-37

Proxy Debt Ratios

October 3, 2019

Proxy Company Debt Ratios

	A	B	C	D	E
1					
2					
3	Company		Ticker		Debt Ratio
4					
5	Algonquin Pwr & Util		AQN		NR
6	Ameren Corp.		AEE		50%
7	Avangrid, Inc.		AGR		26%
8	Avista Corp.		AVA		51%
9	Black Hills Corp.		BKH		58%
10	CenterPoint Energy		CNP		52%
11	CMS Energy Corp.		CMS		69%
12	Dominion Energy		D		61%
13	DTE Energy Co.		DTE		54%
14	Edison International		EIX		54%
15	El Paso Electric Co.		EE		53%
16	Emera Inc.		EMA		NR
17	Entergy Corp.		ETR		63%
18	Exelon Corp.		EXC		53%
19	FirstEnergy Corp.		FE		72%
20	Hawaiian Elec.		HE		48%
21	IDACORP, Inc.		IDA		44%
22	NorthWestern Corp.		NWE		52%
23	OGE Energy Corp.		OGE		42%
24	Otter Tail Corp.		OTTR		45%
25	PNM Resources		PNM		61%
26	Sempra Energy		SRE		56%
27					
28	Average				53%
29					
30					
31					
32	Projected debt ratios from Value Line Investment Survey				
33	NR - not reported				