Management Estimates of Cost of Capital

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Abstract: This study empirically examines the cost of capital employed by company management in their asset valuation decisions. Using a sample of cost of capital estimates manually collected from firms' 10-K filings, we find that several firm characteristics, such as firm age, financial leverage, cash holding, and cash flow volatility, are among the important determinants of firms' overall cost of capital. Further, management estimates of cost of equity are correlated with firm size, CAPM beta, and momentum, but not with book-to-market ratio or popular estimates derived from market data and valuation models (e.g. PE, PEG, or MPEG ratio). Finally, we find that cost of capital has a significant impact on investment, with 1% increase in cost of capital reducing the firm's average annual capital expenditure over the next three years by $7 million.

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1. Introduction

Cost of capital is fundamental to a firm's investment and financing decisions. As learned from textbooks, cost of capital directly affects a firm's choice of financing and capital structure, and influences a firm's investment decisions through the setting of hurdle rates. Cost of capital is also essential to asset pricing as many of the valuation methodologies require it as a key input for discounting future cash flows.

Given its importance, a large body of accounting and finance literature has been devoted to studying cost of capital and its determinants. Several approaches have been developed to estimate cost of equity capital, such as the Capital Asset Pricing Model (CAPM) of Lintner (1965) and Sharpe (1964), Arbitrage Pricing Theory (APT) of Ross (1976), and methods that back out cost of equity by inverting accounting-based valuation models (e.g. Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002; Easton, 2004). These studies mostly use price and return data from stock market and hence the resulting cost of capital estimates reflect the view of investors.

In this paper, we take a different approach to study cost of capital by empirically examining the cost of capital estimates that reflect company management's view. Specifically, we collect from companies' financial reports the cost of capital estimates used by managers in asset valuation decisions, and examine their characteristics and how they are related to cost of capital estimated from market data. Studying the management's estimates of cost of capital is important for several reasons. First, cost of capital is a critical input to many corporate decisions that jointly determine the fundamental value and growth prospect of a firm (Copeland et al., 2005; Penman, 2007; and Brealey et al., 2008). As such, examining the cost of capital directly used by the decision makers provides a new perspective that will help us better understand the

role of this information in those decisions. Second, the inherent asymmetry of information between managers and investors suggests that the two parties' estimates of cost of capital are likely to diverge, as they are conditional on different information sets. Hence, it is inappropriate to use estimates implied solely by market price as proxy for managers' belief. Finally, limitations on data and methodology cause empirical estimates of cost of capital from market data to be contaminated by measurement errors, which under certain circumstances may lead to spurious conclusions (Easton and Sommers, 2007). In contrast, the cost of capital used by management examined in this study is largely free of such problems, as the data are directly collected from companies' published reports.

We obtain management estimates of cost of capital from 10-K reports. Under some accounting standards, a firm is required to conduct discounted cash flow analysis and thus it is necessary for the firm to estimate a discount rate, which in most cases is the firm's cost of capital. For example, *Statement of Financial Accounting Standard 142* (SFAS 142) requires a firm that carries goodwill balance to conduct goodwill impairment tests periodically, in which the firm has to determine whether an impairment loss is incurred by comparing fair value with book value of goodwill. To estimate the fair value of goodwill, the firm is recommended to use a discounted cash flow model when the market value of goodwill is not available.[1] While SFAS 142 does not mandate the disclosure of the discount rates used in such analysis, some companies choose to do so voluntarily in their annual reports, thus making our empirical analyses of this information possible.[2]

[1] Other standards that require a firm to conduct a discounted cash flow analysis include tests of impairments and recoveries of intangible assets (SFAS 121, 142 and 144).

[2] Auditors are held responsible for footnote disclosures and assumptions reported in firms' 10-K reports. For example, Statement on Auditing Standards (SAS) No. 101, which provides auditors guidance for auditing fair value measurements and disclosures, requires auditors to evaluate whether the assumptions (such as discount rate) used in the valuation model are reasonable.

Our sample consists of 307 firm-year observations from 2001 to 2008. The mean (median) overall cost of capital of our sample firms is 13.3% (12.3%).[3] We then investigate the cross-sectional variation of the sample firms' cost of capital and find that certain firm characteristics, such as firm age, financial leverage, cash holdings, and cash flow volatility, are among the important factors that influence managers' cost of capital estimates. In particular, the overall cost of capital is higher for firms with shorter history of operation, lower financial leverage, higher cash holding, and more volatile cash flows, all of which are consistent with economic intuition and supported by finance theories (e.g., Fama and French, 1992; Minton and Schrand, 1999; and Opler et al., 1999; Modigliani and Miller, 1963; and Myers and Majluf, 1984).

In contrast to cost of debt, studies of cost of equity have taken the central stage of much of the finance and accounting literature, probably due to the inherent difficulty of obtaining accurate estimates.[4] The influential CAPM introduces systematic risk (beta) as the only firm-specific factor that determines a firm's cost of equity. In addition to CAPM beta, prior research has also identified firm size, book-to-market ratio, and momentum as empirical "risk factors" that drive variation in cost of equity.[5] On the other hand, CAPM beta as an empirical determinant of cost of equity has found little support from historical data, while the debate has never abated over whether the other "risk factors" are really firm characteristics that happen to be correlated with co-movements in stock return (e.g., Daniel and Titman, 1997). Our dataset provides a

[3] We note this figure is significantly higher than the overall cost of capital estimated by Fama and French (1999). It is also higher than the cost of equity estimates provided by prior studies that use the discounted cash flow valuation approach or asset-pricing model approach. For example, both Claus and Thomas (2001) and Gebhardt et al. (2001) document that risk premiums over their sample periods are about 3 percent, while Easton et al. (2002) report risk premium over their sample period is about 5.3 percent, which is close to the estimate of 4.5 percent in Fama and French (2002). The risk free rates (10-year treasury bond) for our sample period range from 2.42% to 6.66%, averaging at 4.59%. To the extent that a firm's overall cost of capital is lower than cost of equity capital because of the tax advantage of interest expenses, our findings suggest the cost of equity capital used by managers may be much higher than researchers' estimates.

[4] Broader data availability could be another reason for the disproportionally large number of studies of equity markets.

[5] Strictly speaking, these factors have been shown to be correlated with future realized return. Elton (1999) points out that realized return is a poor proxy for expected return or cost of equity.

unique opportunity to re-examine this longstanding issue from a new perspective. By directly examining the cost of equity estimates used by managers, we are able to evaluate the importance of these factors in affecting cost of equity, at least from company management's point of view, and hence the related financing and investment decisions. We find that management's estimates of cost of equity is negatively associated with firm size and positively associated with CAPM beta. Moreover, managers tend to lower their estimates of cost of equity when their companies' stock experience recent run-up, suggesting that they do not view short-term momentum as risk factor. Finally, we find no evidence that book-to-market ratio affects cost of equity estimated by management.

