The Term Structure of Implied Costs of Equity Capital

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Abstract

Using data extracted from forward looking option contracts, we estimate the term structure of implied costs of equity capital and implied risk premia at the firm-level for the years 1996-2009. We are able to reject the assumption that implied firm-level costs of equity capital are constant over time. Instead, we find that the term structure of implied costs of equity capital and of implied risk premia are upward sloping and concave for most years and industries. Interestingly, we also find that the term structure of implied costs of equity capital and risk premia were downward sloping for 2008, which suggests that during the height of the economic crisis investors required a high risk premium in the short term but expected the premium to fall in the future. We further validate the term structure cost of capital estimates by reference to future stock returns. Cross-sectional and time-series asset pricing tests indicate that time varying implied costs of equity capital are positively and significantly associated with future stock returns. In contradistinction, Easton's PEG and the "street" based earnings per share ratio (EPR) implied cost of capital estimates are either not associated with future stock returns or the associations are less robust than the term structure estimates. In addition to bridging the gap between the empirical accounting valuation literature that assumes a flat term structure for implied costs of equity and the extensive empirical evidence that costs of equity capital are time varying, we also contribute to the literature by linking accounting-based valuation and option pricing.

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1 Introduction

The purpose of this study is to derive and validate empirical estimates of the term structure of implied costs of equity capital and implied risk premia at the firm level. The extant literature extracts intertemporally constant (flat term structure) firm-level implied costs of equity capital by reverse engineering market value and accounting/analyst forecast data. However, the assumption that the cost of equity capital is static stands in contrast to the extensive empirical evidence that firms' costs of equity capital are time varying.

This study employs call and put option data to construct synthetic futures prices that, in turn, are used to extract term structures of the firm's implied costs of equity capital and risk premia. We find that we can reject the hypothesis that the term structure of the firm's implied costs of equity capital and risk premia are intertemporal constants. Rather, for most years and industries, the average cross-sectional term structure of firms' implied costs of equity capital and term structure of implied risk premia are significantly upward sloping and concave with maturity, similar to the conventional upward sloping concave shape of the term structure of risk-free interest rates. Of course, like interest rates, the term structures of implied costs of equity and implied risk premia need not always be upward sloping. In fact, we find that average cross-sectional costs of equity and risk premia term structures are downward sloping during the global crisis period of 2008.[1] Importantly, we find that our dynamic implied costs of equity capital estimates are highly related to future equity returns, in contrast to Easton's (2004) PEG and "street" based earnings per share ratio (EPR) estimates that are either not associated with future stock returns or the association is substantively weaker than for our term structure estimates.

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[1] From this point on until the formal hypotheses, we save on verbiage by referring solely to the term structure of costs of equity with the term structure of risk premia implicitly understood.

This study contributes to the literature in a number of ways. First, we show how to estimate empirically a term structure of implied costs of equity capital, a worthwhile undertaking in light of the extensive finance literature showing that costs of capital are time varying. Second, we show how accounting-based valuation models and forward looking information contained in option prices can be linked in a manner consistent with underlying theory. Third, we show that our term structure estimates convey information about expected future returns. Lastly, our term structure cost of equity measures are relatively easy to implement which should be useful to both academics and practitioners.

In what follows, Section 2 provides a brief review of the relevant literatures and develops the hypotheses. Section 3 provides a calibrated example showing the potential importance for valuation purposes of a time varying term structure of costs of equity relative to a flat term structure. Section 4 describes the models. Section 5 discusses the data and the empirical implementation. Section 6 presents the empirical results including the asset pricing tests. Section 7 concludes.

2 Literature Review and Hypotheses

Is a time varying term structure concept of implied costs of equity capital empirically meaningful beyond the traditional flat term structure approach? Three streams of literature inform on this research question and motivate this study, namely, the implied cost of equity literature, the literature on time varying discount rates, and the literature on the usefulness of option pricing information in predicting future stock returns.

The accounting and finance literatures provide a number of different implied cost of equity capital models (see the recent survey by Easton 2009).[2]The es-

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[2] Although most of the implied cost of capital papers are in the accounting literature, inroads have recently been made in the finance literature as well. See Pastor, Sinha and

sential idea is common across all of these models. Given the current stock price, estimated future cash flows and a valuation model, the implied cost of equity is the discount rate that equates the current market price with the present value of estimated future cash flows. By construction, this approach yields a flat term structure.[3]The model of course defines the exact structural relation between the current stock price and future cash flows. Often, analyst earnings forecasts are used to proxy for the markets expectation of the firm's future cash flows to the extent that such forecasts are available. These models can be further characterized by whether an estimate of the firms' terminal value is required or not.

Early work by Botosan (1997), Claus and Thomas (2001), Gebhardt et al. (2001) and Morel (2003) use various implementations of the residual income and Ohlson (1995) models in their estimation procedures. More recent studies focus on deriving cost of equity capital estimates using common ratios and exploiting the Ohlson and Juettner-Nauroth (2005) model, such as Gode and Mohanram (2003), and Easton (2004). A large body of literature has applied these measures to investigate associations between the implied cost of equity capital and variables of interest to accounting researchers. For instance, Botosan (1997) explores the relation between the implied cost of capital and disclosure. Francis et al. (2004) investigate the association between the implied cost of capital and earnings attributes, while Ogneva et al. (2007) explore the association between cost of equity and internal control effectiveness. However, the validity of these implied cost of capital estimates appears to be uncertain. Guay et al. (2005) and Easton and Monahan (2005) assess the association between realized stock returns and the rate of return implied by flat term structure models. Their results suggest that current measures of costs of equity have a low association with

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Swaminathan (2008), for example.

[3] We use the term cash flows generically. In many of these models, cash flows are in fact replaced by earnings via the clean surplus relation.

realized returns and provide little information beyond a simple earnings/price model. In contrast, Lee et al. (2010) find that some implied cost of capital methods do a credible job of predicting future firm-level returns, especially by comparison to factor model approaches favored by the finance literature.

To date, the empirical implied cost of equity literature has focused exclusively on extracting a flat term structure estimate for the firm's cost of equity capital despite a rather sophisticated theoretical accounting literature whose models incorporate dynamic discount rates (Feltham and Ohlson 1999, Ang and Liu 2001, Gode and Ohlson 2004, Callen and Segal 2004, Hughes et al. 2009). These theoretical studies recognize the potential limitations of the flat term structure assumption. For example, Hughes et al. (2009) develop a parsimonious model showing that the constant cost of equity capital assumption yields expected returns only under very restrictive conditions.

The finance literature and, to a lesser extent, the accounting literature provide extensive empirical evidence that security values are consistent with time varying discount rates.[4]The finance literature finds that variations in the market's required total return is substantial relative to variations in expected real interest rates, implying that a large fraction of the variation in the cost of equity capital may be attributable to intertemporal changes in equity risk premia. In other words, it is not simply the dynamics of the risk-free interest rate that cause costs of equity capital to vary over time. However, as valuable as these studies are to our understanding of the cost of equity capital, either they are purely theoretical in nature or their estimated time varying costs of equity capital are totally model-driven without reference to current market values. For example, Ang and Liu (2004), using various assumptions about dynamic risk-free rates,

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[4] See Campbell and Shiller (1988), Campbell (1991), Hodrick (1992), Jagannathan and Wang (1996), Fama and French (1997,2002), Lamont (1998), Jagannathan et al. (2000), Lettau and Ludvigson (2001, 2002), Vuolteenaho (2002), Chen (2003), Campbell and Vuolteenaho (2004), Ang and Liu (2004), Callen and Segal (2004, 2005, 2006) and Petkova and Zhang (2005) among others.

risk premia and conditional betas, provide a model-driven method for discounting expected future cash flows with time varying discount rates. Their research provides evidence that valuations can be significantly different when using time varying discount rates relative to static constant rates. Nevertheless, their study does not provide a method for estimating, nor do they estimate, time-varying *implied* costs of equity capital.

Why the extant empirical literature has failed thus far to employ time-dependent models for estimating implied costs of equity capital is unclear. Certainly, the issue has been of concern to accounting scholars. Beaver (1999) criticizes the accounting cost of capital literature noting that "it is remarkable that the assumption of a constant [discount rate] across firms and *time* is the best we can do". Cready (2001) notes that if the term structure of the costs of equity capital are indeed upward sloping, an empirical cost of capital estimate predicated on a flat term structure would cause near-term values to be understated and long-term values to be overstated. In a similar vein, Lambert (2009) points out that "of all the potential problems in estimating implied cost of capital, the lack of constancy of the discount rate is probably the most under-researched in the literature". Perhaps, term structure effects are deemed ex ante to be of second order importance and, therefore, of less concern to empirical researchers. But, this conjecture remains an open empirical question, especially given the extensive literature referenced above which shows fairly conclusively that costs of equity capital are time varying. A more plausible explanation for the paucity of empirical research in this area can likely be ascribed to the absence of relevant data. If a researcher would like to estimate a term structure of the *implied* costs of equity capital, she must have access to variables that measure value at different points of time in the future. However these variables are usually not readily available. For example Ang and Liu (2004, p. 2756) state that *"potentially one can obtain the term structure of expected returns* *from observing the prices of stock futures contracts of different maturities. For example, if a series of derivative securities were available, with each derivative security representing the claim on a stock's dividend, payable only in each separate future period, the prices of these derivative securities would represent the spot discount curve. Given the lack of suitable traded derivatives, particularly on portfolios, we directly estimate the discount curves."*

Another relevant body of empirical literature shows that option price data contain useful information for predicting future stock returns and stock volatility. Since the work of Easley et al. (1998) suggesting that informed investors trade in options markets in order to exploit their informational advantage, empirical researchers have tried to exploit the information contained in option markets for understanding equity returns. For example, Ofek et al. (2004) and Cremers and Weinbaum (2010) demonstrate that violations of put-call parity have predictive power for future stock returns. Christensen and Prabhala (1998) find that implied volatility helps to forecast future realized volatility for S&P 100 contracts and Xing et al. (2010) find that volatility smirks contain information about future returns and earnings shocks. Additionally, a number of papers have incorporated option information into CAPM type models following a suggestion by French et al. (1983) to use implied volatilities in the CAPM. For example Buss and Vilkov (2009) and Chang et al. (2009) find that incorporating option information is useful in predicting future betas and market returns. Recently in the accounting literature, Rogers et al. (2009) utilize implied volatilities in the context of management earnings guidance.[5]Intuition suggests that option contracts could be useful in deriving time varying implied costs of equity capital. One of the difficulties with using option contracts is the lack of a theoretically sound, yet relatively simple, model that guides in

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[5] See Patell and Wolfson (1979, 1981) for an early attempt to extract forward looking earnings information from option prices.

using these contracts to extract a term structure of implied costs of equity. We provide such theory in this paper.

