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# Removing predictable analyst forecast errors to improve implied cost of equity estimates

**Partha Mohanram · Dan Gode**

**Abstract** Prior research documents a weak association between the implied cost of equity inferred from analyst forecasts and realized returns. It points to predictable errors in analyst forecasts as a possible cause. We show that removing predictable errors from analyst forecasts leads to a much stronger association between implied cost of equity estimates obtained from adjusted forecasts and realized returns after controlling for cash flow news and discount rate news. An estimate of implied risk premium based on the average of four commonly used methods after making adjustments for predictable errors exhibits strong correlations with future realized returns as well as the lowest measurement error. Overall, our results confirm the validity of implied cost of equity estimates as measures of expected returns. Future research using implied cost of equity should remove predictable errors from implied cost of capital estimates and then average across multiple metrics.

**Keywords** Implied cost of capital · Implied cost of equity · Analyst forecasts · Realized returns · Expected returns · Predictable errors

**JEL Classification** M41 · G12 · G31 · G32

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P. Mohanram (✉)
CGA Ontario Professor of Financial Accounting, Rotman School of Management,
University of Toronto, 105 St. George Street, Toronto, ON M5S 3E6, Canada
e-mail: partha.mohanram@rotman.utoronto.ca

D. Gode
Stern School of Business, New York University, New York, NY 10012, USA
e-mail: dgode@stern.nyu.edu

## 1 Introduction

Cost of equity plays a central role in valuation, portfolio selection, and capital budgeting. Therefore measuring and validating cost of equity metrics has been the subject of much research. Conventional measures of cost of equity are based on risk metrics such as β, which are measured using ex-post returns. However, β often correlates poorly with subsequent realized returns (Fama and French 1992). Elton (1999) provides reasons for why this is so. This has led researchers to infer the implied cost of equity as the discount rate that equates current stock price to present value of expected future dividends. Researchers have primarily used three types of valuation models to infer implied cost of equity. Botosan (1997) and Brav et al. (2005) use the dividend discount model with the target price at the end of the forecast horizon as the terminal value. O'Hanlon and Steele (2000), Gebhardt et al. (2001), Claus and Thomas (2001), and Baginski and Wahlen (2003) use the residual income valuation model based on Ohlson (1995) making different assumptions about terminal value. Gode and Mohanram (2003) and Easton (2004) use the Ohlson and Juettner-Nauroth (OJ) model, which assumes that abnormal earnings growth rate decays asymptotically to long-term economic growth rate. For comparability across time, prior research has typically expressed implied cost of equity as implied risk premium by subtracting the prevailing risk-free rate.

Given that implied risk premium metrics were created because of the weak correlation between conventional measures of risk such as β and realized returns, it is distressing that these metrics also show weak correlations with realized returns. Easton and Monahan (2005) show that none of the commonly used proxies show any meaningful correlation with realized returns after one controls for shocks to expected cash flows and discount rates. They conclude that these proxies are unreliable and caution against their widespread use.

While Easton and Monahan (2005) do not specifically analyze the reasons for the low correlation with realized returns for the implied risk premium metrics, they show that these metrics have considerable measurement error. What drives the low correlation with returns and the high measurement error? Is it the underlying valuation models used to infer the risk premium? Or could the fault lie with the inputs to these models—analyst forecasts?[1] In this paper, we ask the following research question—is the low correlation between implied risk premium estimates and realized returns caused by predictable errors in analyst forecasts? Stated alternatively—does the correlation between implied risk premium and realized returns strengthen after removing predictable errors in analyst forecasts?

Empirical research on valuation has long adjusted for predictable forecast errors. Frankel and Lee (1998) show that the ratio of accounting-based fundamental value to market price predicts realized returns better after one corrects the fundamental value for predictable errors in forecasts. Gode and Mohanram (2001) show that abnormally high implied risk premium estimates are associated with downward

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[1] In a recent theory paper, Hughes et al. (2009) show that when the expected return is stochastic, the implied cost of equity can differ from expected return. Lambert (2009) however suggests that the expected difference between implied cost of equity and expected returns might not be a first-order effect.

revisions in earnings forecasts and poor ex post returns, which suggests that optimistically biased forecasts skew the risk premium upward. Easton and Monahan (2005) find that when analyst forecasts are accurate ex post, implied risk premium metrics show strong correlations with realized returns. Guay et al. (2005) correct for forecast errors that can be predicted based on recent returns, size, book-to-market, and analyst following. They show that such adjustment improves the correlation between implied risk premium and future returns. However, the improvement is modest and does not hold for all implied risk premium metrics.

We take a comprehensive approach to adjusting forecasts for predictable errors, using factors associated with analysts' predictable overreaction (accruals, sales growth, analysts' long-term growth expectations, growth in PP&E, and growth in other long-term assets) and underreaction (recent returns, recent revisions in forecasts) to information. We then test whether these adjustments improve the correlation between implied risk premium and future returns.

