Using Earnings Forecasts to Simultaneously Estimate Firm-Specific Cost of Equity and Long-Term Growth

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Abstract

A growing body of literature in accounting and finance relies on implied cost of equity (COE) measures. Such measures are sensitive to assumptions about terminal earnings growth rates. In this paper we develop a new COE measure that is more accurate than existing measures because it incorporates endogenously estimated long-term growth in earnings. Our method extends Easton, Taylor, Shroff, and Sougiannis' (2002) method of simultaneously estimating *sample average* COE and growth. Our method delivers COE (growth) estimates that are significantly positively associated with future realized stock returns (future realized earnings growth). Moreover, the predictive ability of our COE measure subsumes that of other commonly used COE measures and is incremental to commonly used risk characteristics. Our implied growth measure fills the void in the earnings forecasting literature by robustly predicting earnings growth beyond the five-year horizon.

1. Introduction

In this study, we propose a new firm-specific measure of implied cost of equity capital (COE) that is more accurate than existing measures because it incorporates *endogenously* estimated long-term growth in earnings.

Implied COE measures are internal rates of return that equate a firm's current stock price to the sum of discounted future payoffs. Payoffs beyond the short-term horizon are assumed to grow at a certain constant long-term growth rate, which makes growth an important input in COE estimation.[1] Any error in the growth estimate feeds directly into the implied COE. In particular, the more positive (negative) is the error in the long-term growth rate, the more upwardly (downwardly) biased is the implied COE.[2]

Extant implied COE measures assume the same long-term growth rate across all firms (Claus and Thomas 2001; Gode and Mohanram 2003).[3] This assumption is unlikely to hold in practice, however, because a number of factors influence a firm's terminal growth rate, such as the firm's degree of accounting conservatism and expected growth in investment (Feltham and Ohlson 1995; Zhang 2000). Existing measures of implied COE therefore systematically over- or understate growth, which can lead to spurious inferences

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[1] This growth rate is often referred to as the terminal growth rate or the growth rate in perpetuity. Throughout the paper we use the terms long-term growth, terminal growth, and growth in perpetuity interchangeably.

[2] Valuation textbooks emphasize that firm valuation can be highly sensitive to the assumed terminal growth rate of earnings (Penman 2009; Whalen et al. 2010). For example, Damodaran (2002) states that "of all the inputs into a discounted cash flow valuation model, none can affect the value more than the stable growth rate."

[3] Another commonly used COE measure developed by Gebhardt et al. (2001) assumes a convergence in profitability to an industry benchmark over twelve years with a zero terminal growth thereafter. But as Easton (2006) points out, this approach creates systematic biases to the extent that firms with certain characteristics have other expected growth patterns.

(Easton 2006, 2007). Our measure of COE helps avoid such spurious inferences by taking into account a firm's growth rate as *implied by the data*.[4]

Our estimation method builds upon the pioneering work of Easton, Taylor, Shroff, and Sougiannis (2002) (hereafter, ETSS). ETSS develop a method to simultaneously estimate the *average* COE and *average* earnings growth rate for a given portfolio of firms. Despite this method's conceptual and practical appeal, however, it cannot be used in many research settings because it only allows one to estimate the *average* COE and growth rate for a given sample of firms. In this paper we extend the ETSS approach to allow for estimation of COE and expected earnings growth for individual firms. Our approach is motivated by the industry practice of using firm peers when valuing privately-held companies. Practitioners often compare a given firm against firms with similar characteristics to determine an appropriate COE and/or growth rate (Pratt and Niculita 2007; Damodaran 2002). Accordingly, our method estimates a firm's COE (growth) as the sum of the COE (growth) typical of firms with the same risk-growth profile plus a firm-specific component. Empirically, COE and growth are estimated by regressing the ratio of forecasted earnings to book value of equity on the market-to-book ratio and a set of observable risk and growth characteristics.[5]

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[4] Developing a more accurate and less biased implied COE measure is important given the increasing use of implied COE measures in accounting and finance literature. Implied COE measures have been used to shed light on the equity premium puzzle (Claus and Thomas 2001; Easton et al. 2002), the market's perception of equity risk (Gebhard et al. 2001), risk associated with accounting restatements (Hribar and Jenkins 2004), dividend taxes (Dhaliwal et al. 2005), accounting quality (Francis et al. 2004), legal institutions and regulatory regimes (Hail and Leuz 2006), and quality of internal controls (Ogneva et al. 2007), as well as to test intertemporal CAPM (Pastor et al. 2008), international asset pricing models (Lee et al. 2009), and the pricing of default risk (Chava and Purnanandam 2010).

[5] Specifically, we use the CAPM beta, size, book-to-market, and momentum as the observable risk characteristics, and we use analysts' long-term growth forecast, the difference between the industry ROE and the firm's forecasted ROE, and the ratio of R&D expenses to sales as the observable growth characteristics. We take the part of COE (growth) that is not explained by these observable risk (growth)

We test the accuracy of our COE estimates by examining their ability to explain future stock returns for a sample of I/B/E/S firms over the 1980 to 2007 period. The analysis uses unadjusted earnings forecasts as well as forecasts adjusted for predictable analyst biases as in Gode and Mohanram (2009). We find that using either adjusted or unadjusted earnings forecasts our implied COE measure has return predictive ability that is incremental to the benchmark COE measures and commonly used risk proxies (the CAPM beta, size, book-to-market, and past twelve-month stock returns). Specifically, our measure remains significantly positively related to future realized stock returns even after controlling for the benchmark COE measures and commonly used risk proxies. In contrast, none of the benchmark COE measures is significantly related to future stock returns after controlling for our measure. Additional tests that rely on Easton and Monahan's (2005) methodology suggest that our implied COE measure delivers the lowest measurement error compared to the benchmark COE estimates.

Analysis of the cross-sectional determinants of relative predictive ability of our measure compared to the best performing benchmark—COE based on the GLS model (Gebhardt et al. 2001)—suggests that our measure performs markedly better for firms that are very different from other firms in the industry in terms of their profitability, forecasted long-term growth, and past sales growth, or very different from the average firm in the sample in terms of size, book-to-market ratio, CAPM beta, or past returns.

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characteristics to be due to unobservable risk (growth) factors. Examples of such risk factors may include the risk of increased competition and extreme weather, credit risk, and litigation risk as perceived by market participants but not fully captured by the set of observable risk characteristics that we consider. We acknowledge that the set of risk and growth characteristics that we use in the estimation may be incomplete, however the flexibility of our method allows incorporating any number of additional factors pertinent to a specific study.

These findings may guide future empirical research in the choice of an appropriate COE measure.

To examine the accuracy of our implied growth estimates, we test their predictive ability with respect to future earnings growth rates. Specifically, we estimate the realized growth in aggregate four-year cum-dividend earnings from years *t*+1 to *t*+4, to years *t*+5 to *t*+8. We find that our implied growth estimates are significantly associated with future earnings growth: when we sort stocks into quintiles based on implied growth, the annualized growth spread between the top and bottom quintiles is between 2.5% and 10.4% (5.5% and 8.6%) per annum using our unadjusted (adjusted) measure. Multivariate regression analyses indicate that the predictive ability of our implied growth measure is entirely attributable to the growth characteristics used in its estimation, which leads us to further investigate the role of observable characteristics in our method.

Our method embeds observable risk and growth characteristics into the residual income valuation framework. The valuation equation determines the optimal weights on these characteristics, and allows estimating COE and growth components due to unobservable risk and growth factors. It could be the case however that most of the predictive ability of our COE and growth measures comes from simply relying on observable characteristics. To examine this possibility, we construct a statistically predicted COE (growth) based on the same risk (growth) characteristics that we use in our model [6] and compare its predictive ability to the predictive ability of our implied COE (growth) measure. The analysis shows that (1) the statistically predicted return

[6] Specifically, we use a cross-sectional prediction model that first regresses past realized returns (growth) on past risk (growth) characteristics and then applies the resulting coefficients to current return (growth) characteristics to arrive at a return (growth) forecast.

measure does not have significant return predictive ability, and (2) although the statistically predicted growth is significantly associated with future long-term growth, it does not subsume the predictive ability of our implied growth measure. Therefore, it appears that embedding risk and growth characteristics into the valuation equation is superior to constructing simple statistical predictions using the same characteristics.

In addition to examining COE and growth rates for individual firms, we revisit ETSS' findings with respect to the market-wide levels of COE and earnings growth. Using our method, we obtain estimates of average implied COE and equity risk premia that are significantly lower than those obtained from the ETSS model and more in line with low risk premia from prior theoretical studies (Mehra and Prescott 1985).

Our paper contributes to the literature in several ways. First, we expand the literature on COE estimation by developing an implied COE measure that relies on endogenously determined long-term earnings growth. By taking into account growth rates implied by the data, our implied COE measure is less likely to be biased due to using incorrect terminal growth assumptions. Second, our COE estimation marries the implied COE approach with a long-standing industry practice of using benchmark characteristics in firm valuation. The flexibility of our method allows incorporating any risk and growth characteristics that are pertinent to a specific study. Third, our implied growth measure fills the void in the earnings forecasting literature by robustly predicting earnings growth beyond the five-year horizon.[7] Finally, we contribute to the equity premium literature by

[7] We are not aware of any papers that construct and validate forecasts of terminal growth, or even growth beyond five-year horizon. However, several papers forecast earnings over horizons beyond two years. For example, Chan et al. (2003) and Gao and Wu (2010) forecast earnings growth over the next five years, while Hou et al. (2010) forecast three-year-ahead earnings. Estimates from these models may serve as an alternative to short-term analysts' forecasts.

providing a measure that delivers average firm-level equity risk premia consistent with a theoretically justified low implied market-wide risk premium.

The rest of the paper is organized as follows. Section 2 discusses our estimation of firm-level COE and growth. Section 3 describes the data and variable estimation. In Section 4 we present the empirical results. Section 5 contains robustness checks and additional analyses. Session 6 provides concluding remarks.

2. Estimation of Implied Cost of Equity and Growth

In this section, we develop a method to simultaneously estimate firms' COE and expected earnings growth using stock prices, book values of equity, and earnings forecasts. Our method extends Easton, Taylor, Shroff, and Sougiannis (2002) (ETSS), who simultaneously estimate *average* COE and expected earnings growth for a given sample of firms.

Similar to ETSS, our approach is based on the residual income model (e.g. Ohlson 1995), which expresses firm value as the book value of equity plus the discounted sum of expected residual earnings: [8]

$$P_0^i = B_0^i + \sum_{t=1}^{\infty} \frac{E_t^i - r^i B_{t-1}^i}{(1+r^i)^t} \tag{1}$$

where P_0^i is the market value of equity, B_0^i is the book value of equity, E_0^i is expected earnings for year t given information at t=0, and r^i is the COE (unless

[8] The residual income model is equivalent to the discounted dividend model assuming the clean surplus relation, i.e. the book value of equity at the end of year t+1 is equal to the book value of equity at the end of year t plus net income for year t+1 minus dividends for year t+1.

specifically stated otherwise, we use COE and expected return interchangeably throughout the paper).

Following ETSS, we re-write the valuation equation using finite (four-year) horizon forecasts and define g^i as the perpetual annual growth rate such that:

$$P_0^i = B_0^i + \frac{X_{cT}^i - (R^i - 1)B_0^i}{R^i - G^i} \tag{2}$$

where $G^i = (1+g^i)^4$ is one plus the expected rate of growth in four-year residual income, $R^i = (1+r^i)^4$ is one plus the four-year expected return, $X_{CT}{}^i = \sum_{t=1}^{4} E_t + \sum_{t=1}^{3}((1+r)^{4-t} - 1)d_t$ is expected aggregate four-year cum-dividend earnings, and d_t is expected dividends in year t given information at t=0.

In order to estimate COE and growth, ETSS re-arrange valuation equation (2) as:

$$X_{CT}{}^i = G^i - 1 + (R^i - G^i)MB^i \tag{3a}$$

ETSS further observe that the sample average R and G in equation (3a) can be estimated from the intercept and the slope in a cross-sectional regression of the ratio of cumulative earnings to book value on the market-to-book ratio:

$$X_{CT}{}^i / B_0{}^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \tag{3b}$$

where $\gamma_0 = \overline{G} - 1$, $\gamma_1 = \overline{R} - \overline{G}$, and $\varepsilon^i = \varepsilon^i{}_G(1 - MB^i) + \varepsilon^i{}_R MB^i$. The $\overline{R}$ and $\overline{G}$ are the sample means of R^i and G^i respectively, and $\varepsilon^i{}_R = R^i - \overline{R}$ and $\varepsilon^i{}_G = G^i - \overline{G}$ are the firm-specific deviations of R^i and G^i from their sample means.

Estimating regression (3b) using OLS obtains sample means of COE and growth $\overline{R} = \gamma_0 + \gamma_1 + 1$ and $\overline{G} = \gamma_0 + 1$, leaving firm-specific components of R and G unidentified.

Our approach introduces two innovations to the ETSS method. First, we explicitly recognize that COE and growth rates are associated with certain firm characteristics.

Specifically, we express a firm's COE (growth) as the COE (growth) typical of firms with the same risk-growth profile plus a firm-specific component due to unobservable risk (growth) factors:

$$R^i = \overline{R} + \boldsymbol{\lambda}_{\mathbf{R}}{}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i$$
$$G^i = \overline{G} + \boldsymbol{\lambda}_{\mathbf{G}}{}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i$$

where $\overline{R}$ ($\overline{G}$) is the sample mean of R^i (G^i) in year t, $\mathbf{x}_{\mathbf{R}}^{\mathbf{i}}$ ($\mathbf{x}_{\mathbf{G}}^{\mathbf{i}}$) is a vector of observable risk (growth) drivers (the drivers are demeaned to ensure that $\overline{R}$ and $\overline{G}$ can be interpreted as sample means) [9], $\boldsymbol{\lambda}_{\mathbf{R}}$ ($\boldsymbol{\lambda}_{\mathbf{G}}$), is a vector of premia (weighs) on the observable risk (growth) drivers, and $\varepsilon^i{}_R$ ($\varepsilon^i{}_G$) is a firm-specific component of R^i (G^i) that is due to unobservable risk (growth) factors.[10]

Incorporating observable risk and growth drivers serves two purposes. First, it provides estimates of firm-specific COE and growth rates conditional on observable firm characteristics. Second, it helps to obtain more accurate estimates of *average* COE and growth rates. To see this, note that the estimates of average COE and growth rate ($\overline{R}$ and $\overline{G}$) are derived from the intercept and slope estimates in (3b). The residuals in (3b) are a linear function of the firm-specific components of COE and growth rate ($\varepsilon^i = \varepsilon^i{}_G (1 - MB^i) + \varepsilon^i{}_R MB^i$). The residuals are therefore likely to be correlated with firm-specific COE and growth rates, which are in turn correlated with the independent variable in regression (3b) − the market-to-book ratio (e.g. Fama and French 1993; Penman 1996). Note, that

[9] Empirically, we use the CAPM beta, size, book-to-market ratio, and momentum as observable risk drivers, and we use the analyst long-term growth forecast, R&D expenditures and the deviation of firm's forecasted ROE from the industry target ROE as observable growth drivers.

