Control Number: 44809

Item Number: 130

Addendum StartPage: 0

RECEIVED
2016 MAY 18 PM 3:54
PUBLIC UTILITY COMMISSION
FILING CLERK

SOAH DOCKET NO. 473-16-1848.WS
PUC DOCKET NO. 44809

| | | |
|---|---|---|
| APPLICATION OF QUADVEST L.P. | § | BEFORE THE STATE OFFICE OF |
| FOR A RATE/TARIFF CHANGE | § | ADMINISTRATIVE HEARINGS |

# REBUTTAL TESTIMONY

OF

GREGORY E. SCHEIG,
CPA/ABV/CFF/CGMA, CFA

ON BEHALF OF

QUADVEST L.P.

MAY 18, 2016



130

**REBUTTAL TESTIMONY**

**OF GREGORY E. SCHEIG**

**Table of Contents**



**Exhibits**

**REBUTTAL TESTIMONY OF GREGORY E. SCHEIG**

**ON BEHALF OF**

**QUADVEST L.P.**

## I. PURPOSE AND SUMMARY OF TESTIMONY

**Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.**

A. My name is Gregory E. Scheig. I am a Principal in ValueScope, Inc., 950 E. State Highway 114, Suite 120, Southlake, TX 76092.

**Q. BY WHOM ARE YOU RETAINED IN THIS PROCEEDING?**

A. I have been retained by Quadvest, L.P. ("Quadvest" or the "Company").

**Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

A. The purpose of my testimony is to address the direct testimony of Ms. Emily Sears' recommended rate of return for Quadvest.

**Q. WHAT RETURN ON EQUITY DID MS. SEARS CONCLUDE?**

A. Ms. Sears concluded a return on equity of 8.90% for Quadvest.

**Q. DO YOU AGREE WITH HER CONCLUSION?**

A. No. As discussed later in my testimony, Ms. Sears' analyses have some mathematical errors and do not adequately account for the risk of an equity investment in a small private company such as Quadvest.

**Q. PLEASE OUTLINE AND DESCRIBE THE TESTIMONY YOU WILL PRESENT.**

A. My testimony is divided into ten sections, including this section.

- In Section II, I discuss the areas of general agreement between Ms. Sears' and my analyses.
- In Section III, I discuss her use of the constant growth discounted cash flow analysis and the errors within that analysis.

- In Section IV, I review her Capital Asset Pricing Model Analysis and specifically the beta coefficients utilized.
- In Section V, I address her criticism of the companies included in my comparable companies or "Barometer" group.
- In Section VI, I provide additional support for the consideration and reasonableness of my risk premium analyses included in my direct testimony.
- In Section VII, I address her criticisms of my small stock premium to account for the additional risks for a shareholder in a small, private company like Quadvest, as compared to that of an investment in a large publicly traded water utility.
- In Section XIII, I review recent rate case decisions as compared to Ms. Sears' recommended rate of return for Quadvest.
- In Section IX, I compare Ms. Sears' recommended ROE to returns being earned by water utilities.
- In Section X, I present my conclusions.

## II. GENERAL AREAS OF AGREEMENT

**Q. AFTER YOUR REVIEW OF MS. SEARS' TESTIMONY, WHAT ARE THE ASSUMPTIONS AND CONCLUSIONS THAT YOU BOTH AGREE ON?**

A. Both of our testimonies have the following things in common:

- We both developed Discounted Cash Flow models (DCF),
- We both considered the Capital Asset Pricing Model (CAPM),
- We both developed a comparable company, or "barometer" group of water utilities,
    - The water utility groups that we both selected for our groups were almost

identical, as shown in Rebuttal Schedule 1, and

- We calculated a similar cost of debt for Quadvest, 4.8% (rounded).

## III. SEARS CONSTANT GROWTH DCF

**Q. AFTER YOUR REVIEW OF MS. SEARS' TESTIMONY, DO YOU AGREE WITH HER CONCLUDED RETURN ON EQUITY FROM THE APPLICATION OF THE DCF MODEL?**

A. No. Ms. Sears incorrectly applies this model.

**Q. PLEASE EXPLAIN.**

A. Ms. Sears relied upon what is called a "constant growth DCF", which if applied correctly equals the present value of a stream of dividend grown at a growth rate "g" into perpetuity. As stated in Page 12 of her testimony, "My analysis employs the standard discrete DCF model as portrayed in the following formula: $k = D1/P0 + g$."

**Q. DOES MS. SEARS PROPERLY CALCULATE THE DIVIDEND YIELD INPUT D1 TO HER MODEL?**

A. No. In order to use the constant growth DCF model correctly, D1 needs to be the value of the current dividend multiplied by (1+g) to account for a <u>full year's growth rate</u>. In Ms. Sears' testimony, she states that the correct application of the growth rate is to only consider <u>one half</u> of the growth rate in calculating D1, which is not correct. In addition, it appears Ms. Sears did not apply <u>any growth rate whatsoever</u>, and she is therefore using D0 in her analysis as opposed to D1. This has the effect of understating her cost of equity.

**Q. HAVE YOU DEVELOPED ANY ANALYSES TO ILLUSTRATE THE POINTS MADE ABOVE?**

A. Yes. As shown in Rebuttal Schedule 2 of this report, I present two analyses of the constant growth DCF, each of them relying on Ms. Sears' analyses and assumptions. As a proof of concept, I also show a 250 year analysis as a proxy to perpetuity. When applied correctly, mathematically these two analyses must produce identical results.

**Q. PLEASE DESCRIBE YOUR ANALYSIS OF MS. SEARS' MODEL.**

A. For the first analysis shown in Rebuttal Schedule 2, I have relied on the inputs developed by Ms. Sears:

- An annual dividend yield, D0, of 2.64%, and
- An annual growth rate of 6.21%, and
- A corresponding growth rate divided by 2 of 3.105%.

As shown in the first column, Ms. Sears adds her concluded value for D0 with the growth rate g and concludes an ROE of 8.85%. It is important to note that Ms. Sears did not even include the ½ of the growth rate percentage (3.105%), as she stated was appropriate in footnote 2 on Page 12 of her analysis:

> *"The adjustment of 1/2 the growth rate is used when the timing of the dividend increase is not known for certain. It could occur next month, or in the twelfth month. On average, it is safe to assume that the increase will occur half way through the prospective year. Therefore, an adjustment by ½ the expected growth rate is appropriate."*

**Q. HAVE YOU PREPARED AN ANALYSIS THAT SHOWS THE RESULTS OF MS. SEARS' INPUTS, HAD THEY BEEN APPLIED CORRECTLY?**

A. Yes, in the second column of Rebuttal Schedule 2, I corrected Ms. Sears' D0 to account for a full year's growth rate in determining an appropriate D1.[1] This change to her constant growth DCF model results in an ROE of 9.01%. I then applied these same

[1] Corporate Financial Theory, William L. Meggison, p. 192 clearly shows that D1 = D0 * (1+g) when used in the DCF model (versus the incorrect mathematical assumption of using (1+g/2).

inputs to my 250-year analysis which results an earned rate of return for an investor of 9.01%, confirming the results of the constant growth DCF model.

**Q. WHAT DO YOU CONCLUDE FROM YOUR ANALYSIS?**

A. Based on my analysis of Ms. Sears' schedules ES-4 through ES-6, had she correctly applied these inputs, Ms. Sears would have concluded a 9.01% cost of equity, versus 8.85% for Quadvest.

## IV. SEARS CAPITAL ASSET PRICING MODEL (CAPM)

**Q. DO YOU AGREE WITH MS. SEARS' CONCLUSIONS FROM HER APPLICATION OF THE CAPM?**

A. No.

**Q. PLEASE EXPLAIN.**

A. In Schedule ES-10 of her analysis, Ms. Sears utilizes a beta of 0.71, "Be", which she derived in Schedule ES-7 of her analysis. This beta was based on the average of the Value Line betas for eight publicly traded water utilities. However she did not adjust these betas to reflect difference in leverage between her barometer group companies and Quadvest.

**Q. HOW IS CAPITAL STRUCTURE RISK (I.E., LEVERAGE) CONSIDERED IN THE CALCULATION OF AN APPROPRIATE BETA MEASUREMENT?**

A. In corporate finance, Hamada's equation, named after Robert Hamada, is used to separate the financial risk of a levered firm from its business risk. This equation relates the beta of a levered firm (a firm financed by both debt and equity) to that of its unlevered (i.e., a firm which has no debt) counterpart. Therefore, it is useful to compare betas between two firms with different financial leverage risk (amounts of debt as compared to equity).

**Q. HOW WOULD THIS IMPACT MS. SEARS' CAPM ANALYSIS?**

A. Quadvest has a significant amount of debt as compared to equity, as compared to Ms. Sears' barometer group of companies. By her reliance on an average beta from the group, she implicitly assumes that Quadvest has the same capital structure as the large public companies in her group. This is not the case and she makes no adjustment for this in her analysis.

**Q. DID YOU PROVIDE AN ANALYSIS THAT SHOWS THE EFFECT OF A BETA COEFFICIENT, REFLECTING QUADVEST'S ACTUAL CAPITAL STRUCTURE, WOULD IMPACT MS. SEARS' CAPM CONCLUSIONS?**

A. Yes. As shown in Rebuttal Schedule 3.B, Ms. Sear's calculated a range of 8.37% - 9.42% for Quadvest's' ROE using her average barometer group beta 0.71 (Schedules ES-10 and ES-11). Adjusting this beta for Quadvest's actual capital structure results in an appropriate beta of 0.91 as shown in Rebuttal Schedule 3A. Using this beta in Ms. Sears' CAPM analyses results in a range of 9.41 - 11.32%, with a midpoint of 10.36%. This conclusion is 1.47% higher than Ms. Sears' conclusion of 8.89%.

## V. BAROMETER GROUP CRITICISMS

**Q. IN MS. SEARS' TESTIMONY, DID SHE CRITICIZE THE GROUP OF WATER UTILITIES THAT YOU SELECTED AS COMPARABLE?**

A. Yes. Ms. Sears stated that two of the comparable companies I selected, Artesian Resources and Pure Cycle Corporation, were not comparable (see Rebuttal Schedule 1). As a test, I removed both of those companies from my group and the median results, relied upon in my conclusions, did not change (see Rebuttal Schedule 4). Therefore her criticism of those two companies had no impact on my concluded results.

## VI. APPROPRIATENESS OF RISK PREMIA ANALYSIS

**Q. IN MS. SEARS' TESTIMONY, DID SHE CRITICIZE YOUR CONSIDERATION OF GAS AND ELECTRIC UTILITIES' ALLOWED EQUITY RETURNS IN YOUR RISK PREMIA ANALYSES?**

A. Yes. In our DCF and CAPM analyses, Ms. Sears and I used very similar groups of water utilities. However, in my risk premia approach, she criticized my use of data from Regulatory Research Associates' data for gas and electric utilities. These two groups were considered since that publication did not cover allowed rates of return specifically for regulated water utilities.

**Q. DID MS. SEARS' CONSIDER A RISK PREMIUM APPROACH IN HER ANALYSES?**

A. No she did not. This method provides valuable insights into regulated/market rates of return for utilities and has a strong statistical relationship, as evidenced by its high coefficient of determination ("R-Squared" or "$R^2$") with interest rates.