We focus on four commonly used implied risk premium metrics. $RP_{OJ}$ is based on the OJ model from Ohlson and Juettner-Nauroth (2005) as implemented by Gode and Mohanram (2003), who assume that growth in earnings declines asymptotically to the long-run growth rate of the economy. $RP_{PEG}$ is based on a simplified version of the OJ model, similar to Easton (2004). $RP_{GLS}$ is based on the residual income valuation model as implemented by Gebhardt et al. (2001), who assume that company ROE converges to industry median ROE. $RP_{CT}$ is also based on the residual income valuation model as implemented by Claus and Thomas (2001), who assume that earnings grow in the long run at the rate of inflation. We also analyze the mean of the above four metrics ($RP_{AVG}$) to replicate the common approach of averaging across multiple models. As a naive benchmark of implied cost of equity, we use the forward earnings to price ratio ($RP_{EP}$).[2]

We start by replicating prior results on the performance of implied risk premium metrics. The relationship between implied risk premium metrics and realized returns is weak, especially for $RP_{OJ}$ and $RP_{PEG}$ (see Table 4, Panel A). The spread in mean returns between extreme quintiles of $RP_{OJ}$ is merely 2.34 %, compared with a 6.56 % spread in risk premium. Similarly, the spread in mean returns between extreme quintiles of $RP_{PEG}$ is 2.86 %, compared with a 6.86 % spread in risk premium. A naïve measure ($RP_{EP}$) based on the E/P ratio outperforms both these metrics. The only metric to show a spread in returns comparable to the spread in risk premium is the $RP_{GLS}$ metric (6.08 % spread in returns vs. 7.75 % spread in risk premium across quintiles). When we regress future returns on implied risk premium metrics, controlling for cash flow shocks and discount rate shocks as Easton and Monahan (2005) recommend, we find that none of the measures shows a significant correlation with realized returns. Further, all the implied risk premium metrics contain significant measurement error, though the approach of averaging across multiple metrics does mitigate this partially.

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[2] We do not estimate implied cost of equity using the dividend discount model as in Botosan and Plumlee (2002) and Brav et al. (2005) for two reasons. First, these models rely on target prices and forecasts of dividends that are available only for a small subset of firms. Second, bias in target future prices is less clearly understood than bias in earnings forecasts, as the latter has been the focus of much research.

Next, we remove predictable errors from analyst forecasts using a comprehensive model based on Hughes, Liu, and Su (2008). We run annual regressions to predict surprises in one-year-ahead EPS ($EPS_1$) and two-year-ahead EPS ($EPS_2$). We use coefficients from once-lagged (twice-lagged) annual regressions to avoid look-ahead bias and estimate expected errors in $EPS_1$ ($EPS_2$). We adjust the forecasts for the expected error, recompute implied risk premium, and evaluate the adjusted risk premium metrics based on their correlations with future returns.

The results demonstrate the central point of our paper—the adjusted implied risk premium metrics show a much stronger relationship with realized returns for all risk premium measures. For the adjusted $RP_{OJ}$, the spread in one-year ahead realized returns across quintiles increases from 2.34 to 4.68 % (Table 8, Panel A). For the adjusted $RP_{PEG}$, the return spread increases from 2.86 to 5.21 %, while for $RP_{CT}$, the return spread increases from 3.40 to 4.66 %. Even for the $RP_{GLS}$ measure, which had a sizable return spread without adjusted forecasts, the adjustments increase the return spread from 6.08 to 7.11 %. Finally, the adjusted composite measure, $ARP_{AVG}$, shows an improvement in return spreads from 4.32 to 6.09 %. The regressions confirm the portfolio tests; even with controls for cash flow news and discount rate news, all risk premium metrics show significant correlations with realized returns. We further find that, while the measurement error declines for some metrics ($ARP_{OJ}$, $ARP_{PEG}$) and increases for others ($ARP_{GLS}$, $ARP_{CT}$), the measurement error declines significantly for the composite measure ($ARP_{AVG}$), almost halving with respect to the measurement error for the unadjusted forecasts. Finally, all the theoretically motivated risk premium metrics outperform the naïve $RP_{EP}$ benchmark.

Our paper makes the following contributions. First, we validate the implied cost of equity approach by showing that implied risk premium metrics are significantly correlated with future returns, once predictable forecast errors are removed. This suggests that flawed proxies of market expectations of future earnings, not inherent weaknesses in the measurement of implied risk premiums, may cause the high measurement error observed in implied risk premium metrics in prior research. Second, we provide a practical method to remove predictable forecast errors. Our error correction model is more comprehensive than prior research and yields improvements in correlations with future returns for all risk premium metrics that persist after one controls for cash flow and discount rate shocks. Third, we show that the average of risk premium metrics from different models after adjusting for predictable errors ($ARP_{AVG}$) is strongly associated with realized returns and has the lowest measurement error. This suggests that, by purging earnings forecasts of predictable errors and then averaging across multiple models, researchers can obtain reliable proxies for implied cost of capital.

The rest of the paper is organized as follows. Section 2 summarizes prior research related to implied cost of equity and predictability of analyst forecast errors. Section 3 outlines how we compute and evaluate the implied risk premium metrics and describes the sample selection procedure. Section 4 replicates prior findings on the weak correlation between implied risk premium metrics and realized returns and sheds light on the role of analyst forecast errors. Section 5 outlines a procedure to correct the predictable errors in analyst forecasts. Section 6 evaluates the adjusted implied risk premium metrics based on their correlations with future returns and measurement error.

## 2 Related literature

This paper relies on three strands of prior research on implied cost of equity, biases and errors in analysts' earnings forecasts, and prediction of these forecast errors.