[10] The component due to unobservable risk (growth) factors is defined as the part of COE (growth) that is not explained by the observable risk (growth) drivers. For example, unobservable risk factors may include the risk of increased competition, liquidity risk, credit risk, litigation risk, and political risk as perceived by market participants but not fully captured by the above observable risk drivers.

because the residuals in (3b) are a complex function of the firm-specific COE, growth rate, and market-to-book ratio, it is unclear whether such correlations represent a source of bias in the regression coefficients. Explicitly incorporating observable risk and growth factors in equation (3b) mitigates any concerns regarding the possible bias and may lead to more accurate estimates of average COE and growth rates.

As a second innovation, we decompose residuals ε^i in the cross-sectional regression (3b) into the COE ($\varepsilon^i{}_R$) and expected growth ($\varepsilon^i{}_G$) components by jointly minimizing the components of COE and expected growth due to unobservable risk and growth factors, $\varepsilon^i{}_R$ and $\varepsilon^i{}_G$. For this purpose, we set up the following minimization program:

$$\begin{cases} \underset{\bar{R},\bar{G},\lambda_R,\lambda_G,\varepsilon^i_R,\varepsilon^i_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ R^i = \bar{R} + \boldsymbol{\lambda}_{\mathbf{R}}{}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i \\ G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}{}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i \end{cases} \tag{4}$$

where $w_1{}^i$ and $w_2{}^i$ are some predetermined non-negative weights (with at least one of the two weights being positive), and the other variables are as defined above.

Intuitively, the minimization function in (4) represents a loss (cost) function that increases with the magnitude of unexplained components of COE and growth. Tying the cost function to unexplained components is akin to Occam's razor principle – everything else being equal, estimates that can be explained by observable factors are preferred to estimates that appeal to some unobservable factors. The weights $w_1{}^i$ and $w_2{}^i$ reflect relative importance of components due to unobservable risk and growth factors, respectively. For example, setting $w_1{}^i$ equal to zero, assumes that growth does not vary across firms beyond variation implied by observable growth factors, i.e. $G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}`\mathbf{x}_{\mathbf{G}}^{\mathbf{i}}$.

Appendix A shows that our minimization program (4) is equivalent to the following minimization program that can be estimated using a weighted least squares (WLS) regression:[11]

$$\begin{cases} \underset{\varepsilon^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G}{Min} \sum_i w^i (v^i)^2 \\ \text{s.t.} \quad X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i + \boldsymbol{\lambda}_\mathbf{R}\,' \mathbf{x}^\mathbf{i}_\mathbf{R} MB^i + \boldsymbol{\lambda}_\mathbf{G}\,' \mathbf{x}^\mathbf{i}_\mathbf{G} (1 - MB^i) + v^i \end{cases} \tag{5a}$$

where the weights w^i are equal to $w_1{}^i w_2{}^i / (w_1{}^i(1\text{–}MB^i)^2 + w_2{}^i(MB^i)^2)$.[12]

Using the coefficient and residual estimates (γ_0, γ_1, $\boldsymbol{\lambda}_\mathbf{R}$, $\boldsymbol{\lambda}_\mathbf{G}$, and ε^i) from the WLS regression (5a), firm COE (R^i) and growth rate (G^i) are determined as follows (derivation can be found in Appendix A):

$$R^i = \overline{R} + \boldsymbol{\lambda}_\mathbf{R}\text{`}\mathbf{x}_\mathrm{R}{}^\mathrm{i} + \varepsilon^i{}_R \tag{5b}$$
$$G^i = \overline{G} + \boldsymbol{\lambda}_\mathbf{G}\text{`}\mathbf{x}_\mathrm{G}{}^\mathrm{i} + \varepsilon^i{}_G.$$

where

$$\overline{R} = \gamma_0 + \gamma_1 + 1$$
$$\overline{G} = \gamma_0 + 1$$

$$\varepsilon^i_R = v^i \frac{w^i_2 MB^i}{w^i_1 (MB^i - 1)^2 + w^i_2 (MB^i)^2}$$

$$\varepsilon^i_G = v^i \frac{w^i_1 (1 - MB^i)}{w^i_1 (MB^i - 1)^2 + w^i_2 (MB^i)^2}$$

[11] Regression (5a) assumes that independent variables are exogenous, i.e. E[ε^i | MB^i, $MB^i x_R{}^i$, $(1 - MB_i)x_\mathrm{G}{}^i$] = 0. A sufficient but not necessary condition for the exogeneity is the assumption that $\varepsilon^i{}_R$ and $\varepsilon^i{}_G$ are independent of MB^i, $x_R{}^i$, and $x_G{}^i$.

[12] Note that the WLS regression restricts neither the magnitudes nor the signs of the risk premia and growth weights, λ_R and λ_G, which are determined endogenously based on earnings forecasts and stock prices.

To summarize, our method allows simultaneously estimating implied COE and terminal growth by incorporating observable risk and growth drivers into the valuation equation, while minimizing COE and growth variation due to unobservable factors.

Estimation Procedure

We estimate firms' COE and growth rates in the two steps detailed below.

Step 1: Each year, we estimate the following cross-sectional regression using WLS with the weights equal to $1 / ((1–MB^i)^2 + (MB^i)^2)$:[13]

$$X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i + \underbrace{(\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret^i_{-12})}_{\lambda_R' x^i_R} MB^i$$
$$+ \underbrace{(\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)}_{\lambda_G' x^i_G} (1 - MB^i) + v^i \quad (6)$$

where the vector of risk characteristics, $\mathbf{x^i_R}$, corresponds to the three-factor Fama-French model augmented with Carhart (1997) momentum factor: the CAPM beta (*Beta*), market value of equity (*LogSize*), market-to-book ratio (*MB*), and past twelve months stock return (ret_{12}).[14] The vector of growth characteristics, $\mathbf{x_G^i}$, consists of the analysts' long-term growth forecast (*Ltg*), the difference between industry ROE and the firm's average forecasted ROE over years t+1 to t+4 (*dIndROE*), which serves as a proxy for the mean-reversion tendency in ROEs, and the ratio of R&D expenses to sales (*RDSales*). The latter characteristic serves a dual purpose as a proxy for the extent of accounting

[13] These weights assume equal weighting of the COE and growth components due to unobservable factors in (4), that is $w_1^i = w_2^i = 1$. As a robustness check, we vary the ratio of the weights (w_1^i / w_2^i) from 0.5 to 2. Our inferences are robust to these variations.

[14] Leverage is another characteristic associated with equity risk. We do not include leverage in the estimation because Fama and French (1992) show that the power of leverage to predict future stock returns is subsumed by the CAPM beta, size, and book-to-market ratio.

conservatism, which affects terminal growth in residual income (Zhang 2000), and as one of the known predictors of the long-term growth in earnings (Chan et al. 2003).[15]

Calculation of X_{cT}^{i} requires a COE estimate, R^{i}, which is not known. We use an iterative procedure similar to that described in ETSS to estimate both X_{cT}^{i} and R^{i}. Namely, we first set R^{i} equal to 10% for all firms and calculate the initial values of X_{cT}^{i}. We then use obtained X_{cT}^{i} to estimate the WLS regression, which produces revised estimates of R^{i}. We then re-calculate X_{cT}^{i} using the revised estimates of R^{i} and again re-estimate the WLS regression. The procedure is repeated until the mean (across all firms) of absolute change in R^{i} from one iteration to the next is less than 10^{-7}. The estimation is robust to using other initial values of R^{i} and in most cases involves less than 10 iterations.[16]

Step 2: Using the intercept and the slope of the market-to-book ratio from Step 1, we calculate the mean $\overline{R}$ and $\overline{G}$ as $\overline{R} = \gamma_0 + \gamma_1 + 1$ and $\overline{G} = \gamma_0 + 1$. We use residuals from the same regression to calculate the firm-specific components of R and G, as $\varepsilon^{i}_{R} = v^{i}MB^{i} / ((MB^{i} - 1)^2 + (MB^{i})^2)$ and $\varepsilon^{i}_{G} = v_i\,(1 - MB_i\,)/\,((MB^{i} - 1)^2 + (MB^{i})^2)$. Finally, we combine estimates $\overline{R}$ and $\overline{G}$ and residuals ε^{i}_{R} and ε^{i}_{G}, with estimated $\boldsymbol{\lambda_R}`\mathbf{x}_R^{\mathrm{i}}$ and $\boldsymbol{\lambda_G}`\mathbf{x}_G^{\mathrm{i}}$ from

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[15] Our search of growth drivers reveals that the literature on forecasting growth in earnings over long horizons is very sparse. To our knowledge, there are no empirical papers that would forecast growth in *residual* earnings. There are also no papers documenting growth in accounting earnings over horizons exceeding ten years into the future. Chan et al. (2003) explore growth over the ten-year horizon. However, their cross-sectional prediction model forecasts earnings growth only five years into the future. In our sensitivity tests, we have also included other growth predictors suggested in Chan et al. (2003), including past sales growth, earnings-to-price ratio, and alternative conservatism proxies used in Penman and Zhang (2000). Our results are not sensitive to including them in the estimation, and we opt for a parsimonious set of variables to avoid additional sample restrictions.

[16] Note that numerical estimation of implied COE is typical in models that assume different short-term and long-term growth rates in earnings (e.g. Gebhardt et al. 2001, Claus and Thomas 2001). The method proposed here is not more computationally complex than the extant COE estimation methods.

regression (6), and calculate total COE and expected growth as $R^i = \overline{R} + \boldsymbol{\lambda}_{\mathbf{R}}`\mathbf{x}_R{}^i + \varepsilon^i{}_R$ and $G^i = \overline{G} + \boldsymbol{\lambda}_{\mathbf{G}}`\mathbf{x}_G{}^i + \varepsilon^i{}_G$.

3. Data and Variable Estimation

Our sample consists of December fiscal-year-end firms available in *I/B/E/S*, *Compustat*, and *CRSP* from 1980 to 2007. The one- and two-year-ahead analyst earnings forecasts, long-term growth forecasts, realized earnings, stock prices, dividends, and number of shares outstanding are obtained from *I/B/E/S*; book values of common equity are obtained from *Compustat*; CAPM betas, as well as past and future buy-and-hold stock returns are estimated using monthly stock returns from CRSP. We exclude firm-years with negative two-year-ahead earnings forecasts, book-to-market ratios less than 0.01 or greater than 100, or stock prices below one dollar. Our main sample consists of 50,636 firm-year observations. Tests that involve COE based on the PEG model use a smaller sample of 48,033 firm-year observations due to requiring positive earnings forecasts.

Inputs to Simultaneous Estimation of COE and Growth

Our COE and long-term growth measures are estimated by first running the following cross-sectional regression using WLS:

$$\begin{aligned} X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i &+ (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret^i_{-12}) MB^i x^i_R \\ &+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x^i_G + v^i \end{aligned} \tag{6}$$

where

X_{cT} = four-year cum-dividend earnings forecast, $\sum_{t=1}^{4} E_t + \sum_{t=1}^{3} ((1+r)^{4-t} - 1) d_t$,

where E_1 and E_2 are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year t+1; E_3 and E_4 are three- and four-year-ahead earnings per share forecasts computed using the long-term growth rate from *I/B/E/S* as: $E_3 = E_2(1+Ltg)$ and $E_4 = E_3(1+Ltg)$;[17] d_1 to d_3 are expected dividends per share calculated assuming a constant dividend payout ratio from fiscal year t;

B_0 = book value of equity from *Compustat* at the end of year t divided by the number of shares outstanding from *I/B/E/S*;

MB = market-to-book ratio, calculated as the stock price from *I/B/E/S* as of June of year t+1, divided by per share book value of equity;

Beta = CAPM beta estimated using sixty monthly stock returns preceding June of year t+1 (with at least twenty four non-missing returns required);

LogSize = the log of the market value of equity calculated as stock price from *I/B/E/S* as of June of year t+1 multiplied by shares outstanding from *I/B/E/S*;

Ret_{-12} = twelve-month buy-and-hold stock return preceding June of year t+1;

Ltg = consensus long-term growth forecast from *I/B/E/S* as of June of year t+1;

dIndROE = the industry mean ROE (income before extraordinary items divided by the average book value of equity) minus the firm's average forecasted ROE over years t+1 to t+4. Industries are defined using the Fama and French (1997) 48-industry classification. Industry ROE is calculated as a ten-year moving median ROE after excluding loss firms (Gebhardt et al. 2001);

RDSales = the ratio of R&D expenses to sales.

All variables are demeaned using yearly sample means.

COE from Benchmark Models

We compare the performance of our COE measure to three widely used COE measures derived using an *assumed* long-term earnings growth rate. The first implied COE measure, r_{CT}, is based on Claus and Thomas (2001). It represents an internal rate of return from the residual income valuation model assuming that after five years residual

[17] We substitute missing *Ltg* with *E2/E1* – 1. Values of *Ltg* greater than 50% are winsorized.

earnings will grow at a constant rate equal to the risk-free rate (proxied by the ten-year Treasury bond yield) minus historical average inflation rate of three percent.

The second implied COE measure, r_{GLS}, is developed by Gebhardt et al. (2001) and is frequently used in both accounting and finance studies. It is derived using explicit earnings forecasts for years t=1 and t=2, and assumes that return on equity converges to the industry median ROE from year t=3 to year t=12. A zero growth in residual earnings is assumed afterwards.

The third implied COE measure, r_{PEG}, is taken from Gode and Mohanram (2003). It is based on the abnormal earnings growth model (Ohlson and Juettner-Nauroth 2005) and assumes a zero abnormal earnings growth beyond year t+2.

The details of benchmark COE estimation are in Appendix B.

Adjusting Analysts' Forecasts for Predictable Errors

Prior literature shows that analyst earnings forecasts are systematically biased, with the direction and the magnitude of the bias correlated with various firm-year characteristics (e.g. Guay et al. 2005, Hughes et al. 2008). Using biased earnings forecasts as inputs in the valuation equation inevitably produces biased implied COE estimates (Easton and Sommers 2005). To mitigate the effect of the bias, we follow Gode and Mohanram (2009) and adjust analyst forecasts for predictable errors and then re-compute the implied COE measures using the adjusted forecasts.[18,19]

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[18] We would like to thank Partha Mohanram for sharing his forecast error adjustment codes.

[19] Hughes et al. (2008) suggest that the trading strategy based on exploiting predictable analyst forecast errors does not produce statistically significant returns, which is consistent with the market not being subject to the same biases as analysts. However, it is possible that in some instances stock prices may incorporate earnings expectations biased in the same direction as analyst earnings forecasts. If this is the case, adjusting earnings forecasts for such predictable errors leads to implied COE estimates that do not

We obtain predictable errors in earnings forecasts by first regressing realized forecast error in *k*-year-ahead earnings scaled by price ($FERR_k$, k = 1, 2, 3, and 4) on the forward earnings-to-price ratio, long-term growth forecast, change in gross PP&E, trailing twelve-month stock return, and the revision of one-year-ahead earnings forecast from the forecast made three months earlier. The regressions are estimated annually based on the hold-out sample lagged by *k* years. The obtained coefficients are combined with variables in year *t* to estimate the predictable bias in *k*-year-ahead earnings forecasts. We then correct earnings forecasts for the predictable bias and calculate the adjusted COE and growth rate based on the corrected forecasts. The obtained COE and implied growth rates are labeled as "*adjusted*".