Another method commonly used in prior studies to estimate cost of equity is to "invert" a particular discounted cash flow (DCF) valuation model to find out the "implied" cost of equity (Claus and Thomas, 2001; Gebhardt et al., 2001, Easton et al., 2002, Easton, 2004).[6] We calculate cost of equity for our sample firms using this method and compare them with those used by management. Because the firms in our sample rarely disclose their cost of equity estimates, we assume a simple capital structure and a constant tax rate to filter out the impact of after-tax cost of debt from our weighted average cost of capital data. We examine three variations of DCF valuation model, PE, PEG, and MPEG, and find that management's estimates of cost of equity are significantly higher than the estimates from all three methods. Further, and somewhat to our surprise, none of the DCF estimates is reliably correlated with managers' estimates. While it is always a possibility that the power of our test is restricted by the relatively small sample size, our results suggest there may be fundamental differences between "implied" cost of capital and the cost of capital used by managers in their actual decision-making process.

[6] This method does not rely on a specific risk-factor pricing model, but requires estimation of the market's expectation for future pay-offs over an infinite period, which in many cases involves significant measurement errors that result in systematically biased cost of equity estimates (Easton and Sommers, 2007).

Taken together, our analyses suggest that managers are more in favor of factor asset pricing model approach in estimating cost of equity, though their choice of the specific set of risk factors is likely to differ from those found in academic literature.

The final part of the paper examines the impact of a firm's cost of capital on its investment level. We find that firms with more expensive source of capital invest significantly less on long-term physical assets, with 1% increase in cost of capital reducing the firm's average capital expenditure over next three years by 0.09% of total assets, which amounts to about 7 million dollars per year for our sample firms. Further, this relation remains largely unaffected by the inclusion of other factors that influence investments, such as growth opportunities (measured by Tobin's Q) and the availability of internally generated cash flows.

Our paper contributes to the cost of capital literature on two fronts. First, to the best of our knowledge, we are the first study that empirically examines the cost of capital used by company managements of firms from a wide cross-section of industries. This fills a void in existing literature, which has mainly focused on estimating the return on investments required by equity investors. Second, our paper adds to survey studies of managers' choice of cost of capital, such as Graham and Harvey (2001) and Poterba and Summers (1995). While both of the studies reveal numerous interesting findings on firms' capital budgeting practices, our study, by examining cost of capital estimates that are part of the actual managerial decision-making process, complements these studies and extends them by providing evidence on issues that are difficult to address through questionnaires.

The rest of the paper is organized as follows. In section two we review the institutional background. Section three describes the data collection process, and section four discusses the results of our empirical tests. Section five concludes.

2. Institutional Background

Some accounting standards require firms to estimate fair value of asset or liability (e.g., SFAS 141, SFAS 142, etc.). When market price is not available for a particular asset or similar assets, firms would usually have to carry out discounted cash flow analysis to estimate fair value.[7] To conduct the valuation analysis, various inputs are required and discount rate is one of them. While it is not mandatory for firms to disclose those input information for the valuation analysis, some firms do so voluntarily in their annual reports. Below we briefly review some of the accounting standards that require firms to estimate fair value.

Goodwill and Non-amortizable Intangible Assets

The issuance of SFAS 142 fundamentally changed the way of accounting for goodwill. Before SFAS 142, goodwill and intangible assets with indefinite useful-lives was systematically amortized. After SFAS 142, those assets are no longer amortized but reviewed for impairment at least annually. SFAS 142 also provides guidance for testing impairments of goodwill and intangible assets with indefinite useful-lives.

Under SFAS 142, firms perform goodwill impairment tests at segment level using a two-step process: Step 1: Compare the fair value and the book value (including goodwill) of a reporting unit. If the fair value is less than the book value, managers perform step 2 to see if goodwill is impaired. If the fair value exceeds the book value, step 2 is unnecessary. Step 2: Compare the implied fair value and the book value of goodwill in the reporting unit. If the implied fair value is less than the book value, the difference is recognized as goodwill impairment loss. For intangible assets with indefinite useful-life, SFAS 142 states that impairment loss is determined by comparing the book value of the asset with its fair value, where

[7] Under most circumstances, it is recommended but not required for the firm to use the discounted cash flow valuation technique to estimate fair value.

the amount of the impairment loss is equal to the excess amount of the fair value over the book value.

To estimate fair value, SFAS 142 indicates that the best measure of fair value is market prices from active markets, if available. The standard also states that the market price, however, may not be representative of fair value in some circumstances.[8] In a situation where market price is not representative or not available, the estimation of fair value is needed. The statement recommends the use of discounted cash flows to derive fair value, although it also allows other valuation techniques, such as market multiple approach or appraisal approach. In applying the discounted cash flow approach to estimate fair value, the management has to estimate the discount rate reflecting the firm's cost of capital commensurate with risk (FASB Concepts Statement 7).

For intangible assets with definite useful-life, impairment losses are recognized and measured in the same manner as long-lived assets, which are supervised by SFAS 144. Therefore, we discuss the accounting treatments of impairment losses for those assets together with long-lived assets in the next section.

Long-lived Assets

SFAS 144 directs how a firm accounts for the impairment or disposal of long-lived assets except goodwill and intangible assets with indefinite useful-lives.[9] According to the statement, a firm is required to record an impairment loss if the firm finds that the book value of the asset is not recoverable and exceeds its fair value. The book value is deemed as unrecoverable if the book value of the asset is greater than the sum of the undiscounted cash flows associated with the

[8] For example, some assets have to be priced in a bundle with other assets and liabilities. That is, those assets cannot be valued separately from other assets and liabilities and thus the prices for those assets are not objective and representative for fair values.

[9] SFAS 144 also does not apply to long-term customer relationships of a financial institution, financial instruments, deferred policy acquisition costs, deferred tax assets, unproved oil and gas properties and to long-lived assets which are prescribed by SFAS 44, 50, 63, 86 and 90.

asset. An impairment loss should be recorded when the book value of the asset is greater than its fair value with an amount equal to the excess amount of the book value to the fair value.

To obtain fair value, the statement indicates that market prices from active markets are the best measure of fair value if available. The statement also mentions that prices from similar assets or estimated values from other valuation techniques would be measures of fair value if market prices of assets are not available or applicable. To estimate fair value, the SFAS Concept 7 provides two approaches to estimate fair value – expected present value and traditional present value. Under both approaches, cash flows should be discounted to the present value to obtain fair value and thus discount rate is required and must be estimated by the management.

