Estimating an Equity Yield to Maturity: Deficiencies of the Implied Cost of Capital (ICC) and an Alternative

Stephen Penman*

Columbia Business School, Columbia University and Bocconi University

shp38@columbia.edu

Julie Zhu

Fudan Fanhai School of Finance

leizhu@fudan.edu.cn

Haofei Wang

Shanghai Advanced Institute of Finance

hfwang2.12@saif.sjtu.edu.cn

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*Corresponding author. Address: Columbia Business School, 612 Uris Hall, 3022 Broadway, New York, NY 10027. Part of this paper appeared in an earlier paper, "The Implied Cost of Capital: Accounting for Growth."

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Abstract. This paper involves a critique of the Implied Cost of Capital (ICC) that leads to an alternative measure which, like the ICC, is extracted from accounting data. The critique deals with how the ICC handles the accounting involved. First, the ICC fails an accounting consistency condition. Second, expected earnings growth conveys risk and return, but this is not recognized when a growth rate is inserted in the reverse engineering exercise. Empirical tests so confirm. An alternative accounting-based measure accommodates these points and validates on criteria indicating risk and return. The resulting measure is a yield to maturity for equities, much like that for a bond.

Keywords: Implied Cost of Capital; Earnings Growth; Risk

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1. Introduction

There has been significant effort over the years to estimate the cost of capital. The product from accounting research, the so-called Implied Cost of Capital (ICC), is the internal rate of return that reconciles the inputs in an accounting-based valuation model to the traded price. With the cost of capital (or expected return) so central to investing, the endeavor is important, but research in a number of fields has not been particularly effective in arriving at an operational estimate. While asset pricing research in finance has been successful in explaining in-sample returns in the cross-section with factor models, it has been unsuccessful in developing a cost-of-capital measure out of sample from those models. In the words of Fisher Black, "the key issue in investments is *estimating* the expected return. It is neither explaining return…nor explaining average return" (Black 1993, emphasis in the original). Responding to Black's point, the ICC is an out-of-sample estimate of the expected return, a measure that potentially can be employed in real time by investors.

The labelling of the ICC is unfortunate. As it is estimated from payoffs over the long run for going concerns, it is a yield to maturity for equity, much like a bond yield, rather than the "cost of capital." Like a bond yield, that is useful for screening stocks on risk and return. However, the ICC has had difficulty in satisfying validation tests. This paper provides a critique that points to reason for this and adds empirical tests that support the critique. But it also offers an alternative that, like the ICC, extracts an equity yield to maturity from accounting numbers but which exhibits the properties on which the ICC fails under the critique.

Early ICC estimates exhibited only weak correlation with risk measures, and had difficulty in predicting returns, a property required of a valid estimate and the feature that investors are interested in.[1] This failure was distressing given that many accounting numbers, with less pretense to being the expected return, readily predict returns, for example, earnings-to-price (E/P), book-to-price (B/P), accruals, and asset growth. The inputs in the reverse engineering exercise are typically book value, forecasts of near-term earnings, and a subsequent long-term growth rate. More recent ICC papers have focused on errors in short-term forecasts to explain the deficiencies in the metric, with improvement on validation criteria.[2]

This paper focuses on the long-term growth rate inserted in the reverse engineering exercise. This is sometimes just assumed to be the same for all firms, though some papers go to lengths to estimate growth rates that vary over firms.[3] The paper makes three points.

First, the relevant growth rate is determined by the accounting for the other inputs, book value and forecasted near-term earnings. The ICC is extracted from observed prices and, for a given price that forecasts life-long earnings, higher (lower) book value and forecasted near-term earnings imply a lower (higher) long-term earnings (growth). So, a consistency condition requires that the inserted growth rate must be that implied by this accounting.

Second, the accounting principles determining those earnings and book values deal with earnings recognition under uncertainty such that the resulting growth rate indicates risk and, potentially, the cost of capital. The ICC does not recognize this feature of the accounting.

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[1] For reviews, see Easton and Monahan (2005 and 2016), Guay, Kothari, and Shu (2011), Botosan, Plumlee, and Wen (2011), and Echterling, Eierle, and Ketterer (2015).

[2] See, for example, Easton and Sommers (2007), Hou, van Dijk, and Zhang (2012), Larocque (2013), Mohanram and Gode (2013), Fitzgerald, Gray, Hall, and Jeyaraj (2013), Li and Mohanram (2014), and Wang (2020).

[3] Papers that allow varying growth rates include Easton, Taylor, Shroff, and Sougiannis (2002), Huang, Natarajan, and Radhakrishnan. (2006), Nekrasov and Ogneva (2011), Ashton and Wang (2013), Ketterer, Tsalavoutas, and Eierle (2017), and Wang, Peng, and Christodoulou (2019).

Third, the ICC calculation reverse engineers a residual income model. But the growth rate in a residual income model is the growth rate in residual earnings and that is earning growth in excess of a charge against those earnings for the cost of capital. Thus, this growth rate takes out the part of earnings growth due to risk. Indeed, the calculation is circular: A growth rate conditional on a cost of capital is inserted to estimate the cost of capital. The same critique applies to an ICC estimated from abnormal earnings growth models.

To demonstrate these points empirically, the paper compares existing ICC calculations against a benchmark expected return that responds to this critique. That is the ER measure in Penman and Zhu (2014, 2022) that is based on accounting that connects to the discount factor in a general no-arbitrage pricing model as a matter of theory in Penman and Zhang (2020) and validates on criteria on which the ICC has failed. The empirical tests show that failure to recognize the above three points in ICC calculations significantly limits their ability to convey validated risk and return information, even with the corrections for errors in near-term forecasts.

That then leads to an alternative to the ICC that is derived from the ER measure. Like the ICC, the alternative is a "yield to maturity" for equities serving to discriminate on risk, as with the yield to maturity for a bond. In contrast to the ICC (but like a bond yield), it forecast the returns and the risk to returns that investors experience in holding equities. And it is a measure estimated in real time that Fisher Black (and investors) seek.

The expected return is a key measure in valuation, investing, corporate finance, and project evaluation—and in the classroom on these topics. In research, the ICC has been used extensively to investigate whether X affects the cost of capital, where X is accounting methods, disclosure, auditing, regulations, corporate governance mechanisms, and more. The ICC has also been applied to validate asset pricing models (in Hou, Xue, and Zhang, 2015, for example). So, much rides on the determination of such a measure.

2. Expected Earnings Growth and the Expected Return to Investing

This section lays out issues in specifying a growth rate for the ICC calculation, evaluates *a priori* the extent to which ICC calculations incorporate these issues, and introduces the empirical tests. But first it establishes the point of departure by documenting the current "state-of-the art" in developing an ICC product.

2.1 Point of Departure

The ICC had been criticized both on theoretical and empirical grounds.

On the theory side, Hughes, Liu, and Liu (2009) point out that ICC estimates a constant discount rate for all future periods but a constant discount rate is inconsistent with no arbitrage if discount rates are time varying. While challenging the ICC as "the cost of capital," this does not necessarily invalidate the exercise; a series of changing discount rates can be summarized by an "average" rate over the term. The yield-to-maturity for a bond with a term structure is not the cost of capital for the bond but serves as a useful metric for investors to indicate risk and an approximate yield to investing. With the cost of capital for equity so elusive, the ICC can serve the same function. The ICC can also serve as a screen for active investing. As with the yield-to-maturity for a bond, the ICC is not necessarily the return for risk, rather the internal rate of return from buying at the market price, so includes an abnormal return if the market price is "inefficient," a point highlighted in Cheng and Fang (2021). While these points suggest a relabeling of the measure, but that is not the issue for this paper. Rather, we are concerned about the integrity of the measure as a yield to maturity for both purposes.

On the empirical side, criticisms of ICC calculations have to do with measurement error in the inputs, with near-term earnings forecasts and long-term growth estimates the main concerns. Easton and Sommers (2007), Larocque (2013), and Mohanram and Gode (2013) correct the ICC calculation for estimated errors in analysts' forecasts, while some papers substitute model forecasts for analysts' forecasts, for example Hou, van Dijk, and Zhang (2012) and Li and Mohanram (2014). Others, such as Callen and Segal (2004), Lyle, Callen, and Elliott (2013), Lyle and Wang (2015), and Wang, Peng, and Christodoulou (2019), impose an assumed auto-regressive process for the evolution of accounting numbers, some with the (autoregressive) model of Voulteenaho (2002).[4] Papers that strive for enhanced estimates of long-term growth include Easton, Taylor, Shroff, and Sougiannis (2002) and Nekrasov and Ogneva (2011). The choice of a residual income model versus an Ohlson-Juettner Model for the ICC calculation is a matter of characterizing the long-term growth rate (Ketterer, Tsalavoutas, and Eierle 2017).

These efforts have led to improvement on validation criteria, particularly the association with forward returns.[5] This paper joins those critiques with a focus on the growth estimate in the ICC calculation. However, it takes a different approach. *First,* it recognizes that earnings growth is an accounting phenomenon, it depends on accounting principles. Thus, growth rates that are inputs to the ICC calculation must be consistent with the accounting involved. *Second*, it then recognizes that growth under GAAP and IFRS accounting principles connects to risk both in theory and empirically. Rather than treating expected growth as something to be controlled for in

[4] These papers are critiqued separately in Penman (2016) and Penman and Yehuda (2019, appendix) with the point that an autoregressive process is not consistent with how accounting evolves under (conservative) accounting principles that indicate risk and return. Those papers are not covered here.