**Q. PLEASE EXPLAIN R-SQUARED.**

A. This is a statistical measure that indicates "goodness of fit" of a series. When R-squared is close to zero, essentially no statistical relationship exists. As R-Squared approaches 1.0, a much stronger relationship exists. In my analyses, the R-Squared measures were 0.86 and 0.89, indicating that changes in utility interest rates explained 86% - 89% of the changes in utility returns on equity.

**Q. WHY DO YOU BELIEVE THESE TWO GROUPS OF UTILITIES CAN BE CONSIDERED AS COMPARABLE TO A GROUP OF WATER UTILITIES?**

A. Electric, natural gas and water utilities are all subject to rate regulation and are allowed to earn regulated returns. Also, all of these companies sell a commodity product.

**Q. DO YOU CONSIDER THE RISKS OF AN EQUITY INVESTMENT IN THESE THREE GROUPS OF UTILITIES TO BE SIMILAR?**

A. Yes. The beta input used in Ms. Sear's CAPM analysis reflects the risk of a specific company or group of companies as compared to that of an index of stocks. As shown in my Rebuttal Schedules 5-6, Sears' group of water utilities had a similar, but slightly higher beta than a group of electric and gas companies, indicating a comparable level of risk for an equity investment in these companies.

**Q. WHAT DOES THAT IMPLY?**

A. The two risk premium analyses in my direct testimony calculated the risk of regulated utility equity returns over and above the cost of utility debt. If the betas of a regulated group of water utilities are similar or higher than the other types of utilities, then those utilities could be considered to have comparable risks and would require a similar or higher rate of return. Therefore, I consider my risk premium analysis to be appropriate.

## VII. ADDITIONAL RISKS GIVEN QUADVEST'S SMALL SIZE / OWNERSHIP

**Q. DOES MS. SEARS AGREE WITH YOUR ADDITION OF A SMALL STOCK PREMIUM THAT REFLECTS THE ADDITIONAL RISK OF QUADVEST AS COMPARED TO A MUCH LARGER PUBLIC WATER UTILITY?**

A. No. She cites two articles, both published 23 years ago, which concluded that "utility **betas** would not necessarily be related to firm size" and "that firm size is a missing factor from the CAPM for industrial but not utility stocks."

**Q. DO YOU AGREE WITH THE CONCLUSION OF THESE TWO ARTICLES CITED BY MS. SEARS?**

A. No. In my CAPM analyses, I relied upon the betas of public companies and then added an additional risk premium for Quadvest's small size and private company status. Since I did not adjust the beta factor in my CAPM for size, the arguments regarding beta are irrelevant. Also, both of these articles examined <u>public</u> utility company returns and did not address the additional risk associated with an investment in a small private company.

**Q. DOES MS. SEARS CONSIDER THE DIFFERENCE BETWEEN SMALL <u>PRIVATE</u> COMPANIES AS COMPARED TO A MUCH LARGER <u>PUBLICLY TRADED</u> UTILITIES?**

A. No. As a small private company, Quadvest has limited access to capital markets. It also lacks the diversification of larger utilities. For instance, the recent downturn in oil prices and its effect on Houston's economy will impact Quadvest much more than other larger, more diversified utility companies.

Ms. Sears also ignores the fact that an investment in a private company's equity is a non-marketable interest. In other words, an investor cannot sell their shares or units on a public exchange. Therefore, investors discount the value of these shares, as compared to more liquid publicly traded shares. The discount on share prices equates to a higher expected rate of return on equity, all else equal. This term is called a discount for lack of marketability ("DLOM").

**Q. PLEASE DESCRIBE THE DISCOUNT FOR LACK OF MARKETABILITY?**

A. Discounts for lack of marketability are applied to the shares of private companies based on the premise that an asset or interest in an entity without a readily available market would sell for less to a hypothetical buyer than an identical asset or interest that was readily marketable. Several factors are widely recognized to affect marketability, such as distributions or dividends, investment performance, required or expected holding period to complete a sale, and management performance, among others.

There are several restricted stock studies that measure discounts for lack of marketability (see Rebuttal IX). These studies conclude mean and median discounts for a lack of marketability (which ranged from 9% to 45%).

**Q. COULD YOU PROVIDE AN EXAMPLE OF HOW A DISCOUNT FOR LACK OF MARKETABILITY WOULD REFLECT AN EQUITY INVESTOR'S RETURNS IN A SMALL PRIVATE COMPANY LIKE QUADVEST?**

A. As shown in Rebuttal Schedule 7, I present three different scenarios of an investment in a private company like Quadvest for a five-year period. For this illustrative example, an investor invests $100 and starts a utility business which earns 8.85%. This amount is paid out annually as a dividend which means that theoretically the value of his initial investment would not change.

In the first column, which ignores a DLOM, I show an investment of $100, annual dividends of 8.85% (Ms. Sears DCF ROE) and a sale at the end of year 5 for $100. This results in earned rate of return for the investor of 8.85% and serves as the starting point for the next two columns.

**Q. WHAT EFFECT DOES INCLUDING A DLOM HAVE ON THE INVESTOR'S RATE OF RETURN?**

A. As shown in the second column, if at the end of the 5th year the investor could only sell his stock for $80, given an assumed 20% discount for lack of marketability, then that investor would actually earn only 5.25% per year on his investment, a shortfall of 3.60% from the 8.85% ROE target, as suggested by Ms. Sears in her DCF analysis. In the third column, I show that the same investor would actually need to earn an annual rate of return of 12.2% over the five years in order to realize 8.85% on their investment after considering a 20% DLOM on the sale of their equity. This equates to an additional

3.35% rate of return per year to offset the cost of an investment in an illiquid private company like Quadvest.

## XIII. SEARS ROE COMPARED TO RECENT RATE CASE DECISIONS

**Q. HOW DOES MS. SEARS' CONCLUDED ROE FOR QUADVEST COMPARE TO RECENT RATE CASE DECISIONS IN OTHER PROCEEDINGS?**

A. As shown in my Rebuttal Schedule 8, Regulatory Research Associates reported that the average allowed rate of return for electric utilities in 2015 was 9.85% and for year-to-date 2016 it has been over 10.25%. The average allowed rate of return for gas utilities in 2015 was 9.60% and for year-to-date 2016 it has been 9.25%. Given my review of water utility betas as compared to other electric and gas utility betas, which indicate comparable levels of risk, Ms. Sears' conclusion of 8.90% is not supportable when compared to recent rate case decisions. Also, these cases all involved public utilities (or subsidiaries of utility holding companies) and did not confirm any small private companies like Quadvest.

## IX. SEARS ROE COMPARED TO EARNED RETURNS OF COMPARABLE COMPANIES

**Q. HOW DOES MS. SEARS' CONCLUDED ROE FOR QUADVEST COMPARE TO THE EARNED RETURNS OF THE COMPANIES IN HER BAROMETER GROUP?**

A. As shown in my Rebuttal Schedule 9, I analyzed the earned returns on common equity for the companies in Ms. Sears' barometer group. These returns were based on the companies' 2014 net income and average book values of common equity for 2013 and 2014. The public water utility median earned ROE was 10.75% and the average ROE was 11.26%. Both of these values are significantly greater than the 8.90% recommended by Ms. Sears in this matter for Quadvest. These findings further support my reasoning that an investor would require a higher return for an equity investment in Quadvest that Ms. Sears recommends.

There would be no reason to invest in a smaller, more leveraged, and riskier company like Quadvest if the investor could earn a higher rate through investing in a larger and safer public company.

## X. CONCLUSION

**Q. DO YOU BELIEVE AN INFORMED INVESTOR WOULD EVER MAKE AN INVESTMENT IN A SMALL PUBLIC COMPANY LIKE QUADVEST, KNOWING THAT THE MOST HE COULD EXPECT TO EARN WAS 8.90%?**

A. No I do not. As Ms. Sears noted in her testimony, two of the key factors to consider when assessing a fair rate of return are:

1) A utility is entitled to a return similar to that being earned by **other enterprises with corresponding risks and uncertainties**, and

2) A utility is entitled to a return sufficient to maintain and support its credit **and raise necessary capital** *(emphasis added)*.

Quadvest is a small business competing in the marketplace with other "enterprises" for capital. In order for Quadvest to raise capital from new investors, most likely a private equity group, they would have to offer equity at a price allowing that investor to earn a rate of return commensurate with the risks associated with an investment in Quadvest. A hypothetical investor would expect to earn a rate of return on equity higher than 8.90%, in my opinion at least 12.0%, in order to invest in Quadvest as opposed to the much larger, more diversified, more liquid, higher credit rating public utilities in Ms. Sears' analyses. Put differently, if an investor required only an 8.90% return on an equity investment in a water utility, they would certainly go to a publicly traded utility company or mutual fund/ETF over investing in a small, illiquid, private company such as Quadvest.

**Q. BASED ON YOUR REVIEW OF MS. SEAR'S TESTIMONY, SHOULD HER CONCLUSIONS BE REVISED?**

A. Yes. Correcting the errors in her DCF analysis resulted in a rate of return of 9.01%. Using an appropriately levered beta in her CAPM resulted in a range of 9.41 - 11.32%, with a midpoint of 10.36%. The midpoint of the DCF and CAPM methods is 9.69%, before consideration of any adjustment for Quadvest's size and private company considerations. Recent rate case decisions have all been at least 9.25%, per RRA. Also, in 2016, the public water utilities in Ms. Sears' barometer group earned an average ROE of 11.26%. Adding a 3.0% adjustment to her corrected amounts indicates an ROE of at least 12.69% would be appropriate, which supports that my concluded ROE for Quadvest of 12.0% is reasonable.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

A. Yes, it does.

EXHIBIT QVLP-GS-1

**Table 2-1:** Total Returns, Income Returns, and Capital Appreciation of the Basic Asset Classes: Summary Statistics of Annual Returns

| Series | Geometric Mean (%) | Arithmetic Mean (%) | Standard Deviation (%) | Serial Correlation |
|---|---|---|---|---|
| **Large Company Stocks** | | | | |
| Total Returns | 9.8 | 11.8 | 20.2 | 0.01 |
| Income | 4.1 | 4.1 | 1.6 | 0.91 |
| Capital Appreciation | 5.6 | 7.5 | 19.5 | 0.01 |
| **Ibbotson Small Company Stocks** | | | | |
| Total Returns | 11.9 | 16.5 | 32.3 | 0.06 |
| **Mid-Cap Stocks*** | | | | |
| Total Returns | 10.9 | 13.7 | 24.6 | -0.04 |
| Income | 3.9 | 3.9 | 1.8 | 0.90 |
| Capital Appreciation | 6.9 | 9.6 | 23.9 | -0.04 |
| **Low-Cap Stocks*** | | | | |
| Total Returns | 11.4 | 15.2 | 29.0 | 0.02 |
| Income | 3.5 | 3.6 | 2.0 | 0.90 |
| Capital Appreciation | 7.7 | 11.6 | 28.3 | 0.01 |
| **Micro-Cap Stocks*** | | | | |
| Total Returns | 12.0 | 18.0 | 38.7 | 0.07 |
| Income | 2.5 | 2.5 | 1.7 | 0.91 |
| Capital Appreciation | 9.5 | 15.4 | 38.1 | 0.06 |
| **Long-Term Corporate Bonds** | | | | |
| Total Returns | 6.1 | 6.4 | 8.3 | 0.09 |
| **Long-Term Government Bonds** | | | | |
| Total Returns | 5.7 | 6.1 | 9.7 | -0.12 |
| Income | 5.1 | 5.1 | 2.6 | 0.96 |
| Capital Appreciation | 0.4 | 0.8 | 8.7 | -0.22 |
| **Intermediate-Term Government Bonds** | | | | |
| Total Returns | 5.4 | 5.5 | 5.6 | 0.12 |
| Income | 4.5 | 4.6 | 2.9 | 0.96 |
| Capital Appreciation | 0.6 | 0.7 | 4.5 | -0.16 |
| **Treasury Bills** | | | | |
| Total Returns | 3.5 | 3.6 | 3.1 | 0.91 |
| **Inflation** | 3.0 | 3.1 | 4.1 | 0.64 |

Data from 1926–2012. Total return is equal to the sum of three component returns: income return, capital appreciation return, and reinvestment return.