3. Sample Selection

We search the keywords "discount/discounted/discounting" and "cost of capital/cost of funds" in all 10-K reports filed to SEC between 2001 and 2008 through Lexis-Nexis Academic database.[10] An initial search result of 2,950 reports is returned.[11] We then carefully read each returned 10-K reports to collect usable cost of capital data. In order to be included in our sample, the firm must unambiguously indicate the discount rate used in valuing its goodwill or intangible assets in compliance with SFAS 142 or 144.[12] Since SFAS 142 requires the impairment test to be performed at a segment level, we assume the discount rate reflects the project-specific cost of capital that applies to one particular segment within the firm, unless it is explicitly indicated that the discount rate is the firm-wide cost of capital (Sample reports are provided in Appendix A). If a firm reports cost of capital estimates from multiple segments, we calculate a single cost of capital estimate for each firm-year by averaging all project-specific cost of capital estimates

[10] We start our sample in 2001 because SFAS 142 and 144 were both issued in 2001.
[11] The text of keyword search is (((discount! w/p (cost of capital or cost of fund)) AND EXCHANGE(NYSE or NASDAQ or AMEX) and DOCUMENT-DATE AFT(January 1, 2001) and DOCUMENT-DATE BEF(May 31, 2009))).
[12] If the firm discloses a range of discount rates we use the mid-point of the range as the discount rate.

disclosed by a firm during the same year. We then merge these firms with CRSP and COMPUSTAT databases to get required accounting and market data. Our final sample consists of 307 firm-year cost of capital estimates from 205 unique firms, of which 77 are firm-wide cost of capital and 230 are project-specific cost of capital.[13]

4. Empirical Results

4.1 An overview of sample firms' cost of capital

Panel A of Table 1 presents descriptive statistics of the sample. Compared with the COMPUSTAT database, our sample tends to include larger firms, as consistently indicated by various measures such as book value of total assets, sales, and market capitalization. Our sample firms also hold higher levels of intangible assets. The median values of intangible assets and goodwill as a percentage of total assets for our sample firms are 0.29 and 0.19, respectively, compared with those of 0.04 and 0.02 for the median COMPUSTAT firm. These differences, however, is not unexpected because the cost of capital estimates were collected from the firms that conduct impairment tests for their existing intangible assets and goodwill. Finally, the firms in our sample are more highly levered with median market leverage ratio of 0.30, compared to that of 0.13 for all COMPUSTAT firms.

Panel B shows that the mean (median) cost of capital of the sample firms is 13.3 percent (12.3 percent), ranging from as low as 6.7 percent to as high as 45 percent. When we further break down the full sample into project-specific and firm-wide cost of capital, we find that managers' estimates of project-specific cost of capital are on average higher than their estimates of firm-wide cost of capital (13.9% v.s. 11.6%). This difference is consistent with the coinsurance effect among a diversified firm's different segments reducing the firm's overall systematic risk, as argued in Hann et al. (2010).

[13] Sample size may vary in subsequent analyses due to different data requirements.

Table 2 reports the industry distribution of our sample.[14] Using COMPUSTAT as benchmark, our sample has a higher concentration in Business Equipment and Manufacturing industries, and a significant under-representation of Finance industry, which accounts for only 5.9% (v.s. 32.2% in COMPUSTAT) of all sample firms. This is because many firms in the Finance industry have special sources of funds (e.g., banks and insurance companies), and as a result we exclude a significant portion of those firms during the data collection process.

Consistent with prior studies of industry cost of equity using market data (Fama and French 1997, Gebhardt et al. 2001), we find a significant variation in management estimates of cost of capital across industries. In particular, firms in the Business Equipment industry report the highest average cost of capital (16.6%), while Utility companies enjoy the lowest financing cost (10%). This may reflect the difference in industry-wide risk profile, but could also be driven by other firm-specific factors that vary systematically across industries.[15] Overall, as reported in Panel B, industry affiliation explains 18.3% of variations in our sample firms' cost of capital.

Table 3 reports the temporal variation of cost of capital, and its correlation with measures of market-wide cost of debt and equity. We use 10-year moving average of return on the S&P 500 index as measure for "realized" historical cost of equity and calculate an "implied" cost of equity for the market by averaging the implied cost of equity[16] for all firms estimated at the beginning of each calendar year. For measures of market-wide cost of debt we use the average yields on all S&P rated investment grade bond and speculative grade bonds. These data were obtained from the RatingsDirect® database maintained by S&P and were only available since

[14] We use Fama-French 12 industry classification.
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html .

[15] We explore this possibility in further detail in section 4.2.

[16] We use the PEG approach to estimate the implied cost of equity $r = \sqrt{\frac{eps_{t+2} - eps_{t+1}}{P_t}}$ where eps_t is the earnings forecast for year t and P_t is the price at the end of year t. Botosan and Plumlee (2005) evaluate several alternative methods of estimating cost of equity capital and conclude that the performance of PEG is better than others.

2003. While our sample spans a relatively short period of 8 years, which unavoidably limited the scope of our time-series analysis, we note that several interesting patterns are apparent from the data. First, our sample period covers two recessions in 2001 and 2008[17], and in both years we see a clear spike in firms' overall cost of capital. In particular, during the recent financial crisis the average funding cost of our sample firms increased by 2.6%, from 11.6% in 2007 to 14.2% in 2008. Second, the temporal changes in cost of capital exhibit virtually no correlation with recent stock market performance or the expected return implied by current stock market valuation, suggesting that managers' assessment of cost of equity are likely to differ from the view expressed by investors. In contrast, managers' estimates of cost of capital closely follow developments in bond yield, exhibiting a correlation of 0.84 (0.92) with S&P investment (speculative) grade bond yield. This simple comparison suggests that when estimating their firms' cost of capital, managers tend to place more weight on market signal of cost of debt than cost of equity.

4.2 Cross-sectional determinants of overall cost of capital

In this section, we examine the cross-section of management estimates of overall cost of capital and its determinants. Drawing on prior research, we include the following candidate variables in our test: firm size (SIZE), firm age (AGE), Tobin's Q (Q), cash holdings (CASH), cash flow volatility (σ(CFO)), effective tax rates (TAX), financial leverage (LEV), cash flows from operations (CFO5), and earnings before interest and tax expenses (EBIT).[18] SIZE and AGE capture a firm's stage in lifecycle and hence its business risk (e.g., Fama and French, 1992). Q, CASH, and σ(CFO) are associated with a firm's ex ante demand for external financing (e.g., Minton and Schrand, 1999; and Opler et al., 1999). TAX and LEV are related to a firm's capital

[17] NBER identifies the two recessions as March 2001 – November 2001 and December 2007 – June 2009.
[18] All variables are measured to lead cost of capital estimates by one year.

structure, and CFO5 and EBIT measure a firm's financial performance. To mitigate the impact of outliers and nonlinearity of the co-variation among variables, we replace the variables with their respective decile rankings within the CRSP universe in our correlation and multivariate regression analysis.