### 2.1 Literature on the implied cost of equity

Implied cost of equity is the discount rate that equates the present value of the expected future dividends to current stock price. Because expected dividends are not observable, researchers have either used dividend forecasts available from sources such as Value Line or analysts' earnings forecasts coupled with dividend payout assumptions. Analyst forecasts, however, are available only for a limited horizon. Therefore one needs to model terminal value, which depends on the pattern of dividends beyond the forecast horizon.

As discussed in the introduction, prior research has primarily used three types of valuation models to infer implied cost of equity: (1) the dividend discount model (Botosan 1997 and Brav et al. 2005), (2) residual income valuation model based on Ohlson (1995) (O'Hanlon and Steele 2000; Gebhardt et al. 2001; Claus and Thomas 2001, and Baginski and Wahlen 2003), and (3) the Ohlson and Juettner-Nauroth (OJ) model (Gode and Mohanram 2003 and Easton 2004).

Researchers have used implied cost of equity estimates as summary measures of priced risk. Francis et al. (2004) and Mohanram and Rajgopal (2009) use implied cost of equity to test whether earnings quality and PIN respectively are priced. Hribar and Jenkins (2004) study the impact of restatements on implied cost of equity. Francis et al. (2005) and Hail and Leuz (2006) examine the impact of disclosure incentives and legal institutions respectively on implied cost of equity across countries.

The growing usage of implied risk premium metrics has led researchers to use two yardsticks validate them: (1) correlation with risk measures such as systematic risk (β), idiosyncratic risk, size, book-to-market ratio, and momentum,[3] (2) correlation with future realized returns.

Gode and Mohanram (2003) show that implied risk premium metrics based on the OJ model have a stronger relationship with risk factors such as systematic risk, earnings volatility, and leverage than estimates from the RIV model. However, the OJ-based metrics display a weaker correlation with future returns. Botosan and Plumlee (2005) find that estimates from the PEG model in Easton (2004), and the target price model in Botosan and Plumlee (2002) have the most consistent relationship with risk factors. Easton and Monahan (2005) examine the relationship

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[3] Easton and Monahan (2010) evaluate these two approaches and conclude that ranking implied RP metrics based on their correlation with risk factors is illogical because the use of accounting-based implied RP metrics implicitly assumes that the factors determining expected returns are either unknown or cannot be estimated reliably.

between several implied cost of equity metrics and realized returns while controlling for economic surprises regarding future cash flows and discount rates using the return decomposition model of Vuolteenaho (2002). They conclude that all cost of equity estimates are unreliable: “None of them had a positive association with realized returns, even after controlling for the bias and noise in realized returns attributable to contemporaneous information surprises.”

The weak correlation with realized returns is problematic because the key motivation for using implied risk premium metrics is that the traditional risk proxies such as β correlate poorly with realized returns. Easton and Monahan, however, do find that, when analyst forecasts are accurate, some implied risk premium metrics have higher correlations with realized returns.

### 2.2 Literature on biases and errors in analyst forecasts

Prior literature documents that analyst forecasts tend to be optimistically biased (O’Brien 1988; Mendenhall 1991; Brown 1993; Dugar and Nathan 1995; Das et al. 1998). This bias becomes stronger with longer forecast horizons (Richardson et al. 2004), adversely affecting implied risk premium estimates which rely on long-term earnings forecasts. Prior research has recognized the impact of this bias on implied cost of equity estimates. Claus and Thomas (2001) and Williams (2004) note that optimistic forecasts upwardly bias implied risk premium. Easton and Sommers (2007) show that using actual realized earnings instead of optimistic forecasts significantly lowers implied risk premium.

Prior research has shown that analysts underreact to information in past earnings and returns (Lys and Sohn 1990; Abarbanell 1991; Abarbanell and Bernard 1992; Jegadeesh and Titman 1993). Analyst underreaction causes past forecast revisions to predict future forecast errors (Stickel 1991; Gleason and Lee 2003).

Prior research has also shown that analysts overreact to certain information. De Bondt and Thaler (1990) show that forecasted earnings changes are more extreme than realized changes. La Porta (1996) documents that analysts naively extrapolate past sales growth, while Dechow et al. (2000) find that analysts’ long-term growth estimates are optimistic. Analysts are most optimistic for growth firms with low book-to-market (BM), low earnings-to-price (EP), and high capital expenditures (Dechow and Sloan 1997; Fuller et al. 1993; Doukas et al. 2002; Jegadeesh et al. 2004).[4]

### 2.3 Literature on eliminating the biases and errors from analyst forecasts

Prior research has examined whether one can remove known biases and errors from analyst forecasts by using publicly available information. Elgers and Lo (1994) show that one can substantially reduce forecast errors by incorporating information

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[4] Reconciling these two streams of research, Easterwood and Nutt (1999) show that analysts react differently based on the nature of the earnings news, by under-reacting to extreme bad news and overreacting to extreme good news.

in prior earnings and returns. Hughes et al. (2008) develop a comprehensive forecast error prediction model that incorporates factors related to analysts' overreaction (accruals, sales growth, long-term growth estimates, growth in PP&E), and underreaction (recent returns, forecast errors and forecast revisions) to information. However, they show that one cannot generate excess returns by predicting forecast errors, indicating that the market corrects for the predictable errors in analyst forecasts.

Guay et al. (2005) document that the relationship between implied cost of equity estimates and future returns improves if one adjusts for predictable forecast errors related to the analyst underreaction to recent returns and other factors such as size, book-to-market, and analyst following. However, the improvement is mainly at the portfolio level for some metrics; it is weak at the firm level and does not hold for all implied risk premium metrics.