*Source: Morningstar and CRSP. Calculated (or Derived) based on data from CRSP US Stock Database and CRSP US Indices Database ©2013 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business. Used with permission.

### Annual Total Returns

Annual and monthly total-returns for large company stocks, small company stocks, long-term corporate bonds, long-term government bonds, intermediate-term government bonds, Treasury bills, and inflation rates are for the full 87-year time period presented in Appendix B. Those tables can be used to compare the performance of each asset class on both a monthly and an annual basis.

### Real Rates versus Nominal Rates

The cost of capital embodies a number of different concepts or elements of risk. Two of the most basic concepts in finance are real and nominal returns. The nominal return includes both the real return and the impact of inflation.

The real rate of interest represents the exchange rate between current and future purchasing power. An increase in the real rate indicates that the cost of current consumption has risen in terms of future goods. It is the real rate of interest that measures the opportunity cost of foregoing consumption.

The relationship between real rates and nominal rates can be expressed in the following equation:

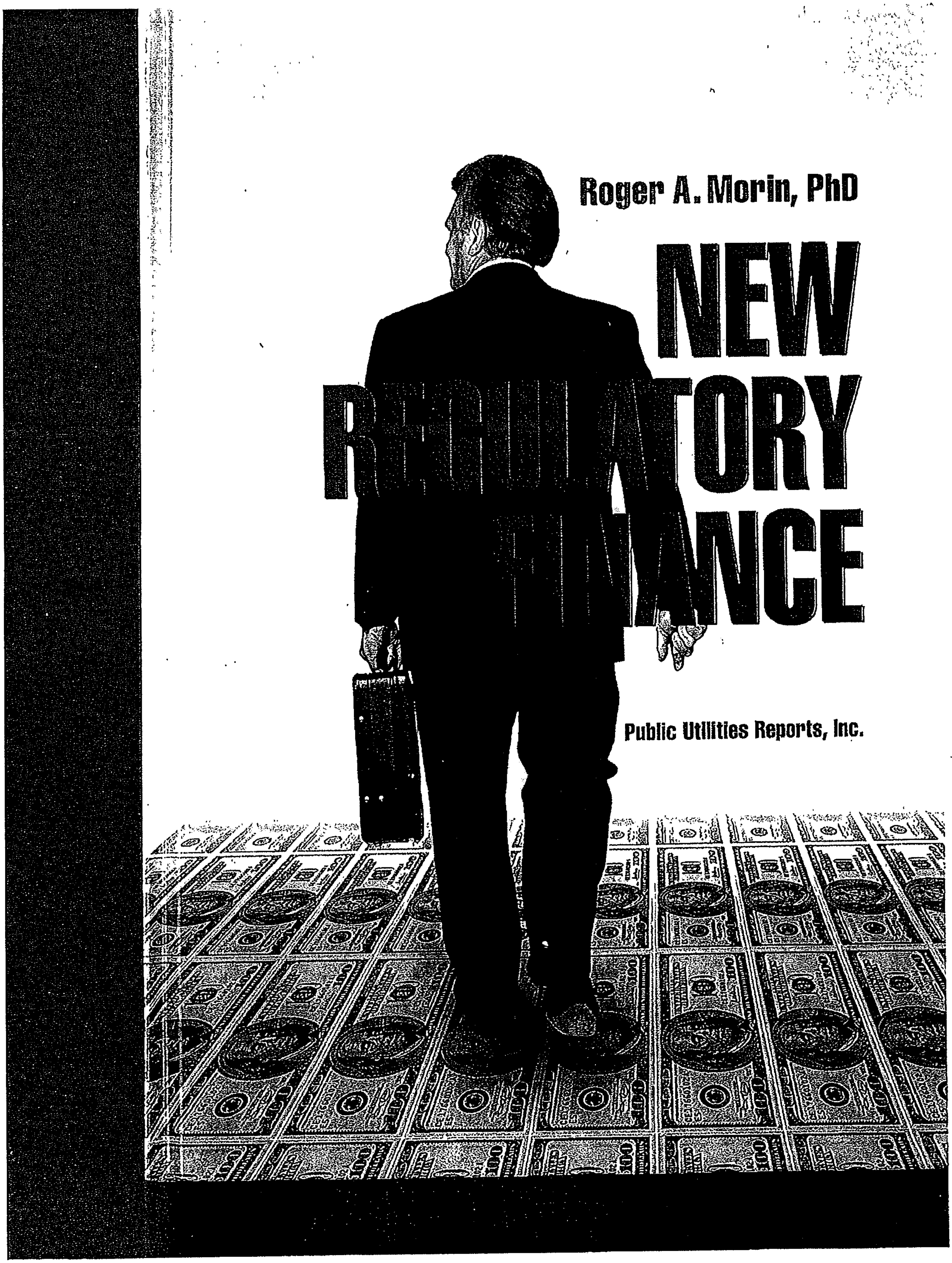
$$\text{Real} = \left[\frac{1+\text{Nominal}}{1+\text{Inflation}}\right] - 1$$

$$\text{Nominal} = \left[(1+\text{Real}) \times (1+\text{Inflation})\right] - 1$$

It is important to note that the conversion of nominal and real rates is not an additive process; rather, it is a geometric calculation. The arithmetic sum or difference is calculated by adding or subtracting one number from the other. As illustrated in the above equation, the real rate of return involves taking the geometric difference of the nominal rate of return and the rate of inflation. Conversely, the nominal rate of return can be determined by taking the geometric sum of the real rate of return and the rate of inflation. For example, if the real rate is 2.5 percent and the inflation rate is 5.0 percent, the nominal rate of interest is not 7.5 percent (2.5+5.0) but 7.625 percent, or $[(1.025) \times (1.05) - 1]$. Similarly, if the nominal rate is 7.625 percent and the inflation rate is 2.5 percent, the real rate is not 5.125 percent (7.625−2.5) but 5.0 percent, $[(1.07625/1.025) - 1]$.

Discount rates are most often expressed in nominal terms. That is, they usually have an inflation estimate included in them. Unless stated otherwise, the cost of capital data presented in this book are expressed in nominal terms.

EXHIBIT QVLP-GS-2


Roger A. Morin, PhD
NEW
REGULATORY
FINANCE
Public Utilities Reports, Inc.

# Chapter 6
# Alternative Asset Pricing Models

## 6.1 Empirical Validity of the CAPM

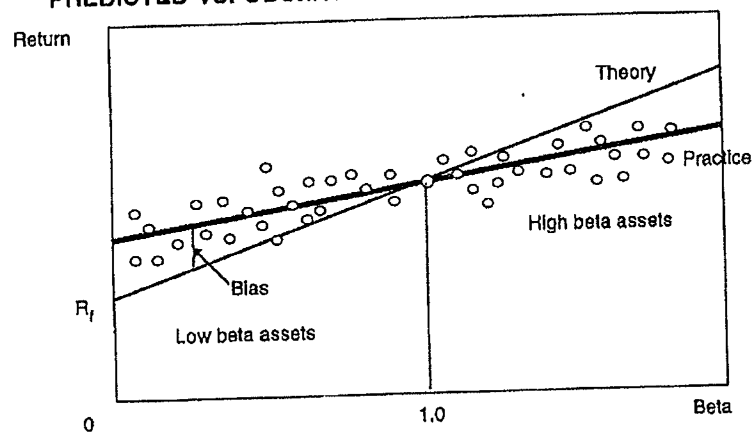
The last chapter showed that the practical difficulties of implementing the CAPM approach are surmountable. Conceptual and empirical problems remain, however.

At the conceptual level, the CAPM has been submitted to criticisms by academicians and practitioners. Contrary to the core assumption of the CAPM, investors may choose not to diversify, and bear company-specific risk if abnormal returns are expected. A substantial percentage of individual investors are indeed inadequately diversified. Short selling is somewhat restricted, in violation of CAPM assumptions. Factors other than market risk (beta) may also influence investor behavior, such as taxation, firm size, and restrictions on borrowing.

At the empirical level, there have been countless tests of the CAPM to determine to what extent security returns and betas are related in the manner predicted by the CAPM. The results of the tests support the idea that beta is related to security returns, that the risk-return tradeoff is positive, and that the relationship is linear. The contradictory finding is that the risk-return tradeoff is not as steeply sloped as predicted by the CAPM. With few exceptions, the empirical studies agree that the implied intercept term exceeds the risk-free rate and the slope term is less than predicted by the CAPM. That is, low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted. This is shown pictorially in Fignre 6-1. A CAPM-based estimate of cost of capital underestimates the return required from low-beta securities and overstates the return required from high-beta securities, based on the empirical evidence. Brealey, Myers, and Allen (2006), among many others,[1] provide recent empirical evidence very similar to the relationship depicted in Figure 6-1. This is one of the most

[1] For a summary of the empirical evidence on the CAPM, see Jensen (1972) and Ross (1978). The major empirical tests of the CAPM were published by Friend and Blume (1975), Black, Jensen, and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973), Blume and Husic (1973), Fama and Macbeth (1972), Basu (1977), Reinganum (1981B), Litzenberger and Ramaswamy (1979), Banz (1981), Gibbons (1982), Stambaugh (1982), Shanken (1985), Black (1993), and Brealey, Myers, and Allen (2006). Evidence in the Canadian context is available in Morin (1980, 1981).

FIGURE 6-1
PREDICTED VS. OBSERVED CAPM RETURN ESTIMATES




well-known results in finance. This result is particularly pertinent for public utilities whose betas are typically less than 1.00. Based on the evidence, as shown in Figure 6-1, a CAPM-based estimate of the cost of capital underestimates the return required from such securities.

The empirical evidence also demonstrates that the SML is highly unstable over short periods and differs significantly from the long-run relationship. This evidence underscores the potential for error in cost of capital estimates that apply the CAPM using historical data over short time periods. The evidence[2] also shows that the addition of specific company risk, as measured by standard deviation, adds explanatory power to the risk-return relationship.