As shown in the correlation matrix in Panel A of Table 4, a firm's overall cost of capital is significantly correlated with the characteristics identified above, and with predicted signs. For example, cost of capital is negatively associated with firm SIZE and AGE, consistent with the intuition that firms with higher business risk tend to have higher cost of equity capital (e.g., Fama and French, 1992). We find a positive correlation between cost of capital and Q, σ(CFO), and CASH, consistent with the prior literature that firms with more investment opportunities, higher information asymmetry, and more frequent access to external capital market will have higher cost of capital (e.g., Calomiris et al., 1995; Minton and Schrand, 1999; Opler et al., 1999).[19] Further, cost of capital is lower for firms with higher effective tax rate and leverage due to the tax benefits of interest expense and lower cost of debt financing (e.g., Modigliani and Miller, 1963; Myers and Majluf, 1984). Finally, we find firms with better financial performance (as measured by CFO5 and EBIT) enjoy lower cost of capital.

Panel B of Table 4 reports the multivariate regression results. In addition to the firm characteristic variables we also include a binary variable indicating whether the cost of capital is firm-wide or project-specific, as we found in earlier analysis that managers' estimates of project-specific cost of capital are generally higher. The regression coefficients on the explanatory variables all exhibit consistent signs with those in bi-variate correlations, but only firm age, cash

[19] Minton and Schrand (1999) argue that firms with higher cash flow volatility are more likely to face cash flow shortfalls and thus have to use external capital to fund their investments, which drives up cost of capital. Calomiris et al. (1995) and Opler et al. (1999) argue that firms with poor access to capital markets tend to hold more cash as a self-insurance device. Note that by their argument, the causal relationship between cash holding and cost of capital should be anticipation of high cost of capital driving managers to hold more cash, instead of the other way round.

holding, leverage, and cash flow volatility show statistically significant impact on cost of capital. These four variables, together with the firm-wide dummy, explains 38% of total variation in the dependent variable, suggesting managers consider them as important factors that affect firms' overall cost of capital.

4.3 Determinants of cost of equity capital

In contrast to cost of debt, existing studies of cost of capital have mostly centered on the measurement of cost of equity, probably due to the inherent difficulty of obtaining accurate estimates. Prior literature has suggested that cost of equity is associated with several risk factors, such as firm size, book-to-market ratio, CAPM beta, and past returns (Fama and French, 1993; Carhart, 1997). In this section, we examine the role of these factors in management's estimates of cost of equity capital. Insights from such analyses would be interesting for two reasons. First, to the extent that the information sets of external investors and corporate insiders do not fully converge, cost of equity estimated using market price data, which reflect the view of external investors, is unlikely to be a perfect proxy for managers' own assessment of cost of equity. By directly examining the cost of equity estimates used by managers, we will be able to better understand how these risk factors influence corporate financing and investment decisions. Second, it remains an unsettled issue in finance literature whether variables such as book-to-market ratio and momentum are indeed risk factors or just firm characteristics that happen to be correlated with stock returns (Daniel and Titman, 1997). If managers are on average better informed than external investors about the risk profile of their company, our analyses of management estimates of cost of equity may contribute to solving this longstanding puzzle.

The basic construct of our analyses is a multivariate regression model. Since our sample data are mostly overall cost of capital, we must control for effects of leverage and cost of debt to isolate the cost of equity capital. We develop the empirical approach as follows. We start with

the weighted-average cost of capital (WACC) equation and express WACC as a function of assets, debt, equity, tax rate, cost of debt and cost of equity: [20]

$$WACC = \frac{D}{A} \times K_D \times (1 - T) + \frac{E}{A} \times K_E \quad (1)$$

We assume that cost of debt (K_D) and cost of equity (K_E) can each be expressed by a linear factor model, respectively:

$$K_D = \alpha_0 + \sum \alpha_i D_i + \varepsilon_D \quad (2)$$

$$K_E = \beta_0 + \sum \beta_i E_i + \varepsilon_E \quad (3)$$

For simplicity, we define $L = \frac{D}{A} = 1 - \frac{E}{A}$ and $\tau = 1 - T$. We plug (2) and (3) into (1) and get (5):

$$WACC = L \times \tau \times (\alpha_0 + \sum \alpha_i D_i + \varepsilon_D) + (1 - L) \times (\beta_0 + \sum \beta_i E_i + \varepsilon_E) \quad (4)$$

After rearranging the equation and assuming a constant tax rate across firms, we get the following model for regression analyses:

$$WACC = \gamma_0 + \gamma_1 L + \sum \gamma_i D_i \times L + \sum \gamma_j E_j \times (1 - L) + \varepsilon \quad (5)$$

where

WACC = Weighted-average cost of capital;

D_i = Factors that determine cost of debt;

E_i = Factors that determine cost of equity;

L = Leverage ratio.

[20] We make a simplifying assumption that all firms have only debt and common equity components in the capital structure.

We use S&P long-term credit rating as our proxy for cost of debt[21]. For cost of equity determinants, we include CAPM beta, firm size, book-to-market ratio, and momentum as risk factors (Fama and French, 1993; Carhart, 1997). The results are reported in Table 5. Our sample size is reduced to 91 due to the additional data requirement, mainly the use of S&P credit rating as the proxy for cost of debt. In the regression analysis, we translate the letter grade credit rating into numerical scores, with 1 representing AAA and 10 representing D.[22] We also replace the cost of equity risk factors (size, beta, the book-to-market ratio, and momentum) with their respective decile rankings within the CRSP universe.

We find that the coefficient on leverage is negative and highly significant across all model specifications, consistent with the intuition that weighted-average cost of capital decreases in the degree of leverage because after-tax cost of debt is lower than cost of equity.[23] We also find the coefficients on credit rating (interacted with leverage ratio) are consistently positive with high statistical significance, suggesting that it is an effective control for cost of debt. For our main variables of interest, the results show that firm size, CAPM beta, and short-term stock price momentum (all interacted with one minus leverage ratio) are significantly correlated with cost of equity capital, while the book-to-market ratio is not. The result on CAPM beta is particularly interesting. Consistent with the survey evidence of Graham and Harvey (2001), our analyses suggest that, despite the many criticisms, CAPM is still an important method that managers rely on to gauge their cost of equity capital. However, the results also suggest managers do not apply CAPM in a manner that is strictly consistent with its theoretical development, which allows systematic risk (beta) as the only firm-specific determinant of cost of equity. In particular, the

[21] Hand et al. (1992) find that S&P's credit rating changes are associated with changes in bond prices, and Calomiris et al. (1995) find that firms with more favorable S&P rating have better access to commercial paper markets.
[22] The remaining rating-score translations are: AA~2, A~3, BBB~4, BB~5, B~6, CCC~7, CC~8, C~9
[23] The pecking order theory (Myers and Majluf, 1984) argues that debt financing tends to be less expensive than equity.

finding that firms with larger market capitalization have lower cost of equity is inconsistent with CAPM, but is in line with the conventional argument that size is related to a firm's underlying risk and accessibility to external financing. In addition, the result that recent stock price performance has a contrarian effect on managers' estimate of cost of equity may seem surprising, especially given the well-known phenomenon that share price tends to continue its recent momentum into the near future, but on the other hand is consistent with the strategic market timing hypothesis for equity issuance. (Marsh 1982, Jung et al. 1996)

Taken together, our analyses in this section suggest managers' approach to estimating cost of equity is more consistent with a multi-factor asset pricing model, but their choice of specific risk factors are likely to be different from those found in the academic literature.