### 2.4 Putting it all together: motivation for this paper

Implied risk premium metrics are being increasingly used in accounting research as summary statistics for risk and expected return. However, these measures are weakly or insignificantly correlated with future returns and tainted by significant measurement error. This has led to researchers advising caution with the use or interpretation of implied risk premium metrics.

The weak relationship between implied risk premium and realized returns is potentially driven by errors in the key input into these models—analyst forecasts. Prior research indicates that errors in analyst forecasts are predictable, and more importantly, the market adjusts for them. Removing predictable forecast errors may provide better proxies for market expectations and more reliable estimates of implied risk premium.

In this paper, we use a comprehensive model that incorporates known causes of analysts' overreaction and underreaction. We use this model to remove predictable error from analyst forecasts and recompute implied risk premium metrics. We then validate the adjusted implied risk premium metrics by showing that the correlation with realized returns increases and measurement error declines.

## 3 Models and data

### 3.1 Models used

#### *3.1.1 Implied cost of equity based on the full Ohlson-Juettner model (OJ)*

The OJ model is based on the following equation

$$r_{OJ} = A + \sqrt{A^2 + \frac{EPS_1}{P_0} * (STG - (\gamma - 1))} \qquad (1)$$

where

$$A = \frac{1}{2}\left((\gamma - 1) + \frac{DPS_1}{P_0}\right) \quad \text{and} \quad STG = \frac{EPS_2}{EPS_1} - 1 \tag{2}$$

where $EPS_1$ and $EPS_2$ are forecasts of one-year-ahead and two-year-ahead EPS respectively; $P_0$ is the price at the time of the forecasts, and $DPS_1$ is the expected one-year-ahead dividend per share (defined as $EPS_1$ times payout, where payout is estimated as the ratio of the most recent dividends to net income).[5] $(\gamma - 1)$ is the expected long-run economy growth rate. Consistent with Gode and Mohanram (2003), we set $(\gamma - 1)$ to $r_f$—3 %, where $r_f$ is annual yield on ten-year Treasury.

The STG variable can be noisy. STG is inflated if $EPS_1$ is very low relative to $EPS_2$; STG can even be negative if $EPS_2$ is less than $EPS_1$. To reduce the noise in STG, we use the geometric mean of two-year growth ($EPS_2/EPS_1$ −1) and long-term growth (LTG) from I/B/E/S as our estimate of short-term growth. If two-year growth is lower than LTG, we set STG to equal LTG.

### 3.1.2 *Implied cost of equity based on the price-earnings-growth model (PEG)*

If one sets $\gamma = 1$ and ignores dividends, then the OJ model simplifies to

$$r_{PEG} = \sqrt{\frac{EPS_1}{P_0} * STG} \tag{3}$$

The implied cost of equity in this case is the square root of the inverse of the PEG ratio (Easton 2004). Consistent with our OJ implementation, we set STG to the average of forecasted two-year growth ($EPS_2/EPS_1$ −1) and long-term growth (LTG) when two-year growth is greater than LTG, and equal to LTG when two-year growth is less than LTG.

### 3.1.3 *Implied cost of equity based on the residual-income-valuation model (RIV)*

Gebhardt et al. (2001) use RIV to estimate implied cost of equity. They use EPS estimates for the future 2 years and the expected dividends payout (from historical data) to derive book value and return on equity (ROE) forecasts. Beyond the forecast horizon, they assume that ROE declines to the industry median ROE by year 12 and remains constant thereafter.[6] The cost of equity is computed by equating current stock price to the sum of the current book value and the present value of future residual earnings. Claus and Thomas (2001) also use the RIV model to estimate the implied cost of equity. They assume that earnings grow at the

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[5] Payout is estimated as the ratio of indicated annual dividend from I/B/E/S (iadiv) to actual earnings (fy0a). If it cannot be estimated from I/B/E/S, payout is calculated as the ratio of annual dividend (Compustat #21) to net income before extraordinary items (Compustat #18). If earnings are negative, payout is estimated as the ratio of earnings to 6 % of total assets (Compustat #6).

[6] Industry median ROE is estimated as the median of all ROEs from firms in the same industry defined using the Fama and French (1997) classification over the past 5 years with positive earnings and book values, where ROE is defined as the ratio of net income before extraordinary items (Compustat #18) to lagged total common shareholders' equity (Compustat #60).

analyst's consensus long-term growth rate until year five and at the rate of inflation (set at to $r_f$—3 %) thereafter.

### 3.1.4 *Implied cost of equity based on earnings/price ratio (EP)*

Finally, we use the forward earnings to price ($EPS_1/P_0$) ratio as a naïve benchmark for cost of equity. For comparability across time, we compute risk premium defined as the cost of equity minus the risk-free rate, defined as the prevailing yield on the 10-year Treasury. The risk premium from the OJ model, the PEG model, the Gebhardt et al. (2001) implementation of the RIV model, the Claus and Thomas (2001) implementation of the RIV model, the E/P ratio, and the average of the first four are labeled as $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, $RP_{CT}$, $RP_{EP}$, and $RP_{AVG}$ respectively.