4. Empirical Analyses

Descriptive Statistics

Table 1 reports descriptive statistics for our sample firms.[20] Consistent with other studies that use *I/B/E/S* analyst earnings forecasts, the firms in our sample are relatively large with the mean (median) market capitalization of $3,631 ($517) million. The mean CAPM beta is 1.07 which is comparable to the beta of one for the market value-weighted portfolio. The high average long-term growth forecast of 0.171 and the negative average

represent the market's expectations of future returns, but instead are equal to the market's expectation of future returns plus the predictable return due to subsequent correction of the mispricing. The adjusted COE measure then represents the total COE that the firm faces due to both risk and mispricing. In our empirical analyses, we do not distinguish between the two interpretations of implied COE.

[20] To avoid the influence of extreme observations, we winsorize all variables except future realized returns at the 1st and 99th percentiles.

difference between the industry ROE and the firm's average forecasted ROE, *dIndROE*, are consistent with on-average optimistic bias in analyst earnings forecasts.

Cost of Equity Estimation Results

Our estimation of firms' COE and growth is based on regression (6):

$$X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret^i_{-12}) MB^i x^i_R$$

$$+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x^i_G + v^i ,$$

where all variables are previously defined in Section 3. Regressions are estimated by year, with an iterative procedure described in Section 2.[21]

Table 2 Panel A reports regression results. The first (last) three columns use unadjusted analyst earnings forecasts (forecasts adjusted for predictable errors). The panel reports time-series averages of estimated regression coefficients (λ). In addition to assessing statistical significance of regression coefficients, we evaluate economic importance of the risk and growth drivers by calculating standardized regression coefficients. Namely, we multiply regression coefficients by corresponding average yearly standard deviations of risk and growth drivers. The obtained standardized coefficients can be interpreted as changes in COE (implied growth) due to one standard deviation increase in the risk (growth) driver.

The results in Panel A of Table 2 indicate that the most important risk (growth) driver is the market-to-book ratio (difference between industry ROE and firm's

[21] Regression (6) is estimated using WLS. As a robustness check, we have replicated estimation using an OLS regression. The results are similar—implied COE measures predict future realized returns with coefficients significantly different from zero—but the predictive ability is weaker (the coefficient on unadjusted COE measure is significantly different from one). This deterioration in COE predictive ability underscores the importance of utilizing theoretically correct weights for the regression residuals.

forecasted ROE, *dIndROE*). The increase in *MB* (*dIndROE*) by one standard deviation corresponds to a decrease (increase) in four-year COE (growth) by 12.9% (10%) using unadjusted forecasts and 9.8% (8.5%) using adjusted forecasts. On annualized basis, these differences correspond to 3.4% (2.4%) and 2.5% (2.1%), respectively.

The signs of coefficients on *MB* and Ret_{-12} are consistent with prior literature. When using adjusted forecasts, the loading on *Beta* is negative, which is inconsistent with the single-period CAPM. However the effect is economically negligible (one standard deviation increase in *Beta* decreases annualized return by 0.2%) and is in line with negative insignificant coefficient documented in asset-pricing tests based on realized returns (Fama and French 1992; Petkova 2006).[22] The loading on size is negative but not economically significant suggesting that size effect is negligible in I/B/E/S sample (Frankel and Lee 1998). Regression based on unadjusted forecasts suggests a negative relation between past returns and COE consistent with the sluggishness in analyst forecasts (Guay et al. 2005).[23] In contrast, regressions based on adjusted forecasts suggest that COE is positively associated with past returns reflecting momentum in stock returns. [24]

Overall, our estimation produces loadings on risk and growth drivers that are generally consistent with prior literature. In our sample, the book-to-market ratio is the

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[22] The insignificant relation between the CAPM beta and stock returns is a key motivation for alternative asset-pricing models (Merton 1973; Jagannathan and Wang 1996; Lettau and Ludvigson 2001).

[23] When analyst forecasts are sluggish, they do not incorporate the recent positive (negative) earnings news and are therefore biased downward (upward) following recent positive (negative) stock returns. The bias in forecasts mechanically leads to downwardly (upwardly) biased implied COE estimates following positive (negative) stock returns.

[24] Some risk (growth) drivers are not loading significantly in either Unadjusted or Adjusted Forecast regressions. These drivers include CAPM beta, analysts' long-term growth forecast, and size. When we perform estimation excluding these drivers, our validation results are predictably very similar.

most important determinant of COE, while the difference between the firm's forecasted ROE and industry's ROE is the most important determinant of terminal growth.

Panel B of Table 2 reports descriptive statistics of implied COE and terminal growth estimates. The mean (median) of our COE estimate, r_{SE} (where *SE* stands for simultaneous estimation), is 8.2% (7.7%) and the mean (median) of our growth estimate, g_{SE} , is 0.6% (0.4%). Our COE estimates are somewhat lower than those based on the Claus and Thomas model, GLS model, and PEG model (with the means of 11.1%, 10.3%, and 11.1% respectively). When earnings forecasts are corrected for analyst forecast biases, COE estimates from all models decline suggesting that earnings forecasts are on average adjusted downwards to correct for the overall optimistic forecast bias.

Panel C of Table 2 presents means of by-year correlations among the COE estimates. The average correlations between unadjusted (adjusted) r_{SE} and r_{CT}, r_{GLS}, and r_{PEG} are 0.49, 0.71, and 0.53 (0.31, 0.61, and 0.43), respectively. Overall, correlations among all COE measures are positive and significant in majority of sample years, suggesting that they capture the same underlying construct.

Implied COE and Future Realized Returns

In this subsection, we validate the implied COE measures by documenting their association with future realized returns (Guay et al. 2005; Easton and Monahan 2005; Gode and Mohanram 2009).

We first document COE's out-of-sample predictive ability with respect to future stock returns by sorting firms into quintiles of implied COE distribution at the end of June of each year. For each portfolio, we calculate the mean buy-and-hold return for the next twelve months. We also calculate hedge returns as the difference in returns between the top (Q5) and bottom (Q1) quintiles of implied COE.

Figure 1 plots the time-series means of portfolio returns. The magnitudes of hedge returns are reported next to 'Q5-Q1' labels. Panel A reports returns by portfolios based on unadjusted COE measures. Our measure, r_{SE}, exhibits a strong monotonic relation with future realized returns. The difference in returns between the top and bottom quintiles of r_{SE}, Q5-Q1, is equal to 6.5% (statistically significant at the 5% level). In contrast, the predictive ability of r_{CT}, r_{GLS} and r_{PEG} is weak. The hedge returns, Q5-Q1, for r_{CT}, r_{GLS}, and r_{PEG} are only 3.9%, 3.8%, and 0.1% respectively, and not statistically significant for r_{GLS}, and r_{PEG}.

Panel B of Figure 1 plots returns by portfolios based on COE measures adjusted for forecast errors. Performance of all COE measures is markedly improved,[25] with our measure still performing best. The hedge returns, Q5-Q1, increase to 9.3%, 4.4%, 6.8%, and 4.5% for r_{SE}, r_{CT}, r_{GLS}, and r_{PEG} respectively, and are significant at the 1% (5%) level for r_{SE} (all benchmark models). Overall, our COE measure significantly outperforms the benchmark models at the portfolio level.

Next, we investigate the return predictive ability of COE measures at the firm level. Panel A of Table 3 reports the results of cross-sectional regressions of one-year-ahead stock returns on the COE measures. Each slope coefficient has two corresponding *t*-statistics reflecting how significantly different the coefficient is from zero and one. The slope on a valid COE measure should be significantly different from zero, and not

[25] This result is consistent with Gode and Mohanran (2009) and Larocque (2010) who show that COE based on the PEG model improves its return predictability when analysts' forecasts are adjusted for predictable errors.

significantly different from one. Consistent with the evidence from Figure 1, our measure, r_{SE}, is significantly related to future stock returns, with regression coefficient statistically indistinguishable from one. None of the other measures unadjusted for analyst forecast errors can predict future returns. After the forecast error adjustment, the slopes increase for all measures and become (remain) significantly positive for r_{CT} and r_{GLS} (r_{SE}). The slope on r_{PEG}, although positive, remains insignificant.

Next, we examine the incremental explanatory power of r_{SE} and the benchmark COE measures relative to each other by regressing future realized returns on the pairs of COE measures. The results are reported in Panel B of Table 3. Both unadjusted and adjusted r_{SE} have significant explanatory power after controlling for r_{CT}, r_{GLS}, or r_{PEG}. In contrast, neither of the benchmark COE is significant after controlling for r_{SE}, suggesting that r_{SE} subsumes the predictive power of other COE measures.

Finally, we provide evidence on the relative importance of the two information sources underlying our measure, r_{SE}: (1) the risk profile (i.e. risk characteristics) of the company, and (2) residual COE unexplained by risk characteristics, but implied by the valuation equation. Specifically, we regress realized returns on COE proxies controlling for *Beta*, Size, *B/M*, and past stock returns. Results reported Panel C of Table 3 show that the slopes on both adjusted and unadjusted r_{SE} remain statistically significant. That confirms the construct validity of our measure beyond simply capturing the observable risk profile of the company.[26]

[26] We further explore the role of observable risk characteristics in the sub-section on statistical prediction of returns and growth rates.

Overall, the results in Figure 1 and Table 3 demonstrate that our COE measure is significantly positively associated with future realized returns. Furthermore, it contains information about firms' expected returns that is not captured by the CAPM beta, firm size, book-to-market ratio, past stock returns, as well as other implied COE measures.

Implied Growth Rates and Future Realized Earnings Growth

In this subsection, we validate the implied growth rates by documenting their association with future realized growth in earnings.

Our implied growth measure captures expected growth in four-year cum-dividend residual earnings from period *t*+4 onwards. A direct validation test would involve correlating implied growth with earnings growth from *t*+4 to perpetuity. Such test is infeasible in practice. Accordingly, we estimate growth in four-year cum-dividend earnings from [*t*, *t*+4] to [*t*+5, *t*+8] as:[27]

$$GR_{t+4,t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1,$$

where $X_T^{cumd} = \sum_{t=T-3}^{T} E_t + \sum_{t=T-3}^{T-1} ((1+r)^{4-t} - 1) d_t$, E_t is realized earnings for year *t*, d_t is dividends declared in year *t*, and *r* is the rate of return at which dividends are

[27]A more direct validation requires estimating realized growth in *residual* earnings. We choose not to use growth in residual earnings in our main tests for two reasons. First, if our implied growth and COE estimates are correlated, using our COE estimate to calculate realized residual earnings may cause the latter to be spuriously correlated with our implied growth estimate. Second, when we use risk-free rates to calculate realized residual earnings, over 50% of cumulative residual earnings before extraordinary items (EBEI) over the first four years are negative and thus cannot be used as a base to estimate growth. Percentage of negative observations is lower when operating income before depreciation (OI) is used to estimate residual earnings. Accordingly, we replicate analyses presented in this subsection using growth in residual OI, and obtain a qualitatively similar set of results (untabulated).

reinvested, which is set equal to the risk-free rate at period *t*.[28] The realized earnings are either earnings before extraordinary items (*EBEI*), or operating income before depreciation (*OI*). Although earnings before extraordinary items correspond more directly to earnings underlying our implied long-term growth, it is frequently negative or close to zero causing problems when used as a basis for calculating growth. Using growth in operating income before depreciation mitigates this problem.

Table 4, Panel A contains descriptive statistics for the growth rates in four-year cum-dividend earnings. The mean (median) growth rates are 0.48 (0.30) for *EBEI* and 0.52 (0.32) for *OI*. These growth rates can be interpreted as a geometric average growth over four years, and they correspond to annualized rates of 10% (7%) for *EBEI* and 11% (7%) for *OI*.[29]

Figure 2 plots mean growth rates by quintiles of the implied growth measures. Casual observation suggests a positive association between the implied and realized growth rates, except when of unadjusted implied growth is used to predict growth in *OI*. These observations are formally confirmed in regression analysis. Specifically, we regress realized growth rates on the quintile rank of unadjusted (adjusted) implied growth, $R(g_{SE})$. The regressions use a pooled sample, with time fixed effects and standard errors clustered by firm and year. The results are reported in Panels B and C of Table 4. The coefficients on the quintile ranks of unadjusted (adjusted) implied growth rate are 0.122 (0.098) and 0.026 (0.060) when predicting growth in *EBEI* and growth in *OI*,

[28] By using a risk-free rate we avoid spurious correlations with implied growth rates that could arise had we used previously estimated implied COE estimates. The results are robust to using a uniform 10% rate as in Penman (1996), or a 0% rate that assumes no dividend reinvestment.

[29] We do not use annualized growth rates in the analysis because we cannot annualize four-year growth rates that are less than negative 100%.

respectively. These slope coefficients multiplied by four can be interpreted as average differences in four-year earnings growth between the extreme quintiles of implied growth. On annualized basis, the above coefficients correspond to 10.4% (8.6%) and 2.5% (5.5%) differences in realized growth rates, respectively. All the slope coefficients, except the of the one from regressing *OI* growth on unadjusted implied growth, are statistically significant at the 1% level. Overall, we find that our implied growth measure is a statistically and economically significant predictor of future growth in earnings.

Next, we investigate whether implied growth retains ability to predict future realized growth after controlling for the growth drivers underlying implied growth estimation. For that purpose, we regress future realized growth rates on quintile ranks of implied growth, $R(g_{SE})$, and control variables – analysts' predicted earnings growth, *Ltg*, deviation of industry's ROE from the firm's forecasted ROE, *dIndROE*, and the ratio of R&D expenses to sales, *RDSales*. The results reported in Panels B and C of Table 4 suggest that the predictive ability of our implied growth measure derives entirely from the growth drivers – none of the coefficients on implied growth ranks remains statistically significant after controlling for growth characteristics. While this result uncovers the ex-post source of predictive ability of implied growth *within our estimation method*, it does not imply that these growth drivers can be successfully combined in a simple statistical prediction model ignoring information contained in the valuation equation. We investigate the relative performance of simple statistical earnings growth prediction in the next subsection.

Overall, the implied growth measures are predictive of future long-term growth in earnings, with predictive ability stemming from the growth drivers. The analyses in this subsection are, however, subject to an inherent survivorship bias, which is unavoidable when measuring growth over long horizons. We further investigate the effects of the bias in Section 5.

Statistical Prediction of Returns and Earnings Growth

The predictive ability of our implied COE and growth measures partly derives from the risk and growth drivers that are embedded in the valuation equation. We next investigate how our valuation-model-based estimates compare to predictions from simple statistical models based on the same risk or growth drivers.

First, we construct statistically predicted returns. For this purpose, we estimate hold-out cross-sectional regressions of realized one-year returns for year t on the risk drivers from year t–1 (market-to-book ratio, logarithm of market value of equity, CAPM beta, and prior twelve-month return). We combine obtained coefficients with risk drivers at time t to come up with a statistical forecast of year t+1 realized return (*Stat_pRet*).

To compare the predictive ability of the obtained return forecasts to our implied COE, we regress future realized returns on quintile ranks of the predicted return measure (implied COE). Due to the hold-out sample requirements, these regressions are based on the 1981 – 2007 sample period. Panel A of Table 5 reports regression results. The slope coefficients multiplied by four can be interpreted as an increase in average one-year-ahead return from the bottom to the top quintile of statistical return forecast (implied COE). The results suggest that statistically predicted returns have little forecasting ability—the average change in realized returns between extreme quintiles is around two percent (=0.005*100%*4) and is not statistically significant. In contrast, implied COE based on unadjusted (adjusted) analysts' forecasts yields an average change of 6.8 (9.6)%

(calculated as 0.017*100%*4 (0.024*100%*4)), significant at least at the 5% level. Overall a simple statistical return forecast based on the same risk drivers as our COE measure, does not achieve the predictive power of the latter.