4.4 Alternative estimates of cost of equity capital

As an alternative to the factor asset pricing model approach, prior studies of cost of equity have also developed empirical measures of "implied" cost of capital by using various accounting-based valuation models (e.g. Claus and Thomas, 2001; Gebhardt et al., 2001; Easton et al., 2002; Easton, 2004; Ohlson and Juettner-Nauroth, 2005). In this section we compare these model-implied measures of cost of equity with company management's estimates. In particular, we examine three alternative estimates using the PE, PEG, and MPEG approach.[24] We assume a constant tax rate of 40% and a simple capital structure consisting of only debt and equity, and calculate the firm's weighted average cost of capital using the following equation:

[24] Under the PE approach, cost of equity (r_{PE}) is implied by $P_t = \frac{\mathrm{eps_{t+1}+r\times dps_t+eps_{t+2}}}{(1+\mathrm{r})^2-1}$. Under the PEG method, cost of equity (r_{PEG}) is calculated as $r = \sqrt{\frac{eps_{t+2}-eps_{t+1}}{P_t}}$. Under the MPEG approach, cost of equity (r_{MPEG}) is implied by $P_t = \frac{\mathrm{eps_{t+2}+r\times dps_t-eps_{t+1}}}{\mathrm{r}^2}$, where eps_{t+1} and eps_{t+2} are the earnings forecast for year t+1 and t+2, respectively, both measured in December of year t. P_t is the price at the end of year t, and dps_t is dividend per share paid in year t.

$$WACC = K_D \times \frac{D}{A} \times 0.6 + K_E \times (1 - \frac{D}{A}) \quad (6)$$

where K_D is cost of debt, estimated using the average bond yield of all firms within the same S&P rating category as the current firm.[25] D is book value of long-term debt, A is the sum of book value of long-term debt and market value of common equity, K_E is cost of equity capital estimated using the PE, PEG, or MPEG approach.

Due to the additional requirement of analyst forecasts and bond yield data, our sample size is reduced to 46. As reported in Panel A of Table 6, the weighted-average cost of capital estimates derived from the valuation model approach range from 5.3% to 8.7%, which are consistently lower than those estimated by company management (10.4%). In addition, both PEG and MPEG estimates of overall cost of capital exhibit positive, albeit weak, correlations with managers' estimates. However, since these figures combine both the effects of cost of debt and equity, it is too early to conclude that PEG and MPEG estimates of cost of equity are more closely related to managers' estimates. To purge the debt component from overall cost of capital, we adopt a similar approach as in section 4.3, and replace the equity risk factors in equation (5) with one of the estimates from the PE, PEG, or MPEG method. The multivariate regression results in Panel B of Table 6 show that, after controlling for the impact of leverage and S&P credit rating, none of valuation-model-implied estimates of cost of equity is reliably related to management's estimates of cost of capital. Aside from the possibility that the power of our test is restricted by the relatively small sample size, these results suggest there may be fundamental differences between "implied" cost of capital and the cost of capital used by

[25] The analyst forecast and bond yield data were collected from the I/B/E/S and S&P RatingsDirect® databases, respectively.

managers in their actual decision making process. Instead, our analyses suggest managers are more in favor of using the multi-factor asset pricing model approach to estimate cost of equity.

4.5 Investment and cost of capital

Standard finance textbooks have established that cost of capital is a fundamental piece of capital budgeting decision and thus affects the firm's investment (e.g., Copeland et al., 2005). Loosely speaking, for a firm whose available investment opportunities are not mutually exclusive, its investment level should be an inverse function of its cost of capital, other things being equal. Compared with cost of capital estimated by market data, our sample of cost of capital that reflect company management's estimates provides an ideal opportunity to empirically examine this prediction, because arguably the cost of capital estimates and investment decisions are both made by the same party.

The results in Panel B of Table 7 show that a firm' cost of capital has a major impact on its investment level. In particular, firms with more expensive source of capital invest significantly less on long-term physical assets. By our estimate, 1% increase in cost of capital reduces the firm's average capital expenditure over next three years by 0.09% of total assets, which for our sample firms amounts to about 7 million dollars per year.[26] In additional analyses, we control for firms' investment opportunity sets (measured by Tobin's Q) and internal financing capability (measured by average operating cash flows over the past five years), both of which have been suggested by prior research as important determinants of corporate investment (e.g. Fazzari et al., 1988). Our results are robust to these alternative model specifications.

5. Conclusion and discussion

We add to the cost of capital literature by studying management estimates of cost of capital. Using a sample of cost of capital estimates manually collected from firms' 10-K filings,

[26] The average total assets for our sample firms for this test is 7.64 billion (untabulated).

we find that several firm characteristics, such as firm age, financial leverage, cash holding, and cash flow volatility, are among the important determinants of firms' overall cost of capital. Further, management's estimates of cost of equity are correlated with firm size, CAPM beta, and momentum, but not with book-to-market ratio or cost of equity "implied" by various accounting-based valuation models (e.g. PE, PEG, or MPEG ratio). Finally, we find that cost of capital has a significant impact on corporate investment.

The findings of our study suggest that there may be fundamental differences between managers' choice of cost of capital and estimates derived from market data and popular valuation models, which have important implications for understanding manager's investment and financing decisions. It is our maintained assumption that the difference arise from investors' and managers' divergent views on cost of equity, because it is generally easier to obtain accurate estimates of, and hence to agree on the cost of debt. In theory, cost of equity should reflect the return demanded by equity investors on their investment in the firm, and therefore the cost of equity used by managers should be their best estimates of investors' demand. By such reasoning, any deviation from the market's expected return will lead managers to make suboptimal decisions and hence should be avoided. On the other hand, it is usually extremely difficult, if not impossible at all, to develop a perfect estimate of expected return. So the difference may as well be the joint result of multiple forces, such as the information asymmetry between management and investors, or the inadequacy of current estimation methodology of cost of equity. Regardless of its cause, the difference itself suggests that the study of management's estimate of cost of capital offers promising opportunities for future research that seek to understand managerial behavior and corporate finance decisions.