As stated above, the term structure of futures contracts potentially offers an ideal approach for extracting information useful in constructing a term structure of implied costs of equity capital. The problem is that futures contracts are not often traded on individual stocks or on dividend streams.[6] To overcome this problem, we use call and put options with the same maturity and strike prices to construct synthetic futures contracts. Options offer a number of practical advantages in this regard relative to other derivatives. They are traded on an increasing number of firms, have multiple expiry dates (a term structure of expiries) and, with the emergence of research databases, there is a large amount of daily data available. The synthetic contracts derived from options are shown below to give market implied values for future dividend (cash flow) risk which play a crucial role in shaping the term structure of the implied cost of equity. Together with other inputs derived from basic valuation theory, we use these synthetic futures contracts to extract estimates of the term structure of implied costs of equity capital. Further, we conduct asset pricing tests to determine if these estimates provide information about future risk-adjusted stock returns. Thus, this study bridges the gap between prior research which estimates a static implied cost of equity from current stock prices utilizing accounting-based valuation models and research that estimates time varying expected returns.

To summarize, much of prior research finds that accounting based measures of static implied costs of equity capital have very low associations with realized returns (Easton and Monahan 2005, Guay et al. 2005). The finance and, to a lesser extent, accounting literatures provide extensive evidence that costs of equity capital are time varying. There is a growing literature which demon-

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[6] There are small exchanges, for example the company One Chicago, www.onechicago.com, which provides a platform for trading individual futures contracts. However, these exchanges are in their infancy.

strates that option market data contain information useful for predicting stock returns. We link these literatures together by incorporating option information into a valuation model in order to derive time varying implied costs of equity capital at the firm-level. We conjecture that time varying implied costs of equity are more informative about future returns than existing static methods. These considerations lead to the following hypotheses (stated in the alternative):

Hypothesis 1 (H1). The term structures of the firm's implied costs of equity capital and implied equity premia are not flat.

Hypothesis 2 (H2). Time varying implied cost of equity capital and risk premia estimates have a positive and more statistically significant association with (risk-adjusted) realized returns than estimates derived from conventional flat term structure models.

Rejection of the H2 *null* hypothesis would lead us to conclude that time varying term structures of implied costs of equity convey more information about future returns than traditional methods which assume a flat term structure. Inability to reject the null is also potentially informative because it suggests that option prices may not be useful in explaining time varying implied costs of equity capital and that alternative methods should be considered.

3 Valuation Implications of Using a Flat Term Structure: A Calibrated Example

This section presents a simple calibrated example to illustrate the potential valuation errors caused by assuming a flat cost of equity capital when the true cost of equity capital is time varying. Assume that stocks are priced using the standard dividend discount model $S_t = \sum_{i=1}^{\infty} E_t[R_{t+i}^{-1} D_{t+i}]$ where S_t is the stock price (at time t), E_t is the expectation operator, R_t is the discount factor and D_t represents cash dividends paid out to investors. Since our focus is on the role of time varying discount rates, without loss of generality, we set $\mathrm{D}_{t+i} = 1$, $\forall i \geq 1$. Assuming a flat term structure yields a stock price of

$$S_t^F = \frac{1}{R-1}$$

To simplify the exposition, assume a simple time varying term structure of the form $R_t = e^{a+\frac{b}{t}}$ where a and b are constants, $a > 0$.For any b, $R_t \to e^a$ as $t \to \infty$; that is, the time dependent discount factor eventually converges to some constant value e^a. For negative values of b, this term structure exhibits concavity in t which is consistent with our empirical findings below. This form of discount factor yields a stock price of

$$S_t^V = \frac{e^{-b}}{e^a - 1}.$$

Also, for simplicity, assume that the constant discount factor takes the form $R = e^c$, where $c \in (0, a]$. This implies a stock price of

$$S_t^F = \frac{1}{e^c - 1}.$$

for the flat term structure model.

If the time varying discount rate is the rate that the market uses when pricing stocks, the valuation error generated by using the flat term structure instead of a time varying term structure is

$$\frac{S_t^V - S_t^F}{S_t^V} = 1 - e^b \left(\frac{e^a - 1}{e^c - 1} \right).$$

The valuation error is a function of all three parameters a, b and c. In the extreme case where $c = a$, the error in valuation is minimal for very small values of b. For example, in this study we find that the average upward slope of the two-year term structure is approximately 0.41 basis points per year. This implies an approximate value of -0.11% for b and a modest 0.11% valuation error. However, suppose that we fix b at -0.11% and let $a = 8.26\%$ (the average estimated value for the two-year term) while setting c to be the average level of the discount rate over the two years of 7.57%. This yields a valuation error of around 10%, which is economically very meaningful. As we move c further away from a the pricing error becomes more extreme. More generally, as these parameters change, valuation levels change non-linearly resulting in large valuation errors except for a few particular cases. Significantly, Ang and Liu (2004) report potential valuation errors in the range of 50% or higher suggesting that time variation in discount rates is very important economically.

4 The Model

4.1 Expected Returns (The Costs of Equity Capital)

This section models the term structure of implied costs of equity capital. First, we show how to compute expected returns (costs of capital) and then how to incorporate option prices.

Given a stochastic discount factor m_{t+1}, the value of the stock S_t at time $t \geq 0$ is given by the well-known pricing equation (this equation generates the dividend discount model and the residual income model):

$$\begin{aligned} S_t &= E_t[m_{t+1}(S_{t+1} + D_{t+1})] \\ &= E_t[m_{t+1}]E_t[S_{t+1} + D_{t+1}] + cov(m_{t+1}, S_{t+1}) + cov(m_{t+1}, D_{t+1}) \\ &= R_{t+1}^{-1}E_t[S_{t+1} + D_{t+1}] + \pi_{t+1}^{s} + \pi_{t+1}^{d}. \end{aligned} \tag{1}$$

where $E_t[m_{t+1}] = R_{t+1}^{-1}$, $R_t = 1 + r_t$, and r_t is the risk-free interest rate at time t.[7] This equation says that the price of the stock is the future payoff—stock appreciation plus cash disbursement—to investors adjusted for the risk of the future stock price component (π^s_{t+1}) and the risk of the future dividend component (π^d_{t+1}). Rearranging terms allows us to write next period's expected return (μ_{t+1}) (cost of equity) as:

$$\mu_{t+1} = E_t[\frac{S_{t+1} + D_{t+1}}{S_t}] = \frac{1}{S_t} R_{t+1}(S_t - [\pi^s_{t+1} + \pi^d_{t+1}]). \tag{2}$$

In order to compute a term structure of implied costs of equity, we simplify the stochastic discount factor and assume it takes the standard form $m_{t+1} = (\frac{c_{t+1}}{c_t})^{-\alpha}$ where α is the (constant) coefficient of risk aversion and c_t denotes consumption.[8] Linearizing the latter function as in Savov (2010), yields $m_{t+1} \approx \alpha_1 - \alpha \frac{c_{t+1}}{c_t}$ where α_1 is a constant.

Dividing equation (1) by S_t and then substituting the linearized stochastic discount factor into the stock price risk adjustment component (π^s_{t+1}), yields:

$$\begin{aligned} 1 &= R^{-1}_{t+1} E_t[\frac{S_{t+1} + D_{t+1}}{S_t}] + \frac{\pi^s_{t+1}}{S_t} + \frac{\pi^d_{t+1}}{S_t} \\ &\approx R^{-1}_{t+1}\mu_{t+1} + cov(\alpha_1 - \alpha\frac{c_{t+1}}{c_t}, \frac{S_{t+1}}{S_t}) + \frac{\pi^d_{t+1}}{S_t} \\ &= R^{-1}_{t+1}\mu_{t+1} - \alpha\rho_{c,\mu}\sigma^c_{t+1}\sigma^\mu_{t+1} + \frac{\pi^d_{t+1}}{S_t}. \end{aligned} \tag{3}$$

where σ^c_{t+1} denotes relative consumption volatility, σ^μ_{t+1} stock return volatility and $\rho_{c,\mu}$ the correlation between relative consumption and the stock return.

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[7] The stochastic discount factor is the marginal rate of substitution between consumption today and consumption tomorrow; that is, $m_{t+1} = \frac{U'(c_{t+1})}{U'(c_t)}$, where U is the investor's utility function and c_t is consumption. See Ang and Liu (2001) and Cochrane (2005) for overviews of stochastic discount factors.

[8] This stochastic discount factor is derived by assuming that investor's utility functions takes on the power utility form $U(c) = c^{1-\alpha}(1-\alpha)^{-1}$.