Next, we construct statistically predicted long-term earnings growth. Each year *t*, we use a hold-out sample lagged by eight years to regress past realized four-year cum-dividend earnings growth rates ($GR_{t\text{-}4,t}$) on the growth characteristics (*Ltg*, *dIndROE*, and *RDSales*) from year *t*-8. We then combine the obtained coefficients with the growth characteristics from year *t* to calculate a statistical predictor of future growth in four-year cum-dividend earnings ($Stat\_pGR_{t+4,\, t+8}$).

Panels B and C of Table 5 report regressions of realized growth rates on the quintile ranks of both the implied and statistically predicted growth. Due to the hold-out sample requirements, these regressions are based on the 1987 – 2001 sample period. For this period, the implied growth measure exhibits a stronger predictive ability – the coefficients on $R(g_{SE})$ are higher than in Panels B and C of Table 4, and significant at least at the 1% level. The implied growth measure retains incremental predictive ability after controlling for the statistical predictors. Moreover, it subsumes the predictive ability of the latter with respect to future growth in *EBEI*. Importantly, statistical predictors of growth seem to be "fitted" to a specific earnings measure. Namely, statistically predicted growth in *OI* (*EBEI*) has no power in predicting growth in *EBEI* (*OI*). The above evidence, combined, suggests that while it is possible to predict future realized growth in earnings statistically, the statistical growth measures need to be "fitted" to a specific earnings metric and they do not perform as well as the implied growth at predicting growth in bottom-line earnings. The implied growth measure, on the other hand, provides universal predictive ability, regardless of earnings definition, and contains information beyond simple statistical predictors.

Cross-Sectional Determinants of Return Predictability Relative to GLS

Results in Table 3 show that our COE measure on average surpasses the benchmark COE measures in predicting future returns over a broad cross-section of firms. In this subsection we explore the cross-sectional variation in the relative predictive ability of our measure. Specifically, we focus on our measure's performance relative to the best performing benchmark—COE from the GLS model (r_{GLS}).[30]

We expect to see the largest difference in the two measures' performance in the subsample of firms where the two measures differ from each the other most. Accordingly, we sort firms into portfolios based on absolute values of differences between our measure and r_{GLS}. To evaluate the relative performance of the two measures, we then estimate firm-specific regressions of future realized returns on the COE measures within these portfolios.

Panel A of Table 6 contains regression results. Our measure has significant predictive ability with respect to future returns across all sample partitions—the slope coefficient for r_{SE} is statistically significant at least at the 10% level. In contrast, the slope coefficient for r_{GLS} turns statistically insignificant in the top two quintiles, where r_{GLS} is most different from our measure. Relative to our measure, r_{GLS} performs the worst in quintile five, where the absolute deviation between our measure and r_{GLS} is the highest.

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[30] In this subsection, we focus on COE measures adjusted for predictable forecast errors.

Next, we explore the determinants of relatively poor performance of the GLS measure in the quintile with the highest deviation from our measure. There are two main reasons why our measure outperforms r_{GLS} in that quintile. First, our growth assumptions may be relatively more accurate if either the key assumption in the GLS model—firms' ROE convergence to the industry average—is violated, or the terminal growth in residual earnings is not equal to zero. Second, risk characteristics may play a relatively more important role in COE estimation in that quintile, which would be the case if these characteristics are more salient for this subsample, i.e. they are further away from sample averages.

Following the above line of reasoning we calculate by-quintile averages of the following variables. First, to reflect how the firm is different from its industry in terms of its growth prospects, we calculate absolute deviations of firm's growth drivers (R&D expenses over sales, analysts' predicted long term growth, and the current level of ROE) from respective industry averages. Second, to reflect how the implied terminal growth rate is different from zero, we calculate absolute value of our implied growth estimate. Third, to capture the salience of risk characteristics, we calculate absolute deviation of risk drivers (CAPM beta, size, book-to-market ratio, and past one-year stock returns) from respective sample averages. In addition, we report an absolute deviation from the industry average for a growth variable not included into our COE estimation—sales growth over the past five years.

Panel B of Table 6 reports averages of by-year variable means by quintiles of absolute difference in r_{GLS} and r_{SE}. The last two columns report average differences between the top and the bottom quintiles and the corresponding Fama-MacBeth *t*-

statistics with the Newey-West autocorrelation adjustment. As expected, we observe that all growth drivers' deviations from industry averages are significantly higher for quintile five, where our measure is the most different from GLS, compared to quintile one, where the two measures are the closest. The deviation in R&D expenses, however, is higher in quintile four. Also as expected, the deviation of implied growth from zero is the highest in the fifth quintile. Finally, the risk characteristics of the firms in the fifth quintile are furthest away from the sample means, with the book-to-market ratio standing out in terms of the relative magnitude of absolute distance to the mean.

Overall, we uncover several cross-sectional determinants of our measure's relative performance compared to GLS. We find that our measure works relatively better for firms that are further from their industry in terms of profitability, forecasted long-term growth, and past sales growth, or further away from the average firm in terms of size, book-to-market ratio, CAPM beta, or past returns. These findings may guide future empirical research in the choice of an appropriate COE measure.

Comparison with ETSS: Average COE and Growth Rate

One of the main findings in ETSS is that their average COE estimate is significantly higher than average implied COE estimates from prior studies. As discussed in Section 2, our average COE and long-term growth estimates may deviate from those in ETSS because our model explicitly incorporates the observable risk and growth drivers. Next, we compare the average of by-year means of the COE (expected earnings growth) produced by our model to ETSS' estimates.[31] The (untabulated) results suggest that our model yields notably lower COE and earnings growth estimates. When using the ETSS model, the average COE is 11.7% (9.7%) and growth rate is 9.7% (7.4%) before (after) correction for analyst forecast errors. The corresponding values produced by our model are 9% (7.6%) and 6.7% (5.2%). Both our and ETSS' growth estimates are greater than the average historical earnings growth rate for the US market of around 3.2% per annum, with our estimates being closer to the historical rate. [32]

Using the average risk-free rate (proxied by five-year Treasury bond yield) of 7.22% for our sample period, the average implied risk premium from ETSS model is 4.43% (2.50%) compared to 2.50% (0.34%) from our model before (after) correction for analyst forecast errors.[33] Although the average risk premium from our model is significantly lower than the historical premium based on realized returns, it is consistent with theoretically derived equity risk premia (Mehra and Prescott 1985). Moreover, lower estimates of COE are consistent with the finding in Hughes et al. (2009) that, when expected returns are stochastic, the implied COE is lower than the expected return.[34] These results, however, need to be interpreted with caution given the lack of reliable benchmarks of market risk premia, against which model estimates can be judged.

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[31] To derive growth in earnings using growth in residual earnings, we use the formula derived in the appendix in ETSS. Since we assume a constant future dividend payout while ETSS assume constant future dividends, we adjust the formula to make it consistent with our assumption.

[32] The estimate of the average historical rate is based on the data for aggregate nominal earnings of the S&P 500 firms from 1871 to 2009 provided by Robert Shiller at http://www.econ.yale.edu/~shiller/data/ie_data.xls.

[33] Risk premia are often measured relative to the rate on one-month Treasury bills. Based on this measure of the risk free rate, the average implied risk premium from ETSS model is 5.82% (3.89%) compared to 3.89% (1.17%) from our model before (after) correction for analyst forecast errors.

[34] Hughes et al. (2009) provide a ball-park estimate of the difference between expected returns and implied cost of capital of 2.3%. They note that the actual difference can be larger.

5. Robustness Tests and Additional Analyses

Easton and Monahan Tests of Construct Validity

A valid COE proxy should be positively associated with future *expected* stock returns. Our validation tests based on realized returns implicitly assume that realized stock returns on average are equal to expected returns. This assumption may not hold in finite data samples. For example, Elton (1999) argues that historical realized returns deviate from expected returns over long periods of time due to non-cancelling cash flow or discount rate shocks. To address this limitation, Easton and Monahan (2005) propose a method to control for future cash flow and discount rate shocks in realized returns – COE regressions.[35]

In this subsection, we conduct the Easton and Monahan tests for our implied COE measures. The tests consist of two parts. The first part involves regressing the log of one-year-ahead stock returns on the log of the COE measure (proxy for expected return) and the logs of contemporaneous cash flow and discount rate news proxies. The coefficient on the valid COE measure should not be statistically different from one. The second part involves calculating implied measurement errors for the COE estimates, using a modified Garber and Klepper (1980) approach.

Table 7 reports average by-year coefficients of Easton and Monahan regressions, where Panel A (Panel B) pertains to unadjusted (adjusted) COE measures. In Panel A, regression coefficients for all COE measures are significantly negative, suggesting that

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[35] The Easton and Monahan (2005) test has proven to be a high bar for estimating construct validity of COE measures. Most conventional implied COE measures are negatively correlated with realized stock returns after controlling for cash flow and discount rate news, and have significant measurement errors.

all unadjusted measures are invalid. In contrast, Panel B reports that two COE measures adjusted for analyst forecast errors—our measure, r_{SE}, and r_{PEG}—have regression coefficients statistically indistinguishable from one. One caveat in interpreting these results is that COE proxies as well as cash flow and discount rate news proxies can be measured with error. In case these errors are correlated, the regression coefficients can no longer be interpreted at the face value.

The second part of the Easton and Monahan tests addresses the aforementioned issue of correlated measurement errors. Specifically, Easton and Monahan construct a statistic for the extent of the measurement error in the COE proxy that controls for correlation in measurement errors across the three variables in the regression. We report this statistic ("modified noise variable") in the last column of both Panels A and B in Table 7. The results show that our implied COE measure, r_{SE}, has the lowest measurement error across all unadjusted (adjusted) COE measures.

To summarize, Easton and Monahan tests of construct validity suggest the following. First, the tests unambiguously establish construct validity of our COE measure adjusted for analyst forecast errors, while our unadjusted COE measure exhibits a negative association with future expected returns (possibly due to correlated measurement errors in cash flow and discount rate news proxies). Second, among all COE measures adjusted (unadjusted) for analyst forecast errors, our measure exhibits the lowest degree of measurement error.

Future Realized Earnings Growth and Survivorship Bias

The growth rates used in validation of implied growth measures are estimated only for the firms that survive over the [*t*+1, *t*+8] period. Next, we explore the effects that sample attrition may have on our implied growth validation tests.

Panel A of Figure 3 plots percentage of firms for which realized growth in either *EBEI* or *OI* is unavailable. Clearly, the percentage of firms leaving the sample ("non-survivors") is higher within higher quintiles of implied growth. For example, growth in *OI* cannot be estimated for 51% (31%) of firms within the highest (lowest) quintile of unadjusted implied growth.[36] To the extent that "non-survivors" would have had lower realized growth rates, the growth estimates are systematically biased upwards, and the degree of bias is higher for the higher quintiles of implied growth.

To investigate the potential extent of the bias, we first classify "non-survivors" by reasons for leaving the sample. For that purpose, we use CRSP classification of stock delistings from exchanges. The main categories of delistings are: mergers or stock exchanges, bad performance (such as bankruptcy or liquidation), and other miscellaneous reasons (such as switching to a different exchange or going private). The bad performance-related category is classified following Shumway (1997). Panel B of Figure 3 reports percentage of firms delisted within eight years following the implied growth estimation by quintiles of implied growth measures.[37] The evidence from the figure suggests that the main reason behind sample attrition is related to mergers. Mergers are

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[36] The sample attrition for growth in *EBEI* is higher than for *OI* due to more frequent negative growth base (growth in EBEI cannot be calculated when four-year cum-dividend earnings for [*t*+1, *t*+4] are negative).

[37] Note, that the percentages of delisted firms do not add up to the total percentage of "non-survivors" from Panel A of Figure 3. The difference is due to the cases where earnings are available, but growth cannot be computed due to negative four-year cum-dividend earnings for [*t*+1, *t*+4].

also the biggest source of the higher sample attrition for firms in the higher implied growth quintiles. For example, the difference in delisting percentage between the top and the bottom quintiles of unadjusted (adjusted) implied growth is 7.6% (8.8%) for merger-related delistings versus 0.7% (3%) for bad performance-caused delistings.

Using the above classification results, we perform a robustness check by substituting missing realized earnings growth for non-surviving firms with plausible ad-hoc growth estimates. Arguably, a firm that goes bankrupt has a relatively lower realized earnings growth compared to a firm that undergoes a merger. Accordingly, as our first robustness check we substitute the missing [t+4, t+8] earnings for firms with bad performance-related delistings with a negative book value of equity at t+4. Such substitution assumes that equity becomes entirely worthless after performance delisting, which is a conservative assumption. We re-run the analyses in Table 4, Panels B and C using substituted growth rates. The results are presented in Table 8, Panel A. Both the unadjusted and adjusted implied growth is positively and significantly associated with future realized growth in *OI*, while the unadjusted implied growth is positively associated with future realized growth in *EBEI*.

Next, we make an additional assumption of a zero growth rate for firms delisting due to mergers. Note, that this is a conservative assumption. Zero represents the 26th (34th) percentile of *OI* (*EBEI*) growth distribution. Regression results after performing this additional substitution are presented in Panel B of Table 8. Despite the conservative growth assumptions, unadjusted (adjusted) implied growth rate quintiles are positively and significantly associated with the realized growth in *EBEI* (*OI*).

Overall, the survivorship bias is a serious concern for the implied growth validity tests. However, robustness tests suggest that our results are unlikely entirely explained by such bias.

Implied COE Based on Aggregate Earnings

Our implied COE measure is different from benchmark measures (r_{GLS}, r_{CT}, and r_{PEG}) on a number of dimensions, including the underlying valuation model, forecast horizon, and earnings aggregation. To confirm that endogenously estimated terminal growth is the main source of our measure's superior return predictive ability, we construct an implied COE measure that is similar to our measure on all dimensions, except assumed terminal growth. Namely, we calculate r_{ZERO} as an internal rate of return from equation (2), assuming zero growth in four-year cum-dividend residual earnings (i.e. $G_i = 1$). We then replicate the validation tests summarized in Figure 1 and Table 3 using r_{ZERO}. The portfolio results (untabulated) suggest that r_{ZERO} on average performs better than the benchmark COE measures, but somewhat worse than our measure in predicting future returns. Using earnings forecasts adjusted for predictable errors, the average difference in one-year-ahead returns between the stocks in the top and the bottom quintiles of r_{ZERO} is 8.43%, compared to 9.45% for our measure. However, at the firm level, our measure dominates r_{ZERO}. In the firm-level regressions of one-year-ahead returns on COE measures, the slope on r_{ZERO} is 0.45 (significant at the 10% level), compared to 1.45 (significant at 1% level) for our measure. When both measures are included in the regression, r_{ZERO} is no longer statistically significant, while our measure is significant at the 1% level.

To further confirm that the superior predictive ability of our measure comes from a more accurately estimated terminal growth, we perform analyses similar to those reported in Table 6 for r_{GLS}. Namely, we partition the sample based on the absolute value of our implied growth (to capture deviation from the zero growth assumed for r_{ZERO}). In untabulated results, we find that r_{ZERO} does not predict future returns in the top quintile with the highest absolute implied growth (the average slope estimate is 0.17 with a *t*-statistic of 0.98), whereas our measure remains significantly associated with future returns (the average slope estimate is 1.47 with a *t*-statistic of 3.41).