[5] See Easton and Monahan (2005) and Clubb and Makrominas (2018) on validation with forward realized returns.

extracting the cost of capital from price, expected growth is an input that conveys the cost of capital that discounts price.

2.2 Growth is an Accounting Phenomenon

To appreciate the *first* point—growth is determined by the accounting involved—consider the standard residual income model often applied to estimate the ICC. In its short form (with a forecast one-year-ahead earnings and subsequent growth), equity price,

$$P_t = B_t + \frac{Earnings_{t+1} - r.B_t}{r - g}, \qquad \text{(RIM)}$$

where r is the (constant) required return for equity (the "cost of capital") and g is a growth rate in expected residual income ($Earnings_{t+1} - r.B_t$) for years subsequent to year t+1. (Here and elsewhere subscripts greater than t indicate expected values at time t.) The inputs are current book value of equity, B_t, a forecast of $Earnings_{t+1}$, and an estimate of the growth rate, g. ICC = r, is then reversed-engineered to reconcile these inputs to the observed price, P_t, which imbeds a discount for r. ICC calculations typically use forecasts of earnings for a number of years ahead, with the growth rate then applied to subsequent years, but this simple representation serves to make the points. Those points also apply to the Ohlson-Juettner (2005) "abnormal earnings growth" (AEG) model, employed in Gode and Mohanram (2003) for example, for the target there, AEG, is simply the expected change in residual income.

The accounting for book value, B_t, and $Earnings_{t+1}$ are clearly involved in the ICC calculation. However, that accounting also determines the growth rate, g. To exhibit the point, if fair value accounting is applied such that $B_t = P_t$ and $Earnings_{t+\tau} - r.B_{t+\tau-1} = 0$, all τ, there is no expected growth: $g = 0$. Departure from fair value accounting such that $B_t \neq P_t$ is necessary for $g \neq 0$. However, it is not sufficient: For $B_t \neq P_t$ and $Earnings_{t+\tau} - r.B_{t+\tau-1} = Earnings_{t+\tau-1} - r.B_{t+\tau-2} =$

0, all τ, $g = 0$ also, and that depends on the accounting for $Earnings_{t+\tau}$ and $Earnings_{t+\tau-1}$, all τ. So, g in the short-form RIM above also depends on the accounting $Earnings_{t+1}$. Further, because P_t is an expectation of all future earnings, lower $Earnings_{t+1}$ implies higher subsequent earnings (growth) for a given P_t and B_t. Thus, for inferring ICC = r, g depends on the accounting for both B_t and $Earnings_{t+1}$, and that accounting must be recognized when inserting a growth rate, *g,* into RIM for the reverse-engineering exercise: An accounting consistency condition must be satisfied.[6]

Under U.S. GAAP and IFRS employed in ICC calculations, the accounting typically departs from fair value accounting, with $B_t \neq P_t$ (and $B_t < P_t$ is typical). Usually $Earnings_{t+\tau} - r.B_{t+\tau-1} \neq Earnings_{t+\tau-1} - r.B_{t+\tau-2}$, for some τ. Thus, $g \neq 0$ (and $g > 0$ is typical). This accounting is referred to as historical cost accounting but is more insightfully referred to as accounting that defers earnings recognition to the future. That yields $B_t < P_t$ because the earnings expected in price have not yet been added to book value. Further, with near-term earnings reduced by the deferral of earning recognition, it also implies $Earnings_{t+\tau} > Earnings_{t+1}$, for some τ, that is, expected earnings growth *ceteris paribus.*

2.3 Growth Connects to Risk

To appreciate the *second* point—growth induced by the accounting connects to risk—the deferral of earnings recognition is governed by an accounting principle that deals with risk (or uncertainty): Earnings are not booked until uncertainty is resolved. In asset pricing terms,

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[6] Feltham and Ohlson (1995) and Zhang (2000) show that accounting determines growth rates. Penman (1997) shows that g in a "terminal value" calculation is determined by a parameter capturing the accounting for earnings and book value. Monahan (2011), Ke and Liu (2014), and Ketterer, Tsalavoutas, and Eierle (2017) recognize the point in the context of ICC calculations. The latter paper shows that growth in the abnormal earning growth model of Ohlson and Juettner-Nauroth (2005) better captures the effect of conservative accounting on earnings.

earnings are booked (and added to book value) only when the firm has a near-zero-beta asset (cash or a receivable discounted for risk of non-collection). Until that point, expected earnings are deemed to be at risk—they might not be realized; in asset pricing terms, they are positive beta. In short, deferral of earnings recognition to periods after $t+1$ implies lower $Earnings_{t+1}$ and expected earnings growth subsequently, and that growth implies risk. The accounting is implemented via the revenue recognition principle and conservative accounting for investment. That is, revenue is not booked until there is a completed contract with a customer and receipt of cash is "highly probable." In addition, particularly risky investments (such as R&D and promotion for brand building) are expensed against earnings, reducing those earnings and yielding expected earnings growth from the investments on a reduced earnings base. This growth is at risk—it might not be realized.

Penman and Zhang (2020) link this accounting and the earnings growth it implies to risk and the cost of capital under no-arbitrage asset pricing theory, and a line of papers supplies the empirical support.[7] Thus, if the ICC is to convey the cost of capital that reflects risk, identifying earnings growth that indicates that risk might well enhance the measure.

These ideas can be demonstrated with a simple valuation model.[8] Given full payout and positive forward earnings, the stock price at time t,

[7] The empirical support is in Penman and Reggiani (2013), Penman, Reggiani, Richardson and Tuna (2018), Penman and Reggiani (2018), and Penman and Zhang (2021). Penman and Yehuda (2019) show how the revenue recognition principle and conservative accounting for investment convey "discount-rate news" to the market.

[8] The simple model is presented just to convey the ideas. The full payout assumption may not be palatable, but payout (retention) other than full payout adds to earnings growth, g, but does not add price under M&M conditions. So the model isolates the growth that potentially affects price and the expected return, r, and at the same time is M&M consistent. The point here can be made with an M&M consistent model accommodating all payouts, as with the Ohlson and Juettner-Nauroth (2005) model with the added accounting assumptions in Penman, Reggiani, Richardson, and Tuna (2018).

$$P_t = \frac{Earnings_{t+1}}{r - g^{Eatnings}} \quad (1)$$

and thus,

$$r = \frac{Earnings_{t+1}}{P_t} + g^{Earnings} . \quad (1a)$$

It is usually presumed that the growth rate in expected future earnings, $g^{Earnings}$, increases P_t and thus the P/E ratio (decreasing E/P) with no effect on the required return for risk, r, on the left-hand side of equation (1a); expected growth goes into the price, it adds value. But that assumes no change in r. If r increases with $g^{Earnings}$ —expected growth is priced as risky—expected growth does not necessarily add to price, but rather adds to r with price unaffected. That is implied under accounting principles.

Leverage provides an example. Penman (2013, Chapter 14) and Penman, Reggiani, Richardson and Tuna (2018) show that financing leverage increases expected earnings growth, $g^{Earnings}$, deterministically. However, leverage does not change equity price, P_t, under Modigliani and Miller (1958) assumptions. That is because leverage and the expected growth it induces also increases r (in equation 1a), as Modigliani and Miller show in their leverage equation for the required equity return. With reference to equation (1), r increases with g to leave $r - g$ and P_t unchanged.

Further evidence indicates that this is so on average for the risk in operating activities. From equation (1),

$$\frac{Earnings_{t+1}}{P_t} = r - g^{Earnings} . \quad (1b)$$

Under standard theory, the required return,

$$r = \textit{risk-free rate} + \textit{risk premium}.$$

Suppose, in the extreme, all growth is priced as risky such that $g^{Earnings} = \textit{risk premium}$.

Then,

$$r - g^{Earnings} = \textit{risk-free rate} + \textit{risk premium} - \textit{risk premium} = \textit{risk-free rate}$$

and

$$\frac{Earnings_{t+1}}{P_t} = \textit{risk-free rate}. \tag{1c}$$

That is, the forward earnings yield is equal to the risk-free rate. Ohlson (2008) presents an accounting model where expected growth ties one-to-one to the risk premium, with the result that E/P is close to the risk-free rate. Strikingly, the median trailing E/P for all U.S. stocks from 1963-2015 was 5.6%, a little less than the average 10-year Treasury yield for the same period of 6.6%.[9] The mean forward E/P for the S&P 500 at each December 31 from 1988-2015 was 5.2% which is close to the average 10-year U.S. Treasury yield of 5.1% for that period. Thus, on average, expected growth is priced as risky. E/P ratios vary significantly from this average, of course, because some growth is priced as not entirely risky—it is positive net-present-value growth—and thus goes into the price rather than *r* in equation (1b). However, Grambovas, Lara, Ohlson, and Walker (2017) show that E/P revolves around the core ratio in equation (1c); the unconditional E/P ratio is equal to the risk-free rate.