Solving for the expected return (the cost of capital) μ_{t+1} yields:[9]

$$\mu_{t+1} = R_{t+1}(1 + \alpha\rho_{c,\mu}\sigma^c_{t+1}\sigma^\mu_{t+1} - \frac{\pi^d_{t+1}}{S_t}). \tag{4}$$

Both risk aversion and consumption volatility are quite difficult to estimate reliably. Instead, we proxy for relative consumption by the return on the market portfolio. This allows us to replace $\alpha\sigma^c_{t+1}$ by σ^M_{t+1}, the future volatility of the market portfolio, and $\rho_{c,\mu}$ by $\rho_{m,\mu}$, the correlation between the stock return and the return on the market portfolio, thereby yielding:[10]

$$\mu_{t+1} = R_{t+1}(1 + \rho_{m,\mu}\sigma^M_{t+1}\sigma^\mu_{t+1} - \frac{\pi^d_{t+1}}{S_t}). \tag{5}$$

In what follows, we use equation (5) to compute the next period implied cost of equity capital and implied risk premium. This in turn requires us to estimate the future risk-free interest rate, R_{t+1}, the correlation between the return on the market portfolio and the stock return, $\rho_{m,u}$, future market volatility, σ^M_{t+1}, future stock volatility, σ^μ_{t+1}, and dividend risk, π^d_{t+1}. We now describe how dividend risk, π^d_{t+1}, is estimated.

4.2 Estimating Dividend Risk

We estimate dividend risk using synthetic forward contracts. To see the connection between dividend risk and synthetic forwards, we reformulate the basic equity pricing equation:

$$S_t = E_t[m_{t+1}[S_{t+1} + D_{t+1}]] = E_t[m_{t+1}S_{t+1}] + E_t[m_{t+1}D_{t+1}] \tag{6}$$

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[9] In theory, the dividend risk term $(\frac{\pi^d_{t+1}}{S_t})$ could be represented in the same fashion. However, dividends tend to be sticky and estimates of dividend volatility unreliable. Instead, we use option prices (described below) to obtain a market implied estimate of dividend risk obviating the need to estimate dividend volatility and the correlation between dividends and relative consumption directly.

[10] More technically, these substitutions are equivalent to assuming that the power utility function is logarithmic, as in Xiong (2001) among others, and that relative consumption is proxied by the market portfolio.

so that:[11]

$$S_t - E[m_{t+1}S_{t+1}] = R_{t+1}^{-1}E_t[D_{t+1}] + \pi_{t+1}^d. \tag{7}$$

We know from basic asset pricing theory that in the absence of arbitrage opportunities, a forward contract which expires at time $t+1$ has a time t price of $F_{t,t+1}$ such that the expected discounted difference between the forward price and the future stock price is zero:

$$0 = E_t[m_{t+1}[S_{t+1} - F_{t,t+1}]]. \tag{8}$$

It therefore follows that:[12]

$$F_{t,t+1} = R_{t+1}E_t[m_{t+1}S_{t+1}]. \tag{9}$$

Substituting (9) into (7) and rearranging yields:

$$\pi_{t+1}^d = S_t - R_{t+1}^{-1}(F_{t,t+1} + E_t[D_{t+1}]). \tag{10}$$

Further substituting (10) into (5) gives:

$$\begin{aligned}\mu_{t+1} &= R_{t+1}\{1 + \rho_{m,\mu}\sigma_{t+1}^M\sigma_{t+1}^\mu - 1 + R_{t+1}^{-1}(\frac{F_{t,t+1} + E_t[D_{t+1}]}{S_t})\} \\ &= R_{t+1}\rho_{m,\mu}\sigma_{t+1}^M\sigma_{t+1}^\mu + \frac{F_{t,t+1} + E_t[D_{t+1}]}{S_t}. \qquad (11)\end{aligned}$$

Equation (11) decomposes the expected return into the sum of two terms; the first term, $R_{t+1}\rho_{m,\mu}\sigma_{t+1}^M\sigma_{t+1}^\mu$, is comprised of future volatilities for both the firm and the market and the second term, $\frac{F_{t,t+1}+E_t[D_{t+1}]}{S_t}$, incorporates information from options markets and information about firm-level fundamentals

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[11] Equation (7) follows since $E_t[m_{t+1}D_{t+1}] = E_t[m_{t+1}]E_t[D_{t+1}] + \pi_{t+1}^d = R_{t+1}^{-1}E_t[D_{t+1}] + \pi_{t+1}^d$.

[12] Note that $F_{t,t+1}$ is a known amount at time t.

through expected dividends. There are several key innovative features in this representation of the cost of equity capital: 1) It has the desirable feature of being forward looking in that the options-derived values are based on expectations of future states of the economy. 2) Corresponding to intuition, expected returns in (11) are increasing in the level of risk of the economy (σ^M_{t+1}) and the level of risk of the firm (σ^μ_{t+1}). Moreover, we do not need to estimate an expected return on the market, which is not observable and difficult to estimate, but only the expected volatility of the market which can be estimated from options. 3) We are able to invoke prior work in the accounting valuation literature because this formula preserves expected dividends, $E_t[D_{t+1}]$(which allows firm fundamentals such as book value and earnings -under clean surplus- to be included) without making any earnings dynamics or terminal value assumptions. 4) We are also able to incorporate information beyond volatility levels through the synthetic forward contract. The latter variable incorporates additional information from the options markets—the equivalent of dividend risk in our setting—that has been found to predict future stock returns. 5) Finally, this measure of expected returns can be computed at high frequency with relative ease given that options data are available on a daily basis. As a result, this measure of expected returns can be used in event studies, which may be of keen interest to researchers whose analyses are constrained by the time delay between updates, analyst forecasts and the event.

Equation (11) provides the expected return for period t+1. Similarly, the expected return for any period t+i, μ_{t+i}, can be computed as:

$$\mu_{t+i} = R_{t+i}\rho_{m,\mu}\sigma^M_{t+i}\sigma^\mu_{t+i} + \frac{F_{t,t+i} + E_t[D_{t+i}]}{S_t} \tag{12}$$

4.3 Static Implied Cost of Equity Models

We compare the time varying implied costs of equity capital derived from implied volatilities and synthetic futures with the static implied costs of equity derived from the Easton (2004) PEG model and a simple earnings price ratio (EPR) model. The PEG model has become a popular method for estimating the implied cost of equity and is one of the two cost of equity models recommended by Botosan and Plumlee (2005). Denoting one- and two-year ahead analyst forecasts as f_{y1} and f_{y2}, respectively, the (constant) implied cost of equity using the PEG model is

$$\mu_{peg,t} = \sqrt{\frac{f_{y2,t} - f_{y1,t}}{S_t}}. \tag{13}$$

Following prior research, we ignore observations for which $f_{y2} < f_{y1}$.

The EPR model is commonly used by the 'street' to derive a first pass cost of equity estimate. This model does not require the difference between earnings forecasts to be positive as in the PEG model. An additional reason to use this model is provided by Lee et al. (2010) who find that the constant cost of equity estimates derived from this model are associated in the cross-section with future stock returns. Furthermore, Ohlson (2010) shows theoretically that the EPR model should have predictive power even for growth firms. The EPR based implied cost of equity is calculated as:

$$\mu_{epr,t} = \frac{f_{y1,t}}{S_t}. \tag{14}$$

5 Empirical Implementation

5.1 Data

Option contract data are obtained from the OptionMetrics Standardized Options database beginning January 1, 1996 up to October 31, 2009. We also use the zero coupon bond file provided by OptionMetrics to calculate risk-free forward interest rates. These are the same values OptionMetrics uses when computing implied volatility estimates. Firm fundamentals are taken from the Compustat annual and quarterly xpressfeed files. Analyst forecasts are obtained from the IBES historical unadjusted summary file. We use the monthly CRSP files for price and return data. We use the monthly Fama-French four factors downloaded from the Wharton Research Data Services website for the asset pricing tests. To reduce outliers, we eliminate observations with non-positive prices and non-positive book values of equity. We further winsorize all estimated variables at the 0.5 and 99.5 per cent levels. After merging the CRSP and Compustat data and winsorizing, we are left with 90,819 firm-month observations sufficient to calculate one-year ahead implied costs of equity and 46,322 firm-month observations sufficient to calculate both one- and two-year ahead implied costs of equity. Of those firms with sufficient data to construct a one year-ahead term structure, 75,918 firm-month observations are available to compute a PEG implied cost of capital and 80,694 firm-month observations are available to compute an EPR implied cost of equity. We have a total of 1,831 unique firms in our sample.

5.2 Implementing Cost of Equity Term Structure Estimation

Forward contracts are not readily available for all required dates. Instead, we estimate forward prices synthetically using the put-call price parity relation:

$$F_{t,t+i} = (C(t+i,K) - P(t+i,K))R_{t+i} + K \tag{15}$$

where C denotes the call price, P the put price, and both instruments have the same strike price K and expiry date, $t+i$. Assuming that the the price of the put, call and the interest rates for time $t+i$ are observable and known, then the synthetic forward is also known and non-stochastic at time t. A potential problem with this estimation approach is that put-call price parity holds, strictly, only for European options whereas available firm-level data are of the American option variety. To address this issue, we compute synthetic European option prices from American options data. In particular, implied volatilities derived from American option prices (controlling for dividends and early exercise premia) are used as inputs into the Black-Scholes equation to generate synthetic European call and put prices, Cl_t^{bs} and P_t^{bs}, respectively.[13]These synthetic option prices are then used to a calculate a series of synthetic future stock prices iteratively from equation (15) as follows:

$$F_{t,t+i} = [Cl_{t+i}^{bs}(\sigma_c^{iv}(t+i)) - P_{t+i}^{bs}(\sigma_p^{iv}(t+i))]R_{t+i} + K. \tag{16}$$

where $\sigma_c^{iv}(t+i)$ and $\sigma_p^{iv}(t+i)$ denote the the implied call and put volatilities at time $t+i$, respectively. The standardized option data produced by OptionMetrics are used to obtain implied volatilities, strike prices, risk-free rates, and times to expiry. i is expressed in days and takes the values 30, 60, 91, $182, 273$, 365, $547,$ and 730.