6. Conclusion

The implied COE has recently gained significant popularity in accounting (and increasingly in finance) research. Despite its theoretical and practical appeal, the implied COE, as any other valuation model output, is only as good as the model inputs.[38] In particular, the implied COE is sensitive to the assumption about the expected earnings growth rate. In this study, we propose a method of estimating COE that avoids relying on ad-hoc assumptions about the long-term growth by estimating growth rates *implied by the data*.

Our estimation method follows Easton, Taylor, Shroff, and Sougiannis (2002), who simultaneously estimate sample averages for COE and expected growth in earnings.

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[38] The two other commonly used approaches to estimating COE (multiplying historical estimates of factor risk premia on historical factor loadings, and using ex-post realized returns) have their own merits and demerits. The first, approach is problematic given the ongoing debate about the appropriate asset pricing model and substantial measurement errors in the estimates of factor risk premia and risk loadings (Fama and French 1997). The second approach requires a very large sample spanning dozens of years (which is often not available to the researcher), since more risky stocks can underperform less risky stocks for multiple consecutive years (Elton 1999). Also, ex-post returns approach does not allow estimating the (ex-ante) COE in real time necessary for capital budgeting and other decisions.

The two assumptions that allow us to estimate firm-specific COE and expected growth are that each company has a unique risk-growth profile that can be proxied by observable characteristics, and that parsimonious measures of risk and growth should allow minimal deviations from such risk-growth profiles.

Our paper is related to earlier work by Huang et al. (2005), who use ETSS' method to estimate firms' COE and growth based on the *time series* of monthly stock prices and earnings forecasts. Our method differs from that proposed by Huang et al. along several dimensions. First, their method assumes that a firm's risk exposure and expected earnings growth do not change over the estimation period (36 months), which limits the practical appeal of the resulting measures (i.e., they cannot be used to examine changes in risk over short horizons). In contrast, we provide point-in-time COE estimates. Second, their estimation pairs monthly stock prices with annual book values of equity, which implicitly assumes that the book value of equity does not change within a given fiscal year. Our method relies on annual stock prices corresponding to annual book values of equity. Finally, by using monthly analyst forecasts and stock prices, their method assumes that forecasts and prices are simultaneously updated to reflect new information on a timely basis, which is inconsistent with prior research documenting significant sluggishness in analyst forecasts (Guay et al. 2005).

We validate our COE and growth estimates by examining their association with future stock returns and realized earnings growth, respectively. We find that our COE measure has a significant out-of-sample predictive ability with respect to future returns, which subsumes the predictive ability of other commonly used COE measures. At the same time, our expected growth measure is significantly associated with the future long-term earnings growth. Therefore, both the COE and the long-term growth measures appear to have construct validity.

Appendix A

Simultaneous Estimation of COE and Long-Term Growth

In this appendix, we derive expressions for implied COE and growth. Combining equation (3b) with assumption (4) from Section 2 yields the following system of equations:

$$\begin{cases} \underset{\varepsilon_R^i,\varepsilon_G^i,\varepsilon^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ s.t.\ X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \\ \varepsilon^i = (G^i - \overline{G})(1 - MB^i) + (R^i - \overline{R})MB^i \\ \gamma_0 = \overline{G} - 1 \\ \gamma_1 = \overline{R} - \overline{G} \\ R^i = \overline{R} + \lambda_R x_R^i + \varepsilon_R^i \\ G^i = \overline{G} + \lambda_G x_G^i + \varepsilon_G^i \end{cases} \tag{A1}$$

Next, we simplify the problem in (A1) so that it can be solved using standard regression analysis. Substituting the expressions for ε^i, R^i, and G^i into the second equation in (A1) and defining $\nu^i = \varepsilon_G^i + (\varepsilon_R^i - \varepsilon_G^i)MB^i$, we express the above system of equations as follows:

$$\begin{cases} \underset{\varepsilon_R^i,\varepsilon_G^i,\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ \text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \\ \nu^i = \varepsilon_G^i + (\varepsilon_R^i - \varepsilon_G^i)MB^i \end{cases} \tag{A2}$$

Substituting $\varepsilon_G^i = (\varepsilon_R^i MB^i - \nu^i)/(MB^i - 1)$ from the last equation, we obtain

$$\begin{cases} \underset{\varepsilon_R^i,\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i((\varepsilon_R^i MB^i - \nu^i)/(MB^i - 1))^2 \\ \text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \end{cases} \tag{A3}$$

Finally, substituting the expression for ε_R^i that satisfies the first order conditions, $\varepsilon_R^i = w_2^i MB^i \nu^i / (w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2)$, we obtain the following weighted least square regression:

$$\begin{cases} \underset{\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i \dfrac{w_1^i w_2^i (\nu^i)^2}{w_1^i(1-MB^i)^2 + w_2^i(MB^i)^2} \\ \text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i \end{cases} \tag{A4}$$

Combining equations (A4) with the above expressions for $\overline{R}$, $\overline{G}$, ε_R^i, ε_G^i, R^i, and G^i, we have the following WLS regression and equations that uniquely determine firm COE and expected growth rate:

$$\begin{cases} \underset{\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i \dfrac{w_1^i w_2^i (\nu^i)^2}{w_1^i(1-MB^i)^2 + w_2^i(MB^i)^2} \\ s.t.\ X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i \\ \overline{G} = \gamma_0 + 1 \\ \overline{R} = \gamma_1 + \gamma_0 + 1 \\ \varepsilon_R^i = \nu^i \dfrac{w_2^i MB^i}{w_1^i(MB^i - 1)^2 + w_2^i(MB^i)^2} \\ \varepsilon_G^i = \nu^i \dfrac{w_1^i(1-MB^i)}{w_1^i(MB^i - 1)^2 + w_2^i(MB^i)^2} \\ R^i = \overline{R} + \lambda_R x_R^i + \varepsilon_R^i \\ G^i = \overline{G} + \lambda_G x_G^i + \varepsilon_G^i \end{cases} \tag{A5}$$

The first equation specifies the weights $w^i = w_1^i w_2^i / (w_1^i(1-MB^i)^2 + w_2^i(MB^i)^2)$ that should be used in the WLS regression $X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i$. Having found the intercept, slopes, and residuals from the regression, the third and the fourth equations can be used to obtain the sample mean *R* and *G*, the fifth and the sixth equations can be used to calculate the components of R^i and G^i due to unobservable risk and growth factors, and finally the last two equations can be used to calculate the firm COE and growth rate.

Comparison of between Our Model and ETSS

Recall that our minimization problem outlined in Section 2 is specified as:

$$\begin{cases} \underset{\bar{R},\bar{G},\lambda_R,\lambda_G,\varepsilon_R^i,\varepsilon_G^i}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ R^i = \bar{R} + \boldsymbol{\lambda}_{\mathbf{R}}{}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i \\ G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}{}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i \end{cases} \tag{4}$$

Estimating regression (3b) in ETSS implies a different minimization problem. Because OLS minimizes the sum of squared residuals, the deviations of R^i and G^i from the sample means are jointly minimized in the following way:

$$\underset{\bar{R},\bar{G},\varepsilon^i}{Min} \sum_i (\varepsilon_G^i(1-MB^i) + \varepsilon_R^i MB^i)^2$$
$$\begin{cases} R^i = \bar{R} + \varepsilon_R^i \\ G^i = \bar{G} + \varepsilon_G^i \end{cases} \tag{A6}$$

The key difference between ETSS' and our minimization problems is that ETSS' minimization function (A6) does not increase even as ε_R^i and ε_G^i go to infinity as long as their linear combination, $\varepsilon_G^i(1-MB^i) + \varepsilon_R^i MB^i$, remains the same. In contrast, our loss function (4) always increases in the magnitude of ε_R^i and ε_G^i. Mathematically, our minimization function is positive definite while that in ETSS is positive semi-definite.[39] The assumption of a positive definite function is a standard assumption in the definition of a loss function. We find that the minimization of any positive definite quadratic function of ε_R^i and ε_G^i is sufficient to uniquely identify firm-specific *R* and *G* (the proof is available from the authors upon request).

[39] A quadratic function $w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 + w_3^i\varepsilon_R^i\varepsilon_G^i$ is positive (semi-)definite if it is positive (non-negative) for any non-zero argument, $\varepsilon_R^i\varepsilon_G^i \neq 0$, which holds if and only if $w_1^i > 0\,(\geq 0)$ and $4w_1^i w_2^i - (w_3^i)^2 > 0\,(\geq 0)$.

Appendix B

Benchmark COE Measures

Implied COE from Claus and Thomas (2001), r_{CT}, is an internal rate of return from the following valuation equation:

$$P_0 = B_0 + \sum_{\tau=1}^{4} \frac{E_\tau - r_{CT} B_{\tau-1}}{(1+r_{CT})^t} + \frac{E_5 - r_{CT} B_4}{(r_{CT} - g_{CT})(1+r_{CT})^4} \qquad (r_{CT})$$

where P_0 is the stock price as of June of year t+1 from *I/B/E/S*; B_0 is the book value of equity at the end of year t from *Compustat* divided by the number of shares outstanding from *I/B/E/S;* E_1 and E_2 are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year t+1; E_3, E_4 and E_5 are three-, four- and five-year-ahead earnings per share forecasts computed using the long-term growth from *I/B/E/S* as: $E_3 = E_2(1+Ltg)$, $E_4 = E_3(1+Ltg)$, and $E_5 = E_4(1+Ltg)$; B_τ is the expected per-share book value of equity for year τ estimated using the clean surplus relation ($B_{t+1} = B_t + E_{t+1} - d_{t+1}$); g_{CT} is the terminal growth calculated as the ten-year Treasury bond yield minus three percent.[40]

Implied COE from Gebhardt et al. (2001), r_{GLS}, is an internal rate of return from the following valuation equation:

$$P_0 = B_0 + \sum_{\tau=1}^{11} \frac{(ROE_\tau - r_{GLS})B_{\tau-1}}{(1+r_{GLS})^t} + \frac{(IndROE - r_{GLS})B_{11}}{r_{GLS}(1+r_{GLS})^{11}} \qquad (r_{GLS})$$

where ROE_τ is expected future return on equity calculated as earnings per share forecast (E_τ) divided by per share book value of equity at the end of the previous year ($B_{\tau\text{-}1}$); ROE_1 and ROE_2 are calculated using one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year t+1; ROE_3 is computed by applying the long-term growth rate from *I/B/E/S* to the two-year-ahead consensus earnings per share forecast; beyond year t+3, ROE is assumed to linearly converge to industry median ROE (*IndROE*) by year t+12.

Implied COE from Gode and Mohanram (2003), $r_{PEG,}$, is calculated as:

$$r_{PEG} = \sqrt{\frac{E_1}{P_0}}(r_{PEG}), \qquad g_2 = \frac{(E_2 / E_1 - 1) + Ltg}{2} \qquad (r_{PEG})$$

where P_0 is the stock price as of June of year t+1 from *I/B/E/S*; E_1 and E_2 are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year t+1; *Ltg* is the long-term earnings growth forecast from *I/B/E/S* reported in June of year t+1. This measure is a modified version of the Easton (2004) PEG measure, which assumes g_2=E_2/E_1.

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[40] To avoid using very high terminal growth in years with high risk-free rate we winsorize g_{CT} at the 3% level. When we do not winsorize g_{CT}, r_{CT} performs worse and none of the inferences regarding our COE measure change.

References

Botosan, C., and M. Plumlee. 2005. Assessing alternative proxies for the expected risk premium. *The Accounting Review* 80 (1): 21-53.

Carhart, M. 1997. On persistence in mutual fund performance. *Journal of Finance* 52: 57-82.

Chan, L.K.C, J. Karceski, and J. Lakonishok. 2003. The level and persistence of growth rates. The Journal of Finance 58 (2): 643-684.

Chava, S., and A. Purnanadam. 2010. Is default risk negatively related to stock returns? Review of Financial Studies 23 (6): 2523-2559.

Claus, J., and J. Thomas. 2001. Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock market. *Journal of Finance* 56 (5): 1629-66.

Damodaran, A. 2002. Damodaran on valuation. Second Edition. John Wiley & Sons, Inc. New York.

Dhaliwal, D., L. Krull, O. Li, and W. Moser. 2005. Dividend taxes and implied cost of capital. *Journal of Accounting Research* 43, 675–715.

Easton, P. 2004. PE ratios, PEG ratios, and estimating the implied expected rate of return on equity capital. *The Accounting Review* (January): 73-95.

Easton, P. 2006. Use of forecasts of earnings to estimate and compare cost of capital across regimes. *Journal of Business Finance and Accounting* 33 (3) 374-394.

Easton, P. 2007. Estimating the cost of capital implied by market prices and accounting data. *Foundations and Trends in Accounting* 2 (4) 241-346.

Easton, P., and G. Sommers. 2007. Effect of analysts' optimism on estimates of the expected rate of return implied by earnings forecasts. *Journal of Accounting Research* 45 (5): 983-1015.

Easton, P., and S. Monahan. 2005. An evaluation of accounting-based measures of expected returns. *The Accounting Review* 80 (2): 501-538.

Easton, P., G. Taylor, P. Shroff, and T. Sougiannis. 2002. Using forecasts of earnings to simultaneously estimate growth and the rate of return on equity investment. *Journal of Accounting Research* 40 (3): 657-676.

Elton, J. 1999. Expected return, realized return and asset pricing tests. *Journal of Finance* 54: 1199-1220.

Fairfield, P. M. 1994. P/E, P/B and the present value of future dividends. *Financial Analysis Journal* July–Aug: 23–31.

Fama, E., and J. MacBeth. 1973. Risk, return, and equilibrium: empirical tests. *Journal of Political Economy* 81: 607–636.

Fama, E., and K. French. 1992. The cross-section of expected stock returns. *Journal of Finance* 47 (2): 427-465.

Fama, E., and K. French. 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33 (1): 3-56.

Fama, E., and K. French. 1995. Size and book-to-market factors in earnings and returns. *Journal of Finance* 50 (1): 131-155.

Fama, E., and K. French. 1997. Industry costs of equity. *Journal of Financial Economics* 43 (2): 153-193.

Feltham, G., and J. Ohlson. 1995. Valuation and clean surplus accounting for operating and financial activities. *Contemporary Accounting Research* 11 (2): 689-731.

Francis, J., R. LaFond, P. Olsson, and K. Schipper. 2004. Costs of capital and earnings attributes. *The Accounting Review* 79, 967–1011.

Gao, Z. and W. Wu, 2010. Predicting future growth: can anything beat analysts' long-term growth forecasts? Working paper, Lancaster University and Arizona State University.

Garber, S. and S. Klepper, 1980. "Administrative pricing" or competition coupled with errors of measurement? *International Economic Review* 21: 413-435.

Gebhardt, W., C. Lee, and B. Swaminathan. 2001. Towards an ex-ante cost of capital. *Journal of Accounting Research* 39 (1): 135-176.

Gode, D. and P. Mohanram. 2003 Inferreng the cost of capital using the Ohlson-Juettner model. *The Review of Accounting Studies*, 8, 399-431.

Gode, D. and P. Mohanram. 2009. Improving the Relationship between Implied Cost of Capital and Realized Returns by Removing Predictable Analyst Forecast Errors. Working paper, New York University and Columbia University. The paper is available at http://w4.stern.nyu.edu/emplibrary/092208_gode-mohanram.pdf.