[9] To maximize coverage of stocks, these numbers are for the trailing E/P rather than the forward E/P in the valuation model (1), but the same point can be made from observed (trailing) earnings at t, with growth forecast from that point rather than from t+1.

We now take these points to review ICC calculations.

2.4 ICC, Growth, and Risk

The ICC is obtained by reverse engineering RIM (or a similar expression for a longer forecast horizon):

$$r = \left[\frac{B_t}{P_t} \times ROE_{t+1}\right] + \left[(1 - \frac{B_t}{P_t}) \times g\right] \tag{2}$$

provided that $ROE_{t+1} > g < r$. That is, ICC = r is a weighted average of forward return on equity (ROE) and subsequent growth where the weight is given by observed B_t/P_t. Equivalently,

$$r = \frac{Earnings_{t+1}}{P_t} + \left[(1 - \frac{B_t}{P_t}) \times g\right]. \tag{2a}$$

That is, the ICC is calculated with a weight of 1.0 on forward E/P and a weight of 1 – B/P on g.

The discussion in section 2.2 requires that the growth rate inserted in this calculation must honor a consistency condition: The growth rate must be that implied by the accounting for B_t and $Earnings_{t+1}$. The discussion in section 2.3 says that the consistent growth rate is one that is related to risk. Without the consistency condition, it is unlikely that the inserted growth rate will be that which connects to risk. Many ICC calculations input the same growth rate for all firms without regard for these points. Some papers, for example Nekrasov and Ogneva (2011), estimate firm-specific growth rates, though not necessarily under the consistency condition.

One notable attempt to input accounting-consistent growth rates is Easton, Taylor, Shroff, and Sougiannis (2002) (ETSS). They develop a methodology to estimate r and g jointly. Multiplying equation (2) by P_t/B_t and rearranging,

$$ROE_{t+1} = g + (r - g)\frac{P_t}{B_t} \tag{3}$$

$$\equiv \gamma_0 + \gamma_1 \frac{P_t}{B_t}.$$

This is the equation that ETSS estimate in portfolios to extract $\gamma_0 = g$ and $\gamma_1 = r$ – g, with an added error term because r and g are not likely to be the same for all stocks in a portfolio. An alternative expression can also be derived that delivers the same r and g. Rearranging equation (2a),

$$\frac{Earnings_{t+1}}{P_t} = (r - g) + g\frac{B_t}{P_t}. \tag{3a}$$

Thus, estimating r and g from the ETTS expression is equivalent to estimating them from a regression of the forward earnings yield on B/P.

Expression (3a) depicts E/P and B/P as linearly related, varying by a multiplicative constant, g. That is, higher growth goes into price, increasing P_t such that, for given $Earnings_{t+1}$ and B_t, E/P and B/P are positively related (and $r - g$ decreases with increasing g). In contrast, the recognition of accounting principles determining earnings and book values entertains the notion that higher earnings growth, at least in part, goes into r rather than P_t, with $r - g^{Earnings}$ diminished. Indeed, under accounting principles, both r and $g^{Earnings}$ vary with B/P while holding E/P constant. That is modeled and demonstrated empirically in Penman, Reggiani, Richardson and Tuna (2018). That paper shows empirically how B/P orders both expected earnings growth and average returns for a given E/P, and the growth so indicated by B/P is growth at risk.

This point is demonstrated in Penman and Reggiani (2018). By dividing the simple model in equation (1) through by ROE_{t+1},

$$\frac{B_t}{P_t} = \frac{B_t}{Earnings_{t+1}} \times \frac{Earnings_{t+1}}{P_t} = \frac{r - g^{Earnings}}{ROE_{t+1}}. \tag{4}$$

That is, for a given $\frac{Earnings_{t+1}}{P_t} = r - g^{Earnings}$, a lower ROE_{t+1} yields a higher B/P. Conservative accounting that reduces $Earnings_{t+1}$ (and thus a lower ROE_{t+1}) increases g, and that accounting connects to risk. Holding $r - g$ and thus E/P constant in equation (4), r also increases with the increase in g, and so does B/P. That is, both r and $g^{Earnings}$ change as ROE_{t+1} changes and, for a given E/P = r - g, B/P increases with r and $g^{Earnings}$. The empirical demonstration is in Penman and Zhang (2021) and Penman and Reggiani (2018). This differs from equation (2a) that sees B/P as a weight to apply to expected growth to recover r from the E/P ratio. Rather, B/P indicates that growth and the risk associated with it.

2.5 Earnings Growth and Value-added Growth

There is a crucial point to be recognized in the standard ICC calculation. The "g" in RIM is growth in residual income, not growth in earnings, $g^{Earnings}$. In expressions (2), (2a), (3) and (3a), g should be notated as $g(r)$. As residual income for any $t + \tau$ equals $\text{Earnings}_{t+\tau} - r.B_{t+\tau-1}$, growth in these expressions is a function of the required return that is being estimated. This is circular; r is on both sides of equations (2) and (2a).[10] It is growth in earnings that is at risk, and this risk determines r that charges residual income for growth at risk.

The growth rate in these ICC calculations, $g(r)$, is expected growth in excess of a required return—value adding, positive NPV growth—that goes into the price rather than r in equation

[10] $g(r) = g^{Earnings}$ if the growth rate in book value equals the growth rate in earnings (with a constant r). That will be the case if $\frac{Earnings_{t+\tau+1}}{B_{t+\tau}}$ is constant all τ. (Note that this is not the expected book rate of return, rather a ratio of expectations.) As a special case, note that $g^{Earnings} > 0$ can occur with $g(r) = 0$.

(2a). And it is this positive NPV growth that goes into price and the E/P ratio on the left-hand side of equation (3a) rather than r, as the discussion of equation 3(a) and the ETTS estimates in the next section demonstrate. Thus r is not being extracted from this growth rate. Further, the r that determines the value-added growth is unknown and r is what is being estimated, thus the circularity. This is also the case with an ICC extracted from an Ohlson-Juettner abnormal earnings growth model. Indeed, the term, abnormal earnings growth implies earnings growth in excess of the cost of capital.

3. Evaluating ICC Estimates Empirically

This section takes the critique above to an empirical investigation of the deficiencies of ICC estimates in the literature. We consider several ICC estimates, calculated as in the papers from which we elicit them and with the same sources for near-term earnings forecasts as in those papers. The estimates are made for all U.S. firms on Compustat files for any of the years, 1981-2016, which also have stock price and returns for those years on CRSP files. For some ICC estimates, the number of firms is limited by the availability of analysts' forecasts. Financial firms (in SIC codes 6000-6999) are excluded because the (fair value) accounting differs in part from the historical cost accounting that yields earnings growth, and so are utility firms (in SIC codes 4900-4949) where accounting numbers are partially a result of regulation. Firms were deleted for any year in which Compustat reports a missing number for book value of common equity, income before extraordinary items, common shares outstanding, or total assets. Firms with negative book value for common equity or a per-share price of less than 50 cents were also eliminated.

Prices (P_t in the expressions above) were observed on CRSP three months after each fiscal year, by which time the annual accounting numbers (for fiscal year t) must be reported by law. It is at this point that ICC and ER are calculated for each firm in each year. Returns (R_{t+1}) that validate the respective cost-of-capital estimates, also observed on CRSP, are annual buy-and-hold annual returns over the following 12 months, calculated as compounded monthly returns with an accommodation for non-survivors.

There are many estimates of the ICC in the literature. We consider the ones that have also been examined in subsequent papers that introduced modified inputs into the calculations, in Hou, van Dijk, and Zhang (2012), Li and Mohanram (2014), and Mohanram and Gode (2013). These modifications involve near-term earnings estimates using forecasting models rather than analysts' forecasts and corrections of analysts' forecasts for a calculated bias. The modifications improved results on validation criteria, but none dealt with the growth rate. The ICC are listed below, along with the growth-rate assumption in their calculation.

ICC Calculation	**Growth Rate Assumption**
Claus and Thomas (2001)	Current risk-free rate minus 3%
Ohlson and Juettner-Nauroth (2005)	Average of analysts' near-term and five-year rate (in Gode and Mohanram 2003) and a subsequent long-term growth rate of the current risk-free rate minus 3%
Gebhardt, Lee, and Swaminathan (2001)	Implied by an assumed reversion of return on equity (ROE) to the industry average
Easton (2004) modified PEG	Implied in forecasts of earnings growth two years ahead
Gordon and Gordon (1997)	Growth rate set to zero

Further details of these ICC calculations are in the appendix to Hou et al (2012). We also examine the ICC calculation in Easton, Taylor, Shroff, and Sougiannis (2002) where the growth rate is estimated rather than assumed.

3.1 An Instrument for Empirically Evaluating ICC Estimates

For the empirical analysis, we introduce the expected return measure, ER, of Penman and Zhu (2014 and 2022) that explicitly incorporates the accounting consistency condition and incorporates the accounting principles and consequent expected earnings growth that connects to priced risk in Penman and Zhang (2020). It thus serves as a benchmark for evaluating the extent to which ICC estimates imbed these properties.