To compute $\rho_{m,\mu}$, we use rolling 36 month correlations between the S&P500 index and firm specific ex-dividend stock returns; only observations with at least 12 months of data are included. We use a relatively long horizon in our estimation to avoid a large number of observations with negative correlation

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[13] More specifically, options that have an American-style exercise feature are priced by Optionmetrics using a proprietary pricing algorithm that is based on the industry-standard Cox-Ross-Rubinstein (CRR) binomial tree model. This model can accommodate underlying securities with either discrete dividend payments or a continuous dividend yield. We use these implied volatilities along with stock prices reduced by discounted expected dividends (as specified in the optionmetrics dividend file) similar to the method used by Bakshi, Kapadia and Madan (2003). We substitute these modified stock prices and implied volatilities into the Black-Scholes formula to produce 'synthetic' European option prices. The latter are then used to determine synthetic forward prices. This does not imply that European options are priced in a Black-Scholes economy (log-normal asset prices), only that the Black-Scholes model provides a simple one to one mapping from implied volatilites to price (see Figlewski 2008) which allows us to compute the price of the forward contract.

coefficients. To obtain an estimate of future expected volatility, we use implied volatility estimates, which are the market's expectation of volatility over the life of the contract, from the OptionMetrics standardized options file. We use implied volatility from option contracts traded on the S&P500 index to proxy for expected market volatility (σ^{M}_{t+i}).[14]The implied firm-level volatilies from OptionMetrics proxy for expected future firm-specific volatility (σ^{μ}_{t+i}). Expected dividends are estimated wherever possible based on consensus analyst earnings forecasts times one minus the two-year average historical retention rate. In the absence of analyst earnings forecasts, we estimate expected earnings from analyst long-term earnings growth rate forecasts to which we again apply the historical retention rate in order to obtain expected dividends. If long-term growth forecasts are also unavailable, we use past dividends to proxy for expected dividends. Forward risk-free interest rates are obtained from the zero coupon bond file provided by OptionMetrics. Forward risk-free rates are interpolated using a spline function whenever i does not correspond to the eight days listed in the previous paragraph.

Eight term structure cost of equity capital estimates are calculated each month for each firm using equation (12). To construct these monthly measure, we first obtain daily, firm-specific, estimates of each input required to compute our cost of equity value, beginning the first trading day after the 21st day of the month and ending on the last trading day of that month. These data are then used to obtain a firm-specific average for each input into equation (12).[15]The cross-sectional average term structure of the costs of equity capital are computed (and summarized in the tables below) for the one month ahead (μ_{m1}), two months ahead (μ_{m2}), and one through eight quarters ahead costs of equity capital excluding the fifth and seventh quarters (μ_{qk} , k=1,2,3,4,6,8). All

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[14] These are the same contracts from which the VIX is computed.

[15] We use average values to mitigate potential idiosyncratic noise that may arise from using only the last trading day of the month.

cost of equity estimates are annualized.

5.3 Implementing the PEG and EPR Models

Easton and Monahan (2005) calculate cost of equity values once per year (on December 31'st). However, we have sufficient data to compute cost of equity values at much higher frequencies. We choose to focus on monthly values in this study. In order to produce monthly benchmark costs of equity measures, we modify the Easton-Monahan method to calculate the PEG cost of equity on a monthly basis. We obtain monthly analyst earnings forecast estimates for each firm from the IBES unadjusted summary database. IBES provides updated consensus forecasts on the third Thursday of every month. For each month, we collect four forecasts, eps_1, eps_2, eps_3 and ltg. eps_1 is the consensus analyst earnings forecast for the fiscal year closest to the current date, eps_2 is the consensus analyst earnings forecast for the following fiscal year and eps_3 for the year after. ltg is the consensus analyst long term growth forecast. f_{y1} in (13) is calculated as the weighted average of eps_1 and eps_2, where $f_{y1} = \omega\ eps_1 + (1-\omega)\ eps_2$. The ω weights are computed based on the number of months between the current date and the upcoming fiscal year-end; that is, $\omega = \frac{FM-CM}{12}$ where FM is the fiscal year-end month and CM is the current month. Following Easton and Monahan, if the current month is the fiscal year-end month then $f_{y1} = eps_2$. Similarly, $f_{y2} = \omega\ eps_2 + (1-\omega)\ eps_3$. We require each firm to have either eps_3 or failing that ltg. In the latter case, eps_3 is estimated as $eps_2(1 + ltg)$. Otherwise, the firm is deleted from the PEG sample.[16] We then compute the PEG cost of capital estimate, μ_{peg}, monthly as per equation (13) and the EPR cost of capital estimate, μ_{epr}, monthly as per equation (14).

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[16] One caveat to this method bears mentioning. The difference between a firm's fiscal year-end and the annual statement report date is usually between two and three months during which time the current eps_1 analyst estimates are for a past time period. In the latter case, we set $f_{y1} = eps_2$ and $f_{y2} = eps_3$ until the actual quarterly numbers are announced, after which time we resume the weighted average calculation.

6 Empirical Results: The Term Structure

6.1 Summary Statistics

Summary statistics for three key variables are provided in Table 1, Panel A for the full CRSP sample and the final merged sample. β is the regression coefficient of the firm's return on the weighted CRSP market return based on a rolling five year window. $Size$ is the logarithm of the market value of equity and BM is the logarithm of the book-to-market ratio. The final sample is composed of larger firms with greater systematic risk and lower book to market ratios than the CRSP sample. This is not surprising since firms with actively traded options tend to be larger more mature firms. Panel B shows summary statistics for the implied (annualized) costs of equity estimates μ_{peg}, μ_{epr}, μ_{q1}, μ_{q4} and μ_{q8}.[17] On average, the term structure estimates lie between the EPR and PEG estimates and increase with maturity.

To compare our results with that of Easton and Monahan (2005), we restrict our validation (asset pricing) sample to December year-end firms.[18] Implied costs of capital are estimated for each firm in our sample as of the end of December. Table 1, Panel C provides a summary of the implied cost of capital measures used in the validation section. The latter summary data are not much different from the full sample summary data despite the reduction in sample size.[19]

Panel D presents the Spearman correlations between the implied costs of equity measured at the December year-end and β, $Size, BM$, short-term momentum, mom_s, long-term momentum, mom_l, stock price reversion, rev and

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[17] Observations for which the market data do not allow us to estimate two-year ahead costs of equity are extrapolated using the implied growth rate from quarter one to quarter six. More specifically, we estimate the slope of the term structure between quarters one and six and then use this slope to extrapolate the value for quarter eight from quarter six.

[18] Empirical results prior to the validation section are based on the full sample.

[19] The reduction in sample size comes from two sources: 1) Only the month of December is used for calculating the cost of equity estimates. The other tables include cost of equity estimates for every month of the year. 2) We further restrict the sample to include only December 31 year-end firms.

(normalized) accruals, $Accr$. Short-term momentum is measured as last month's return prior to the date of portfolio formation; long-term momentum is measured as the average return from months 2 to 12; Price reversion is measured as the average monthly return for years $t-3$ to $t-2$, Accruals are measured as total accruals scaled by average total assets over the year. Total accruals are measured as income before extraordinary items availible to common less cash flow from operations less extraordinary items and discontinued operations. The results indicate that the implied cost of equity capital term structure estimates are more highly correlated with the PEG measure than the EPR measure. Further, the time varying term structure measures are significantly and positively correlated with β and rev, negatively correlated with the two momentum measures and uncorrelated with accruals.

In Panel E of Table 1, the various implied costs of equity estimates are sorted by quintiles on the firm attributes of size, market beta, the log book to market ratio, (scaled) earnings and (scaled) accruals where quintile one is the lowest and quintile five the highest. Earnings are measured by income before extraordinary items availible to common scaled by average total assets over the year. As size increases, the term structure of implied costs of equity tends to increase for short maturities. For longer maturities, implied costs of equity increase initially and then decrease, suggesting that longer term expected returns are negatively associated with firm size. In contrast, the PEG estimates decrease monotonically with size while the EPR estimates increase monotonically with size. The time varying implied costs of equity estimates increase monotonically in β for all maturities along the term structure. The same pattern holds for the PEG model, whereas the EPR model shows an inverse relation. The log book to market ratio and costs of equity tend to be inversely related for all term to maturity estimates. The PEG and EPR models yield similar results. Sorting on (normalized) earnings quintiles leads to a monotonic decrease in costs of equity. Similar results hold for the PEG model whereas the EPR model estimates increase initially and then (surprisingly) decrease. Finally, as (normalized) accruals increase, costs of equity estimates decrease until the highest quintile when they increase for all term structure maturity estimates. The same pattern holds for the PEG estimates but not for the EPR model for which accruals and the implied cost of equity are positively associated. Overall, this panel shows that the term structure cost of capital estimates and the PEG estimates are similarly related to firm attributes. These relations accord by and large with intuition since costs of capital are likely to increase (decrease) with β and BM (Size, earnings and accruals). Contrariwise, the EPR estimates are often in opposite relation to the term structure and PEG estimates.

6.2 The Shape of the Term Structure

Is the term structure of implied costs of equity capital flat? To answer this question, we explore the properties of the term structure over the 1996-2009 time period. Table 2, Panel A presents the average annualized cross-sectional term structure of implied costs of capital for the years 1996 to 2009 together with the static annualized PEG and EPR estimates. Panel A indicates significant variation of the time varying term structure over the years, with the rates peaking in the year 2000. This is followed by a sharp subsequent drop followed by a build up from 2004. In most years, estimates derived from the time varying term structure lie between μ_{peg} and μ_{epr}.We find (untabulated) that term structure cost of equity estimates are significantly different from both μ_{peg} and μ_{epr}. Importantly, term structure implied costs of equity capital increase almost monotonically with maturity, with the exception of the 2008 crisis year for which costs of equity capital are decreasing fairly monotonically with maturity. The last two rows show the time average implied costs of equity capital and their standard deviations, respectively. The time average implied costs of equity capital increase monotonically with maturity. Consecutive mean costs of equity along the term structure are significantly different from each at the 5% level for all periods. Standard deviations decrease almost monotonically with maturity. The latter result is consistent with the Samuelson (1965) prediction that the highest levels of volatility are in the rates closest to expiry. Overall, Table 2 indicates that, except for the crisis year of 2008, implied costs equity capital are significantly upward sloping.