In short, the currently available empirical evidence indicates that the simple version of the CAPM does not provide a perfectly accurate description of the process determining security returns. Explanations for this shortcoming include some or all of the following:

1. The CAPM excludes other important variables that are important in determining security returns, such as size, skewness, and taxes.
2. The market index used in the tests excludes important classes of securities, such as bonds, mortgages, and business investments. There is a further argument that the CAPM can never be really tested and that such a test is infeasible. This is because the market index proxy used

[2] See Friend, Westerfield, and Granito (1978) and Morin (1980).

in empirical tests of the CAPM is inadequate; since a true comprehensive market index is unavailable, such tests will be biased in the direction shown by the actual empirical results.[3] Moreover, the CAPM is a forward-looking expectational model and in order to test the model it is necessary to predict investor expectations correctly. Any empirical test of the CAPM is thus a test of the joint hypothesis of the model's validity and of the function used to generate expected returns from historical returns.

3. Constraints on investor borrowing exist contrary to the assumption of the CAPM.
4. Investors may value the hedging value of assets in protecting them against shifts in later investment opportunities. See Merton (1973) and Morin (1981).

Revised CAPM models have been proposed relaxing the above constraints, each model varying in complexity, each model attempting to inject more realism into the assumptions. Ross (1978), Tallman (1989), and more recently Guo (2004) present excellent surveys of the various asset pricing theories and related empirical evidence. These enhanced CAPMs produce broadly similar expressions for the relationship between risk and return and engender an SML that is flatter than the CAPM prediction, in line with the empirical evidence. Section 6.2 focuses on the more tractable extensions of the CAPM that possess some applicability to public utility regulation. Section 6.3 discusses the Empirical CAPM. Section 6.4 describes the Arbitrage Pricing Model, a viable alternative to the CAPM. Section 6.5 discusses the Fama-French Three-Factor Model of asset pricing. The Market-Derived Pricing Model is described in Section 6.6.

## 6.2 CAPM Extensions

Several attempts to enrich the CAPM's conceptual validity and to ameliorate its applicability have been advanced. One popular explanation of the CAPM's inability to explain security returns satisfactorily is that beta is insufficient and other systematic risk factors affect security returns. The implication is that the effects of these other independent variables should be quantified and used in estimating the cost of equity capital. The impact of the supplementary variables[4] can be expressed as an additive element to the standard CAPM equation as follows:

[3] See Roll (1977).

[4] The Arbitrage Pricing Model and the Fama-French three-factor asset pricing model, discussed in a later section, include factors other than the market that explain observed security returns.

Letting 'a' stand for these other effects, the CAPM equation becomes:

$$K = R_F + a + \beta(R_M - R_F) \quad (6\text{-}1)$$

To capture the variables' impact on the slope of the relationship, a coefficient 'b' is substituted for the market risk premium. The revised CAPM equation becomes:

$$K = R_F + a + b \times \beta \quad (6\text{-}2)$$

The constants 'a' and 'b' capture all the market-wide effects that influence security returns, and must be estimated by econometric techniques. Principal factors purported to affect security returns include dividend yield, skewness, and company size. Each factor is discussed individually below.

## Dividend Yield Effect

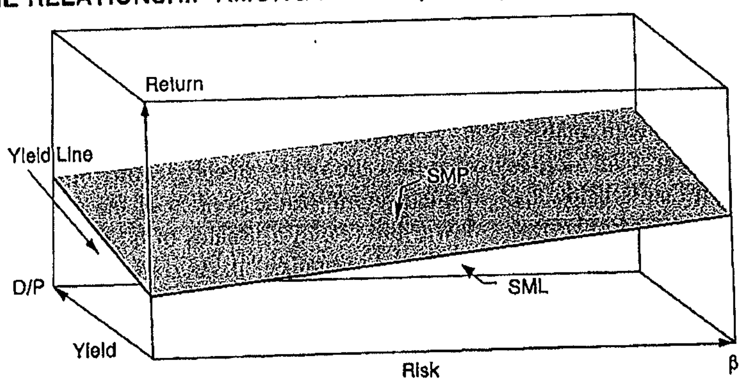
Empirical studies by Litzenberger and Ramaswamy (1979), Litzenberger, Ramaswamy, and Sosin (1980), and Rosenberg and Marathe (1975) find that security returns are positively related to dividend yield as well as to beta. These results are consistent with after-tax extensions of the CAPM developed by Brennan (1970) and Litzenberger and Ramaswamy (1979) and suggest that the relationship between return, beta, and dividend yield should be estimated and employed to calculate the cost of equity capital.

The dividend yield effects stem from the differential taxation on corporate dividends and capital gains. The standard CAPM does not consider the regularity of dividends received by investors. Utilities generally maintain high dividend payout ratios relative to the market, and by ignoring dividend yield, the CAPM provides biased cost of capital estimates. To the extent that dividend income is taxed at a higher rate than capital gains, investors will require higher pre-tax returns in order to equalize the after-tax returns provided by high-yielding stocks with those of low-yielding stocks. In other words, high-yielding stocks must offer investors higher pre-tax returns.[5] Even if dividends and capital gains are undifferentiated for tax purposes, there still is a tax bias in favor of earnings retention (lower dividend payout), as capital gains taxes are paid only when such gains are realized.

In order to recognize the dividend yield effect on security returns, the traditional two-dimensional SML can be expanded into a three-dimensional security market plane (SMP) by adding a dividend yield line as in Figure 6-2, which portrays the relationship among return, beta, and dividend yield. The positive

[5] The strength of the tax effect on yield is diluted by non-taxable institutional ownership and by the tax reduction on dividend income enacted in 2003.

FIGURE 6-2
THE RELATIONSHIP AMONG RETURN, BETA, AND DIVIDEND YIELD

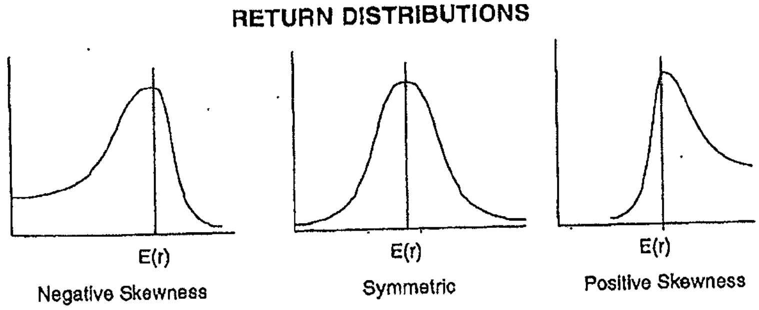



effect of yield on return can be seen on the graph. In a given risk class, the required return increases with the dividend yield. Some institutional portfolio managers have in fact implemented the SMP approach for actual investment management decision making, in effect recommending for purchase undervalued securities situated above the SMP.

## Skewness Effects

Skewness is a measure of symmetry, or more precisely, the lack of symmetry in a probability distribution of returns. Figure 6-3 shows three frequency distributions of returns, one symmetrical, one skewed left, and one skewed right. If the probability distribution is symmetrical, specialized measures of downside risk are unnecessary, since a normal symmetrical distribution has no skewness; the areas on either side of the mean expected return are mirror

FIGURE 6-3
RETURN DISTRIBUTIONS



images of one another. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. In positive skewness, there is more upside potential than downside potential ("long shot"). In negative skewness, there is more downside potential than upside potential.

Investors eschew negative skewness since they are more concerned with losing money than with total variability of return. If risk is defined as the probability of loss, it appears more logical to measure risk as the probability of achieving a return that is below the expected return. In the context of the CAPM, the traditional CAPM provides downward-biased estimates of cost of capital to the extent that these skewness effects are significant. As shown by Kraus and Litzenberger (1976), expected returns depend on both a stock's systematic risk (beta) and its systematic skewness:

EXPECTED RETURN = RISK-FREE RATE + MARKET RISK
+ SKEWNESS RISK

Denoting the risk-free rate by $R_F$, the return on the market as a whole by $R_M$, the stock's systematic market risk by beta (β), the stock's systematic skewness by gamma (γ), and the market price of skewness reduction by $S_M$, the amended CAPM is stated as follows:

$$K_e = R_F + \beta(R_M - R_F) + \gamma(S_M - R_F) \qquad (6\text{-}3)$$

Systematic skewness, γ, is measured as the ratio of the co-skewness of the stock with the market to the skewness of the market.

Empirical studies by Kraus and Litzenberger (1976), Friend, Westerfield, and Granito (1978), and Morin (1980) find that, in addition to beta, skewness of returns has a significant negative relationship with security returns. This result is consistent with the skewness version of the CAPM developed by Rubinstein (1973) and Kraus and Litzenberger (1976).

Skewness is particularly relevant for public utilities whose future profitability is constrained by the regulatory process on the upside and relatively unconstrained on the downside in the face of socio-political realities of public utility regulation. The distribution of security returns for regulated utilities is more likely to resemble the negatively skewed distribution displayed in the left-hand portion of Figure 6-3. The process of regulation, by restricting the upward potential for returns and responding sluggishly on the downward side, may impart some negative asymmetry to the distribution of returns, and is more likely to result in utilities earning less, rather than more, than their cost of capital. The traditional CAPM provides downward-biased estimates of the cost of capital to the extent that these skewness effects are significant. A security market plane (SMP) similar to that envisaged in the case of dividend yield effects in Figure 6-2 can be imagined, substituting a skewness line for the dividend yield line.

California water utilities in the late 1990s and continuing in the 2000s provide a good example of skewness effects. Because of the asymmetry in the future water supply, there is a greater probability of downside returns to investors under adverse supply conditions, but essentially no probability of correspondingly large positive returns. That is, these water utilities' future profitability is constrained by both the regulatory process and by a negatively skewed water supply. Hence, measures of variability and covariability, such as standard deviation and beta, are likely to provide downward-biased estimates of the true risk relative to that of unregulated firms and other utilities.

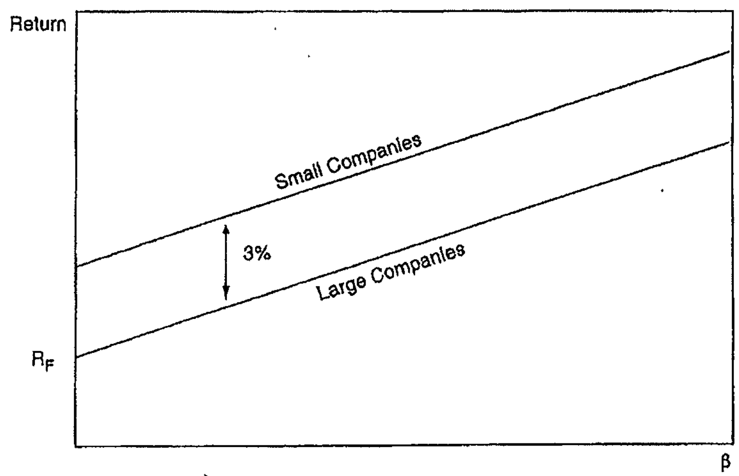
Another example is provided by some regulatory incentive plans where the risks of potential losses are borne exclusively by shareholders due to an absence of any return floor and the presence of a limit on the allowable recovery of cost increases. The benefits of added efficiencies and productivity gains achieved by the company over and above the allowed return are absorbed totally by ratepayers. Such lack of symmetry ("heads I win, tails you lose") clearly increases risk and results in a deterioration of the regulatory climate and higher capital costs.