A two-stage procedure to estimate ER identifies accounting observables that forecast growth under accounting principles (in the first stage) and validates that the market price discounts the forecasted growth for risk (in the second stage). In so doing, the consistency condition is honored. In terms of equations (1) - (1b), for a given E/P = $r - g^{Earnings}$, these variables indicate the g that is at risk and the r associated with that risk. The reader is referred to the originating papers for details of the ER estimation.

Table 1 reports on some of the validating results. These are reported in Penman and Zhu (2022) but presented here as they will be referred to in comparisons with ICC calculations later in the paper. The table gives the mean estimated ER and associated properties for 10 portfolios formed from ranking firms each year on the ER estimates. Columns two and three of the table first compare portfolio mean expected returns, ER_t estimated at point t with mean actual returns over the following year, t+1. The two align, and monotonically so, validating that the estimates forecast actual returns out-of-sample, a criterion which ICC estimates have had difficulty satisfying. Similarly, mean out-of-sample forecasts of earnings growth rates two years ahead, estimated from accounting numbers determined under the relevant accounting principles, also align with actual subsequent earnings growth rates (though not strictly monotonically), and both the estimated and actual growth rates align with estimated and actual returns: Growth connects to returns and, if returns are reward for risk, growth identified by ER connects to risk.

The increasing growth and returns associated with increasing ER are indeed associated with increasing risk in Table 1. Forward earnings betas—fundamental betas measuring the sensitivity of portfolio earnings to market-wide earnings—increase from low ER to high ER. Correspondingly, return betas—sensitivity of portfolio stock returns to market-wide returns—are higher for higher ER. They are also relatively high for low ER but, while up-market betas are high for these portfolios, down-market betas are relatively low. Note that these forward betas are those actually experienced by investors when investing on the basis of ER, not historical betas. The beta estimates are complemented in the table with the range of portfolio returns and their kurtosis, also increasing in ER, indicating higher risk with more outcomes in the tails of return distributions.

3.2 ICC and ER

Table 2 reports mean ICC estimates for the ER portfolios in Table 1. Panels A and B cover the ICC estimates examined in Hou et al. (2012), calculated using analysts' forecasts of near-term earnings (Panel A) and with forecasts from models based on observed accounting numbers rather than analysts' forecasts (Panel B). In both cases, results with a composite measure involving all five estimates are included, as in the original paper. Hou et al. report that the model ICC estimates are a better forecast of actual returns than those with analysts' forecasts. As ER forecasts are also based on accounting observables, the Hou et al. estimates make a worthy comparison. Using model forecasts also extends the coverage to firms without analysts' forecasts, as does ER.

For ICC using analyst forecasts in Panel A, there is not much variation in the ICC estimates over ER portfolios, although the high ER portfolio reports slightly higher estimates. Nor does the composite forecast align with ER. These comparisons are made at a point just after annual financial statements for the year are published (three months into the next fiscal year) and it may well be that analysts' forecasts improve as the fiscal year progresses. There again, further accounting information also arrives in quarterly reports, prompting an update of ER calculations (though we do not do so).

The ICC estimates in Panel B with the model forecasts and the wider coverage exhibit some positive correlation with ER, though not with the same spread across portfolios as in Table 1. Model forecasts, based on accounting observables appear to anticipate some of the growth-at-risk expectations in ER. However, there is little variation in the ICC estimates over portfolios 1 to 7.

Li and Mohanram (2014) also apply earnings forecasting models to estimate ICC, reporting improvement in predicting stock returns over the ICC with Hou et al. model forecasts. So Panel C of the table reports the same analysis as in Panel B, but now with the residual income model (RI) forecast in the Li and Mohanram paper. The correlation of the resulting ICC estimates with ER is positive but, again, there is not much variation in the estimates, except over portfolios 7 - 10. Results (not reported) are similar with the earnings persistence (EP) forecasting model in Li and Mohanram (2014).

Mohanram and Gode (2013) point to deficiencies in earlier ICC calculations due to bias in analysts' forecasts inserted in the reverse engineering exercise. So, Panel D of the table repeats the tests with their adjustments for analysts' forecast bias. There is not much improvement over Panel A, so we attribute the low correlation with ER to the specification of the growth rate rather than to forecast errors.[11]

Table 3 reports, for each ER portfolio, ICC estimated with procedures in Easton, Taylor, Shroff, and Sougiannis (2002) (ETSS) that estimate ICC and growth jointly. As in the original paper, the ETSS estimates are inferred from cross-sectional regressions of expected four-year ROE on P_t/B_t for the portfolios, based on equation (3) above, with the four-years of expected earnings for the ROE calculation provided by analysts' forecasts.[12]

The mean estimated intercepts and slope coefficients from these annual regressions are reported in the table. The inferred ICC (r in the table) are decreasing in ER_t, though they vary little. Further, the implied ETSS annualized growth rates (g in the table) have little relation to the implied r estimates and are actually decreasing over the ER_t portfolios. This stands in contrast to Table 1 where both expected and actual earnings growth are increasing in ER_t. The positive relationship between r and expected growth that underlies ER is not at all evident in the ETSS estimates. This observation must be qualified, however. The growth rate in the ETSS analysis is

[11] The methods in Mohanram and Gode to deal with samples selection and data, forecasting dates, and short-term EPS growth rates, are different from the original papers they referenced and also ours (which imitate those papers). Therefore, we reconstructed ICC estimates unadjusted for analyst errors, as in their paper. The results were similar to those in Panel A of Table 2. Note that the PEG model in Mohanram and Gode (2013) differs somewhat from the MPEG, so we performed calculations with both, with similar results.

[12] Our analysis is for 1981-2016. To ensure consistency with the ETSS findings, we first replicated their analysis for their sample period up to 1998. We maintained their criteria for dealing with data issues and reinvestment rates for the longer period. We also obtained similar results when we used analysts' forecasts and P/B ratios three months after fiscal-year end rather than at fiscal-year end, when we used IBES prices and shares outstanding rather than those from Compustat, when we made adjustments for differences in IBES and Compustat numbers for shares outstanding, and when we used different dividend reinvestment rates.

that after four years ahead whereas that in the ER calculation is for two years ahead. Of course, the two-year-ahead growth forecast might be incorporated in the four years of analysts' forecasts in the ETSS calculations but, nevertheless, the implied *r* with these analysts' forecasts has little relation to ER. Repeating the ETTS analysis with forecasts just one year ahead, as in equation (3), incorporates two-year-ahead earnings growth, and that produced similar results to those in Table 3. Section 2.5 of the paper explains the findings in Table 3.

3.3 ICC, ER, and Returns

The primary validating criterion for the ICC has been the prediction of forward stock returns that are either reward for risk that the ICC captures or reward from discovery of mispricing with ICC as a screen. Table 4 compares ICC estimates with ER on this criterion. The four panels correspond to those in Table 2, with Panel A involving ICC using analysts' forecasts, Panel B those with the Hou et al. model forecasts, Panel C with the Li and Mohanram forecasts, and Panel D the ICC with adjustments for analyst forecast bias. The papers with the ICC estimates in Panels B, C, and D report improvement in predicting returns over the ICC estimates in Panel A. The table reports the results of yearly cross-sectional regressions of forward returns over the 12 months after the point where ER and ICC are estimated (three months after fiscal-year end). Reported coefficients are means of those estimated each year. (The ETSS estimates are from the cross-section, so are not available for individual firms).

In the first regression in all four panels of Table 4, ER alone predicts returns, as with the portfolio returns in Table 1. Indeed, ER maps into realized returns one-to-one: The t-statistic testing the slope coefficient relative to 1.0 is -0.91. A slope of 1.0 is an estimate of the return on a long-short portfolio of left-hand-side assets with unit ER_t, as explained in Fama and French (2020): one-for-one. Further, the zero intercept indicates that this projection is with mean zero error. The estimated intercept is the return on a portfolio with zero amount of ER_t and reports a zero return. So ER looks like a good benchmark for validating ER estimates.

In Panel A with the respective ICCs based on analysts' forecasts, all ICC fit with a negative mean slope coefficient, possibly due to error in analysts' forecasts but also to arbitrarily inserted growth rates (the same for all firms in most of the ICC calculations here). The panel confirms that these earlier ICC estimates fail on the validation criterion, in contrast to the benchmark ER. When all ICC estimates are included, most do not load, though R^2 increases. However, ER returns a significant positive coefficient when included in the last column.

The results in Panels B and C suggest that analysts' forecasts may be part of the problem with the ICC estimates in Panel A. Now the mean slope coefficient is positive for all ICC measures, including $ICC_{Composite}$, though marginally significant for some. The improvement can be attributed to the (weak) positive correlation of these estimates with ER in Table 2. In Panel C, slope coefficients are typically higher than in Panel B and closer to that for ER. However, mean intercepts with all ICC estimates are high in all three panels, indicating significant returns not explained by the estimates. In Panel B, $ICC_{Composite}$ adds marginally to the ER prediction of returns ($t = 2.20$, 35 degrees of freedom), though not in Panel C. In both panels, ER dominates with all ICC measures in the regression and the addition of ER to the other estimates returns zero intercepts. Results in Panel C are similar with the Li and Mohanram (2014) EP forecasts.