Guay, W., S. Kothari , and S. Shu. 2005. Properties of implied cost of capital using analysts' forecasts. Working paper, University of Pennsylvania, Massachusetts Institute of Technology, and Boston College.

Hail, L. and C. Leuz. 2006. International differences in the cost of equity capital: Do legal institutions and securities regulation matter?. *Journal of Accounting Research* 44, 485–532.

Hamada, R. 1972. The effect of the firms' capital structure on the systematic risk of common stocks. *Journal of Finance* 27 (2): 435-452.

Hou, K., M. A. van Dijk, and Y. Zhang. 2010. The implied cost of capital: a new approach. Working paper.

Hribar, P. and N. Jenkins. 2004. The effect of accounting restatements on earnings revisions and the estimated cost of capital. Review of Accounting Studies 9, 337–356.

Huang, R., R. Natarajan, and S. Radhakrishnan. 2005. Estimating firm-specific long-term growth rate and cost of capital. Working paper, University of Texas at Dallas.

Hughes, J. Liu, and J. Liu. 2009. On the relation between expected returns and implied cost of capital. *Review of Accounting Studies* 14: 246-259.

Hughes, J., J. Liu, and W. Su. 2008. On the Relation between Predictable Market Returns and Predictable Analyst Forecast Errors. *Review of Accounting Studies* 13: 266-291.

Jagannathan, R., and Z. Wang. 1996. The conditional CAPM and the cross-section of expected returns. *Journal of Finance* 51: 3-53.

Larocque, S. 2010. Analysts forecasts errors and cost of equity capital estimates. Working paper, University of Notre Dame.

Lee, C., D. Ng, and B. Swaminathan, 2009, “Testing international asset pricing models using implied costs of capital,” *Journal of Financial and Quantitative Analysis* 44, 307-335.

Lettau, M., and S. Ludvigson. 2001. Consumption, aggregate wealth, and expected stock returns. *Journal of Finance* 56 (3): 815-849.

Mehra, R, and E. C. Prescott. 1985. The equity premium: a puzzle. *Journal of Monetary Economics* 15 : 145–161.

Merton, R. 1973. An intertemporal capital asset pricing model. *Econometrica* 41 (5): 867–887.

Newey, W., and K. West. 1987. A simple, positive semi-definite heteroscedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55: 703-708.

Ogneva, M., K. R. Subramanyam, and K. Raghunandan. 2007. Internal control weakness and cost of equity: Evidence from SOX section 404 disclosures. *The Accounting Review* 82 (October), 1255–1298.

Ohlson, J. 1995. Earnings, book values, and dividends in security valuation. *Contemporary Accounting Research* 11 (2): 661-687.

Ohlson, J. and B. Juettner-Nauroth. 2005. Expected EPS and EPS growth as determinants of value. *Review of Accounting Studies* 10(2–3): 349–365.

Pastor, L., M. Sinha, and B. Swaminathan, 2008, "Estimating the Intertemporal Risk-Return Tradeoff Using the Implied Cost of Capital", *The Journal of Finance* 63(6), 2859-2897

Penman, S. 1996. The articulation of price-earnings ratios and market-to-book ratios and the evaluation of growth. Journal of Accounting Research 34 (2): 235-259.

Penman, S. 2009. Financial Statement Analysis and Security Valuation. Fourth Edition. McGraw-Hill Irwin, New York.

Penman, S., Zhang, X. 2002. Accounting Conservatism, the Quality of Earnings, and Stock Returns. *The Accounting Review* 77: 237-264.

Petersen, M. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22 (1): 435-480.

Petkova, R., 2006. Do the Fama–French factors proxy for innovations in predictive variables? *Journal of Finance* 61, 581–612.

Pratt, S. P. and A.V. Niculita. 2007. Valuing a Business: The Analysis and Appraisal of Closely Held Companies. Fifth edition. McGraw-Hill.

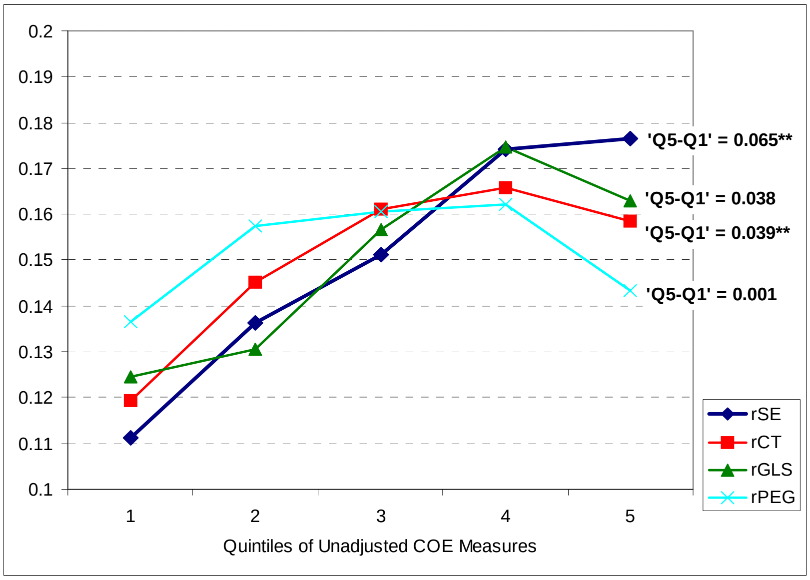
Shumway, T. 1997. The delisting bias in CRSP data. *Journal of Finance* 52: 327–340.

Whalen, J., S. Baginski, M. Bradshaw. 2010. Financial reporting, financial statement analysis, and valuation. Seventh Edition. South-Western Centage Learning, Mason.

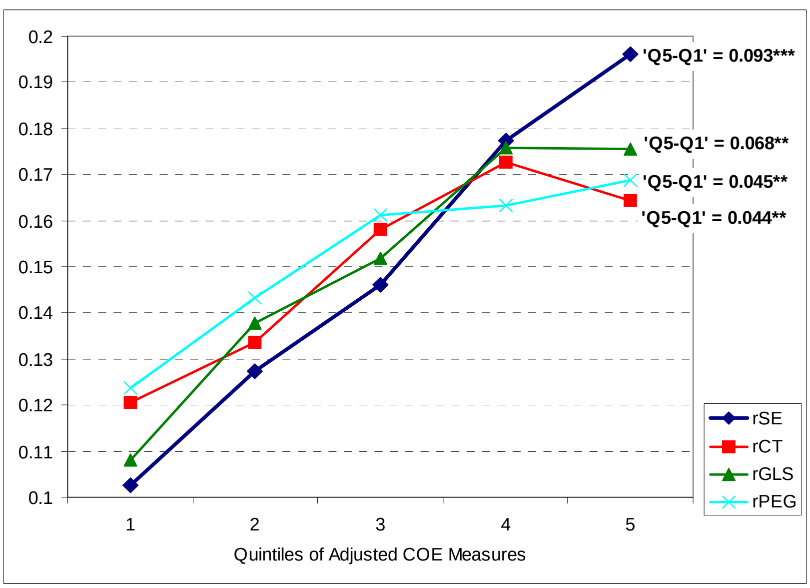
Zhang, X. J. 2000. Conservative Accounting and Equity Valuation. *Journal of Accounting and Economics* 29: 125-149.

Figure 1. Future Realized Returns for COE Portfolios

Panel A. Average Returns by Quintiles of Unadjusted COE Measures



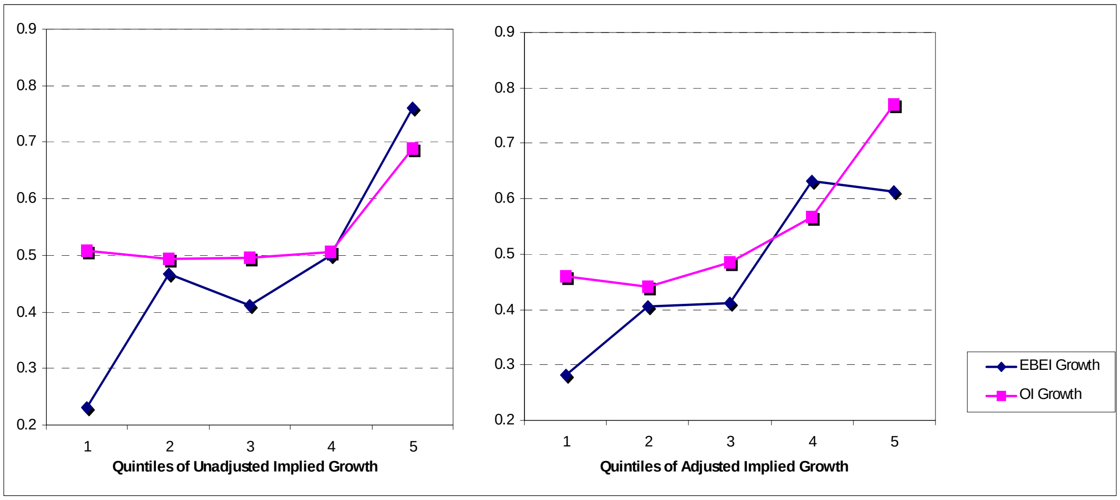
Panel B. Average Returns by Quintiles of Adjusted COE Measures



***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The figure plots average one-year-ahead buy-and-hold returns for equal-weighted quintile portfolios based on COE measures for a sample of 50,636 firm-year observations from 1980 to 2007. r_{SE} is the COE measure based on our model, r_{CT} is the COE measure based on the Claus and Thomas (2001) model, r_{GLS} is the COE measure based on the Gebhardt et al. (2001) model, r_{PEG} is the COE measure based on the PEG model (Gode and Mohanram 2003). Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors). 'Q5-Q1' refers to hedge returns on portfolios long (short) in quintile five (one) stocks. Statistical significance of hedge returns is based on Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation.

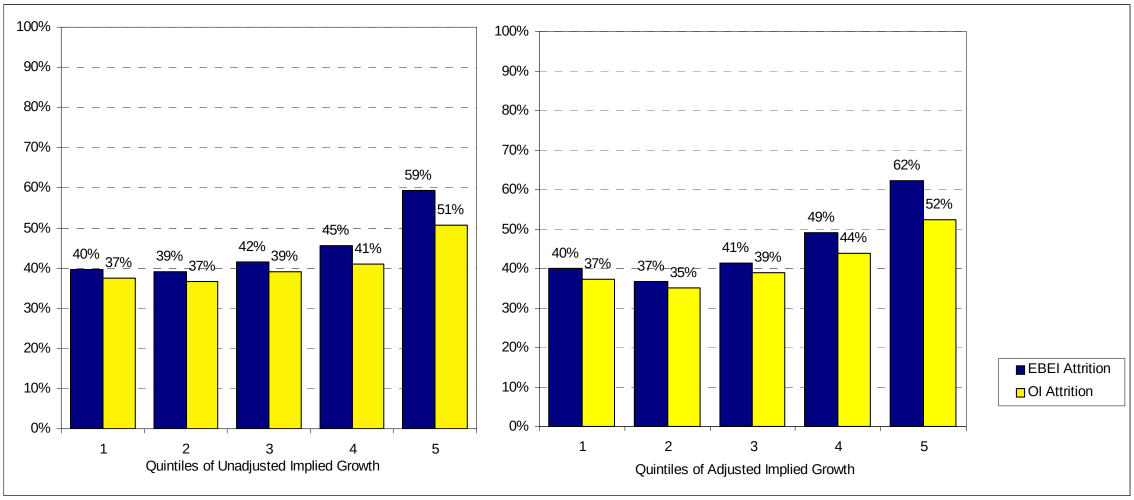
Figure 2. Realized Growth Rates by Quintiles of Implied Growth



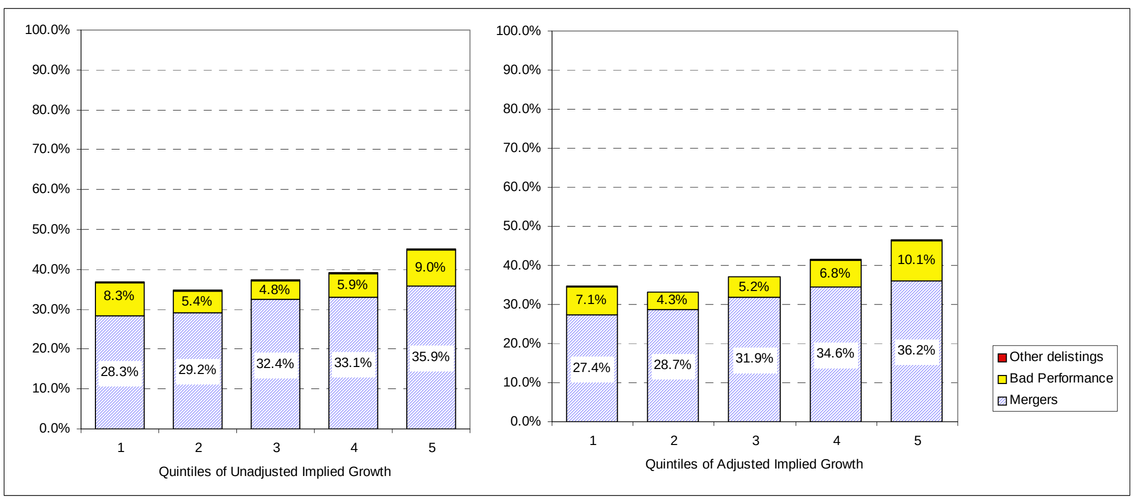
The figure plots average growth in four-year cum-dividend earnings before extraordinary items (*EBEI*) or operating income before depreciation (*OI*) by quintiles of unadjusted (adjusted) implied growth. Unadjusted (adjusted) implied growth is based on raw analyst earnings forecasts (forecasts adjusted for predictable forecast errors (Gode and Mohanram 2009)). Growth rates are calculated as $GR_{t+4,\, t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T-3,T]}(E_t) + \Sigma_{[t=T-3,T-1]}((1+r)^{4-t}-1)d_t$, and E_t is realized earnings for year t, d_t is dividends declared in year t, and r is the risk-free rate at period t.

Figure 3. Sample Attrition

Panel A. Sample Attrition Rates during [*t*, *t*+8] by Quintiles of Implied Growth



Panel B. Reasons for Delisting during [*t*, *t*+8] by Quintiles of Implied Growth



The figure documents the rates and causes of sample attrition within eight years following implied earnings growth estimation. Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors). Percentages are calculated using firms with available implied earnings growth estimates at time *t*.

Panel A reports average percentage of firms with unavailable four-year cum-dividend earnings growth by quintiles of implied growth. *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

Panel B reports average percentage of firms delisted from the exchanges. “Bad performance” category includes delistings due to various adverse events, including bankruptcies, liquidations, and failure to satisfy listing requirements. “Mergers” category includes delistings following merger and acquisition activity, or stock exchanges. “Other delistings” include all delistings not included in the two previous categories (for example, moving to a different exchange). Delisting classification is performed based on CRSP delisting codes; bad performance-related delistings are coded following Shumway (1997).