## 3.2 Evaluating implied risk premium metrics

### 3.2.1 *Prior approaches to evaluating implied risk premium metrics*

Prior research has evaluated implied risk premium metrics in two ways: (1) the correlation with conventional risk proxies such as systematic risk (β), idiosyncratic risk, size, book-to-market, and growth, and (2) the correlation with realized returns. While we document the first approach, our emphasis is on the second approach. This is because the first approach makes sense only if the conventional risk proxies are valid (Easton 2004). Prior research has regressed implied risk premium metrics on realized returns, implicitly assuming that realized returns on average equal expected returns. However, this assumption may not be empirically valid. Elton (1999) argues that historical realized returns deviate from expected returns over extended periods as cash flow shocks or discount rate shocks do not cancel out. Easton and Monahan (2005) address this limitation by building on the Vuolteenaho (2002) decomposition of realized returns into expected returns and shocks to expected cash flows and expected rates of return, as described next.

### 3.2.2 *Easton and Monahan approach*

Easton and Monahan (2005) base their analysis on the following equation developed in Vuolteenaho (2002), which we restate with terminology consistent with our paper as below

$$RET_{i,t+1} = RP_{i,t+1} + CNEWS_{i,t+1} + DNEWS_{i,t+1} \tag{4}$$

where $RET_{i,t+1}$ is the one-year-ahead realized return; $RP_{i,t+1}$ is the estimated implied risk premium metric (expected risk premium for period $t + 1$ measured at time t); $CNEWS_{i,t+1}$ is the proxy for cash flow news realized in the future year (year $t + 1$), and $DNEWS_{i,t+1}$ is the proxy for the discount rate news realized in the following year. Easton and Monahan state that Eq. (4) is an identity, which suggests that the expected coefficient on each of the independent variables is 1. Further, they suggest that univariate regressions of returns on the implied risk premium metrics are misspecified by the omission of proxies for cash flow news and discount rate news. Consistent with Easton and Monahan, we develop proxies for cash flow news and discount rate news as described below.

CNEWS, the proxy for 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 two-year-ahead forecasted ROE as

$$\begin{aligned}\mathrm{CNEWS}_{i,t+1} = {} & \mathrm{LOG\_FERR}_{i,t} + \Delta\mathrm{LOG\_FROE}_{i,t} + \rho/(1-\rho\omega) \\ & * \Delta\mathrm{LOG\_FROE}_{i,t+1}\end{aligned} \tag{5}$$

where $\mathrm{LOG\_FERR}_{it}$ is the realized forecast error on the $\mathrm{EPS}_t$ forecast made at the end of fiscal year t (scaled by beginning book value of equity per share), and revisions refer to changes in forecasts from the time of the estimation of implied risk premium to the end of the fiscal year. Forecasted ROE is defined as EPS forecast divided by beginning book value of equity divided by number of shares used to calculate EPS. We use the ρ estimates reported in Easton and Monahan. Persistence coefficients $\omega_t$ are estimated through a pooled time-series cross-sectional regression for each of the 48 Fama and French (1997) industries using 10 years of lagged data, that is, $\mathrm{LOG\_ROE}_{i,t\text{-}\tau} = \omega_{0t} + \omega_t \times \mathrm{LOG\_ROE}_{i,t-(\tau-1)}$, where τ is a number between zero and nine, and ROE is return on equity.

DNEWS, the proxy for discount rate news, is measured as

$$\mathrm{DNEWS}_{i,t+1} = -\rho/(1-\rho) * (\mathrm{LOG\_ER}_{i,t+2} - \mathrm{LOG\_ER}_{i,t+1}) \tag{6}$$

where $\mathrm{LOG\_ER}_{\ i,t+1}$ is the continuously compounded implied cost of equity estimate (expected return for period t + 1 measured at time t), and $\mathrm{LOG\_ER}_{i,t+2}$ is the one-year-ahead compounded implied cost of equity estimate (expected return for period t + 2 measured at time t + 1). Note that future returns are increasing in discount rate news in Eq. (4); accordingly, a reduction in the expected discount rate is coded as positive discount rate news. Each implied risk premium metric will have its own estimate of discount rate news.

### 3.3 Sample selection

Table 1 summarizes the selection process for the final sample used to infer the cost of equity. We use I/B/E/S for the analyst forecasts, COMPUSTAT for accounting data, and CRSP for the stock returns. We get stock price ($P_0$), mean one-year-ahead annual EPS forecast ($\mathrm{EPS}_1$), mean two-year-ahead annual EPS forecast ($\mathrm{EPS}_2$), and median long-term-growth estimates (LTG) from the I/B/E/S summary database. The data is obtained 6 months after the end of the prior fiscal year to ensure that analysts have incorporated information from the prior year financials into their forecasts. I/B/E/S coverage starts from 1981 and includes 80,055 observations for which price ($P_0$), $\mathrm{EPS}_1$, $\mathrm{EPS}_2$ and LTG are available.

We eliminate observations with negative $\mathrm{EPS}_1$ or $\mathrm{EPS}_2$ because the OJ model requires positive earnings forecasts. We also eliminate observations with extreme values of price or PE ratios and a few observations where the OJ model does not produce a valid estimate.[7] We calculate book value per share as total common equity

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[7] Note from Eq. 1 that the expression for $\mathrm{RP}_{\mathrm{OJ}}$ contains a square root. When short-term growth is very low [less than (γ−1)], this expression can be negative, and hence no valid estimate can be inferred.