Panel D is with analysts' forecasts corrected for bias, as in Mohanram and Gode (2013). While the ICC estimates in Panel A based on unadjusted forecasts exhibit negative correlation with returns, the negative correlation disappears here. That correlation is typically zero for the ICC estimates one at a time but, when employed together (without ER_t), the R^2 increases to 5%, indicating joint explanatory power. Further, when ER_t is added in the last column of the panel, it has less incremental explanatory power than in the other panels. The correction to analysts' forecasts appears to capture some of the returns indicated by ER_t, at least when all ICC measures are employed together, suggesting that the forecast errors are confounding.[13]

3.4 ICC and Earnings Growth

Expected earnings growth at risk is the feature that distinguishes different levels of ER, and in Table 1 ER aligns with both forecasted and actual future earnings growth, as it does with realized returns. Comparatively, the ICC measures with assumed growth rates do not perform as well in predicting returns. Is this because they do not capture the expected growth that is deemed to be at risk?

Table 5 answers the question. Portfolios are formed from ranking each year on the $ICC_{Composite}$ measures in Panels A-D in Tables 2 and 4. For these portfolios, the table reports mean of median forecasts of two-year ahead earnings growth rates over years, calculated as for ER in Table 1, along with mean of median actual earnings growth rates realized two years ahead. The mean of medians are reported rather than mean of means because of negative skewness in actual growth rates for some portfolios (though pattern of results are similar with means). There are two features in the table to comment on.

[13] While the most of the ICC here have little correlation with returns here (by themselves), even slightly negative, Mohanram and Gode (2013) report positive correlation. As we kept to the methods in the original papers (see footnote 10) that may explain some of the difference. Further, the samples differ somewhat because of different sample periods and availability of forecasts on IBES. Several research assistants replicated with their procedures for the period covered by their sample, 1983-2008, but with the number of firm/years observations reduced from 36,012 in their sample to 21,073 due to availability of forecasts and corresponding firm data on Compustsat. Results were similar to those here.

First, for ICC using analyst forecasts, there is little relation between the ICC and the expected earnings growth indicated by ER_t. However, for the ICC using model forecasts and bias-corrected analyst forecasts, there is a positive relation. This calibrates with the findings for the ICC for ER_t portfolios in Table 2 and the association with returns in Table 4.

Second, for all ICC, the median actual growth rates are decreasing with higher ICC: Though higher ICC indicates higher expected earnings growth two years ahead, those growth rates are typically not realized. Most ICC in $ICC_{Composite}$ are based on forecasts of earnings for two years ahead so possibly capture the expected growth in ER_t, and higher near-term earnings expectations mean a higher ICC in the equation (2a) calculation. However, equation (2a) adds a growth estimate, g, weighted higher for a higher P/B. That g is a constant for all firms in many calculations, without discrimination, but the consistency condition implies that a higher near-term earnings forecast require a lower growth rate for a given P_t. A higher ICC is thus associated with lower realized growth on average.

4. Extracting the Yield to Maturity from Accounting Numbers

The ICC, as calculated, fails to capture the risk in expected earnings growth. Though nominally working with accounting-based valuation models, the measure fails to recognize the accounting that conveys risk through expected growth. Indeed, by inserting growth rates into the ICC calculation without this consideration, the method fails an accounting consistency condition.

4.1 Can the ICC be Redeemed?

In answer to this question, we have the following observations:

First, by using the RIM valuation model, standard ICC calculations reverse engineer with growth in residual earnings reconciled to price, not $g^{Earnings}$. As pointed out, residual earnings incorporates r and thus the growth rate, $g(r)$, inserted into the calculation is a function of the cost of capital being estimated. ICC from Ohlson-Juettner abnormal earnings growth models have the same problem. As Section 2.5 explains, the growth rate in these ICC calculations is value-added growth (over the required return) rather than growth that conveys risk for which earnings growth is to be charged.

The circularity can be finessed, at least in principle. For a constant discount rate, r,

$$P_t^T = \frac{\sum_{\tau=t+1}^{T}\left[Earnings_\tau + Dividend_\tau\left(\left(1+r^f\right)^{T-\tau} - 1\right)\right]}{(1+r)^T - 1}$$

approaches P_t in RIM (and in the no-arbitrage dividend discount model) as T → ∞. See Ohlson (1995). That is, price is expected cumulative future earnings with dividends reinvested (at the risk-free rate), capitalized at the required return. Transposition renders r:

$$(1+r)^T - 1 = \frac{\sum_{\tau=t+1}^{T}\left[Earnings_\tau + Dividend_\tau\left(\left(1+r^f\right)^{T-\tau} - 1\right)\right]}{P_t^T} \qquad (5)$$

for T → ∞. Thus, the equity yield to maturity that the ICC estimates is given by (long-term) expected cum-dividend earnings relative to the current price that is discounted for the risk to the expected earnings. This is the expected earnings yield that Ball (1978) suggested is related to risk and return, but now formally so. That refocuses the exercise.

However, *second*, forecasting long-term earnings (growth) is problematic. Estimates of earnings for a T beyond two or so years are problematic, involving considerable error as experience with analysts' three- and five-year earnings growth forecasts have shown. Indeed, long-term earnings (for high T) are typically not observed, particularly for the many non-survivors, so a target variable for forecasting cannot be identified and validated ex post. One might forecast up to a given (short-term) T and add a terminal value, but that terminal value would, again, involve an assumed subsequent growth rate. In short, the internal rate of return calculation that is relatively straight-forward for a finite-horizon investment such as a project or a bond, does not lend itself to a going-concern with an indefinite (possibly infinite) forecast horizon.

Yet there is a demand for an estimate of the cost of capital for firms and equities that works in practice, more pressing given out-of-sample estimates from extant asset pricing models do not seem to work either.

4.2 Can ER Serve as an Alternative?

Given these difficulties, one might entertain ER, the instrument against which the ICC is evaluated in the paper, as an indicator of *r*. The measure is based on accounting principles that convey priced risk in asset pricing theory in Penman and Zhang (2020) and accordingly exhibits the features on which the ICC has been critiqued. And it dominates extant asset pricing models empirically in Penman and Zhu (2022). However, ER is an estimate of the expected return for just one year ahead, not a "yield to maturity," *r*. The estimate can be modified for two, three, of four years ahead (with an accommodation for non-survivors), and a short-term expected return may be all investors are seeking if they cannot grapple with the diffuse growth forecasts for the long term.

However, there is a property of the ICC that ER lacks. In asset pricing theory the cost of capital is determined by the amount of risk and risk premium (the price of risk), and the ICC extracts both from price. This compelling feature of the ICC is absent from the ER; while ER differentiates risk, it does not imbed the price of risk. That said, the price from which the ICC is extracted could misprice risk (in an “inefficient market”), so the ICC then indicates abnormal return for risk,

Further, ER is estimated with sample bias. While estimated out-of-sample, the estimates are based on estimated coefficients from fitting accounting data to realized growth rates and returns in sample. The sample period for the ER in this paper is for a specific period in a specific country when investment (in U.S. stocks) paid off handsomely with high ex post earnings growth and realized returns. Thus, the ER in Table 1 are higher on average than one typically expects—about 17 percent at the median (portfolios 5 and 6), well above the risk-free rate plus an average 5 percent risk premium that surveys regularly report for equities. And 25.4 percent for portfolio 10 also seems excessive. The portfolio realized returns are similar, indicating that both expected and actual returns have a positive ex post bias. However, extraction of the cost of capital from accounting numbers is attractive because those accounting numbers are generated under accounting principles that respond to risk and which connect to priced risk under asset pricing theory in Penman and Zhang (2020). So we lay out how ER might be modified to accommodate its deficiencies. This is done in two steps.

4.2.1 Shrinkage Estimates of ER

The issue of ex post bias lies with the estimated intercept in the forward return regression in Penman and Zhu (2014) that is applied to estimate ER. So, the out-of-sample estimate of ER_{it} for each firm was recalibrated with the applied intercept set as

$$Intercept_t = ERM_t - \sum_{j=1}^{K} \beta_j \overline{A}_{jt}$$

where $ERM_t = R_{ft} + 0.05$ is the estimated expected return for the market for the year and $\overline{A}_{jt}$ is the mean of each of the K explanatory variables in the forward return regression for all firms over the past rolling ten years, the period over which the mean β_{jt} are estimated. This calculation simply recognizes the property that the OLS intercept is always the mean of the dependent variable minus the mean of the explanatory variables multiplied by their estimated coefficients. Rather than the mean A_{jt} variables being that for the cross-section for the relevant year (which may be influenced by ex post factors in that year), the mean, $\overline{A}_{jt}$, is now the mean over all firms for the preceding ten years. The procedure recognizes that the mean expected return must be equal to the expected return on the market. As the revised intercept just shifts ER_t by a constant in the cross-section, the properties of the portfolios formed on the shrinkage estimate are the same as those in Table 1.