Like most of the studies that employ hand-collected data, our study has a modest sample size and hence is subject to potential limitations on the generalizability of our findings. However, as discussed in section 4.1, while our sample covers a relatively short time period, it spans a wide cross-section of industries and does not exhibit significant idiosyncracy in most of the major firm characteristics. Therefore, while unable to verify that the firms examined in our study are drawn through a random process, we are also unaware of any peculiarity of the sample that would bias our results in a systematic way. Another concern is that the discount rates we collected may actually reflect the hurdle rates that were set by managers with discretion, and hence may not track the firms' cost of capital perfectly. While it is certainly a possibility that a manager's choice of discount rates could deviate from her estimates of cost of capital due to certain strategic considerations or agency problem, it needs not to have any material impact on our results because the focus of our study is on the determinants of cross-sectional variation in cost of capital, rather than the magnitude of cost of capital per se. For this reason, we allow the discount rates to track cost of capital with error, as long as the errors are random and do not consistently co-vary with the firm characteristic variables that were examined in our tests. Finally, in this study we examine only factors that are grounded in economic theory, while leaving out the role of any personal attributes or human heuristics in affecting the manager's estimate of cost of capital.[27] We believe it is an interesting question, and leave it for future research to answer.

[27] Prior studies have documented that managers differ in skills, preferences, risk aversion, and reputation, and that these characteristics affect corporate accounting, financing and investing decisions (e.g., Graham and Harvey, 2001; Bertrand and Schoar, 2003; Aier et al., 2005).

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Appendix A Sample disclosures of firms' cost of capital

1. Firm-wide cost of capital

Eddie Bauer Holdings (2008, 10-K, emphasis added)

Our goodwill impairment test was completed using the two-step approach prescribed in SFAS 142. The first step included a determination of the enterprise value of the Company using a discounted cash flow model which included our five-year long-range plan related to the future cash flows of our primary assets; ***a discount rate of 17.0%, which represented our weighted average cost of capital***; and a terminal value growth rate of 3.0%. In order to assess the fair value of the Company in its entirety, following the calculation of the discounted cash flows of our primary assets, the book value of our interest-bearing debt was deducted and the fair values of the assets not contributing to the discounted cash flows of our primary assets, including our net operating loss carryforwards, were added to derive the fair value of our total net assets. Upon completion of step one of the goodwill impairment test, the estimated fair value of the Company was less than the carrying value of our net book value and long-term debt. Accordingly, we completed step two of the goodwill impairment test, which included comparing the implied fair value of the Company with the carrying amount of goodwill. Upon completion of step two of the goodwill impairment test, we recorded an impairment charge of $64.6 million related to our goodwill. Consistent with the decline in the fair value of our trademarks, the decline in our enterprise value since the prior year-end was driven by the overall downturn in the economy and projected continued declines in consumer retail spending.

2. Project-specific cost of capital

FEDEX CORP (2008 10-K, emphasis added)

We performed our annual impairment testing in the fourth quarter for the Kinko's trade name and the recorded goodwill for the FedEx Office reporting unit. In accordance with the accounting rules, the trade name impairment test was performed before the goodwill impairment test.

In accordance with SFAS 142, "Goodwill and Other Intangible Assets," a two-step impairment test is performed on goodwill. In the first step, we compared the estimated fair value of the reporting unit to its carrying value. The valuation methodology to estimate the fair value of the FedEx Office reporting unit was based primarily on an income approach that considered market participant assumptions to estimate fair value. Key assumptions considered were the revenue and operating income forecast, the assessed growth rate in the periods beyond the detailed forecast period, and the discount rate.

In performing our impairment test, the most significant assumption used to estimate the fair value of the FedEx Office reporting unit was the discount rate. ***We used a discount rate of 12.5%, representing the estimated weighted-average cost of capital ("WACC") of the FedEx***

Office reporting unit. The development of the WACC used in our estimate of fair value considered the following key factors:

- benchmark capital structures for guideline companies with characteristics similar to the FedEx Office reporting unit;
- current market conditions for the risk free interest rate;
- the size and industry of the FedEx Office reporting unit; and
- risks related to the forecast of future revenues and profitability of the FedEx Office reporting unit.

The WACC used in the estimate of fair value in future periods may be impacted by changes in market conditions (including those of market participants), as well as the specific future performance of the FedEx Office reporting unit and are subject to change, based on changes in specific facts and circumstances.

Appendix B Definition of Variables

AT	Total assets (AT#)
SALE	Sale (SALE#)
DTL	Total long-term debt (DLTT#+DD1#)
MV_EQ	Market value of common equity (PRCC_F#*CSHO#)
SIZE	Firm size (DTL+MV_EQ)
LEV	Leverage (DTL/MV)
Q	Tobin's Q (SIZE/(DTL+CEQ#))
BTM	Book-to-market ratio of common equity (CEQ#/MV_EQ)
CASH	Cash balance divided by total assets (CHE#/AT)
ROA	Income before extraordinary items divided by total assets (IB#/AT)
CFO	Cash flow from operations divided by total assets (OANCF#/AT)
CFO5	Average operating cash flow (CFO) over the most recent 5 years before current fiscal year
IA	Intangible assets divided by total assets (INTAN#/AT)
GW	Goodwill divided by total assets (GDWL#/AT)
EBIT	Earnings before interest and tax, divided by total assets (OIADP#/AT)
TAX	Effective tax rate, measured by income tax divided by pretax income (TXT#/PI#)
FIRM_AGE	Firm age, measured by the number of years since the firm first appears in CRSP
σ(CFO)	Cash flow volatility, measured by standard deviation of CFO over most recent 5 years.
BETA	CAPM Beta measured over the most recent calendar year before current fiscal year end.
RET	Average annual return over the most 3 calendar years before current fiscal year end.
RATING	S&P long-term credit rating converted into scale of 1-10, with 1=AAA and 10=D
PE	Cost of equity estimated using PE approach
PEG	Cost of equity estimated using PEG approach
MPEG	Cost of equity estimated using Modified PEG approach
CAPX	Average capital expenditure divided by total assets (CAPX#/AT) over the 3 years immediately after current fiscal year

COMPUSTAT mnemonics

Table 1 Summary Statistics

Panel A Descriptive Statistics of Sample Firms

Variable	N	Mean	Median	Std Dev	Q1	Q3	COMPUSTAT Median
AT	307	7165.80	1241.63	30319.57	399.05	4983.10	421.04
SALE	307	3372.92	938.45	6380.34	314.80	3443.00	231.64
DTL	307	1483.58	378.34	3061.50	42.11	1306.36	41.11
MV_EQ	307	3498.80	723.19	7083.49	231.73	3068.26	334.63
SIZE	307	4982.39	1199.23	9351.66	390.36	4957.05	451.10
LEV	307	0.32	0.30	0.25	0.10	0.50	0.13
Q	307	1.68	1.27	2.33	1.00	1.79	1.59
BTM	307	0.81	0.65	1.11	0.39	1.00	0.50
CASH	307	0.13	0.08	0.16	0.02	0.18	0.10
ROA	307	-0.12	0.01	0.44	-0.12	0.04	0.02
CFO	307	0.06	0.07	0.11	0.03	0.11	0.06
IA	305	0.31	0.29	0.23	0.12	0.46	0.04
GW	291	0.23	0.19	0.18	0.09	0.35	0.02
EBIT	306	0.00	0.07	0.41	0.02	0.13	0.07
TAX	307	0.09	0.24	1.68	0.00	0.36	0.26
AGE	307	18.21	13.00	16.50	6.00	26.00	10.00
σ(CFO)	307	0.06	0.04	0.06	0.02	0.07	0.05

Panel B Cost of Capital

	N	Mean	Median	Std Dev	Q1	Q3	Max	Min
ALL	307	0.133	0.123	0.046	0.100	0.150	0.450	0.067
Project-specific	230	0.139	0.130	0.046	0.110	0.155	0.450	0.068
Firm-wide	77	0.116	0.103	0.043	0.085	0.130	0.300	0.067

Notes to Table 1: the sample spans from 2001 to 2008. See Appendix B for variable definitions.