**Table 1** Sample selection

| SAMPLE selection filters | # of firm-years | # of firms |
|---|---|---|
| I/B/ES data with price ($P_0$) and forecasts for 1-year ahead and 2-year-ahead EPS ($EPS_1$ & $EPS_2$) and long-term growth (LTG) 6 months after prior fiscal year-end | 80,055 | 14,048 |
| Less observations with negative $EPS_1$ or $EPS_2$ forecast | 6,920 | 1,238 |
| Less observations with $P_0 < 0.5$ or $P_0 > 500$ | 743 | 170 |
| Less observations with PE ratios > 200 | 567 | 92 |
| Less observations with no valid $RP_{OJ}$ and $RP_{PEG}$ | 838 | 70 |
| Less observations either without financial statement data to estimate $RP_{GLS}$/$RP_{CT}$ or where $RP_{GLS}$/$RP_{CT}$ do not converge | 15,401 | 3,391 |
| Less observations deleted because of no prior data available to estimate adjustments to $EPS_1$ and $EPS_2$ (1981 and 1982) | 2,835 | 166 |
| Less observations deleted because of missing data needed to make adjustments to $EPS_1$ and $EPS_2$ | 5,421 | 909 |
| Less observations deleted because adjustments results in negative adjusted $EPS_1$ or $EPS_2$ | 2,457 | 255 |
| Less firms without financial statement data to estimate $ARP_{GLS}$/$ARP_{CT}$ or where $ARP_{GLS}$/$ARP_{CT}$ do not converge | 974 | 85 |
| Less firms without CRSP information to calculate one-year-ahead returns | 25 | 8 |
| Truncation of observations in extreme 0.5 percentiles of any of the RP metrics | 1,274 | 224 |
| SAMPLE used for portfolio tests | 42,600 | 7,440 |
| Less firms without information to calculate discount rate news and cash flow news proxies | 5,588 | 998 |
| SAMPLE used for regressions | 36,012 | 6,442 |

(Compustat #60) divided by shares outstanding. We lose observations either because book values are unavailable or because a valid $RP_{GLS}$ or $RP_{CT}$ does not converge from numerical estimation. Although forecasts are available from 1981, we can adjust forecasts only from 1983 onwards as we use once-lagged and twice-lagged annual regressions to remove predictable error in $EPS_1$ and $EPS_2$. We also lose observations if data for making the adjustments is unavailable, or if, after the adjustment, the adjusted $EPS_1$ or $EPS_2$ is negative and hence $RP_{OJ}$ and $RP_{PEG}$ cannot be estimated, or because adjusted $RP_{GLS}$ or $RP_{CT}$ cannot be solved for numerically. Finally, we match our data with CRSP to obtain one-year-ahead returns.

To ensure that our results are not driven by outliers, the original risk premium measures ($RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{EP}$) as well as the risk premium measures based on adjusted forecasts are all truncated at the 0.5 and 99.5 % using annual distributions. Our sample consists of 42,600 firm-years representing 7,440 distinct firms over the 26 years from 1983 to 2008. For the Easton and Monahan tests, we lose additional observations because of the need for one-year-ahead data to estimate cash flow news and discount rate news proxies. The sample used in the Easton and Monahan analysis consists of 36,012 firm-years representing 6,442 distinct firms over the 25 years from 1983 to 2007.

### 3.4 Sample descriptive statistics

Table 2, Panel A, presents descriptive statistics for the inputs used to estimate the risk premium metrics. The mean estimates of $EPS_1$ and $EPS_2$ are 1.39 and 1.62, respectively. The mean book value per share (BVPS) is 10.21. The mean long-term growth estimate is 15.8 %, while the mean payout is 23.2 %. Finally, the mean industry median ROE used to infer $RP_{GLS}$ is 14.6 %.

Table 2, Panel B, presents the means risk premiums across time. The sample size generally increases over time because of increasing coverage by I/B/E/S. The number of firms per year dips at the end of the internet bubble (1999-2003) but increases afterwards. Mean $RP_{OJ}$ ranges from a low of 3.3 % in 1984 to 6.8 % in 2008. Mean $RP_{PEG}$ has a wider inter-temporal variation between -0.7 % in 1984 to 5.6 % in 2008. Mean $RP_{GLS}$ ranges from 1.4 % in 1985 to 6.5 % in 2008, while mean $RP_{CT}$ ranges from -1.3 % in 1984 to 5.7 % in 2008. In addition, we define $RP_{AVG}$ as the average of $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$. $RP_{AVG}$ ranges from 1 % in 1984 to 6.1 % in 2008.

Table 2, Panel C, presents mean risk premiums across Fama and French (1997) industry classifications. There is no industry clustering as the industry composition of the sample is similar to that of the universe of COMPUSTAT over 1983–2008. Mean $RP_{OJ}$ ranges from a low of 3.9 % for publishing to 6.7 % for entertainment. Mean $RP_{PEG}$ ranges from 1 % for insurance to 5.7 % for entertainment. Mean $RP_{GLS}$ ranges from 3.8 % for medical equipment to 7.2 % for entertainment, while mean $RP_{CT}$ ranges from −1.3 % in 1984 to 5.7 % in 2008. Finally, mean $RP_{AVG}$ ranges from 2.9 % for insurance to 6.4 % for entertainment.