Table 6 reports the resulting mean and median shrinkage estimates, ER_{st}, for portfolios. Around the cross-sectional median (portfolios 5 and 6) they look close to the standard expectation of 10% to 11% for the expected return for equities—the average 10-year risk-free rate for the period of 5.6% plus a 5% risk premium. The ER_{st} also align with actual returns in t+1, but with the actual returns exhibiting the ex post positive outcomes relative to expectation, the ex ante bias that the shrinkage estimates seek to remove.

However, the estimates for the extreme portfolios are still extreme. Indeed, they are negative for portfolio 1. This is due largely to estimates during the "bubble" period, 1995-2001, when E/P and B/P ratios (involved in the ER calculation) were extremely low by historical standards. One might argue that bubble prices are not the basis for estimating a cost of capital; indeed, they forecast lower returns (as bubbles burst), including negative returns. Extreme portfolios are also likely to be those with high measurement error (that throws estimates to the extremes). If an estimate in the extreme is influenced by measurement error, subsequent estimates will regress towards the error-corrected estimate, provided that the measurement error is not strongly serially correlated. So, the table reports the median shrinkage estimate, ER_{st+1}, for firms in each portfolio, estimated one year later. (Medians give lower weight to extreme observations in the extreme portfolios.) The extremes are pulled closer to central values, with the estimates now ranging from 4.2 percent to 14.8 percent around a central value of 10.6 percent. The latter is approximately equal to the historical risk-free rate of 5% plus a 5% risk premium.

The shrinkage estimates use a 5% risk premium. That is the typical number from surveys eliciting estimates of the market risk premium from respondents.[14] That is an average number but the price of risk is a personal matter—it differs over investors and over time according to their risk preferences. The procedure allows investors to insert their own price for taking on risk. In contrast to the ER estimates in Table 1, the estimates in Table 6 "look like" what we expect the expected (required) return to be, though "look like" is hardly definite.

4.2.2 An Estimate of the Equity Yield to Maturity

These estimates are still for the short term. But the comparison of ER_{st+1} with ER_{st} indicates mean reversion and, with mean reversion, companies become more like the average over time. Following the logic in Blume (1975), CAPM beta estimates are often shrunk to a future expectation with this mean reversion in mind, as in the Vasicek (1973) adjustment. So, applying this property, we estimated expected ER for future years and, from those estimates, a long-run yield to maturity, *r*.

[14] For such a survey, see Fernandez, Bañuls, and Acin (2021) that covers 88 countries and provides links to previous surveys from 2008-2020. The Duff and Phelps SBBI Yearbook (once published by Ibbotson and Associates) updates estimates of the market risk premium annually.

From successive ER_{st} and ER_{st+1} for each of the 10 ER_{st} portfolios, we estimated coefficients capturing the time-series shrinkage for every base year in the sample period as follows:

$$ER_{st+1} = a + bER_{st} + e_{t+1}$$

The mean estimated parameters are reported in Table 7 with stronger mean reversion evident in the extremes. These are applied successively in each period ahead to yield an expected $ER_{st+\tau}$ for each year ahead. The table reports the average number of years, T, for the resulting time series of $ER_{st+\tau}$ to converge to 10%, the approximate average for all portfolios in Table 6 and equal approximately to the historical risk-free rate of 5% plus a 5% risk premium. The $ER_{st+\tau}$, $\tau = 0$, T are compounded up to T and the T+1-root of this compounded return (minus one) reported as the equity yield to maturity in the last column of the table, ranging from 6.55% to 13.95%. With $ER_{st+\tau}$ equal to 10% for $\tau > T$ for all portfolios, this differentiates on the long-run expected return. We note that these numbers are not very different from the ER_{st+1} shrinkage estimates in Table 6.

This is not the yield for individual stocks, but that is presumably estimated with considerable error. The estimation here envisions firms assigned to a portfolio risk class, as in Table 1, with their yield then determibed as that for the portfolio that washes out errors at the individual stock level.

We do not have the theoretically correct measure against which these estimates can be benchmarked, but it is the absence of such a measure that is the motivation for the exercise. As indicated in the first paragraph of the paper, factor models have been unsuccessful in estimating the out-of-sample expected return that Fisher Black (and investors) are looking for: Fitting in-sample estimated factor premiums and betas on those factors in real time does not work, as Fama (1997) recognizes. In contrast, this measure is updated in real time as fresh financial statements arrive. As the yields are for the same portfolios as in Table 1, they are associated with the same validating risk and return outcomes as tabulated there. And, in the predecessor papers, the measures are also associated with firm fundamentals that convey risk *a priori*: Sales and earnings realizations, return on equity, realizations of investment opportunities, investment in risky R&D, balance-sheet growth, financing, and accruals, many of which convey priced risk in Penman and Zhang (2020).

5. Conclusion

With its expected returns estimated over the long run, the ICC estimates a yield to maturity rather than the "cost of capital." However, the ICC as calculated, has had difficulty satisfying validation criteria. This paper points to reasons for this: In introducing accounting to the calculation, the measure does not recognize an accounting consistency condition and the associated feature that expected earnings growth conveys risk and return. This is demonstrated empirically against a benchmark measure also based on accounting numbers, but which recognizes these points and validates on risk and return in the data.

The paper concludes that the ICC unfortunately cannot be redeemed as a measure of the yield to maturity for equity. But it offers an alternative equity yield to maturity based on the benchmark measure against which the ICC is evaluated. However, it is not entirely satisfactory. The ICC is extracted from price and price discounts not only for risk but also the price of risk. The alternative accounting measure here demonstratively indicates risk and return, but not the price of risk (the risk premium). The estimates in the paper are based on a 5% risk premium, the number typically reported in surveys of the risk premium. However, perhaps that is not important: The risk premium is a personal matter, varying over individuals, and the estimates here allow investors to insert their own price for risk into the calculation.

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Table 1

Properties of Expected Return (ER) Portfolios

The table reports mean expected annual returns, ER_t, and their associated properties for portfolios formed on out-of-sample expected return estimates each year, 1981-2016. ER_t are estimated three months after fiscal-year end. Reported returns and growth rates are means over years of means for the ten portfolios formed each year. Estimated and actual EPS growth rates are those two years ahead, the year after the forward year, t+1, for which ER is estimated and actual returns are reported. Betas and actual return measures are those during the forward year and are estimated from the time series of portfolio returns or, in the case of earnings betas, from the time series of portfolio earnings relative to beginning-of-period price. All betas are estimated with December 31 fiscal-year firms only to align returns in calendar time. Up markets are those where the CRSP value-weighted index was greater than 10% for the year, and down markets are those where it was less than -10%. The kurtosis measure is relative to 3 for the normal distribution.

Expected Return Portfolio	Expected Return (ER_t)	Actual $Return_{t+1}$	Forecast of EPS Growth Rate	Actual EPS Growth Rate	Forward Earnings $Beta_{t+1}$	Forward Return $Beta_{t+1}$	Forward Up Market $Beta_{t+1}$	Forward Down Market $Beta_{t+1}$	Return $Range_{t+1}$	Return Excess $Kurtosis_{t+1}$
1 (Low)	0.039	0.059	0.125	0.019	0.58	1.13	1.35	0.81	0.977	-0.289
2	0.113	0.098	0.050	0.008	0.85	0.94	1.08	1.08	0.847	-0.274
3	0.140	0.131	0.032	0.009	0.93	1.03	1.14	1.53	0.967	0.486
4	0.156	0.146	0.030	0.010	0.79	0.93	1.01	1.24	1.037	1.718
5	0.168	0.155	0.030	0.035	0.97	1.03	1.34	1.26	1.041	1.185
6	0.179	0.158	0.039	0.025	0.96	0.95	1.20	1.50	0.941	1.514
7	0.188	0.178	0.047	0.042	1.09	0.95	1.16	1.54	0.990	1.276
8	0.200	0.189	0.062	0.040	1.01	1.09	1.57	1.76	1.074	2.020
9	0.215	0.201	0.092	0.067	1.72	1.11	1.53	2.14	1.413	4.013
10 (High)	0.254	0.263	0.200	0.136	2.60	1.52	2.25	2.59	1.826	3.414

Notes to Table 1: The growth rates forecasted two years ahead are calculated (for each firm, i) as $\frac{\Delta EPS^{a}_{it+2} \times 2}{|EPS^{a}_{it+2}| + |EPS_{it+1}|}$ where the superscript, a, indicates dividends in t+1 reinvested at the prevailing risk-free rate for the year. This calculation yields a growth rate that is close to the standard measure with a positive base earnings in t+1 but accommodates the case where t+1 earnings are negative, as well as compressing outliers when the growth rate is on a small base. Similar results are found with growth rates three years and four year ahead, though survivorship bias becomes more of an issue.

Earnings beta is the slope coefficient from estimating the following time-series regression of portfolio annual earnings yield on the market-wide earnings yield:

$$\text{Portfolio}\frac{Earnings_{t+1}}{P_t} = \alpha + \beta \cdot \text{Market}\frac{Earnings_{t+1}}{P_t} + \varepsilon_t$$

The portfolio earnings yield is aggregate earnings for the portfolio relative to aggregate price and the market earnings yield is aggregate earnings for all stocks in the sample for the relevant year relative to aggregate market price.