Table 2 Industry Cost of Capital

Panel A Cost of Capital by Fama-French 12 Industry

Industry	N	%	Mean	Median	COMPUSTAT %
BUSEQ	79	25.7%	0.166	0.150	16.6%
CHEMS	6	2.0%	0.118	0.120	1.8%
DURBL	3	1.0%	0.144	0.140	1.9%
ENRGY	11	3.6%	0.127	0.120	3.4%
HLTH	17	5.5%	0.115	0.103	9.4%
MANUF	51	16.6%	0.114	0.110	7.6%
MONEY	18	5.9%	0.137	0.130	32.2%
NODUR	27	8.8%	0.114	0.108	4.0%
SHOPS	17	5.5%	0.136	0.130	7.1%
TELCM	14	4.6%	0.144	0.118	3.1%
UTILS	7	2.3%	0.100	0.096	2.1%
OTHERS	57	18.6%	0.121	0.120	10.9%

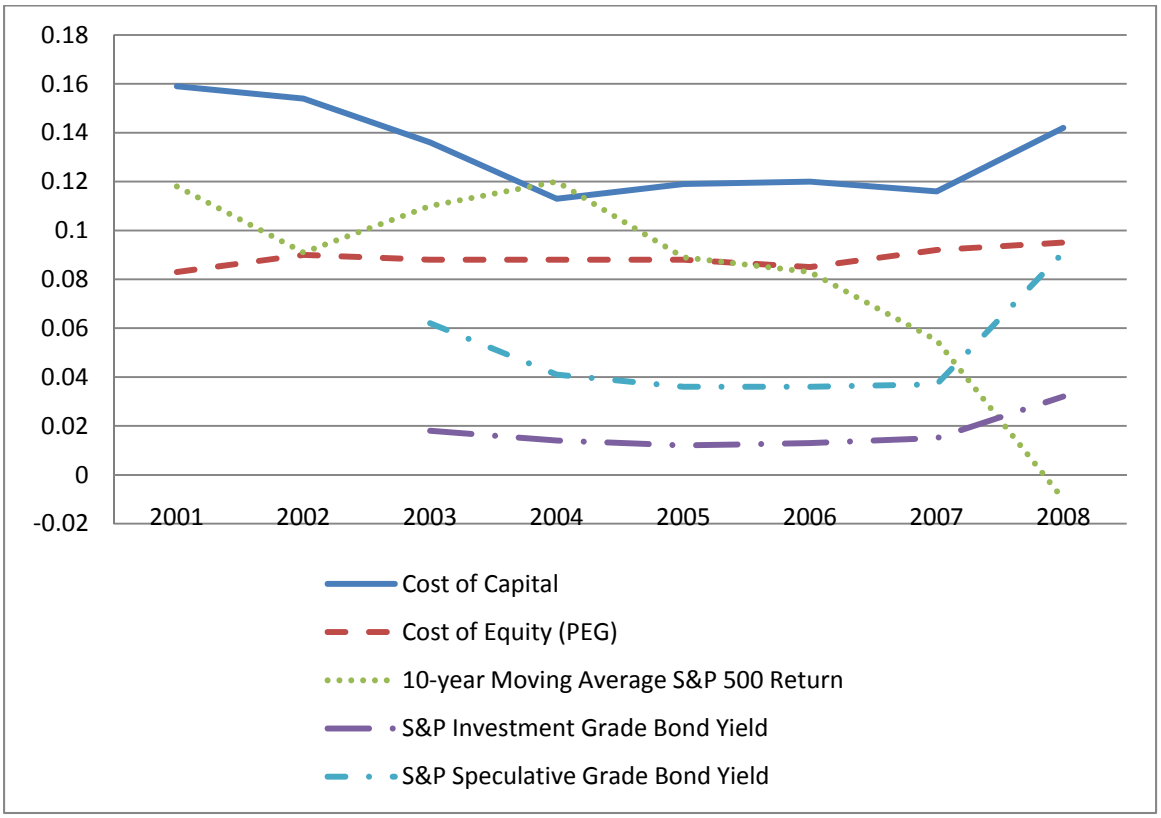
Panel B Regression Analysis of Industry Cost of Capital $CC = \beta_0 + \sum \beta_i \times IND_i$

Industry	Parameter Estimates	t-stat
Business Equipment (Intercept)	0.166***	35.29
Chemicals and Allied Products	-0.048***	-2.70
Consumer Durables	-0.022	-0.90
Oil, Gas and Coal Extraction and Products	-0.039***	-2.90
Healthcare, Medical Equipment, and Drugs	-0.051***	-4.55
Manufacturing	-0.052***	-6.87
Finance	-0.029***	-2.66
Consumer Non-Durables	-0.052***	-5.60
Wholesale, Retail, and Some services	-0.030**	-2.67
Telephone and Television Transmission	-0.021*	-1.77
Utilities	-0.066***	-4.00
Other	-0.045***	-6.20
R^2	0.183	

*, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.

Table 3 Time Series of Cost of Capital

Chart



Summary Time-Series and Correlation

Year	Cost of Capital	PEG	SP 500	Investment Bond Yield	Speculative Bond Yield
2001	0.159	0.083	0.118	-	-
2002	0.154	0.090	0.091	-	-
2003	0.136	0.088	0.110	0.018	0.062
2004	0.113	0.088	0.120	0.014	0.041
2005	0.119	0.088	0.089	0.012	0.036
2006	0.120	0.085	0.083	0.013	0.036
2007	0.116	0.092	0.055	0.015	0.037
2008	0.142	0.095	-0.010	0.032	0.091
Corr(x,rate)	**-**	**-0.08**	**-0.01**	**0.84****	**0.92*****

*, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.