In both of these examples, the implication is that an additional risk premium must be added to the business-as-usual return on equity to compensate for the added risks. The lack of symmetry in investor returns must be considered. A risk premium sufficient to compensate investors for the limited upside returns/unlimited downside returns versus comparable risk companies and other utilities is required. To wit, in California's New Regulatory Framework designed to regulate large telecommunications companies, a 50 basis point increment was added to the benchmark rate of return on equity in order to compensate for the lack of symmetry in the plan.

## Size Effect

Investment risk increases as company size diminishes, all else remaining constant. Small companies have very different returns than large ones, and on average they have been higher. The greater risk of small stocks does not fully account for their higher returns over many historical periods. The size phenomenon is well-documented in the finance literature. Empirical studies by Banz (1981) and Reinganum (1981A) have found that investors in small-capitalization stocks require higher returns than predicted by the standard CAPM. Reinganum (1981A) examined the relationship between the size of the firm and its P/E ratio, and found that small firms experienced average returns greater than those of large firms that were of equivalent systematic risk (beta). He found that small firms produce greater returns than could be explained by their risks. These results were confirmed in a separate test by

FIGURE 6-4
CAPM AND COMPANY SIZE




Banz (1981) who examined stock returns over the much longer 1936–1975 period, finding that stocks of small firms earned higher risk-adjusted abnormal returns than those of large firms. Fama and French (1992, 1993, 1997) find that company size and the reciprocal of the M/B ratio are significantly related to stock returns (cost of equity). The Fama-French asset pricing model is discussed later in this chapter.

The relationship between firm size and return cuts across the entire size spectrum but is most evident among smaller companies that have higher returns than larger ones on average. Ibbotson Associates' well-known historical return series publication covering the period 1926 to the present reinforces this evidence (Ibbotson Associates' *2005 Yearbook, Valuation Edition*). To illustrate, the Ibbotson data suggests that under SIC Code 49, *Electric, Gas & Sanitary Services*, the average return for that group over an almost 80-year period was 14.03% for the small-cap company group and 10.86% for the large-cap group, more than a 300 basis point difference. This is true for all industry groups. Overall, for the period 1926–2004, Ibbotson finds that the smaller companies have experienced returns that are not fully explainable by their higher betas, and that the excess return of that predicted by the CAPM increases as size decreases, suggesting that the cost of equity for small stocks is considerably larger than for large capitalization stocks. Ibbotson Associates provides estimates of the size premium required to be added to the basic CAPM cost of equity, shown in the following table. Figure 6-4 portrays the situation graphically.

| IBBOTSON ESTIMATES OF SIZE PREMIUMS | | |
|---|---|---|
| Size | Smallest Market Cap ($000s) | Premium |
| Large-cap | 4,794,027 | 0 |
| Mid-cap | 1,167,040 | 0.91% |
| Low-cap | 330,797 | 1.70% |
| Micro-cap | 0.332 | 4.01% |

Grabowski and King (1999, 2000) examine the historical returns of publicly listed common stocks over the 1963–1998 period, segregated into 25 equal-size portfolios based on various measures of company size, including market value of equity, assets, sales, and number of employees. The results are shown on Table 6-1, based on ranking companies by market value of equity. As was the case from the Ibbotson findings, it is clear from those results that beta is inversely related to company size. The betas range from 0.91 for large-cap companies to 1.39 for small-cap companies. Returns vary inversely to size as well, ranging from 14.2% for large-cap stocks to 22.9% for small-cap stocks over that period. Grabowski and King also find a systematic relationship between the achieved equity premium and size, as shown on Figure 6-5. The data of Table 6-1, taken from Grabowski and King, strongly suggest that the higher returns realized by small-cap stocks exceed those predicted by the CAPM. For example, take portfolio #10 with a beta of 1.19. Given the risk-free rate of 7.6% and market risk premium of 6.2% prevailing over the 1963–1997 study period, the CAPM estimate of the cost of equity is 14.94%, in contrast to the actual average return of 15.17% for portfolio #10:

$$\begin{aligned} K &= R_F + \beta\,(MRP) \\ &= 7.6\% + 1.19\,(6.2\%) \\ &= 14.98\% \end{aligned}$$

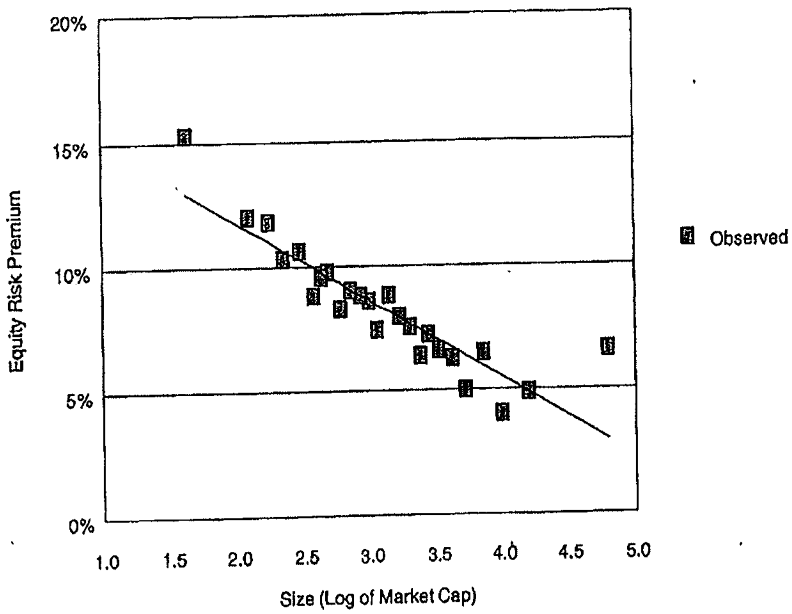
The implication of the Grabowski and King study is that investors in small-cap stocks should add 0.23% (i.e., 15.17% − 14.94% = 0.23%) to the CAPM-derived cost of equity when estimating the required return of a company with a market capitalization similar to that of portfolio #10, about $2,000 million.[6]

[6] Updates are published annually in the Standard & Poor's Corporate Value Consulting Risk Premium Report by Roger J. Grabowski and David W. King at www.Ibbotson.com.

**TABLE 6-1**
**THE RELATIONSHIP BETWEEN COMPANY SIZE, RETURN, AND RISK**

| Portfolio rank by size | Average mkt value ($M) | Log of average mkt value | Beta annual since 1963 | Standard deviation of returns | Geometric average return | Arithmetic average return | Equity risk premium | Smoothed equity risk premium |
|---|---|---|---|---|---|---|---|---|
| 1 | $64,877 | 4.81 | 0.91 | 15.86% | 12.99% | 14.17% | 6.61% | 3.04% |
| 2 | $16,054 | 4.21 | 0.94 | 15.98% | 11.32% | 12.48% | 4.92% | 4.94% |
| 3 | $10,011 | 4.00 | 0.89 | 15.16% | 10.58% | 11.64% | 4.08% | 5.58% |
| 4 | $7,417 | 3.87 | 0.98 | 16.80% | 12.82% | 14.07% | 6.51% | 5.98% |
| 5 | $5,357 | 3.73 | 0.99 | 17.37% | 11.18% | 12.54% | 4.98% | 6.43% |
| 6 | $4,342 | 3.64 | 0.99 | 17.39% | 12.55% | 13.89% | 6.33% | 6.71% |
| 7 | $3,440 | 3.54 | 0.94 | 16.39% | 12.99% | 14.22% | 6.66% | 7.03% |
| 8 | $2,816 | 3.45 | 1.00 | 18.04% | 13.44% | 14.85% | 7.29% | 7.30% |
| 9 | $2,485 | 3.40 | 1.03 | 19.01% | 12.99% | 13.95% | 6.39% | 7.47% |
| 10 | $2,072 | 3.32 | 1.19 | 20.68% | 13.31% | 15.17% | 7.61% | 7.71% |
| 11 | $1,733 | 3.24 | 1.11 | 20.05% | 13.78% | 15.52% | 7.96% | 7.96% |
| 12 | $1,431 | 3.16 | 1.05 | 18.76% | 14.84% | 16.35% | 8.79% | 8.21% |
| 13 | $1,190 | 3.08 | 1.15 | 21.66% | 12.89% | 14.99% | 7.43% | 8.46% |
| 14 | $1,015 | 3.01 | 1.05 | 19.95% | 14.49% | 16.20% | 8.64% | 8.68% |
| 15 | $875 | 2.94 | 1.14 | 20.74% | 14.40% | 16.38% | 8.82% | 8.88% |
| 16 | $753 | 2.88 | 1.19 | 22.11% | 14.48% | 16.66% | 9.10% | 9.09% |
| 17 | $616 | 2.79 | 1.22 | 23.10% | 13.54% | 15.85% | 8.29% | 9.36% |
| 18 | $510 | 2.71 | 1.17 | 23.83% | 14.97% | 17.35% | 9.79% | 9.61% |
| 19 | $448 | 2.65 | 1.28 | 24.71% | 14.46% | 17.17% | 9.61% | 9.79% |
| 20 | $386 | 2.59 | 1.23 | 24.94% | 13.69% | 16.40% | 8.84% | 9.99% |
| 21 | $305 | 2.48 | 1.21 | 24.00% | 15.80% | 18.20% | 10.64% | 10.31% |
| 22 | $234 | 2.37 | 1.26 | 25.78% | 14.98% | 17.83% | 10.27% | 10.67% |
| 23 | $179 | 2.25 | 1.31 | 26.24% | 16.41% | 19.32% | 11.76% | 11.03% |
| 24 | $124 | 2.09 | 1.31 | 26.75% | 16.57% | 19.61% | 12.05% | 11.53% |
| 25 | $44 | 1.64 | 1.39 | 33.24% | 18.63% | 22.88% | 15.32% | 12.93% |
| MEAN | $5,149 | 3.11 | 1.12 | 21.14% | 13.92% | 15.91% | 8.35% | 8.35% |

FIGURE 6-5
EQUITY RISK PREMIUM VS MARKET CAP




Source: Grabowski & King (1999)

In addition to earning the highest average rates of return, small stocks also have the highest volatility, as measured by the standard deviation of returns. Ibbotson defines small stocks as those in the lowest size decile (10%) among NYSE stocks, with size defined as the dollar value of shares outstanding. The size trigger point occurs approximately at a market value of $200 million.

The beta risk measures are typically higher, and the stock quality ratings of small firms are typically less than those of large firms. Figures 6-6 and 6-7 contrast the betas and Value Line Safety Ranks of small versus large capitalization stocks. Large-cap stocks (first decile of companies ranked in descending order of market value of equity) have an average beta of 1.10, versus 1.5 for the small-cap stocks (bottom decile). As far as financial strength is concerned, the large cap category has an average Value Line Safety Rank of 2.2 (on a scale of 1 to 5, with 1 being the highest quality), versus 3.4 for the small-cap category. A similar pattern is observed for bond ratings.