Table 1. Descriptive Statistics

Variable	Mean	10%	25%	Median	75%	90%
Firm Characteristics						
Size	3163	64	161	517	1840	6456
B/M	0.615	0.185	0.317	0.517	0.779	1.144
Beta	1.067	0.292	0.580	0.969	1.410	1.997
Ret_{-12}	0.179	-0.324	-0.107	0.117	0.376	0.722
Ltg	0.171	0.065	0.100	0.140	0.200	0.325
dIndROE	-0.029	-0.134	-0.064	-0.013	0.026	0.065
RDSales	0.030	0.000	0.000	0.000	0.016	0.097

The table reports descriptive statistics for a sample of 50,636 firm-year observations from 1980 to 2007. *Size* is the market capitalization, *B/M* is the book-to-market ratio, *Beta* is the CAPM beta, *Leverage* is the ratio of the book value of debt to the market value of equity, Ret_{-12} is the past one-year buy-and-hold return, *Ltg* is the long-term growth consensus forecast from *I/B/E/S*; *dIndROE* is the industry ROE minus the firm's average forecasted ROE over years t+1 to t+4; *RDSales* is the ratio of R&D expenses to sales.

Table 2. Cost of Equity Estimates

Panel A. Simultaneous COE and Growth Estimation

Variables	Unadjusted Forecasts			Adjusted Forecasts		
	Regression Coefficients (λ)	Driver's Standard Deviation (Std)	λ*Std	Regression Coefficients (λ)	Driver's Standard Deviation (Std)	λ*Std
Intercept	0.035 [1.01]			0.014 [0.61]		
MB	0.399 [13.73]***			0.321 [10.52]***		
MB * ***LogSize***	-0.023 [2.89]***	0.72	-0.017	-0.004 [0.61]	0.72	-0.003
MB * ***MB***	-0.056 [7.01]***	2.32	-0.129	-0.042 [7.58]***	2.32	-0.098
MB * $\boldsymbol{LogRet_{-12}}$	-0.015 [2.20]**	0.42	-0.006	0.083 [5.06]***	0.42	0.034
MB * ***Beta***	0.005 [0.55]	0.62	0.003	-0.014 [2.48]**	0.62	-0.009
(1-MB) * ***dIndROE***	1.149 [4.48]***	0.09	0.100	0.972 [5.09]***	0.09	0.085
(1-MB) * ***Ltg***	0.008 [0.19]	0.11	0.001	0.302 [7.13]***	0.11	0.033
(1-MB) * ***RDSales***	0.355 [2.56]**	0.07	0.023	0.203 [1.88]*	0.07	0.013
R^2	48.9%			54.3%		

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel B: Descriptive Statistics COE and Growth Estimates

Variable	Mean	10%	25%	Median	75%	90%
Unadjusted COE and Growth						
r_{SE}	0.082	0.040	0.057	0.077	0.102	0.134
r_{CT}	0.111	0.067	0.083	0.100	0.124	0.157
r_{GLS}	0.103	0.068	0.082	0.099	0.120	0.143
r_{PEG}	0.111	0.072	0.087	0.105	0.129	0.158
g_{SE}	0.006	-0.030	-0.022	0.004	0.026	0.046
Adjusted COE and Growth						
r_{SE}	0.069	0.032	0.047	0.063	0.085	0.117
r_{CT}	0.095	0.053	0.068	0.084	0.102	0.127
r_{GLS}	0.094	0.060	0.075	0.091	0.111	0.133
r_{PEG}	0.102	0.066	0.081	0.097	0.118	0.144
g_{SE}	0.004	-0.030	-0.017	0.002	0.021	0.038

Table 2 (continued)

Panel C: Correlations Among COE Measures

	Unadjusted COE Measures					Adjusted COE Measures			
	r_{SE}	r_{CT}	r_{GLS}	r_{PEG}		r_{SE}	r_{CT}	r_{GLS}	r_{PEG}
r_{SE}	—	0.489 (26/0)	0.709 (28/0)	0.529 (28/0)	r_{SE}	—	0.314 (18/3)	0.605 (27/0)	0.429 (28/0)
r_{CT}		—	0.522 (28/0)	0.634 (28/0)	r_{CT}		—	0.384 (28/0)	0.309 (27/0)
r_{GLS}			—	0.559 (28/0)	r_{GLS}			—	0.406 (28/0)
r_{PEG}				—	r_{PEG}				—

The table reports results of COE estimation using simultaneous COE and growth estimation approach. The sample consists of 50,636 firm-year observations from 1980 to 2007.

Panel A reports average of yearly coefficients from cross-sectional regression (6) estimated using WLS:

$$X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret^i_{-12}) MB^i x^i_R$$
$$+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x^i_G + v^i \,,$$

where X_{cT}/B_0 is four-year cum-dividend earnings forecast, divided by per-share book value of equity; *MB* is market-to-book ratio, calculated as stock price from *I/B/E/S* as of June of year *t*+1, divided per-share book value of equity; *Beta* is CAPM beta estimated over sixty months preceding June of year *t*+1; *LogSize* is the log of the market value of equity as of June of year *t*+1; ret_{-12} is the twelve-month buy-and-hold stock return preceding June of year *t*+1; *Ltg* is the long-term growth consensus forecast from *I/B/E/S* as of June of year *t*+1; *dIndROE* is the industry ROE minus the firm's average forecasted ROE over years *t*+1 to *t*+4; *RDSales* the ratio of R&D expenses to sales. Regressions are estimated by year, with an iterative procedure described in detail in Section 2.
The first (last) three columns of Panel A use raw analyst earnings forecasts (forecasts adjusted for predictable errors). The panel reports time-series averages of estimated regression coefficients (λ), time-series averages of yearly standard deviations of risk and growth drivers (Std), and the product of the above averages (λ*Std). Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets.

Panel B reports descriptive statistics for COE and growth estimated using regressions from Panel A, as well as descriptive statistics for benchmark COE models. r_{SE} is the COE measure based on our model, g_{SE} is our implied terminal growth in residual earnings, , r_{CT} is the COE measure based on Claus and Thomas (2001) model, r_{GLS} is the COE measure based on the GLS (Gebhardt et al. 2001) model, r_{PEG} is the COE measure based on the PEG model (Gode and Mohanram 2003). Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors).

Panel C reports average by-year correlations between COE measures. Numbers in parentheses indicate the number of years with significantly positive/negative correlations.

Table 3. Predicting Future Returns using COE Measures

Panel A: Univariate Cross-Sectional Regressions of Future Returns on COE Measures

	Unadjusted COE Measures				**Adjusted COE Measures**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Intercept	0.072	0.136	0.094	0.155	0.018	0.125	0.060	0.106
	[2.56]**	[6.86]***	[2.74]***	[4.98]***	[0.44]	[6.89]***	[1.83]*	[3.94]***
$\boldsymbol{r_{SE}}$	**0.714**				**1.453**			
0	**[2.28]****				**[3.34]*****			
1	**[0.91]**				**[1.04]**			
r_{CT}		0.119				0.280		
0		[0.81]				[1.79]*		
1		[6.00]***				[4.60]***		
r_{GLS}			0.507				0.888	
0			[1.47]				[2.52]**	
1			[1.43]				[0.32]	
r_{PEG}				-0.040				0.439
0				[0.16]				[1.60]
1				[4.08]***				[2.04]*
R^2	0.02	0.00	0.01	0.01	0.02	0.00	0.02	0.01

Panel B: Cross-Sectional Regressions of Future Returns on Pairs of COE Measures

	Unadjusted COE Measures			**Adjusted COE Measures**		
	1	**2**	**3**	**1**	**2**	**3**
Intercept	0.078	0.072	0.096	0.027	0.009	0.019
	[2.58]**	[2.02]**	[3.48]***	[0.76]	[0.20]	[0.54]
$\boldsymbol{r_{SE}}$	**1.067**	**0.668**	**0.962**	**1.649**	**1.284**	**1.411**
	[2.36]**	**[2.15]****	**[2.32]****	**[2.98]*****	**[3.59]*****	**[2.9]*****
r_{CT}	-0.363			-0.263		
	[1.39]			[1.01]		
r_{GLS}		0.055			0.245	
		[0.15]			[0.73]	
r_{PEG}			-0.405			0.040
			[1.49]			[0.16]
R^2	0.03	0.03	0.04	0.03	0.03	0.03

Table 3 (continued)

Panel C: Cross-Sectional Regressions of Future Returns on COE Measures and Risk Drivers

	Unadjusted COE Measures				Adjusted COE Measures			
	1	2	3	4	1	2	3	4
Intercept	0.118 [1.95]**	0.168 [2.49]**	0.139 [2.06]*	0.187 [2.66]**	0.088 [1.64]*	0.167 [2.49]**	0.125 [1.75]*	0.163 [2.29]**
r_{SE}	**0.534** **[2.71]*** **				**1.047** **[3.79]*** **			
r_{CT}		0.088 [0.98]				0.126 [1.04]		
r_{GLS}			0.435 [1.54]				0.731 [2.00]**	
r_{PEG}				-0.023 [0.12]				0.190 [0.77]
Beta	-0.008 [0.59]	-0.011 [0.76]	-0.011 [0.75]	-0.011 [0.88]	-0.005 [0.36]	-0.011 [0.74]	-0.011 [0.79]	-0.014 [1.06]
LogSize	-0.014 [0.71]	-0.015 [0.77]	-0.014 [0.73]	-0.018 [0.94]	-0.015 [0.77]	-0.015 [0.78]	-0.014 [0.75]	-0.016 [0.82]
B/M	0.014 [1.05]	0.020 [1.38]	0.003 [0.18]	0.022 [1.36]	0.007 [0.51]	0.022 [1.41]	-0.011 [0.48]	0.021 [1.30]
Ret_{-12}	0.068 [3.99]***	0.065 [3.78]***	0.066 [3.93]***	0.067 [3.88]***	0.058 [3.65]***	0.065 [3.79]***	0.060 [3.81]***	0.068 [3.76]***
R^2	0.074	0.068	0.072	0.070	0.076	0.068	0.073	0.070

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The table reports results of cross-sectional regressions of one-year-ahead returns on COE measures and risk proxies. The sample consists of 50,636 firm-year observations from 1980 to 2007.

Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets. Slopes on the COE measures have two corresponding *t*-statistics, where =0 (=1) denotes a null of zero (one).

r_{SE} is the COE measure based on our model, g_{SE} is our implied terminal growth in residual earnings, r_{CT} is the COE measure based on Claus and Thomas (2001) model, r_{GLS} is the COE measure based on the GLS (Gebhardt et al. 2001) model, r_{PEG} is the COE measure based on the PEG model (Gode and Mohanram 2003). *Beta* is the CAPM beta, *LogSize* is the log of the market capitalization, *B/M* is the book-to-market ratio, Ret_{-12} is the past one-year buy-and-hold return. Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors).

Table 4. Predicting Earnings Growth using Implied Growth Estimates

Panel A. Descriptive Statistics for Realized Growth Rates

Variable	Number of Observations	Mean	10%	25%	Median	75%	90%
Growth in EBEI	18,801	0.48	-1.17	-0.25	0.30	0.93	2.06
Growth in OI	20,267	0.52	-0.39	-0.01	0.32	0.79	1.52

Panel B. Regressions of Realized Growth Rates on Quintile Ranks of Unadjusted Implied Growth

	Dependent Variable = Future Growth in *EBEI*		Dependent Variable = Future Growth in *OI*	
	1	2	3	4
***R*(g_{SE})**	**0.122**	**0.04**	**0.026**	**-0.002**
	[4.35]*	**[1.35]**	**[1.64]**	**[0.15]**
Ltg		0.711		1.666
		[1.00]		[8.19]***
dIndROE		2.226		1.007
		[3.40]***		[3.75]***
RDSales		-3.086		-0.378
		[2.05]**		[0.52]
Intercept	-0.099	0.07	0.350	0.189
	[1.75]*	[0.65]	[10.90]***	[4.38]***
Observations	18,801	18,801	20,267	20,267
R^2	0.03	0.03	0.02	0.04

Panel C. Regressions of Realized Growth Rates on Quintile Ranks of Adjusted Implied Growth

	Dependent Variable = Future Growth in *EBEI*		Dependent Variable = Future Growth in *OI*	
	1	2	3	4
***R*(g_{SE})**	**0.098**	**0.011**	**0.060**	**0.006**
	[2.77]*	**[0.38]**	**[4.24]***	**[0.49]**
Ltg		0.683		1.637
		[0.95]		[7.30]***
dIndROE		2.574		0.923
		[4.40]***		[3.16]***
RDSales		-3.038		-0.387
		[2.04]**		[0.53]
Intercept	-0.053	0.145	0.280	0.174
	[0.76]	[1.46]	[9.67]***	[5.91]***
Observations	18,801	18,801	20,267	20,267
R^2	0.03	0.03	0.02	0.04

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The table documents association between implied earnings growth and future realized earnings growth. The analyses are based on observations with available realized growth rates in four-year cum-dividend earnings before extraordinary items (operating income before depreciation) for a period from 1980 to 2001.

Panel A contains descriptive statistics for the realized earnings growth. Realized growth rates are calculated as $GR_{t+4,\ t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T-3,T]}(E_t) + \Sigma_{[t=T-3,T-1]}((1+r)^{4-t} - 1)d_t$, and E_t is realized earnings for year t, d_t is dividends declared in year t, and r is the risk-free rate at t. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

Panels B and C report coefficients from regressing growth in *EBEI* (*OI*) on the quintile ranks of unadjusted (adjusted) implied earnings growth, $R(g_{SE})$, and control variables: *Ltg* - analysts' long-term growth forecast, *dIndROE* - the difference between the industry ROE and the firm's average forecasted ROE over years *t+1* to *t+4*, and *RDSales* - R&D expenses scaled by sales. Industry ROE is calculated as a ten-year moving median ROE excluding loss firms (Gebhardt et al. 2001). Unadjusted (adjusted) implied growth is based on raw analyst earnings forecasts (forecasts adjusted for predictable errors (Gode and Mohanram 2009)).

All regressions are based on a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). Absolute values of *t*-statistics are reported in brackets.

Table 5. Predicting Returns and Earnings Growth Using Statistical Models

Panel A. Predicting Realized Returns

Independent Variables	Dependent Variable = Future Realized Return		
	1	2	3
Unadjusted R(r_{SE})	0.017		
	[2.44] **		
Adjusted R(r_{SE})		0.024	
		[3.19] ***	
R(*Stat_pRET*)			0.005
			[0.81]
Intercept	0.116	0.103	0.133
	[5.28] ***	[4.89] ***	[4.95] ***
Observations	50,636	50,636	49,875
R^2	0.02	0.02	0.02

Panel B. Predicting Earnings Growth: Unadjusted Implied Growth

Independent Variables	Dependent Variable = Future Growth in *EBEI*				Dependent Variable = Future Growth in *OI*			
	1	2	3	4	5	6	7	8
***R*(g_{SE})**	**0.148**			**0.133**	**0.050**			**0.034**
	[5.01]* **			**[5.22]*** **	**[2.76]*** **			**[1.83]***
R(*Stat_pGrEBEI*)		0.093		0.047		0.028		
		[2.03]**		[1.00]		[0.94]		
R(*Stat_pGrOI*)			0.077				0.105***	0.099
			[1.51]				[5.62]	[5.54]***
Intercept	0.449	0.533	0.571	0.386	0.348	0.384	0.241	0.189
	[11.05]***	[6.10]***	[6.63]***	[3.98]***	[11.08]***	[6.68]***	[7.21]***	[4.08]***
Observations	15,416	15,416	15,416	15,416	16,766	16,766	16,766	16,766
R^2	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.03

Panel C. Predicting Earnings Growth: Adjusted Implied Growth

Independent Variables	Dependent Variable = Future Growth in *EBEI*				Dependent Variable = Future Growth in *OI*			
	1	2	3	4	5	6	7	8
***R*(g_{SE})**	**0.149**			**0.133**	**0.085**			**0.051**
	[4.73]* **			**[4.50]*** **	**[5.14]*** **			**[2.71]*** **
R(*Stat_pGrEBEI*)		0.093		0.048		0.028		
		[2.03]**		[0.96]		[0.94]		
R(*Stat_pGrOI*)			0.077				0.105	0.084
			[1.51]				[5.62]***	[4.20]***
Intercept	0.435	0.533	0.571	0.374	0.274	0.384	0.241	0.183
	[9.70]***	[6.10]***	[6.63]***	[3.94]***	[9.07]***	[6.68]***	[7.21]***	[4.57]***
Observations	15,416	15,416	15,416	15,416	16,766	16,766	16,766	16,766
R^2	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.03

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The table documents predictive ability of statistically predicted returns (earnings growth). The analyses in Panel A (Panels B and C) are based on the 1981 to 2007 (1987 to 2001) period.