Though the time variation within the implied cost of equity term structure is significant, these values include time varying risk-free rates. To ensure that the term structure of risk-free rates are not driving our results, we also present the term structure of risk premia by year where the risk premium is the estimated implied cost of equity less the risk-free rate with the same expiry date provided by OptionMetrics. Panel B replicates Panel A with the term structure of implied risk premia replacing the term structure of implied costs of equity capital. Annual average implied risk premia increase fairly monotonically with maturity, with the exception of 2002 which exhibits a fairly flat term structure of implied risk premia and 2008 where risk premia are decreasing over the term structure. The last two rows show the time average implied risk premia and their standard deviations, respectively. The time average implied risk premia increase fairly monotonically with maturity. Also, the consecutive risk premia along the term structure are significantly different from each at the 5% level for all periods. Standard deviations decrease almost monotonically over time. Overall, Panel B indicates that for most years implied risk premia are significantly upward sloping. Thus, the overall upward sloping behavior of the implied costs of equity term structure does not appear to be driven by the time variation in risk-free interest rates.

We further test formally whether the term structure is concave on average as well as upward sloping. Specifically, we regress, for each year, implied costs of capital estimates (risk premia) on a quadratic function of time to maturity.[20] A positive linear coefficient and a negative quadratic coefficient indicate an upward sloping concave term structure of the costs of equity capital. Table 3, Panel A shows that nearly all linear β coefficients are significantly positive except for 2002 year β which is not significant and the 2008 crisis year β which is significantly negative. Nine of fourteen annual quadratic γ coefficients are significantly negative, consistent with concave term structures of the implied cost of equity. The 2008 crisis year γ coefficient is significantly positive as is the 2002 coefficient, consistent with a convex term structure. The quadratic γ coefficients are insignificant for 2000 and 2001 consistent with a linear (but upward sloping) term structure. The last line of the panel shows that the term structure is upward sloping and concave when all years are pooled together. Panel B yields qualitatively similar results for the term structure of implied risk premia.

Risk free interest rates enter into the cost of equity model multiplicatively in equation (12). Thus, it is possible that the nonlinear impact of the term structure of risk-free interest rates is driving the concavity of the implied cost of equity and risk premia term structure estimates. To explore this possibility, we divide out the risk free interest rates from our term structures and rerun the concavity tests. The results (untabulated) are qualitatively similar to those described in Table 3.

Overall, our empirical results are strongly consistent with H1. The term structure of the implied costs of equity capital is not flat contrary to the (implicit assumption of the) extant empirical literature.

Is the shape of the term structure a function of industry? Table 4 lists mean term structure, PEG and EPR implied costs of capital estimates sorted on the

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[20] This test is derived from a Taylor expansion of a concave function. If the function is concave, the coefficient on the quadratic term will be negative.

Fama-French (1997) 48 industry classification. Overall, implied cost of capitals tend to be upward sloping along the term structure maturity irrespective of the industry. Furthermore, time varying implied costs of equity tend to be greater than the EPR estimate and lower than the PEG estimate for most industries.

6.3 Validity Tests

To validate our measures of the implied costs of equity capital, we initially correlate our cost of equity estimates with realized returns unadjusted for risk. Subsequently, we correlate our cost of equity risk premia estimates with realized returns adjusted for risk. Specifically, we conduct cross-sectional asset pricing tests at the firm level to see whether the term structure of implied costs of equity capital is able to explain future returns after controlling for firm-risk characteristics (e.g., beta, book to market and size). As an alternative, we conduct Fama-French (1993) portfolio level time-series tests to determine if there are statistically significant excess returns not explained by the asset pricing model. Our intent here is not to determine if there is a 'market beating' strategy that can be used to generate excess returns. Rather, we wish to determine if our implied costs of equity estimates are correlated with stock returns, controlling for risk-factors that have been shown to be correlated with stock returns. This approach helps to ensure that our term structure cost of equity measures add information beyond those risk-factors in predicting stock returns. To be consistent with Easton and Monahan (2005), we restrict our validation sample to December year-end firms. Implied costs of capital are estimated for each firm in our sample as of the December year-end.

6.3.1 Asset Pricing Cross-sectional Regression Results

We estimate cross-sectional regressions of one-year ahead excess returns on various measures of implied risk premia and selected firm characteristics. The regressions take the form:

$$r_{i,t} - r^f_{i,t} = \alpha + \nu_1 \hat{\mu}_{i,t-1} + \nu_2 \beta_{i,t-1} + \nu_3 Size_{i,t-1} + \nu_4 BM_{i,t-1} + \epsilon_{i,t} \qquad (17)$$

where $r_{i,t}$ is the firm i's period t stock return, $\hat{\mu}_{i,t-1}$ is last period's implied (cost of equity) risk premium as derived from each of the models described above and the α and the ν_j are parameters to be estimated.[21] The $\epsilon_{i,t}$ are error terms. A positive and significant value for ν_1 indicates that implied costs of equity capital are positively associated with future returns. We also include standard controls which are known to be associated with stock returns. As before, $\beta_{i,t}$ is the firm's rolling five year beta updated monthly. $Size_{i,t}$ is the log market value of the firm and $BM_{i,t}$ is the log book to market ratio.[22] Researchers commonly use the Fama-MacBeth approach to correct for cross sectional correlation in the error term. However as noted by Gow et al. (2010), neglecting time series correlation in the error term can lead to inflated t statistics. Instead, following Gow et al. (2010), we perform two way clustering by firm and time to control for cross-sectional and serial correlations in the error terms. The results are presented in Table 5.

The base line Panel A regressions do not control for any firm characteristics. Panel A shows that the PEG implied cost of equity is insignificant. The EPR estimate is significant at the 5% level.[23] The adjusted R-squared's are 2% or less. In contrast, all of the term structure estimates are more highly and significantly correlated with future returns than the static estimates with correlations that are about twice as large. Furthermore, the one-quarter and one-year ahead term structure implied costs of equity estimates are highly significant at the 1% level

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[21] Unlike McInnis (2010), our regression results are based on costs of equity instead of their ranks. Test results using ranks yield qualitatively similar results (untabulated).

[22] In these tests, β, $Size$, and BM are recalculated for each firm 3 months after the firm's fiscal year-end.

[23] These results are similar to those of Lee et al. (2010).

with adjusted R-squared's of over 7%. The two-year term structure estimate is significant at the 5% level with an adjusted R-squared of over 5%.

Panel B replicates Panel A controlling for the three Fama-French firm-risk characteristics. The results are similar to Panel A except that now all of the term structure estimates are highly significant at the 1% level. The one-quarter and one-year term structure estimates have adjusted R-squared's of about four time that of the earnings-based static measures. These results are indicative of the superiority of the term structure of implied costs of equity estimates over the static earnings-based estimates in predicting future returns.

As an additional robustness check to insure our measures are correlated with future returns we include additional factors that may be important for predicting stock returns. Panel C regresses one year ahead realized returns on various measures of implied costs of equity, the Fama-French-Carthart betas and other control variables known to be correlated with returns. The Fama-French-Carhart betas are the firm specific slope coefficients from rolling five year regression of realized returns on the four factor portfolios. The additional control variables include short-term momentum, *moms*, long-term momentum, *moml*, reversion, *rev*, and (normalized) accruals, *Accr*. rev controls for long-term return reversal. Acc controls for the Sloan (1996) accrual effect. We find that both the PEG and EPR measures are correlated with returns. Adjusted R-squared's are close to 6%. Nevertheless, the term structure implied costs of equity are all more highly and significantly correlated with future returns than either of the static measures. The term structure adjusted R-squared's for the one-quarter ahead and one-year ahead term structure estimates are close to double the static measures. Although we find some statistical evidence in Panel C that the static cost of equity measures are correlated with future monthly returns, the relation between realized returns and implied costs of equity are far more robust for the term structure estimates.

6.3.2 Portfolio Based (Time-Series Regression) Results

Firm level regressions contain significant idiosyncratic noise which may overwhelm any pattern that may be present in the data. By forming portfolios, much of this idiosyncratic noise is reduced. In an alternative approach, we construct portfolios by sorting firms in each time period by the implied cost of equity estimate to determine if implied costs of equity are associated with future returns. More specifically, firms are ranked initially into quintiles based on cost of equity estimates each December year-end. The quintile portfolios are assumed to be held from January until the following December. We then test if the portfolio in the highest implied cost of equity quintile earns a higher realized returns than the portfolio in the lowest implied cost of equity quintile.

Table 6, Panel A shows monthly average excess returns for the five portfolios sorted by each of the implied cost of equity measures. Excess returns increase with all cost of capital measures, although the relation is strictly monotonic only for $\mu_{q1.}$ More importantly, the difference in returns from short-selling the low cost of equity portfolio, π_1, and simultaneously buying the high cost of equity portfolio, π_5, is significant (at the 1% level) for all term structure estimates and the EPR measure. The PEG measure proves insignificant.