**FIGURE 6-6**
**BETA RISK MEASURE**
**Large- vs Small-Cap Stocks**

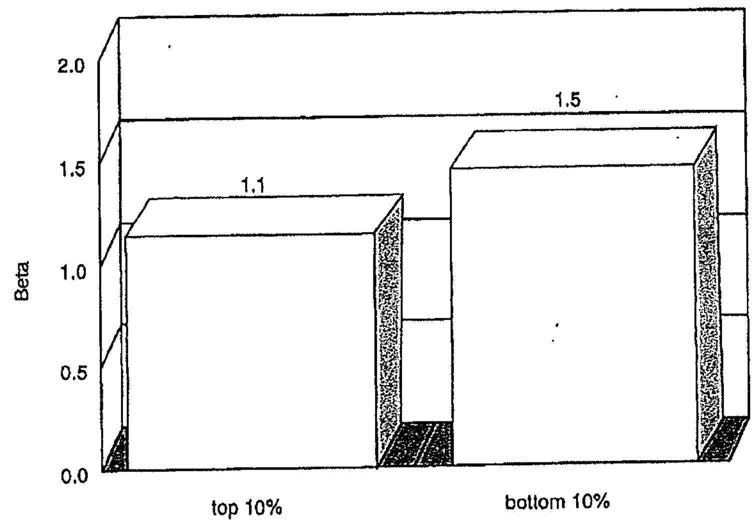
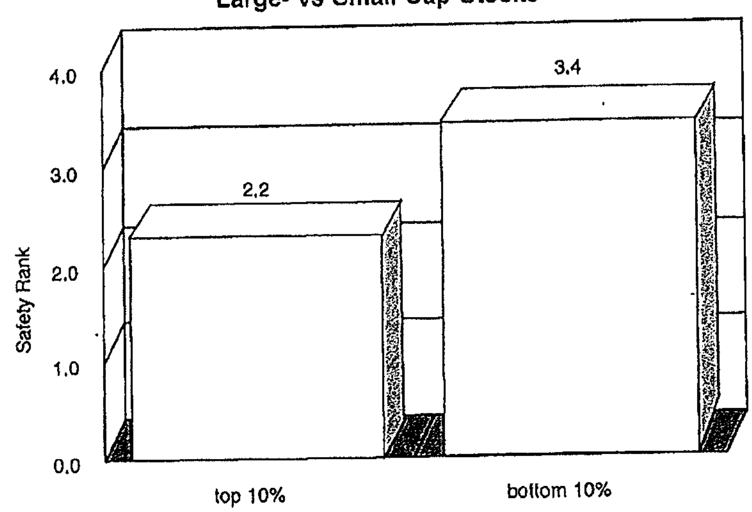



**FIGURE 6-7**
**STOCK SAFETY RANK**
**Large- vs Small-Cap Stocks**



Although much research effort has gone into investigating the size effect, the economic rationale for the size effect is difficult to unravel.[7] Smaller companies are less able to deal with significant events that affect revenues and cash flows than large companies. For example, the loss of sales from a few large customers would exert a far greater effect on a small company that on a larger company with a large customer base. Presumably, small stocks provided less utility to the investor, and require a higher return. The size effect may be a statistical mirage, whereby size is proxying for the effect of different economic variables. Small firms may have low price-earnings ratios or low market prices, for example. The size effect is most likely the result of a liquidity premium, whereby investors in small stocks demand greater returns as compensation for lack of marketability and liquidity. Investors prefer high to low liquidity, and demand higher returns from less liquid investments, holding other factors constant. Another plausible explanation for the size effect is the higher information search costs incurred by investors for small companies relative to large companies. In short, size is a significant factor that increases both business risk and financial risk and, therefore, the cost of capital.

## Cost of Equity and Size Premium

Given the evidence of a small firm premium, that is, small market-cap stocks experience higher returns than large market-cap stocks with eqnivalent betas, the CAPM understates the risk of smaller utilities, and a cost of equity based purely on a CAPM beta will therefore produce too low an estimate for these small companies. This has led some analysts to add a premium to the estimated cost of equity for smaller companies. For example, let us say that small-cap stocks have earned about 2% more than large stocks over the past decade. In order to estimate the cost of equity for a small-cap stock with a beta of 0.80, a risk-free rate of 5% and a market risk premium ("MRP") of 7%, you would perform the following calculation:[8]

$$
\begin{aligned}
K &= R_F + \beta\,(\text{MRP}) + \text{Small size premium} \\
&= 5\% + 0.80\,(7\%) + 2\% \\
&= 12.6\%
\end{aligned}
$$

[7] See Roll (1981).

[8] This procedure opens the door to a whole series of similar adjustments reflecting numerous market inefficiencies (e.g., dividend yield, skewness, low M/B ratio, etc.). In order to resist this temptation, a superior alternative to considering the size premium explicitly is to identify the economic reasons for the premium and develop more direct measures of risk. For example, if the higher risk of small water utilities comes from the higher operating leverage associated with their operations relative to larger utilities, the betas could be adjusted for operating leverage and use these higher betas for small-cap utilities.

### Hedging Effect

As far as hedging potential is concerned, investors are exposed to another kind of risk, namely, the risk of unfavorable shifts in the investment opportunity set. Merton (1973) shows that investors will hold portfolios consisting of three funds: the risk-free asset, the market portfolio, and a portfolio whose returns are perfectly negatively correlated with the riskless asset so as to hedge against unforeseen changes in the future risk-free rate. The higher the degree of protection offered by an asset against unforeseen changes in interest rates, the lower the required return, and conversely. Merton argues that low beta assets, like utility stocks, offer little protection against changes in interest rates, and require higher returns than suggested by the standard CAPM.

### Market Index and Missing Assets

A second explanation for the CAPM's inability to fully explain the process determining security returns involves the use of an inadequate or incomplete market index. Empirical studies to validate the CAPM invariably rely on some stock market index as a proxy for the true market portfolio. The exclusion of several asset categories from the definition of market index misspecifies the CAPM and biases the results found using only stock market data.[9] Unfortunately, no comprehensive and easily accessible data exist for several classes of assets, such as mortgages and business investments, so that the exact relationship between return and stock betas predicted by the CAPM does not exist. This suggests that the empirical relationship between returns and stock betas is best estimated empirically rather than by relying on theoretical and elegant CAPM models expanded to include missing assets effects. In any event, stock betas may be highly correlated with the true beta measured with the true market index.

### Constraints on Investor Borrowing

The third explanation for the CAPM's deficiency involves the possibility of constraints on investor borrowing that run counter to the assumptions of the CAPM. In response to this inadequacy, several versions of the CAPM have been developed by researchers. One of these versions is the so-called zero-beta, or two-factor, CAPM which provides for a risk-free return in a market where borrowing and lending rates are divergent. If borrowing rates and lending rates differ, or there is no risk-free borrowing or lending, or there is risk-free lending but no risk-free borrowing, then the CAPM has the following form:

$$K = R_Z + \beta(R_M - R_F) \qquad (6\text{-}4)$$

[9] Kolbe and Read (1983) provide an illustration of the biases in beta estimates that result from applying the CAPM to public utilities.

The model is analogous to the standard CAPM, but with the return on a minimum risk portfolio that is unrelated to market returns, $R_Z$, replacing the risk-free rate, $R_F$. The model has been empirically tested by Black, Jensen, and Scholes (1972), who find a flatter than predicted SML, consistent with the model and other researchers' findings. An updated version of the Black-Jensen-Scholes study is available in Brealey, Myers, and Allen (2006) and reaches similar conclusions.

The zero-beta CAPM cannot be literally employed to estimate the cost of capital, since the zero-beta portfolio is a statistical construct difficult to replicate. Attempts to estimate the model are formally equivalent to estimating the constants, a and b, in Equation 6-2. A practical alternative is to employ the Empirical CAPM, to which we now turn.

## 6.3 Empirical CAPM

As discussed in the previous section, several finance scholars have developed refined and expanded versions of the standard CAPM by relaxing the constraints imposed on the CAPM, such as dividend yield, size, and skewness effects. These enhanced CAPMs typically produce a risk-return relationship that is flatter than the CAPM prediction in keeping with the actual observed risk-return relationship. The ECAPM makes use of these empirical findings. The ECAPM estimates the cost of capital with the equation:

$$K = R_F + \acute{\alpha} + \beta \times (MRP - \acute{\alpha}) \qquad (6\text{-}5)$$

where $\acute{\alpha}$ is the "alpha" of the risk-return line, a constant, and the other symbols are defined as before. All the potential vagaries of the CAPM are telescoped into the constant $\acute{\alpha}$, which must be estimated econometrically from market data. Table 6-2 summarizes[10] the empirical evidence on the magnitude of alpha.[11]

[10] The technique is formally applied by Litzenberger, Ramaswamy, and Sosin (1980) to public utilities in order to rectify the CAPM's basic shortcomings. Not only do they summarize the criticisms of the CAPM insofar as they affect public utilities, but they also describe the econometric intricacies involved and the methods of circumventing the statistical problems. Essentially, the average monthly returns over a lengthy time period on a large cross-section of securities grouped into portfolios are related to their corresponding betas by statistical regression techniques; that is, Equation 6-5 is estimated from market data. The utility's beta value is substituted into the equation to produce the cost of equity figure. Their own results demonstrate how the standard CAPM underestimates the cost of equity capital of public utilities because of utilities' high dividend yield and return skewness.

[11] Adapted from Vilbert (2004).

**TABLE 6-2**
**EMPIRICAL EVIDENCE ON THE ALPHA FACTOR**

| Author | Range of alpha |
|---|---|
| Fischer (1993) | −3.6% to 3.6% |
| Fischer, Jensen and Scholes (1972) | −9.61% to 12.24% |
| Fama and McBeth (1972) | 4.08% to 9.36% |
| Fama and French (1992) | 10.08% to 13.56% |
| Litzenberger and Ramaswamy (1979) | 5.32% to 8.17% |
| Litzenberger, Ramaswamy and Sosin (1980) | 1.63% to 5.04% |
| Pettengill, Sundaram and Mathur (1995) | 4.6% |
| Morin (1989) | 2.0% |

For an alpha in the range of 1%–2% and for reasonable values of the market risk premium and the risk-free rate, Equation 6-5 reduces to the following more pragmatic form:

$$K = R_F + 0.25\,(R_M - R_F) + 0.75\,\beta(R_M - R_F) \qquad (6\text{-}6)$$

Over reasonable values of the risk-free rate and the market risk premium, Equation 6-6 produces results that are indistinguishable from the ECAPM of Equation 6-5.[12]

An alpha range of 1%–2% is somewhat lower than that estimated empirically. The use of a lower value for alpha leads to a lower estimate of the cost of capital for low-beta stocks such as regulated utilities. This is because the use of a long-term risk-free rate rather than a short-term risk-free rate already incorporates some of the desired effect of using the ECAPM. That is, the