### 3.5 Descriptive statistics for the analysis variables

Table 3 presents the descriptive statistics for the risk premium metrics, future returns, and proxies for cash flow news and discount rate news. Panel A presents the means of the variables. Among the four risk premium measures, $RP_{OJ}$ has the highest mean, while $RP_{PEG}$ has the lowest. The mean cash flow news proxy is −3.6 %, while the mean discount rate news proxy varies across the risk premium metrics. The large magnitudes of the cash flow news and discount rate news proxies highlight the potential need to control for them using the Easton and Monahan methodology.

Table 3, Panel B, presents the correlations between the implied risk premium proxies, future returns, and the proxy for cash flow news. While the risk premium measures are all positively correlated with each other, the level of correlation varies. $RP_{OJ}$ and $RP_{PEG}$ are highly correlated (0.84 Pearson, 0.82 Spearman), as both are derived from the OJ model. However, both these measures show lower correlation with $RP_{GLS}$. For instance, the Pearson (Spearman) correlation between $RP_{OJ}$ and $RP_{GLS}$ is only 0.37 (0.37). $RP_{OJ}$ however shows higher correlation with $RP_{CT}$ (0.80 Pearson, 0.78 Spearman) presumably because both assume similar long-run growth rates.

All risk premium measures also show only modest correlation with future returns ($RET_1$). The correlation is positive but weak for $RP_{GLS}$ (0.06 Pearson. 0.04 Spearman) but almost non-existent for $RP_{OJ}$ (0.02 Pearson, 0.00 Spearman), $RP_{PEG}$

**Table 2** Summary statistics for implied risk premium metrics and the inputs in their estimation

*Panel A: Descriptive statistics for inputs to implied risk premium metrics*

| Variable | N | Mean | P5 | Q1 | Median | Q3 | P95 |
|---|---|---|---|---|---|---|---|
| $P_0$ | 42,600 | 21.35 | 3.985 | 10.06 | 17.25 | 27.5 | 51.51 |
| $EPS_1$ | 42,600 | 1.39 | 0.22 | 0.60 | 1.08 | 1.77 | 3.50 |
| $EPS_2$ | 42,600 | 1.62 | 0.31 | 0.77 | 1.30 | 2.04 | 3.94 |
| LTG | 42,600 | 15.8 % | 6.0 % | 10.0 % | 15.0 % | 20.0 % | 30.0 % |
| BVPS | 42,600 | 10.21 | 1.24 | 3.93 | 7.35 | 12.83 | 26.92 |
| Payout | 42,600 | 23.2 % | 0.0 % | 0.0 % | 13.8 % | 38.5 % | 89.7 % |
| MEDROE | 42,600 | 14.6 % | 11.7 % | 13.0 % | 14.3 % | 15.8 % | 18.6 % |

*Panel B: Means of implied risk premium metrics (%) by time*

| YEARS | N | $RP_{OJ}$ | $RP_{PEG}$ | $RP_{GLS}$ | $RP_{CT}$ | $RP_{AVG}$ |
|---|---|---|---|---|---|---|
| 1983 | 694 | 3.4 | −0.4 | 4.7 | 0.4 | 2.0 |
| 1984 | 878 | 3.3 | −0.7 | 2.9 | −1.3 | 1.0 |
| 1985 | 812 | 4.3 | 1.1 | 1.4 | 3.6 | 2.6 |
| 1986 | 794 | 4.9 | 2.5 | 2.7 | 4.0 | 3.5 |
| 1987 | 941 | 4.0 | 1.4 | 2.1 | 3.5 | 2.8 |
| 1988 | 981 | 4.7 | 2.0 | 2.6 | 4.0 | 3.3 |
| 1989 | 1,134 | 4.7 | 2.3 | 2.9 | 4.1 | 3.5 |
| 1990 | 1,138 | 4.6 | 2.1 | 2.9 | 4.0 | 3.4 |
| 1991 | 1,072 | 4.2 | 1.9 | 2.6 | 3.6 | 3.1 |
| 1992 | 1,348 | 4.7 | 2.6 | 3.2 | 4.0 | 3.7 |
| 1993 | 1,545 | 5.5 | 3.9 | 4.1 | 4.6 | 4.5 |
| 1994 | 1,799 | 4.6 | 2.7 | 2.9 | 4.0 | 3.6 |
| 1995 | 1,994 | 5.5 | 3.9 | 4.2 | 4.7 | 4.6 |
| 1996 | 2,108 | 4.8 | 3.2 | 3.6 | 3.9 | 3.9 |
| 1997 | 2,240 | 4.9 | 3.3 | 3.7 | 3.8 | 3.9 |
| 1998 | 2,304 | 5.7 | 4.5 | 4.7 | 4.5 | 4.8 |
| 1999 | 2,099 | 5.7 | 4.3 | 4.8 | 4.6 | 4.9 |
| 2000 | 1,931 | 5.9 | 4.5 | 4.9 | 4.9 | 5.1 |
| 2001 | 1,529 | 5.4 | 4.2 | 4.5 | 4.2 | 4.6 |
| 2002 | 1,712 | 5.4 | 4.2 | 4.5 | 4.3 | 4.6 |
| 2003 | 1,959 | 6.0 | 5.0 | 5.5 | 4.7 | 5.3 |
| 2004 | 2,324 | 5.1 | 4.0 | 4.2 | 3.9 | 4.3 |
| 2005 | 2,365 | 5.5 | 4.5 | 4.6 | 4.2 | 4.7 |
| 2006 | 2,390 | 5.1 | 3.9 | 4.1 | 4.0 | 4.3 |
| 2007 | 2,364 | 4.8 | 3.6 | 4.0 | 3.5 | 4.0 |
| 2008 | 2,145 | 6.8 | 5.6 | 6.5 | 5.7 | 6.1 |