Although informative, the results from Panel A are not risk adjusted so that the excess returns could be generated by excessive risk taking. Instead, we regress excess monthly portfolio returns $(r_{\pi,t} - r_t^f)$ on the three Fama-French factors, the momentum risk factor and the Alpha (α) as described by the equation:

$$r_{\pi,t} - r_t^f = \alpha + \nu_1(r_t^m - r_t^f) + \nu_2 SMB_t + \nu_3 HML_t + \nu_4 MOM_t + \epsilon_t. \quad (18)$$

$r^m - r^f$ is the excess return on the value-weighted market portfolio from the CRSP database. SMB is the return from a portfolio of small firms less big firms. HML is the return from a portfolio of high book-to-market firms less low book-to-market firms and, finally, MOM (momentum) is the return from a portfolio of high momentum stocks less low momentum stocks. An α significantly different from zero implies that there is a portion of excess returns that cannot be explained by these risk factors. Panel B of Table 6 indicates that trading strategies based on either the PEG or EPR based measures produce $\alpha's$ which are not statistically different from zero. In contrast, the term structure implied costs of equity estimates all produce significant monthly $\alpha's$ (at the 1% level).

Overall, the empirical results from the cross-sectional and time series regressions provide compelling evidence consistent with H2, namely, time varying implied costs of equity estimates proxy for expected returns. The results are far less robust in the case of static implied costs of equity capital estimates. Although there is some evidence that static cost of capital estimates correlate with expected returns in cross-sectional tests, the results of the time-series portfolio tests are less promising.

7 Conclusion

In this paper, we provide a method to estimate the term structure of implied costs of equity and risk premia at the firm-level using option pricing information. The empirical results indicate that we can reject the ubiquitous assumption that firm level costs of equity and risk premia are constant over time. We find that, on average, the term structure of implied costs of equity capital and risk premia are upward sloping and concave. We also find that the term structure of implied costs of equity capital and risk premia were downward sloping in the 2008 global crisis period suggesting that our cost of equity measures are successful at tracking the state of the economy.

We further validate the term structure measures to see if they are positively associated with future stock returns using as our benchmarks the Easton (2004) PEG model and the "street" based simple earnings per share ratio model (Ohlson 2010). Using cross-sectional and portfolio time-series asset pricing tests, we find that time varying implicit costs of equity capital measures are positively and highly significantly associated with future stock returns. In contradistinction, the PEG and EPR model are either weakly associated with future stock returns or not associated at all depending upon the specific test. Irrespective of the test, time varying implied costs of equity are at a minimum at least twice as highly correlated with future returns as the static measures.

Our time varying term structure measure of the costs of equity has several appealing features. First, the term structure is derived from forward looking derivatives which are sensitive to risk. Second, our cost of equity estimates are consistent with a large literature indicating that expected returns are dynamic. Third, our method offers a potentially better set of valuation tools than is currently available in the literature.

In addition to showing how to estimate a term structure of implied costs of equity capital, this study contributes to the literature by linking accounting-based valuation models and option pricing. Future research might fruitfully focus on such issues as the relation between the term structure of costs of equity capital and the dynamics of the firm's disclosure policy and the relation between the term structure of costs of equity capital and the dynamics of the firms investment policy.

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Table 1: Summary Statistics

Panel A: CRSP versus Final Sample

	CRSP Sample			Final Sample		
	β	$Size$	BM	β	$Size$	BM
Mean	1.04	5.51	-0.75	1.34	8.59	-1.19
Std.	1.35	2.11	0.90	0.93	1.60	0.83

Panel B: Estimated Monthly Annualized Implied Costs of Equity Capital

	μ_{peg}	μ_{epr}	μ_{q1}	μ_{q4}	μ_{q8}
Mean	11.00	5.62	7.36	7.69	8.26
Std.	5.26	4.83	4.30	3.61	3.57
N (months)	75,918	80,694	90,819	90,819	90,819

Panel C: Estimated Implied Costs of Equity Capital (as of the December Year-end) for Firms with December Fiscal Year-ends

	μ_{peg}	μ_{epr}	μ_{q1}	μ_{q4}	μ_{q8}
Mean	11.03	5.93	8.10	8.21	8.51
Std.	5.68	5.18	5.29	4.44	4.20
N (years)	4,388	4,756	5,420	5,420	5,420

Panel D: Spearman Correlations in the month of December for firms with December fiscal year ends*

	μ_{peg}	μ_{epr}	μ_{q1}	μ_{q4}	μ_{q8}	β	$Size$	BM	mom_s	mom_l	rev	$Accr$
μ_{peg}		**0.05**	**0.23**	**0.24**	**0.23**	**0.25**	**-0.26**	**0.14**	**-0.10**	**-0.22**	0.01	-0.02
μ_{epr}			**0.10**	**0.08**	**0.06**	**-0.23**	**0.12**	**0.31**	**-0.16**	**-0.21**	**-0.05**	**0.13**
μ_{q1}				**0.95**	**0.83**	**0.34**	0.02	**-0.06**	**-0.25**	**-0.26**	**0.08**	0.00
μ_{q4}					**0.93**	**0.36**	-0.01	**-0.05**	**-0.21**	**-0.26**	**0.08**	-0.01
μ_{q8}						**0.35**	0.02	**-0.03**	**-0.17**	**-0.23**	**0.08**	-0.01
β							**-0.33**	**-0.07**	**-0.04**	**-0.02**	**0.16**	-0.06
$Size$								**-0.13**	**0.04**	**-0.04**	**-0.15**	**0.07**
BM									**0.02**	**0.05**	**-0.18**	**0.06**
mom_s										**0.08**	**0.05**	**-0.02**
mom_l											**-0.01**	-0.04
rev												**0.07**
$Accr$												

*All bolded correlations are statistically significant at the 10% level or better. Values in regular font are not significant.

Panel E: Term Structure Sorted by Attributes

Quintile	*Size*	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1	6.47	6.57	7.14	7.29	7.51	7.68	7.80	8.04	8.37	13.35	4.07
2	7.73	6.99	7.42	7.51	7.67	7.79	7.88	8.13	8.44	11.91	5.31
3	8.55	6.90	7.25	7.31	7.43	7.54	7.63	7.87	8.17	10.86	5.94
4	9.44	7.15	7.40	7.42	7.51	7.60	7.68	7.93	8.24	10.10	6.14
5	10.80	7.02	7.20	7.24	7.30	7.40	7.49	7.77	8.11	9.40	6.30
	β	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1	0.34	5.27	5.55	5.62	5.75	5.87	5.97	6.23	6.54	9.57	6.51
2	0.77	6.22	6.54	6.59	6.71	6.83	6.94	7.20	7.52	10.14	6.59
3	1.14	7.03	7.38	7.43	7.56	7.67	7.76	8.04	8.37	11.17	6.22
4	1.66	7.53	7.92	7.99	8.13	8.26	8.34	8.58	8.89	11.64	5.12
5	2.78	8.58	9.04	9.13	9.26	9.38	9.47	9.68	9.99	12.66	3.48
	BM	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1	-2.37	6.82	7.17	7.23	7.36	7.48	7.57	7.81	8.12	10.07	4.26
2	-1.53	6.96	7.28	7.34	7.46	7.56	7.65	7.88	8.18	10.17	5.30
3	-1.12	6.92	7.27	7.34	7.46	7.56	7.66	7.89	8.19	10.72	5.74
4	-0.74	6.88	7.22	7.29	7.41	7.53	7.64	7.88	8.20	11.40	6.48
5	-0.23	7.06	7.48	7.58	7.73	7.87	7.97	8.27	8.63	12.81	6.32
	Earn	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1	-0.16	7.58	8.08	8.20	8.37	8.52	8.63	8.89	9.24	13.36	2.41
2	0.02	7.20	7.56	7.62	7.72	7.84	7.94	8.20	8.53	11.23	6.16
3	0.05	6.78	7.07	7.12	7.21	7.31	7.40	7.62	7.91	10.48	6.44
4	0.08	6.62	6.90	6.95	7.04	7.13	7.22	7.44	7.73	9.98	6.09
5	0.15	6.55	6.80	6.85	6.93	7.02	7.11	7.32	7.61	9.60	5.65
	Accr	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1	-0.16	7.34	7.72	7.81	7.93	8.03	8.11	8.32	8.62	11.80	4.11
2	-0.08	6.90	7.22	7.29	7.40	7.51	7.60	7.85	8.15	10.76	5.24
3	-0.05	6.86	7.13	7.18	7.27	7.38	7.49	7.74	8.05	10.32	5.78
4	-0.03	6.62	6.95	7.01	7.12	7.24	7.35	7.60	7.94	10.20	5.92
5	0.02	6.88	7.26	7.33	7.44	7.55	7.64	7.88	8.18	11.11	6.19

Table 1 shows summary statistics for key variables and implied costs of equity estimates. μ_{peg} is the Easton (2004) PEG cost of capital estimate derived from equation (13). μ_{epr} is the EPR cost of capital estimate derived from equation (14). μ_{q1}, μ_{q4} and μ_{q8} are the (annualized) term structure implied cost of equity estimates for the one-quarter, one-year and two-year ahead maturities derived from equations (12) and (16). β is the regression coefficient of the firm's return on the weighted CRSP market return based on a rolling five year window updated monthly. Size is the logarithm of the market value of equity and BM is the logarithm of the book-to-market ratio. mom_s denotes short-term momentum measured as last month's stock return (prior to the date of portfolio formation), mom_l denotes long-term momentum measured as the average stock return from months 2 to 12, rev denotes stock price reversion measured as the average monthly return for years t-3 to t-2. *Earn* denotes earnings measured as Income before extraordinary items available for common scaled by average total assets. *Accr* denotes total accruals scaled by average total assets. Total accruals are calculated as earnings less cash flows from operations less extraordinary items and discontinued operations.