Table 2

Selected Implied Cost-of-Capital Estimates (ICC) for ER_t Portfolios

For each ER_t portfolio, Panel A reports mean ICC estimates calculated as in Claus and Thomas (2001) (CT), Ohlson and Juettner-Nauroth (2005) (OJ), Gebhardt, Lee, and Swaminathan (2001) (GLS), Easton (2004) modified PEG (MPEG), Gordon and Gordon (1997) (Gordon) and a composite ICC estimate (the average of the five individual ICC estimates), all with EPS forecasts from IBES analysts' estimates. Panel B of the table reports the same mean ICC estimates as in Panel A, but with Hou et al. (2012) model forecasts rather than analysts' estimates. Panel C repeats the Panel B analysis but with the residual income model (RI) forecast in Li and Mohanram (2014). The mean ICC in Panel D are those in Mohanram and Gode (2013) that remove predictable errors from analyst forecasts. To maximize coverage, we require a firm to have at least one non-missing individual ICC estimate to compute its composite ICC. As with ER_t, the ICC are estimated three months after fiscal-year end each year, 1981-2016, with means over years reported in the table.

Panel A: ICC Estimates with Analysts' Earnings Forecasts

ER_t Portfolio	ICC_{CT}	ICC_{OJ}	ICC_{GLS}	ICC_{MPEG}	ICC_{Gordon}	$ICC_{Composite}$
1 (Low)	0.110	0.071	0.084	0.118	0.065	0.091
2	0.100	0.065	0.083	0.109	0.059	0.082
3	0.096	0.062	0.081	0.103	0.056	0.078
4	0.093	0.061	0.080	0.102	0.057	0.077
5	0.095	0.062	0.081	0.101	0.057	0.077
6	0.093	0.063	0.082	0.101	0.059	0.077
7	0.096	0.067	0.086	0.103	0.063	0.081
8	0.100	0.072	0.090	0.106	0.067	0.085
9	0.106	0.079	0.098	0.111	0.075	0.092
10 (High)	0.116	0.090	0.109	0.124	0.085	0.103

Panel B: ICC Estimates with Earnings Forecasts from the Hou et al. (2012) Forecasting Model

ER_t Portfolio	ICC_{CT}	ICC_{OJ}	ICC_{GLS}	ICC_{MPEG}	ICC_{Gordon}	$ICC_{Composite}$
1 (Low)	0.086	0.077	0.078	0.119	0.071	0.093
2	0.088	0.075	0.081	0.112	0.070	0.089
3	0.090	0.075	0.083	0.106	0.071	0.088
4	0.091	0.075	0.085	0.106	0.071	0.088
5	0.097	0.079	0.089	0.109	0.075	0.093
6	0.100	0.082	0.093	0.111	0.078	0.096
7	0.107	0.088	0.098	0.117	0.084	0.103
8	0.114	0.094	0.104	0.124	0.089	0.108
9	0.131	0.106	0.117	0.139	0.101	0.122
10 (High)	0.159	0.133	0.137	0.169	0.129	0.152

Panel C: ICC Estimates with Earnings Forecasts from the Li and Mohanram (2014) RI Model

ER_t Portfolio	ICC_{CT}	ICC_{OJ}	ICC_{GLS}	ICC_{MPEG}	ICC_{Gordon}	$ICC_{Composite}$
1 (Low)	0.075	0.052	0.072	0.084	0.047	0.065
2	0.076	0.056	0.075	0.084	0.052	0.068
3	0.077	0.058	0.076	0.084	0.054	0.069
4	0.079	0.061	0.078	0.086	0.057	0.071
5	0.081	0.064	0.080	0.089	0.060	0.075
6	0.083	0.067	0.083	0.092	0.063	0.077
7	0.087	0.071	0.087	0.098	0.066	0.081
8	0.093	0.076	0.093	0.104	0.071	0.087
9	0.102	0.084	0.102	0.115	0.078	0.095
10 (High)	0.118	0.098	0.116	0.136	0.092	0.112

Panel D: ICC Estimates, Mohanram and Gode (2013), Removing Predictable Errors from Analyst Forecasts

ER_t Portfolio	ICC_{CT}	ICC_{OJ}	ICC_{GLS}	ICC_{MPEG}	ICC_{Gordon}	$ICC_{Composite}$
1 (Low)	0.086	0.057	0.069	0.155	0.052	0.073
2	0.083	0.055	0.070	0.128	0.051	0.067
3	0.078	0.056	0.070	0.128	0.051	0.067
4	0.080	0.058	0.071	0.124	0.054	0.068
5	0.077	0.059	0.072	0.129	0.054	0.068
6	0.077	0.059	0.073	0.130	0.055	0.069
7	0.081	0.063	0.077	0.121	0.058	0.073
8	0.083	0.066	0.081	0.130	0.062	0.077
9	0.086	0.069	0.087	0.136	0.064	0.082
10 (High)	0.092	0.070	0.097	0.461	0.065	0.101

Table 3

Implied Cost of Capital Estimates for ER_t Portfolios with Joint Estimation of the ICC and Growth

For each ER_t portfolio in Table 1, this table reports mean ICC estimates, *r*, calculated as in Easton, Taylor, Shroff, and Sougiannis (2002) (ETSS), along with mean intercept and slope coefficients and implied growth, *g*. As with ER_t, the ICC and growth rates are estimated three months after fiscal-year end each year, 1981-2016, with means over years reported in the table.

	ETSS Estimates			
ER_t Portfolio	Intercept γ_0	Slope γ_1	Implied *r* (%)	Implied *g* (%)
1 (Low)	0.425	0.110	0.110	0.088
2	0.354	0.181	0.112	0.077
3	0.370	0.192	0.117	0.080
4	0.313	0.211	0.111	0.070
5	0.301	0.228	0.111	0.066
6	0.282	0.213	0.105	0.063
7	0.247	0.224	0.101	0.056
8	0.198	0.287	0.103	0.038
9	0.221	0.268	0.104	0.050
10 (High)	0.210	0.228	0.094	0.044
All Firms	0.318	0.199	0.109	0.071

Table 4

Coefficient Estimates from Annual Cross-sectional Regressions of Forward Actual Returns (R_{t+1}) on ER_t and ICC Estimates

The table reports mean coefficients from estimating cross-sectional regressions each year, 1981-2016. The t-statistics (in parenthesis) are the mean coefficient relative to its standard error estimated from the time-series of estimated coefficients with a Newey-West correction for the serial correlation in the coefficient estimates. Panel A reports results with ICC estimates using analysts' forecasts (as in Table 2 Panel A). Panel B reports results using Hou et. al. (2012) model forecasts (as in Table 2 Panel B). Panel C reports result using Li and Mohanram (2014) RI model forecasts (as in Panel C of Table 2). Panel D is with ICC estimates with an adjustment for estimated analyst forecast errors (as in Panel D of Table 2).The asterisks, ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 level respectively.

Panel A: ER_t and ICC Estimates Using Analysts' Forecasts

	ER_t Alone	ICC_{CT} Alone	ICC_{OJ} Alone	ICC_{GLS} Alone	ICC_{MPEG} Alone	ICC_{Gordon} Alone	$ICC_{Composite}$ Alone	$ICC_{Composite}$ and ER_t	ICC Estimates Excluding ER_t	ICC Estimates Including ER_t
Intercept	0.002	0.211***	0.199***	0.207***	0.249***	0.192***	0.224***	0.106***	0.215***	0.065
	(0.06)	(8.15)	(7.89)	(8.30)	(7.65)	(8.03)	(8.61)	(3.01)	(5.55)	(1.32)
ER_t	0.854***							0.695***		0.627***
	(5.30)							(4.93)		(4.46)
ICC_{CT}		-0.797***							-0.355	-0.058
		(-6.13)							(-0.70)	(-0.11)
ICC_{OJ}			-0.824***						-1.895	-3.024**
			(-5.15)						(-1.35)	(-2.16)
ICC_{GLS}				-0.884***					0.837**	0.858***
				(-4.30)					(2.59)	(2.80)
ICC_{MPEG}					-0.977***				-0.658*	-0.200
					(-5.57)				(-1.70)	(-0.51)
ICC_{Gordon}						-0.746***			1.277	1.737
						(-4.82)			(1.23)	(1.60)
$ICC_{Composite}$							-0.956***	-0.988***		
							(-6.75)	(-7.02)		
Adj. R2	0.014	0.018	0.019	0.016	0.022	0.015	0.020	0.035	0.042	0.058