Table 4 Determinants of Cost of Capital

Panel A Correlation (N = 297)

	SIZE	Q	AGE	CASH	TAX	LEV	CFO5	EBIT	σ(CFO)
RATE	-0.25	0.26	-0.28	0.44	-0.25	-0.44	-0.16	-0.28	0.47
SIZE		0.22	0.24	-0.06[#]	0.11[$]	0.13[^]	0.24	0.34	-0.43
Q			0.03[#]	0.29	-0.08[#]	-0.54	0.23	0.12[^]	0.21
AGE				-0.12[^]	0.22	0.04[#]	0.34	0.12[^]	-0.15
CASH					-0.13[^]	-0.56	-0.13[^]	-0.19	0.40
TAX						0.13[^]	0.27	0.42	-0.18
LEV							-0.05[#]	0.16	-0.43
CFO5								0.40	-0.19
EBIT									-0.37

Panel B Multivariate Regression Analysis $Rate_t = \alpha + \Sigma\beta_k \cdot X_{k,t-1} + \varepsilon_t$

Variable	Coefficient	t-stat	Coefficient	t-stat
Intercept	15.26***	9.68	14.11***	12.65
SIZE	-0.17	-1.27		
Q	0.20	1.65		
AGE	-0.31***	-3.86	-0.36***	-4.81
CASH	0.37***	3.59	0.36***	3.58
TAX	-0.11	-1.36		
LEV	-0.22*	-1.68	-0.32***	-2.84
CFO5	-0.02	-0.18		
EBIT	-0.14	-1.08		
σ(CFO)	0.43***	3.50	0.56***	5.23
FIRMWIDE	-1.83***	-3.62	-1.96***	-3.90
N	297		297	
Adj-R^2	0.388		0.380	

Notes to Table 4: See Appendix B for variable definitions. Annual decile rankings of determinant variables are used in the correlation and regressions. For Panel A, all correlations are significant at 1% except [^] (5%), [$] (10%), and [#] (insignificant). For Panel B, all coefficients are multiplied by 100 for expositional convenience. *, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.

Table 5 Determinants of Cost of Equity Capital

Panel A Descriptive Statistics of Sample

Variable	N	Mean	Median	Std Dev	Q1	Q3
RATE	91	0.12	0.11	0.03	0.09	0.13
LEV	91	0.36	0.33	0.19	0.19	0.52
RATING	91	4.78	5.00	0.93	4.00	6.00
MV_EQ	91	7.07	2.40	15.15	0.61	6.30
BETA	91	1.13	1.04	0.62	0.76	1.48
BTM	91	0.77	0.58	0.84	0.36	0.83
RET	91	0.05	0.06	0.54	-0.22	0.28

Panel B Regression Analysis

$$RATE_t = \alpha_0 + \alpha_1 LEV_t + \beta * RATING_{t-1} * LEV_t + \gamma * K_{Et-1} * (1-LEV_t) + \varepsilon_t$$

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.017	0.091***	0.142***	0.153***	0.029
	(0.42)	(6.17)	(13.94)	(13.36)	(0.66)
LEV	-0.193***	-0.201***	-0.259***	-0.272***	-0.171**
	(-2.84)	(-3.08)	(-3.86)	(-4.11)	(-2.59)
RATING	0.055***	0.038***	0.041***	0.040***	0.048***
	(4.73)	(3.65)	(3.65)	(3.66)	(4.32)
MV_EQ	0.014**				0.011**
	(2.95)				(2.38)
BETA		0.008***			0.006***
		(3.53)			(3.15)
BTM			-0.002		-0.002
			(-0.98)		(-1.06)
RET				-0.004**	-0.003**
				(-2.03)	(-2.05)
N	91	91	91	91	91
Adj-R^2	0.196	0.226	0.125	0.155	0.298

Notes to Table 5: See Appendix B for variable definitions. Annual decile rankings of MV_EQ, BETA, BTM, and RET are used in the regressions. *, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.

Table 6 Alternative Estimates of Cost of Equity

Panel A Descriptive Statistics of Sample

Variable	N	Mean	Median	Std Dev	Q1	Q3	Corr (Rate,X)
RATE	46	0.104	0.100	0.019	0.090	0.120	
YIELD	46	0.068	0.070	0.006	0.067	0.073	0.107
WACC_PE	46	0.053	0.052	0.010	0.046	0.060	0.145
WACC_PEG	46	0.082	0.083	0.020	0.070	0.093	0.250*
WACC_MPEG	46	0.087	0.086	0.020	0.073	0.098	0.246*

Panel B Regression Analysis

$$RATE_t = \alpha_0 + \alpha_1 LEV_t + \beta * RATING_{t-1} * LEV_t + \gamma * K_{Et-1} * (1-LEV_t) + \varepsilon_t$$

	Dependent Variable: Overall Cost of Capital		
Intercept	0.111***	0.123***	0.122***
	(6.89)	(6.51)	(6.22)
LEV	-0.140**	-0.155**	-0.151**
	(-2.33)	(-2.05)	(-2.14)
RATING	0.020*	0.021*	0.020*
	(1.94)	(1.76)	(1.83)
K_E_PE	0.176		
	(0.66)		
K_E_PEG		-0.028	
		(-0.17)	
K_E_MPEG			-0.017
			(-0.10)
N	46	46	46
Adj-R^2	0.129	0.120	0.120

Notes to Table 6: YIELD is average yield of all bonds in the same rating category at the beginning of current year. K_E_PE, K_E_PEG, and K_E_MPEG are cost of equity estimated using the PE, PEG, and MPEG approach, respectively. WACC_PE, WACC_PEG, WACC_MPEG are weighted average cost of capital calculated using PE, PEG, and MPEG estimates of cost of equity, respectively. An effective tax rate of 40% is used when estimating WACC. *, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.

Table 7 Cost of Capital and Investments

Panel A Descriptive Statistics of Sample

Variable	N	Mean	Median	Std Dev	Q1	Q3	Corr (CAPX,X)
CAPX	288	0.034	0.024	0.029	0.014	0.046	
RATE	288	0.132	0.122	0.045	0.100	0.150	-0.144**
Q	288	1.581	1.283	1.093	1.015	1.808	0.164***
CFO5	288	0.063	0.065	0.082	0.044	0.101	0.154***

Panel B Regression Analysis: $CAPX_{t\sim t+2} = \beta_0 + \beta_1 RATE_{t-1} + \beta_2 Q_{t-1} + \beta_3 CFO5_{t-1} + \varepsilon_t$

	Model 1	Model 2	Model 3	Model 4
Intercept	0.046***	0.040***	0.042***	0.034***
	(8.77)	(7.18)	(7.39)	(5.75)
RATE	-0.093**	-0.103***	-0.080**	-0.090**
	(-2.46)	(-2.76)	(-2.12)	(-2.40)
Q		0.005***		0.005***
		(3.08)		(3.35)
CFO5			0.049**	0.055**
			(2.33)	(2.67)
N	288	288	288	288
Adj-R^2	0.017	0.046	0.032	0.066

Notes to Table 7: See Appendix B for variable definitions. CAPX is measured at 1 year lag to cost of capital estimates. Tobin's Q and CFO5 are measured at the same year of cost of capital. *, **, *** denotes significant (two-sided) at 1%, 5%, and 10%, respectively.