[12] Typical of the empirical evidence on the validity of the CAPM is a study by Morin (1989) who found that the relationship between the expected return on a security and beta over the period 1926–1984 was given by:

$$\text{Return} = 0.0829 + 0.0520\,\beta$$

Given that the risk-free rate over the estimation period was approximately 6% and that the market risk premium was 8% during the period of study, the intercept of the observed relationship between return and beta exceeds the risk-free rate by about 2%, or 1/4 of 8%, and that the slope of the relationship is close to 3/4 of 8%. Therefore, the empirical evidence suggests that the expected return on a security is related to its risk by the following approximation:

$$K = R_F + x(R_M - R_F) + (1 - x)\beta(R_M - R_F)$$

where x is a fraction to be determined empirically. The value of x that best explains the observed relationship Return = 0.0829 + 0.0520 $\beta$ is between 0.25 and 0.30. If x = 0.25, the equation becomes:

$$K = R_F + 0.25(R_M - R_F) + 0.75\beta(R_M - R_F)$$

long-term risk-free rate version of the CAPM has a higher intercept and a flatter slope than the short-term risk-free version which has been tested. Thus, it is reasonable to apply a conservative alpha adjustment. Moreover, the lowering of the tax burden on capital gains and dividend income enacted in 2002 may have decreased the required return for taxable investors, steepening the slope of the ECAPM risk-return trade-off and bring it closer to the CAPM predicted returns.[13]

To illustrate the application of the ECAPM, assume a risk-free rate of 5%, a market risk premium of 7%, and a beta of 0.80. The Empirical CAPM equation (6-6) above yields a cost of equity estimate of 11.0% as follows:

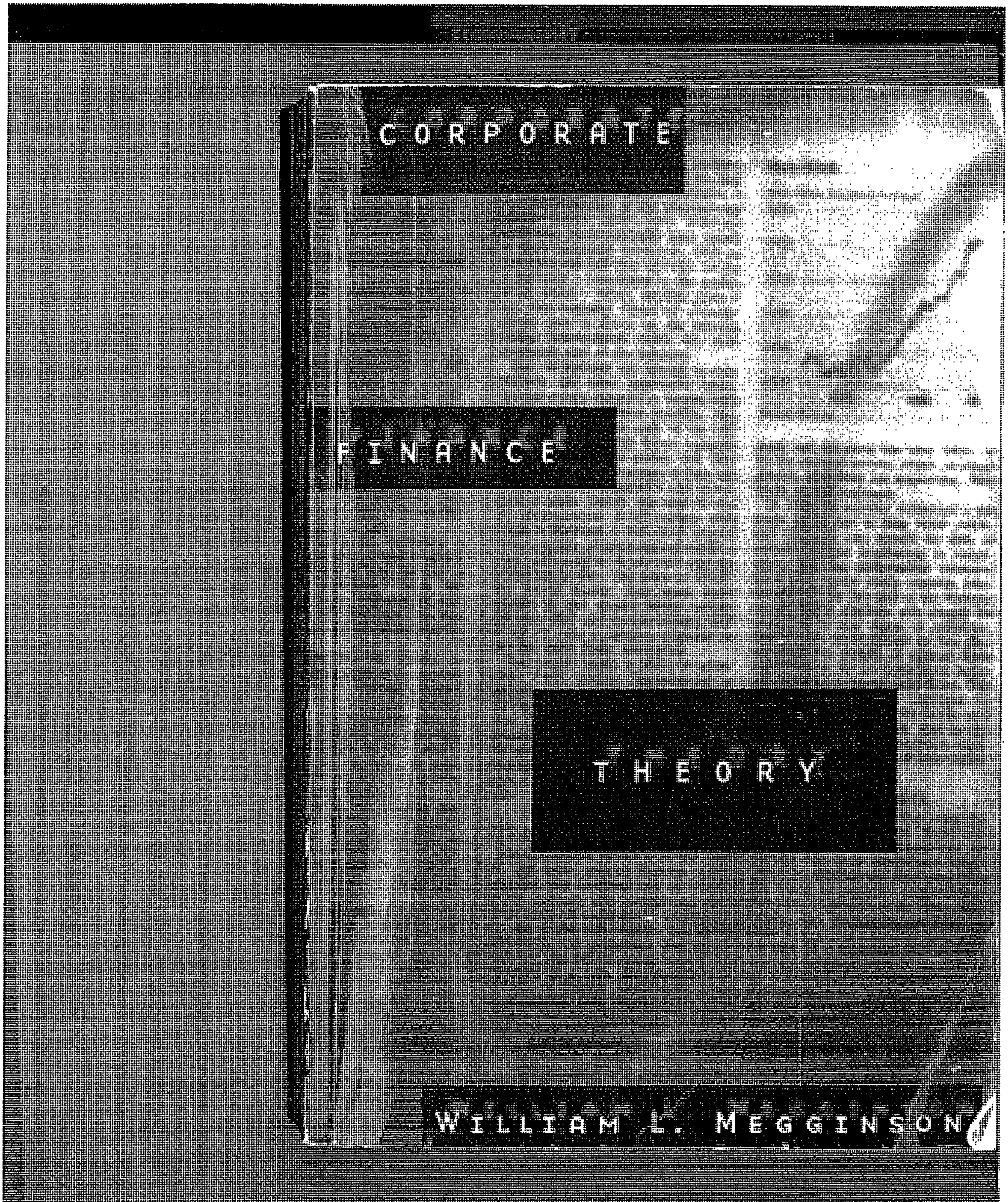
$$\begin{aligned} K &= 5\% + 0.25\ (12\% - 5\%) + 0.75 \times 0.80\ (12\% - 5\%) \\ &= 5.0\% + 1.8\% + 4.2\% \\ &= 11.0\% \end{aligned}$$

As an alternative to specifying alpha, see Example 6-1.

Some have argued that the use of the ECAPM is inconsistent with the use of adjusted betas, such as those supplied by Value Line and Bloomberg. This is because the reason for using the ECAPM is to allow for the tendency of betas to regress toward the mean value of 1.00 over time, and, since Value Line betas are already adjusted for such trend, an ECAPM analysis results in double-counting. This argument is erroneous. Fundamentally, the ECAPM is not an adjustment, increase or decrease, in beta. This is obvious from the fact that the expected return on high beta securities is actually lower than that produced by the CAPM estimate. The ECAPM is a formal recognition that the observed risk-return tradeoff is flatter than predicted by the CAPM based on myriad empirical evidence. The ECAPM and the use of adjusted betas comprised two separate features of asset pricing. Even if a company's beta is estimated accurately, the CAPM still understates the return for low-beta stocks. Even if the ECAPM is used, the return for low-beta securities is understated if the betas are understated. Referring back to Figure 6-1, the ECAPM is a return (vertical axis) adjustment and not a beta (horizontal axis) adjustment. Both adjustments are necessary. Moreover, recall from Chapter 3 that the use of adjusted betas compensates for interest rate sensitivity of utility stocks not captured by unadjusted betas.

[13] The lowering of the tax burden on capital gains and dividend income has no impact as far as non-taxable institutional investors (pension funds, 401K, and mutual funds) are concerned, and such investors engage in very large amounts of trading on security markets. It is quite plausible that taxable retail investors are relatively inactive traders and that large non-taxable investors have a substantial influence on capital markets.

EXHIBIT QVLP-GS-3


CORPORATE
FINANCE
THEORY
WILLIAM L. MEGGINSON

The equation can be simplified somewhat by redefining each year's dividend, $D_t$, in terms of anticipated growth. We will consider three cases here—zero growth, constant growth, and variable growth.

**ZERO GROWTH** The simplest approach to dividend valuation, the zero growth model, assumes a constant, nongrowing dividend stream. In terms of the notation already introduced:

$$D_1 = D_2 = \cdots = D_\infty$$

Letting $D_1$ represent the amount of the annual dividend, Equation 4.9 under zero growth would reduce to:

$$P_0 = D_1 \times \left[\sum_{t=1}^{\infty} \frac{1}{(1+k_s)^t}\right] = D_1 \times (PVIFA_{k_s,\infty}) = \frac{D_1}{k_s} \qquad (4.10)$$

The equation shows that with zero growth the value of a share of stock would equal the present value of a perpetuity of $D_1$ dollars discounted at a rate $k_s$. Let us look at an example.

The dividend of the Disco Company, an established wood products producer, is expected to remain constant at \$3 per share indefinitely. If the required return on its stock is 15 percent, the stock's value is \$20 (\$3/0.15).

**CONSTANT GROWTH** The most widely cited dividend valuation approach, the constant growth model, assumes that dividends will grow at a constant rate, $g$, that is less than the required return, $k_s$ ($g < k_s$). Letting $D_0$ represent the most recent dividend, Equation 4.9 can be rewritten as follows:

$$P_0 = \frac{D_0 \times (1+g)^1}{(1+k_s)^1} + \frac{D_0 \times (1+g)^2}{(1+k_s)^2} + \ldots + \frac{D_0 \times (1+g)^\infty}{(1+k_s)^\infty} \qquad (4.11)$$

If we simplify Equation 4.11, it can be rewritten as follows:

$$P_0 = \frac{D_1}{k_s - g} \qquad (4.12)$$

The constant growth model in Equation 4.12 is commonly called the **Gordon growth model**, after Myron Gordon, who popularized this formula during the 1960s and 1970s. An example will show how it works.

The Lazertronics Company, a small scientific instruments company, from 1991 through 1996 paid the per-share dividends shown below.

| Year | Dividend per share ($) |
|---|---|
| 1996 | 1.40 |
| 1995 | 1.29 |
| 1994 | 1.20 |
| 1993 | 1.12 |
| 1992 | 1.05 |
| 1991 | 1.00 |

**EXHIBIT QVLP-GS-4**

Market Results
Through 2013

# 2014
# Valuation Handbook
## Guide to Cost of Capital

DUFF & PHELPS

In Exhibit 7.2, the largest company in each of the CRSP (NYSE/AMEX/NASDAQ) deciles and size groupings (by market capitalization) as of September 30, 2013.

**Exhibit 7.2:** Largest Company (by market capitalization) in CRSP (NYSE/AMEX/NASDAQ) Deciles and Size Groupings
September 30, 2013

| Decile | Company Name | Recent Market Capitalization (in $thousands) |
|---|---|---|
| 1-Largest | Apple, Inc. | 428,699,798 |
| 2 | Cigna Corp. | 21,739,006 |
| 3 | Molson Coors Brewing Co. | 9,196,480 |
| 4 | Donaldson Inc. | 5,569,840 |
| 5 | Kennametal Inc. | 3,573,079 |
| 6 | Idacorp Inc. | 2,431,229 |
| 7 | Stone Energy Corp. | 1,621,792 |
| 8 | Korn Ferry International | 1,055,320 |
| 9 | Calix Inc. | 632,770 |
| 10-Smallest | Yume Inc. | 338,829 |

**Source of underlying data:** CRSP databases ©2014 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business (2014).

In the following sections we provide an example of (i) calculating a CRSP Deciles Size Premia and (ii) a Risk Premium Report, using example data from each of the two data sets.

### Size Premium Calculation: CRSP Deciles Size Premia

In the *2014 Valuation Handbook*, the CRSP Deciles Size Premia are calculated over the years 1926–2013. The following statistics are calculated over this time period:

- The "historical" average annual long-term equity risk premium is 6.96%.
- The average annual risk-free rate is 5.09%.
- CRSP portfolio 10b average annual return equals 23.57%
- CRSP portfolio 10b OLS beta equals1.36

The beta-adjusted size premium for CRSP portfolio 10b is calculated as follows:

*10b Size Premium = actual excess return – excess return predicted by CAPM*

Looking Exhibit 7.3, the *actual* excess return of portfolio 10b is 18.47% (23.57% - 5.09%), and the excess return that CAPM *predicted* is 9.48% (1.36 x 6.96%). The size premium for CRSP portfolio 10b is therefore 8.99%, which is "what actually happened" (18.47%) minus "what CAPM predicted" (9.48%). This is what is meant when we say that the beta of smaller companies doesn't explain all of their returns. In this simple example, beta fell 8.99% short of explaining what actually happened.