Table 2: The Term Structure of Annualized Implied Costs of Equity Capital and Risk Premia 1996-2009

Panel A: Implied Costs of Equity Capital

Year	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
1996	6.63	7.20	7.42	7.66	7.93	8.18	8.61	9.11	10.89	6.22
1997	8.17	8.71	8.84	8.92	9.14	9.39	9.74	10.15	10.73	5.27
1998	9.28	10.02	10.22	10.38	10.49	10.69	11.06	11.51	10.88	5.11
1999	9.81	10.65	10.82	11.21	11.46	11.64	12.13	12.68	10.12	4.60
2000	11.40	11.81	11.90	12.01	12.27	12.52	12.96	13.57	10.49	5.11
2001	8.15	8.63	8.69	8.61	8.65	8.74	9.14	9.38	11.57	3.73
2002	6.86	7.15	7.13	7.03	7.09	7.18	7.69	7.98	12.21	4.58
2003	4.78	5.11	5.23	5.36	5.47	5.58	5.99	6.53	10.97	5.50
2004	3.50	3.94	4.11	4.46	4.72	4.92	5.41	5.97	9.91	5.77
2005	4.75	5.10	5.27	5.69	5.96	6.13	6.49	6.90	9.95	5.83
2006	6.19	6.50	6.60	6.87	7.05	7.14	7.33	7.67	10.26	5.73
2007	6.71	7.00	7.05	7.15	7.20	7.16	7.23	7.45	10.48	5.36
2008	8.62	8.64	8.49	8.20	8.07	8.03	7.92	7.86	12.31	6.85
2009	8.14	8.75	8.81	9.07	9.24	9.32	9.47	9.70	13.90	6.03
Mean	**6.94****	**7.29****	**7.36****	**7.48****	**7.60****	**7.69****	**7.94****	**8.26**	10.93	5.70
Std.	5.42	4.63	4.30	3.85	3.68	3.61	3.50	3.57	5.01	4.50

Panel B: Implied Risk Premia

Year	p_{m1}	p_{m2}	p_{q1}	p_{q2}	p_{q3}	p_{q4}	p_{q6}	p_{q8}	μ_{peg}	μ_{epr}
1996	1.12	1.65	1.85	2.06	2.27	2.46	2.76	3.16	5.17	0.52
1997	2.43	2.93	3.03	3.07	3.23	3.43	3.69	3.99	4.65	-0.63
1998	3.70	4.46	4.70	4.92	5.06	5.27	5.65	6.08	5.40	-0.35
1999	4.45	5.18	5.32	5.63	5.83	5.95	6.31	6.74	4.43	-1.00
2000	4.82	5.16	5.23	5.32	5.56	5.80	6.20	6.73	3.65	-1.36
2001	4.36	4.94	5.04	4.99	5.00	5.00	5.15	5.16	7.62	0.24
2002	5.05	5.30	5.27	5.06	5.02	4.95	5.08	5.00	9.79	2.64
2003	3.59	3.92	4.04	4.14	4.20	4.23	4.39	4.67	9.51	4.22
2004	1.93	2.24	2.34	2.51	2.63	2.69	2.89	3.18	7.64	3.59
2005	1.28	1.44	1.52	1.76	1.93	2.03	2.29	2.59	5.82	1.74
2006	1.04	1.26	1.34	1.57	1.76	1.88	2.14	2.50	4.96	0.52
2007	1.51	1.79	1.88	2.09	2.23	2.28	2.45	2.72	5.51	0.58
2008	5.99	5.91	5.76	5.48	5.36	5.29	5.11	5.00	9.43	4.31
2009	7.74	8.12	8.15	8.30	8.39	8.37	8.31	8.34	12.72	5.28
Mean	**3.33****	**3.61****	**3.67****	**3.76****	**3.85****	**3.91****	**4.06****	**4.27**	7.13	1.90
Std.	5.50	4.74	4.41	3.96	3.77	3.67	3.52	3.53	5.50	4.90

Table 2 shows the cross-sectional average annual term structure of the implied costs of equity capital and the related term structure of risk premia for maturities of 30 days up to 2 years for the years 1996 to 2009. μ_{m1} is the 30 day-ahead implied cost of equity. μ_{m2} is the 60 day-ahead implied cost of equity. μ_{q1} is the 91 day-ahead (one quarter) implied cost of equity. μ_{q2} is the 182 day-ahead (two-quarter) implied cost of equity and so on up to μ_{q8} which is the implied cost of equity eight quarters (2 years) ahead. This table also shows the cross-sectional average PEG and EPR implied costs of equity capital.

(**) denotes significance of mean differences between adjacent costs of capital along the term structure at the 5% level.

Table 3: Concavity Tests of the Term Structure

Panel A: Concavity of Implied Costs of Equity Capital

	$\boldsymbol{\alpha}$		$\boldsymbol{\beta}$		$\boldsymbol{\gamma}$	
Year	Coefficient	t-stat	Coefficient	t-Stat	Coefficient	t-stat
1996	6.82	165.69	1.70	15.37	-0.30	-5.54
1997	8.36	215.92	1.23	11.76	-0.17	-3.30
1998	9.61	205.60	1.45	11.51	-0.26	-4.34
1999	10.09	240.25	2.11	18.64	-0.43	-7.89
2000	11.46	240.36	1.09	8.46	-0.02	-0.30
2001	8.36	162.36	0.36	2.62	0.07	1.06
2002	6.98	134.24	-0.05	-0.32	0.28	4.10
2003	4.95	142.93	0.65	7.01	0.06	1.38
2004	3.60	169.69	1.64	28.67	-0.24	-8.80
2005	4.82	259.06	1.77	35.25	-0.38	-15.60
2006	6.31	418.09	1.14	28.15	-0.24	-12.33
2007	6.90	413.37	0.43	9.57	-0.09	-4.09
2008	**8.70**	**218.63**	**-1.10**	**-10.26**	**0.33**	**6.38**
2009	8.32	158.74	1.44	10.20	-0.40	-5.91
Overall	7.07	563.90	0.77	25.97	**-0.10**	**-7.22**

Panel B: Concavity Tests of Implied Risk Premia

	$\boldsymbol{\alpha}$		$\boldsymbol{\beta}$		$\boldsymbol{\gamma}$	
Year	Coefficient	t-stat	Coefficient	t-Stat	Coefficient	t-stat
1996	1.27	30.71	1.55	13.91	-0.32	-5.97
1997	2.61	66.95	0.98	9.35	-0.16	-3.08
1998	4.00	82.13	1.73	13.22	-0.37	-5.79
1999	4.70	109.48	1.75	15.12	-0.39	-6.95
2000	4.90	102.45	0.89	6.88	0.01	0.11
2001	4.67	94.67	0.67	5.02	-0.21	-3.33
2002	5.25	98.71	-0.30	-2.11	0.10	1.50
2003	3.75	108.19	0.68	7.25	-0.12	-2.64
2004	2.03	94.23	0.89	15.33	-0.17	-6.08
2005	1.23	65.81	0.98	19.49	-0.16	-6.70
2006	1.04	68.77	1.01	24.67	-0.15	-7.75
2007	1.56	89.22	0.98	20.79	-0.21	-9.39
2008	**6.05**	**145.86**	**-1.08**	**-9.68**	**0.29**	**5.44**
2009	7.90	151.76	0.89	6.32	-0.34	-5.08
Overall	3.43	265.90	0.63	20.80	**-0.11**	**-8.18**

Table 3 estimates an OLS polynomial regression inclusive of linear and quadratic terms of the implied cost of equity on time to maturity T: $\mu(T) = \alpha + \beta T + \gamma T^2$. A negative value for γ indicates concavity of the term structure whereas a positive (zero) value indicates convexity (linearity). t-statistics are based on heteroscedasticity consistent standard errors. The 2008 economic crisis year estimates are bolded.