Panel A reports coefficients from regressing realized one-year-ahead returns on quintile ranks of our implied COE, $R(r_{SE})$, and statistically predicted return, $R(Stat\_pRET)$. Statistically predicted returns are based on (1) estimating the slope coefficients in the hold-out cross-sectional regressions of past realized one-year returns on the risk drivers lagged by one year, and (2) applying slope coefficients to current risk drivers (market-to-book ratio, logarithm of market value of equity, CAPM beta, and prior twelve-month return). Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets.

Panels B and C report coefficients from regressing realized growth in *EBEI* (*OI*) on the quintile rank of unadjusted (adjusted) implied earnings growth, $R(g_{SE})$, and the quintile rank of statistically predicted growth in earnings, $R(Stat\_pGrEBEI)$ or $R(Stat\_pGrOI)$. Realized growth rates are calculated as $GR_{t+4,\ t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T\text{-}3,T]}(E_t) + \Sigma_{[t=T\text{-}3,T\text{-}1]}((1+r)^{4\text{-}t} - 1)d_t$, and E_t is realized earnings for year t, d_t is dividends declared in year t, and r is the risk-free rate at period t. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation). Statistically predicted growth in earnings is based on (1) estimating the slope coefficients in the hold-out cross-sectional regressions of past realized growth in *EBEI* (*OI*) on the growth drivers lagged by eight years, and (2) applying slope coefficients to current growth drivers (analysts' long-term growth forecasts, deviations of firm's forecasted ROE from the industry ROE, and R&D expenses scaled by sales). All regressions use a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). Absolute values of *t*-statistics are reported in brackets.

Table 6. Cross-Sectional Determinants of COE's Return Predictive Ability

Panel A. Return Predictability by Quintiles of Absolute Difference between r_{SE} and r_{GLS}

	Quintiles of $\lvert r_{SE} - r_{GLS} \rvert$				
	Q1	**Q2**	**Q3**	**Q4**	**Q5**
Adjusted r_{GLS}					
r_{GLS}	**1.889** **[3.99]*** **	**1.515** **[2.39]** **	**1.414** **[3.03]*** **	**0.801** **[1.62]**	**0.315** **[0.80]**
Intercept	-0.020 [0.55]	0.005 [0.10]	0.01 [0.22]	0.053 [1.13]	0.106 [2.17]**
R^2	0.03	0.04	0.03	0.03	0.01
Adjusted r_{SE}					
r_{SE}	**1.968** **[4.04]*** **	**1.657** **[2.49]** **	**1.640** **[3.16]*** **	**0.940** **[1.90]* **	**1.211** **[2.99]*** **
Intercept	-0.019 [0.48]	-0.004 [0.08]	0.003 [0.06]	0.043 [1.05]	0.062 [1.75]*
R^2	0.03	0.04	0.03	0.02	0.02
Slope(r_{SE}) − Slope(r_{GLS})	**0.079**	**0.142**	**0.226**	**0.139**	**0.896**

Panel B. Average Firm Characteristics by Quintiles of Absolute Difference between r_{SE} and r_{GLS}

	Quintiles of $\lvert r_{SE} - r_{GLS} \rvert$						
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q5-Q1**	**T-Statistics**
$\lvert g_{SE} \rvert$	0.022	0.020	0.020	0.023	0.027	**0.005**	**[3.24]*** **
$\lvert ROE - iROE \rvert$	0.081	0.074	0.081	0.101	0.137	**0.056**	**[5.24]*** **
$\lvert RDSales - iRDSales \rvert$	0.039	0.061	0.100	0.172	0.163	**0.124**	**[2.23]** **
$\lvert Ltg - iLtg \rvert$	0.064	0.058	0.058	0.066	0.085	**0.020**	**[5.78]*** **
$\lvert SalesGr - iSalesGr \rvert$	0.095	0.092	0.096	0.113	0.129	**0.034**	**[4.53]*** **
$\lvert Beta - mBeta \rvert$	0.470	0.468	0.469	0.502	0.548	**0.077**	**[4.25]*** **
$\lvert LogSize - mLogSize \rvert$	0.584	0.585	0.573	0.568	0.618	**0.034**	**[3.07]*** **
$\lvert B/M - mB/M \rvert$	0.227	0.220	0.239	0.285	0.568	**0.341**	**[12.78]*** **
$\lvert Ret_{-12} - mRet_{-12} \rvert$	0.295	0.251	0.262	0.316	0.402	**0.107**	**[6.04]*** **

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

This table examines the divergence in the return predictability between our and GLS measures and its cross-sectional determinants.

The quintile portfolios in both panels are formed each year based on the absolute difference between r_{SE} and r_{GLS}. r_{SE} is the COE measure based on our model, r_{GLS} is the COE measure based on the GLS model (Gebhardt et al. 2001)

Panel A reports results of cross-sectional regressions of one-year-ahead returns on the COE measures within the quintile portfolios. Reported values are the means of by-year regression coefficients. The absolute values of Fama-MacBeth *t*-statistics with the Newey-West autocorrelation adjustment are reported in brackets.

Panel B reports time-series means of by-year variable means by quintiles of $|r_{SE} - r_{GLS}|$. $|g_{SE}|$ is the absolute value of our implied growth measure; $|ROE - iROE|$ is the absolute difference between firm and industry mean ROE; $|RDSales - iRDSales|$ is the absolute difference between firm and industry mean R&D expense scaled by sales; $|Ltg - iLtg|$ is the absolute difference between firm and industry mean long-term growth forecast form I/B/E/S; $|SalesGr - iSalesGr|$ is the absolute difference between firm and industry mean sales growth over previous five years; $|Beta - mBeta|$ is the absolute difference between firm and sample mean CAPM bets; $|LogSize - LogSize|$ is the absolute difference between firm and sample mean log of market capitalization; $|B/M - mB/M|$ is the absolute difference between firm and sample mean book-to-market ratio; $|Ret_{-12} - mRet_{-12}|$ is the absolute difference between firm and sample mean past twelve-month stock return. The last two columns report average differences between the top and the bottom quintiles and the corresponding Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation.

Table 7. Easton and Monahan (2005) Analysis

Panel A: Regressing Realized Returns on Unadjusted COE Measures, Cash Flow News, and Discount Rate News

COE Measure	*Intercept*	***LOG_ER***	*LOG_CN*	*LOG_RN*	Adjusted R^2	**Modified Noise Variable**
r_{SE}	0.119	**-0.127**	0.802	0.082	0.25	0.0002
=0	[2.77]**	**[0.26]**	[10.67]***	[10.23]***		
=1	[20.6]***	**[2.29]****	[2.63]**	[113.84]***		
r_{CT}	0.128	**-0.098**	0.805	0.044	0.19	0.0009
=0	[5.58]***	**[0.51]**	[10.08]***	[7.34]***		
=1	[38.04]***	**[5.70]*****	[2.44]**	[159.89]***		
r_{GLS}	0.199	**-0.900**	0.799	0.201	0.37	0.0002
=0	[6.69]***	**[3.07]*****	[11.22]***	[22.17]***		
=1	[26.87]***	**[6.47]*****	[2.83]***	[88.21]***		
r_{PEG}	0.187	**-0.633**	0.842	0.074	0.23	0.0095
=0	[7.44]***	**[2.40]****	[9.90]***	[11.79]***		
=1	[32.26]***	**[6.20]*****	[1.86]*	[146.69]***		

Panel B: Regressing Realized Returns on Adjusted COE Measures, Cash Flow News, and Discount Rate News

COE Measure	*Intercept*	***LOG_ER***	*LOG_CN*	*LOG_RN*	Adjusted R^2	**Modified Noise Variable**
r_{SE}	0.033	**1.169**	0.750	0.004	0.18	-0.0003
=0	[0.82]	**[1.98]***	[10.59]***	[0.36]		
=1	[23.75]***	**[0.29]**	[3.53]***	[95.61]***		
r_{CT}	0.079	**0.489**	0.757	0.015	0.16	0.0015
=0	[2.63]**	**[1.94]***	[10.25]***	[2.34]**		
=1	[30.65]***	**[2.03]***	[3.29]***	[149.40]***		
r_{GLS}	0.138	**-0.250**	0.746	0.178	0.32	-0.0001
=0	[4.97]***	**[0.80]**	[10.95]***	[13.87]***		
=1	[30.96]***	**[4.00]*****	[3.73]***	[64.13]***		
r_{PEG}	0.049	**0.784**	0.828	-0.004	0.16	0.0004
=0	[2.35]**	**[2.34]****	[9.46]***	[0.54]		
=1	[45.27]***	**[0.64]**	[1.97]*	[129.24]***		

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The table evaluates the reliability of the COE estimates using the Easton and Monahan (2005) method.

The second to sixth columns contain mean regression coefficients and adjusted R^2 for the annual cross-sectional regressions of (log) realized returns on a COE measure, cash flow news, and expected return news: $LOG\_RET_{i,t+1}$ = $Intercept + \alpha_1 * LOG\_ER_{i,t} + \alpha_2 * LOG\_CN_{i,t+1} + \alpha_3 * LOG\_RN_{i,t+1} + \varepsilon_{i,}$ where $LOG\_RET_{i,t+1}$ is the realized return over the one year after the COE estimation, LOG_ER_i is the expected return, i.e. one of the COE estimates, $LOG\_CN_{i,t+1}$ is the cash flow news measured over the one year after the COE estimation, and $LOG\_RN_{i,t+1}$ is the discount rate news over the one year after the COE estimation. All return measures are continuously compounded. The last column reports the modified noise coefficient for each COE measure.

Cash flow news is measured as a sum of the forecast error realized over year t+1, the revision in one-year-ahead forecasted ROE, and the capitalized revision in the two-year-ahead forecasted ROE: $LOG\_CN_{i,t+1}$=$LOG\_FERR_{i,t+}\Delta LOG\_FROE_{i,t+1}$+ρ/(1-ρω)*$\Delta LOG\_FROE_{i,t+2}$, where LOG_FERR_{it} is the realized forecast error on the EPS_t forecast made at the end of fiscal year t,[41] and revisions refer to changes in forecasts from June of year t to June of year t+1. Forecasted ROE is defined as EPS forecast divided by book value of equity divided by number of shares used to calculate EPS. We use ρ estimates reported in Easton and Monahan (2005). Persistence coefficients ω_t are estimated through a pooled time-series cross-sectional regression for each of the 48 Fama-French industries: $LOG\_ROE_{i,t-\tau} = \omega_{0t} + \omega_t \times LOG\_ROE_{i,t-(\tau-1)},$ where τ is a number between zero and nine, and ROE is return on equity.

Discount rate news is measured as $LOG\_RN_{i,t+1}$= ρ/(1-ρ)*($LOG\_ER_{1,t+1}$-$LOG\_ER_{i,t}$), where $LOG\_ER_{i,t}$ is the continuously compounded COE estimate measured as of June of year t, and $LOG\_ER_{i,t+1}$ is the continuously compounded COE estimate measured as of June of year t+1.

The details of estimating the modified noise coefficient are described in Easton and Monahan (2005) pp. 506-507.

Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth t-statistics with the Newey-West adjustment for autocorrelation are reported in brackets. Slopes on the COE measures have two corresponding t-statistics, where =0 (=1) denotes a null of zero (one).

All estimations are performed after deleting observations that fall in the top and bottom 0.5% for $LOG\_RET_{i,t+1}$, $LOG\_ER_{i,}$, LOG_CN_i, or $LOG\_RN_{i,}$ distributions.

[41] $FERR_{it}$ captures a revision in expectations that occurs in year t+1 due to announcement of actual year t earnings.

Table 8. Survivorship Bias in Earnings Growth Prediction

Panel A. Regressions of Realized Growth Rates on Quintile Ranks of Implied Growth. Substituted Missing Realized Growth for Bad Performance Delistings

	Dependent Variable = Future Growth in *EBEI* 1	Dependent Variable = Future Growth in *OI* 2
	Unadjusted Implied Growth	
$\boldsymbol{R(g_{SE})}$	**0.088**	**0.025**
	[3.32]* **	**[1.95]***
Intercept	-0.032	0.348
	[0.59]	[13.25]***
Observations	21,357	23,508
R^2	0.023	0.016
	Adjusted Implied Growth	
$\boldsymbol{R(g_{SE})}$	**0.050**	**0.050**
	[1.57]	**[3.87]*** **
Intercept	0.042	0.298
	[0.66]	[11.34]***
Observations	21,357	23,508
R^2	0.022	0.018

Panel B. Regressions of Realized Growth Rates on Quintile Ranks of Implied Growth. Substituted Missing Realized Growth for Bad Performance and Merger Delistings

	Dependent Variable = Future Growth in *EBEI* 1	Dependent Variable = Future Growth in *OI* 2
	Unadjusted Implied Growth	
$\boldsymbol{R(g_{SE})}$	**0.061**	**0.014**
	[3.33]* **	**[1.54]**
Intercept	0.006	0.302
	[0.17]	[15.68]***
Observations	25,589	28,290
R^2	0.020	0.012
	Adjusted Implied Growth	
$\boldsymbol{R(g_{SE})}$	**0.032**	**0.031**
	[1.47]	**[3.31]*** **
Intercept	0.063	0.268
	[1.43]	[13.90]***
Observations	25,589	28,290
R^2	0.020	0.013

The table examines sensitivity of growth prediction results in Table 4 to the survivorship bias. Both panels report coefficients from regressing growth in *EBEI* (*OI*) on the quintile rank of unadjusted (adjusted) implied earnings growth rate, $R(g_{SE})$. The missing realized growth rates are substituted with assumed rates depending on the reason of firms' exit from the sample.

In Panel A, missing realized growth rates of firms delisted due to bad performance are calculated as $GR_{t+4,\,t+8} = -BV_{t+4} / X_{t+4}^{cumd} - 1$, where BV_{t+4} is the book value of equity at the end of t+4, $X_T^{cumd} = \Sigma_{[t=T\text{-}3,T]}(E_t) + \Sigma_{[t=T\text{-}3,T\text{-}1]}((1+r)^{4\text{-}t} - 1)d_t$, and E_t is realized earnings for year t, d_t is dividends declared in year t, and r is the risk-free rate at period t. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

In Panel B, in addition to substitution from Panel A, missing realized growth rates of firms delisted due to mergers are set equal to zero.

All regressions use a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). The absolute values of t-statistics are reported in brackets.