**Exhibit 7.3:**CRSP (NYSE/AMEX/NASDAQ) Deciles; Returns in Excess of CAPM (i.e., beta-adjusted Size Premia)

| Size Grouping | | OLS Beta | Arithmetic Mean | Return in Excess of Risk-free Rate (actual) | Return Return in Excess of Risk-free Rate (as predicted by CAPM) | Size Premium |
|---|---|---|---|---|---|---|
| Mid-Cap (3-5) | | 1.12 | 14.01% | 8.91% | 7.81% | 1.11% |
| Low-Cap (6-8) | | 1.22 | 15.57% | 10.48% | 8.50% | 1.98% |
| Micro-Cap (9-10) | | 1.36 | 18.41% | 13.32% | 9.44% | 3.87% |
| Breakdown of Deciles 1-10 | | | | | | |
| 1-Largest | | 0.92 | 11.10% | 6.01% | 6.38% | -0.37% |
| 2 | | 1.04 | 13.04% | 7.95% | 7.20% | 0.75% |
| 3 | | 1.10 | 13.64% | 8.55% | 7.69% | 0.86% |
| 4 | | 1.13 | 14.09% | 9.00% | 7.84% | 1.16% |
| 5 | | 1.16 | 14.92% | 9.82% | 8.08% | 1.75% |
| 6 | | 1.17 | 15.12% | 10.02% | 8.17% | 1.86% |
| 7 | | 1.24 | 15.68% | 10.59% | 8.65% | 1.94% |
| 8 | | 1.31 | 16.55% | 11.45% | 9.09% | 2.36% |
| 9 | | 1.35 | 17.27% | 12.18% | 9.37% | 2.81% |
| 10-Smallest | | 1.40 | 20.85% | 15.75% | 9.77% | 5.99% |
| Breakdown of 10th Decile | | | | | | |
| 10a | | 1.42 | 19.40% | 14.31% | 9.91% | 4.40% |
| | 10w | 1.38 | 18.22% | 13.12% | 9.61% | 3.52% |
| | 10x | 1.48 | 21.05% | 15.96% | 10.29% | 5.67% |
| 10b | | 1.36 | 23.57% | 18.47% | 9.48% | 8.99% |
| | 10y | 1.38 | 22.24% | 17.14% | 9.59% | 7.55% |
| | 10z | 1.35 | 26.59% | 21.50% | 9.38% | 12.12% |

**Source of underlying data:** Calculated (or derived) based on data from CRSP ©2014 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business (2014). Calculations by Duff & Phelps.

EXHIBIT QVLP-GS-5

Preliminary.

# What Do Private Equity Firms Say They Do?

Paul Gompers*, Steven N. Kaplan** and Vladimir Mukharlyamov***

This Draft: February 2015

**Abstract**

We survey 79 private equity (buyout) investors with a total of over $750 billion of assets under management about their practices in firm valuation, capital structure, governance and value creation. Few investors use discounted cash flow or present value techniques to evaluate investments. Rather, they rely on internal rates of return and multiples of invested capital. They also use comparable company multiples to calculate exit values rather than discounted cash flow valuations. Private equity investors typically target a 25% internal rate of return on their investments. They also report that their limited partner investors focus more on absolute, not relative performance. Capital structure choice is based equally on optimal trade-off and market timing considerations. Private equity investors anticipate improving the performance of the companies in which they invest, with a greater focus on increasing growth than on reducing costs. They devote meaningful firm resources to do this. We also explore how the actions that private equity managers say they take group into specific firm strategies and how those strategies are related to firm founder characteristics.

* Harvard Business School and NBER, ** University of Chicago Booth School of Business and NBER, and *** Harvard University. This research has been supported by the Division of Research at the Harvard Business School (Gompers) and the Fama-Miller Center (Kaplan). We thank Brad Cornell, Harry DeAngelo, David Robinson and seminar participants at the American Finance Association, Harvard Business School Accounting and Control workshop, Harvard Business School Finance workshop, Hebrew University, London Business School, Stanford, the University of North Carolina and the Wharton School for helpful comments. Gompers and Kaplan have consulted to private equity general partners and limited partners. The authors' e-mail addresses are pgompers@hbs.edu, skaplan@uchicago.edu, and mukharly@fas.harvard.edu.

## 1. Introduction

The private equity (buyout)[1] industry has grown markedly in the last twenty years and academic research has increasingly focused on the effects of private equity. What has been less explored are the specific analyses and actions taken by private equity (PE) fund managers. This paper seeks to fill that gap. In a survey of 79 private equity firms managing more than $750 billion in capital, we provide granular information on PE managers' practices in determining capital structure, valuing transactions, sourcing deals, governance and operational engineering. We also explore how the actions that private equity managers say they take group into specific firm strategies and how those strategies are related to firm founder characteristics.

Recent academic research has provided accumulating evidence that private equity investors have performed well relative to reasonable benchmarks. At the private equity fund level, Harris, Jenkinson and Kaplan (2014), Higson and Stucke (2013), Robinson and Sensoy (2013) and Ang et al. (2013) all find that private equity funds have outperformed public equity markets net of fees over the last three decades. The outperformance versus the S&P 500 in Harris et al. is on the order of 20% over the life of a fund and roughly 4% per year. Consistent with that net of fee performance, Axelson, Sorensen and Stromberg (2013) find outperformance of over 8% per year gross of fees.

At the private equity portfolio company level, Davis et al. (2013) find significant increases in productivity in a large sample of U.S. buyouts from the 1980s to early 2000s. Cohn and Towery (2013) find significant increases in operating performance in a large sample of U.S. buyouts of private firms. Kaplan (1989) finds significant increases in public to private deals in the 1980s. Cohn et al. (2013) and Guo et al. (2011) find modest increases in operating performance for public to private buyouts in the 1990s and early 2000s, although Guo et al. find large increases in company values.

From Gompers and Lerner (1999), Metrick and Yasuda (2010), and Chung et al. (2012), we also know that the compensation of the partners at the private equity funds creates strong incentives to

[1] We classify private equity as buyout or growth equity investments in mature companies. Private equity as we define it in this paper is distinct from and does not include venture capital investments.

generate high returns, both directly and through the ability to raise subsequent funds. Strong performance for some funds has led to very high compensation for those investors.

The high-powered incentives combined with the largely positive empirical results are consistent with PE investors taking actions that are value increasing or maximizing. Kaplan and Stromberg (2009) classify three types of value increasing actions– financial engineering, governance engineering, and operational engineering. These value-increasing actions are not necessarily mutually exclusive, but it is likely that certain firms emphasize some of the actions more than others.

In financial engineering, PE investors provide strong equity incentives to the management teams of their portfolio companies. At the same time, leverage puts pressure on managers not to waste money. In governance engineering, PE investors control the boards of their portfolio companies and are more actively involved in governance than public company directors and public shareholders. In operational engineering, PE firms develop industry and operating expertise that they bring to bear to add value to their portfolio companies.

Despite the growth in private equity and that evidence, only a few papers have studied the actions private equity investors actually take. Early papers by Baker and Wruck (1989) and Baker (1992) explored value creation in individual cases. More recently, Acharya et al. (2013) study portfolio company performance and relate that performance to PE firm and partner characteristics. There is still much that is unknown. In particular, no paper examines detailed levers of value creation across financial, governance, and operational engineering.

In this paper, we further explore what PE investors actually do by reporting the results of a survey of private equity investing practices. The paper has two parts. First, we identify and tabulate the key decisions that private equity investors make. The range of decisions is significantly more detailed than has been examined in the prior literature. In particular, our survey is structured around examining decisions that support financial, governance, or operational engineering. Second, we attempt to categorize distinct strategies that private equity firms employ.

Our approach is to survey 79 private equity (PE) investors (with a total of over $750 billion of private equity assets under management as of the end of 2012.) We obtain complete answers from 64 of these firms (representing over $600 billion of private equity assets under management.) The sample represents private equity firms across a spectrum of investment strategies, size, industry specialization, and geographic focus. We ask the PE investors questions about financial engineering – how they value companies, think about portfolio company capital structures, and management incentives; governance engineering – how they think about governance and monitoring; and operational engineering – how they think about value creation, both before closing the transaction and after the transaction. We also ask questions about the organization of the private equity firms themselves.

Despite the prominent role that discounted cash flow valuation methods play in academic finance courses, few PE investors use discounted cash flow or net present value techniques to evaluate investments. Rather, they rely on internal rates of return and multiples of invested capital. This contrasts with the results in Graham and Harvey (2001) who find that CFOs use net present values as often as internal rates of return. Furthermore, few PE investors explicitly use the capital asset price model (CAPM) to determine a cost of capital. Instead, PE investors typically target a 22% internal rate of return on their investments on average (with the vast majority of target rates of return between 20 and 25%), a return that appears to be above a CAPM-based rate. We offer several potential explanations for this seemingly ad hoc approach to investment analysis.

We also asked the PE investors how their limited partners (LPs) evaluate the performance of the private equity investors. Surprisingly, the PE investors believe that their LPs are most focused on absolute performance rather than relative performance or alphas. This is also puzzling given that private equity investments are equity investments, some of which had been publicly-traded prior to a leveraged buyout. Such investments carry significant equity risk, suggesting that equity-based benchmarks like public market equivalents (PMEs) are appropriate.

Our results on capital structure are more consistent with academic theory and teaching. In choosing the capital structures for their portfolio companies, PE investors appear to rely equally on factors that are consistent with capital structure trade-off theories and those that are consistent with market timing. The market timing result is consistent with the results in Axelson, Jenkinson et al. (2013), henceforth AJSW (2013), although the capital structure trade-off theory result is not. These results are, however, somewhat different from those in Graham and Harvey (2001) who find that CFOs focus on financial flexibility.

Financial and governance engineering also appear to be important. In terms of portfolio company management, PE investors expect to provide strong equity incentives to their management teams and believe those incentives are very important. They regularly replace top management, both before and after they invest. And they structure smaller boards of directors with a mix of insiders, PE investors and outsiders. These results are consistent with research on value enhancing governance structures that have been identified in other settings.

Finally, PE investors say they place a heavy emphasis on adding value to their portfolio companies, both before and after they invest. The sources of that added value, in order of importance, are increasing revenue, improving incentives and governance, facilitating a high-value exit or sale, making additional acquisitions, replacing management and reducing costs. On average, they commit meaningful resources to add value, although there is a great deal of variation in how they do so.

We take the responses to the various questions about individual decisions and analyze how various decisions are "related" to each other by employing cluster analysis and factor analysis. Essentially, we use cluster analysis to explore whether private equity firms follow particular strategies. We find that the answers to our survey cluster into categories that are related to financial engineering, governance engineering, and operational engineering – the levers of value creation highlighted in Kaplan and Stromberg (2009).

We then consider how those strategies are related to firm founder characteristics. Firms whose founders have a financial background tend to focus more on financial engineering, while those with a previous background in private equity and, to a lesser extent, operations, tend to focus more on operational engineering.