Table 4: Term Structure of Implied Costs of Equity by Industry

	μ_{m1}	μ_{m2}	μ_{q1}	μ_{q2}	μ_{q3}	μ_{q4}	μ_{q6}	μ_{q8}	μ_{peg}	μ_{epr}
Aero	7.85	8.20	8.24	8.30	8.45	8.62	8.99	9.39	10.25	6.64
Agric	6.03	6.46	6.52	6.59	6.62	6.61	6.71	6.85	10.25	7.24
Autos	7.12	7.59	7.71	7.91	8.07	8.22	8.73	9.23	14.40	7.28
Banks	6.74	7.15	7.26	7.45	7.62	7.77	8.19	8.65	11.11	7.92
Beer	5.39	5.59	5.62	5.72	5.80	5.89	6.10	6.35	8.15	5.95
BldMt	7.54	7.76	7.75	7.83	7.94	8.04	8.20	8.47	11.45	6.61
Books	5.91	6.31	6.40	6.64	6.76	6.88	7.08	7.38	8.47	5.74
Boxes	6.32	6.31	6.36	6.43	6.49	6.53	6.64	6.82	8.89	7.22
BusSv	7.66	7.96	8.00	8.05	8.13	8.18	8.33	8.54	10.19	4.11
Chems	6.94	7.29	7.35	7.49	7.63	7.76	8.09	8.47	11.26	6.18
Chips	8.39	8.75	8.84	8.95	9.07	9.17	9.43	9.76	12.01	4.09
Clths	6.80	7.18	7.27	7.41	7.52	7.64	7.88	8.21	11.17	7.57
Cnstr	6.87	7.34	7.44	7.61	7.67	7.70	7.90	8.18	16.35	7.18
Coal	8.01	8.41	8.55	8.64	8.74	8.75	9.00	9.29	15.79	7.16
Comps	7.99	8.29	8.35	8.40	8.49	8.57	8.78	9.06	11.19	4.85
Drugs	6.10	6.53	6.66	6.82	6.96	7.06	7.29	7.60	10.17	3.67
ElcEq	7.43	7.78	7.89	8.09	8.25	8.39	8.72	9.09	12.28	3.18
FabPr	2.21	3.89	4.30	4.30	4.58	4.67	4.96	5.25	12.51	12.60
Fin	7.02	7.37	7.38	7.54	7.67	7.77	8.10	8.45	10.24	6.79
Food	5.49	5.94	6.03	6.21	6.36	6.53	6.83	7.20	8.68	6.29
Fun	5.92	6.46	6.56	6.81	6.97	7.08	7.44	7.82	9.69	4.62
Gold	6.48	6.81	6.88	6.98	7.09	7.22	7.46	7.75	11.43	3.00
Guns	5.83	5.91	6.06	6.15	6.23	6.34	6.55	6.85	10.37	6.86
Hlth	4.71	5.01	5.10	5.25	5.37	5.45	5.59	5.80	10.76	6.57
Hshld	7.08	7.49	7.56	7.71	7.86	7.97	8.28	8.69	9.58	6.28
Insur	6.71	7.00	7.05	7.19	7.32	7.42	7.71	8.05	10.77	9.24
LabEq	6.88	7.27	7.35	7.47	7.56	7.62	7.83	8.10	10.82	4.48
Mach	7.78	8.10	8.15	8.23	8.31	8.39	8.62	8.94	12.04	6.40
Meals	5.69	6.10	6.15	6.34	6.52	6.70	7.05	7.45	9.45	5.26
MedEq	6.24	6.40	6.41	6.46	6.51	6.58	6.71	6.92	10.03	4.33
Mines	7.40	8.03	8.07	8.11	8.23	8.35	8.47	8.69	12.28	8.69
Oil	6.95	7.22	7.27	7.32	7.40	7.46	7.66	7.94	12.77	7.44
Other	6.87	7.08	7.22	7.29	7.41	7.52	7.85	8.21	9.97	6.14
Paper	7.38	7.63	7.68	7.76	7.85	7.96	8.44	8.88	12.38	6.36
PerSv	5.33	5.96	6.02	6.23	6.38	6.46	6.66	6.97	10.58	6.70
RlEst	3.65	4.36	4.50	5.21	5.61	5.95	6.35	6.93	7.93	3.39
Rtail	6.52	6.88	6.92	7.05	7.17	7.25	7.48	7.79	10.38	6.10
Rubbr	7.59	7.79	7.71	7.90	7.92	7.94	8.01	8.27	9.75	8.58
Ships	7.01	7.06	7.19	7.29	7.34	7.43	7.72	8.13	10.21	7.67
Smoke	4.75	5.11	5.22	5.30	5.41	5.43	5.67	5.92	8.79	8.97
Soda	6.17	6.38	6.42	6.59	6.72	6.86	7.17	7.56	7.49	4.72
Steel	8.37	8.71	8.73	8.85	8.95	8.99	9.29	9.66	13.29	7.29
Telcm	7.26	7.62	7.66	7.83	8.00	8.09	8.32	8.65	10.97	2.81
Toys	5.38	5.70	5.76	5.95	6.09	6.18	6.45	6.77	11.78	5.79
Trans	6.30	6.71	6.82	7.00	7.14	7.24	7.47	7.78	12.04	7.05
Txtls	4.71	6.01	6.30	6.89	7.43	7.47	7.51	7.73	13.27	3.81
Util	5.05	5.40	5.47	5.59	5.73	5.84	6.05	6.32	8.73	6.69
Whlsl	6.18	6.64	6.75	6.89	6.98	7.05	7.25	7.51	10.68	6.64

Table 4 lists mean implied cost of equity capital estimates sorted by Fama-French (1997) industries.

Table 5: Cross-sectional Validity Tests

Panel A: Cross-sectional Regressions of One-Year Ahead Average Excess Returns on Implied Costs of Equity Risk Premia

	μ_{peg}		μ_{epr}		μ_{q1}		μ_{q4}		μ_{q8}	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ	**0.1148**	**1.42**	**0.1332****	**2.13**	**0.2506*****	**3.69**	**0.2991*****	**3.35**	**0.2668****	**2.47**
α	-0.5407	-0.90	0.0129	0.02	-0.8192	-0.95	-1.0717	-1.24	-0.9637	-1.15
adj- R^2		0.020		0.015		0.075		0.076		0.053

Panel B: Cross-sectional regressions of One-year Ahead Average Excess Returns on Implied Costs of Equity Risk Premia and Three Firm Characteristics.

	μ_{peg}		μ_{epr}		μ_{q1}		μ_{q4}		μ_{q8}	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ	**0.1206**	**1.53**	**0.1416****	**1.97**	**0.2681*****	**4.15**	**0.3231*****	**3.81**	**0.2874*****	**2.77**
β	-0.1686	-0.84	0.0713	0.24	-0.4604	-2.23	-0.5015	-2.40	-0.4153	-2.04
$Size$	0.0046	0.04	-0.1056	-0.73	-0.0491	-0.32	-0.0410	-0.27	-0.0281	-0.17
BM	-0.0878	-0.43	-0.0973	-0.47	0.0971	0.51	0.0738	0.38	0.0596	0.31
α	-0.5203	-0.35	0.7128	0.47	0.2252	0.12	-0.1030	-0.06	-0.2197	-0.12
adj- R^2		0.020		0.023		0.081		0.083		0.057

Panel C: Cross-sectional Regressions of One-year Ahead Average Excess Returns on Implied Costs of Equity Risk Premia and Firm/Market Controls.

	μ_{peg}		μ_{epr}		μ_{q1}		μ_{q4}		μ_{q8}	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
μ	**0.0954****	**2.03**	**0.1183*****	**3.10**	**0.2990*****	**5.16**	**0.3566*****	**4.82**	**0.2958*****	**3.85**
β_m	-0.0430	-0.24	0.1275	0.59	-0.4097	-1.50	-0.4608	-1.64	-0.3334	-1.12
β_s	-0.1516	-0.47	-0.0133	-0.03	-0.2003	-0.56	-0.2192	-0.61	-0.1850	-0.52
β_h	-0.0562	-0.52	-0.1756	-1.48	0.0980	1.54	0.1039	1.54	0.0653	1.02
β_u	0.3289	1.29	0.1990	0.81	0.2783	1.86	0.3058	2.02	0.3192	2.13
$Size$	-0.1263	-1.29	-0.1812	-1.77	-0.0709	-0.64	-0.0603	-0.55	-0.0599	-0.50
BM	-0.1012	-0.60	-0.0574	-0.35	0.0743	0.54	0.0700	0.50	0.0606	0.44
mom_s	0.0197	0.45	0.0235	0.55	0.0382	1.00	0.0384	1.03	0.0321	0.79
mom_l	-0.1907	-1.68	-0.2152	-1.78	-0.0620	-0.85	-0.0572	-0.88	-0.1068	-1.29
rev	-0.1027	-0.84	-0.1107	-0.88	-0.0227	-0.18	-0.0087	-0.07	-0.0284	-0.22
$Accr$	-3.6542	-2.42	-3.8383	-3.47	-2.2582	-1.96	-2.3082	-2.02	-2.6030	-2.44
α	0.7664	0.55	1.5184	1.09	0.2073	0.15	-0.1331	-0.10	-0.0435	-0.03
$adj\text{-}R^2$		0.058		0.05		0.115		0.114		0.084

Table 5 estimates cross-sectional regressions of one-year ahead returns on various measures of implied costs of equity capital premia and selected firm/market characteristics. Panel A contains the baseline regressions excluding the firm characteristics. The Panel B regression includes three firm characteristics and takes the form:

$$r_{i,t} - rf_{i,t} = \alpha + \nu_1 \mu_{i,t-1} + \nu_2 \beta_{i,t-1} + \nu_3 \text{Size}_{i,t-1} + \nu_4 \text{BM}_{i,t-1} + \varepsilon_{i,t}$$

where $r_{i,t}$ is the firm's period t stock return, $rf_{i,t}$ is the risk-free rate, $\mu_{i,t-1}$ is last period's implied cost of equity risk premium estimate as derived from each of the models. $\beta_{i,t}$ is the firm's rolling five year beta updated monthly, $\text{Size}_{i,t}$ is the log market value of the firm and $\text{BM}_{i,t}$ is the log book to market ratio recalculated for each firm 3 months after the firm's fiscal year-end. The Panel C regressions include the Fama-French-Carthart betas and additional controls. The Fama-French-Carhart betas are the firm specific slope coefficients from rolling five year regression of realized returns on the four factor portfolios. The additional control variables include short-term momentum, moms, long-term momentum, moml, reversion, rev, and annual total accruals normalized by average total assets, Acc. Short-term momentum is measured as last month's return prior to the date of portfolio formation; long-term momentum is measured as the average return from months 2 to 12; reversion is measured as the average monthly return for years t-3 to t-2. Total accruals are calculated as earnings less cash flows from operations less extraordinary items and discontinued operations.

Table 6: Portfolio Based Time-Series Validity Tests

Panel A: Portfolio based returns

	μ_{peg}	μ_{epr}	μ_{q1}	μ_{q4}	μ_{q8}
π_1	0.15	0.03	-0.09	-0.03	-0.01
π_2	0.24	0.25	0.25	0.28	0.32
π_3	0.17	0.20	0.28	0.24	0.22
π_4	0.48	0.60	0.33	0.23	0.26
π_5	0.39	0.54	0.58	0.62	0.56
$\pi_5 - \pi_1$	**0.25**	**0.57*****	**0.67*****	**0.66*****	**0.58*****
$t-stat$	0.50	2.63	3.27	3.25	2.85

Panel B: Portfolio based Alphas

	μ_{peg}	μ_{epr}	μ_{q1}	μ_{q4}	μ_{q8}
π_1	0.15	-0.03	-0.24	-0.25	0.26
π_2	0.29	0.30	0.09	0.14	0.24
π_3	0.01	0.29	0.17	0.22	0.12
π_4	0.41	0.21	0.29	0.06	0.18
π_5	0.41	0.39	0.79	0.93	0.82
$\pi_5 - \pi_1$	**0.25**	**0.43**	**1.02*****	**1.18*****	**1.07*****
$t-stat$	0.72	0.97	2.87	3.10	2.85

Table 6, Panel A shows monthly average excess returns for five quintile portfolios π_1 to π_5 sorted by each of the implied cost of equity measures. Panel B shows alphas derived from portfolios adjusted excess returns based on the Fama-French-Cathart risk-factors as described in the notes to Table 5.