Panel B: ER_t and ICC Estimates Using Hou et al. (2012) Model Forecasts

	ER_t Alone	ICC_{CT} Alone	ICC_{OJ} Alone	ICC_{GLS} Alone	ICC_{MPEG} Alone	ICC_{Gordon} Alone	$ICC_{Composite}$ Alone	$ICC_{Composite}$ and ER_t	ICC Estimates Excluding ER_t	ICC Estimates Including ER_t
Intercept	0.002	0.112***	0.109***	0.101***	0.112***	0.112***	0.104***	-0.012	0.128***	0.029
	(0.06)	(6.72)	(5.85)	(4.84)	(6.84)	(5.99)	(5.72)	(-0.33)	(5.73)	(0.80)
ER_t	0.854***							0.799***		0.682***
	(5.30)							(6.08)		(4.92)
ICC_{CT}		0.368***							0.599*	1.058**
		(2.73)							(1.70)	(2.48)
ICC_{OJ}			0.296**						-0.510	-0.630
			(2.28)						(-0.47)	(-0.54)
ICC_{GLS}				0.506**					0.003	-0.306
				(2.22)					(0.01)	(-1.17)
ICC_{MPEG}					0.278*				-0.421**	-0.581***
					(1.76)				(-2.72)	(-2.92)
ICC_{Gordon}						0.314**			0.630	0.520
						(2.40)			(0.92)	(0.73)
$ICC_{Composite}$							0.350**	0.239**		
							(2.54)	(2.20)		
Adj. R2	0.014	0.008	0.008	0.010	0.008	0.007	0.008	0.018	0.022	0.030

Panel C: ER_t and ICC Estimates Using Li and Mohanram (2014) RI Model Forecasts

	ER_t Alone	ICC_{CT} Alone	ICC_{OJ} Alone	ICC_{GLS} Alone	ICC_{MPEG} Alone	ICC_{Gordon} Alone	$ICC_{Composite}$ Alone	$ICC_{Composite}$ and ER_t	ICC Estimates Excluding ER_t	ICC Estimates Including ER_t
Intercept	0.002	0.093***	0.095***	0.070***	0.097***	0.100***	0.076***	-0.013	0.115***	0.033
	(0.06)	(4.26)	(4.81)	(2.82)	(4.48)	(4.88)	(3.35)	(-0.36)	(4.32)	(1.19)
ER_t	0.854***							0.681***		0.553***
	(5.30)							(5.23)		(4.62)
ICC_{CT}		0.627**							0.195	0.655
		(2.04)							(0.42)	(1.54)
ICC_{OJ}			0.672**						-0.350	0.124
			(2.37)						(-0.23)	(0.09)
ICC_{GLS}				0.834**					-0.282	-0.399
				(2.33)					(-0.86)	(-1.42)
ICC_{MPEG}					0.508*				0.210	-0.151
					(1.87)				(0.87)	(-0.74)
ICC_{Gordon}						0.631**			0.796	0.092
						(2.39)			(0.55)	(0.07)
$ICC_{Composite}$							0.808**	0.525		
							(2.31)	(1.46)		
Adj. R2	0.014	0.010	0.011	0.011	0.010	0.011	0.012	0.022	0.024	0.030

Panel D: ER_t and ICC Estimates Using Mohanram and Gode (2013) Method to Remove Analyst Forecast Bias

	ER_t Alone	ICC_{CT} Alone	ICC_{OJ} Alone	ICC_{GLS} Alone	ICC_{MPEG} Alone	ICC_{Gordon} Alone	$ICC_{Composite}$ Alone	$ICC_{Composite}$ and ER_t	ICC Estimates Excluding ER_t	ICC Estimates Including ER_t
Intercept	0.002	0.149***	0.162***	0.165***	0.134***	0.157***	0.169***	0.072	0.142***	0.096*
	(0.04)	(7.05)	(7.91)	(7.31)	(6.78)	(7.97)	(8.02)	(2.28)	(3.49)	(1.90)
ER_t	0.809***							0.564***		0.324*
	(5.10)							(4.05)		(1.71)
ICC_{CT}		-0.248							-1.254	-0.795
		(-1.61)							(-1.02)	(-0.66)
ICC_{OJ}			-0.297						2.072	1.595
			(-1.39)						(0.63)	(0.55)
ICC_{GLS}				-0.330					0.200	-0.014
				(-1.44)					(0.44)	(-0.03)
ICC_{MPEG}					-0.187*				-0.174	-0.176
					(-1.83)				(-0.74)	(-0.66)
ICC_{Gordon}						-0.288			-1.065	-0.966
						(-1.35)			(-0.50)	(-0.47)
$ICC_{Composite}$							-0.366***	-0.392***		
							(-2.30)	(-2.14)		
Adj. R2	0.014	0.009	0.009	0.013	0.008	0.009	0.009	0.019	0.050	0.050

Table 5

Mean Forecasted and Actual Earnings Growth Rates Two Years Ahead for Portfolios Formed on the $ICC_{Composite}$ Measure

Earnings growth numbers are means over years of medians for the ten portfolios formed each year. Portfolios are formed from a ranking of firms on the composite ICC estimates, $ICC_{Composite}$, in Table 2 Panel A (calculated with analysts' forecasts), on the composite ICC estimates in Table 2 Panel B (calculated from earnings estimates with Hou et al. (2012) model forecasts), on the composite ICC estimates in Table 2 Panel C (calculated from earnings estimates with the Li and Mohanram (2014) RI model, and composite ICC estimates in Table 2 Panel D (with the correction for analyst forecast bias). Earnings growth rates are calculated as in the notes to Table 1.

	ICC Using Analysts' Forecasts			ICC Using Hou et al. Model Forecasts			ICC Using Li and Mohanram RI Model Forecast			ICC Using Mohanram and Gode (2013) Forecast		
	ICC	**Forecast**	**Actual**	**ICC**	**Forecast**	**Actual**	**ICC**	**Forecast**	**Actual**	**ICC**	**Forecast**	**Actual**
1 (Low)	0.031	0.183	0.184	0.033	0.121	0.103	0.038	0.025	0.100	0.014	0.268	0.178
2	0.043	0.158	0.146	0.046	0.062	0.109	0.048	0.041	0.106	0.031	0.186	0.152
3	0.053	0.157	0.136	0.056	0.068	0.105	0.056	0.047	0.094	0.041	0.175	0.133
4	0.063	0.152	0.126	0.065	0.085	0.094	0.063	0.064	0.090	0.050	0.168	0.103
5	0.071	0.151	0.097	0.074	0.103	0.090	0.070	0.069	0.084	0.059	0.170	0.083
6	0.081	0.153	0.065	0.085	0.140	0.074	0.078	0.083	0.085	0.068	0.165	0.072
7	0.092	0.152	0.052	0.100	0.181	0.075	0.086	0.096	0.067	0.077	0.169	0.054
8	0.104	0.152	0.047	0.121	0.239	0.062	0.097	0.115	0.072	0.088	0.162	0.033
9	0.121	0.164	0.011	0.162	0.324	0.070	0.113	0.141	0.064	0.104	0.171	-0.008
10 (High)	0.163	0.190	-0.036	0.280	0.400	0.105	0.149	0.192	0.020	0.142	0.202	-0.096

Table 6

Shrinkage Estimates of the Expected Return

This table reports revised expected return estimates, ER_{st}, for portfolios, calculated after shrinking the expected returns in Table 1 for ex post bias. The table also reports mean actual portfolio returns in the subsequent year, *t*+1 (as in Table 1), and the median shrinkage expected returns, ER_{st+1}, recalculated at the end of that year for same firms in the respective ER_{st} portfolios at time t.

ER_{st} Portfolio	Mean Shrunk $ER_{s,t}$	Median Shrunk $ER_{s,t}$	Actual $Return_{t+1}$	Median Shrunk $ER_{s,t+1}$
1 (Low)	-0.022	-0.025	0.059	0.042
2	0.052	0.045	0.098	0.073
3	0.079	0.069	0.131	0.092
4	0.096	0.090	0.146	0.099
5	0.108	0.103	0.155	0.106
6	0.118	0.115	0.158	0.116
7	0.128	0.125	0.178	0.119
8	0.139	0.137	0.189	0.126
9	0.155	0.154	0.201	0.131
10 (High)	0.194	0.187	0.263	0.148

Table 7

Estimated Equity Yield to Maturity for ER Portfolios

This table reports a long-run yield to maturity estimated for each ER portfolio based on the calculated ER_{st} in Table 6 reverting to mean 10%, the approximate mean for all portfolios. The coefficients, *a* and *b*, are means from each base year estimate, reporting the typical mean reversion (with *t*-statistics in parentheses and the mean R^2 reported). T is the number of years for ER_{sg} to converge to 10%, and Yield is the equity yield to maturity based on the time series of ER estimated under the mean-reverting process.

ER_{st} Portfolio	*a*	*b*	R^2	T	Yield
1	0.056	0.450	0.29	5.27	0.0655
	(12.87)	(3.71)			
2	0.044	0.628	0.51	2.85	0.0796
	(6.89)	(5.86)			
3	0.029	0.770	0.68	2.29	0.0905
	(3.67)	(8.32)			
4	0.022	0.796	0.77	1.55	0.0980
	(2.93)	(10.53)			
5	0.020	0.790	0.81	3.16	0.1035
	(2.62)	(12.01)			
6	0.016	0.807	0.84	3.18	0.1083
	(2.07)	(13.21)			
7	0.017	0.781	0.84	3.16	0.1126
	(2.08)	(13.04)			
8	0.019	0.752	0.82	3.63	0.1169
	(2.22)	(12.47)			
9	0.021	0.722	0.78	3.57	0.1230
	(1.95)	(10.86)			
10	0.023	0.650	0.62	3.06	0.1395
	(1.33)	(7.40)			