**Table 2** continued

*Panel C: Means of implied risk premium metrics (%) by industry (Fama and French* 1997 *classification)*

| Description | N | % of sample | % of compustat | $RP_{OJ}$ | $RP_{PEG}$ | $RP_{GLS}$ | $RP_{CT}$ | $RP_{AVG}$ |
|---|---|---|---|---|---|---|---|---|
| Banking | 4,758 | 11.2 | 8.4 | 5.5 | 3.5 | 4.4 | 4.5 | 4.5 |
| Business services | 3,787 | 8.9 | 10.2 | 5.1 | 4.0 | 4.1 | 3.7 | 4.2 |
| Retail | 2,729 | 6.4 | 4.4 | 5.5 | 4.2 | 4.1 | 4.2 | 4.5 |
| Electronic equipment | 2,276 | 5.3 | 4.8 | 5.2 | 4.1 | 3.5 | 4.0 | 4.2 |
| Utilities | 2,140 | 5.0 | 2.6 | 6.0 | 4.4 | 5.4 | 4.9 | 5.2 |
| Insurance | 2,045 | 4.8 | 4.6 | 4.2 | 1.0 | 3.1 | 3.3 | 2.9 |
| Computers | 1,539 | 3.6 | 4.0 | 5.2 | 4.0 | 4.0 | 4.0 | 4.3 |
| Petroleum and natural gas | 1,448 | 3.4 | 4.4 | 5.0 | 3.2 | 3.9 | 3.9 | 4.0 |
| Machinery | 1,432 | 3.4 | 2.9 | 5.1 | 3.5 | 3.7 | 4.2 | 4.1 |
| Wholesale | 1,421 | 3.3 | 3.7 | 5.7 | 4.2 | 4.0 | 4.6 | 4.6 |
| Transportation | 1,168 | 2.7 | 2.4 | 5.3 | 4.0 | 4.5 | 4.4 | 4.6 |
| Trading | 1,090 | 2.6 | 2.7 | 4.8 | 3.8 | 3.6 | 3.5 | 3.9 |
| Pharmaceuticals | 1,035 | 2.4 | 4.1 | 4.6 | 3.1 | 4.1 | 3.2 | 3.8 |
| Medical equipment | 1,009 | 2.4 | 4.7 | 5.4 | 2.8 | 2.7 | 4.1 | 3.8 |
| Chemicals | 1,004 | 2.4 | 1.6 | 4.5 | 2.2 | 3.5 | 3.5 | 3.4 |
| Telecom | 894 | 2.1 | 1.7 | 5.0 | 3.0 | 3.7 | 3.9 | 3.9 |
| Consumer goods | 886 | 2.1 | 3.6 | 4.4 | 2.3 | 4.0 | 3.0 | 3.4 |
| Food products | 861 | 2.0 | 1.9 | 4.7 | 3.5 | 3.0 | 3.4 | 3.7 |
| Measuring and control equipment | 845 | 2.0 | 1.4 | 4.4 | 2.4 | 3.3 | 3.4 | 3.4 |
| Automobiles and trucks | 768 | 1.8 | 1.9 | 5.3 | 3.4 | 3.9 | 4.2 | 4.2 |
| Construction materials | 755 | 1.8 | 1.4 | 5.3 | 3.5 | 5.5 | 4.7 | 4.8 |
| Business supplies | 749 | 1.8 | 1.2 | 4.7 | 2.3 | 3.4 | 3.8 | 3.5 |
| Restaurants, hotels & motels | 728 | 1.7 | 1.1 | 5.8 | 4.5 | 5.0 | 4.5 | 5.0 |
| Healthcare | 724 | 1.7 | 1.9 | 5.3 | 4.0 | 3.2 | 3.8 | 4.1 |
| Apparel | 659 | 1.5 | 1.3 | 5.4 | 3.9 | 5.2 | 5.2 | 4.9 |
| Steel works | 634 | 1.5 | 1.6 | 5.7 | 4.7 | 5.0 | 4.2 | 4.9 |
| Miscellaneous | 540 | 1.3 | 2.5 | 5.2 | 3.9 | 4.0 | 3.9 | 4.3 |
| Printing and publishing | 531 | 1.2 | 0.8 | 3.9 | 1.7 | 3.4 | 2.5 | 2.9 |
| Entertainment | 504 | 1.2 | 1.2 | 6.7 | 5.7 | 7.2 | 6.0 | 6.4 |
| Construction | 483 | 1.1 | 1.8 | 5.3 | 4.1 | 4.1 | 4.2 | 4.4 |
| Electrical equipment | 438 | 1.0 | 0.9 | 5.1 | 3.2 | 3.6 | 3.9 | 4.0 |
| All other | 2,720 | 6.4 | 8.3 | 5.0 | 3.4 | 4.0 | 4.1 | 4.1 |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. See Table 1 for sample selection criteria. Panel A provides descriptive statistics for inputs used to estimate implied risk premium metrics. $P_0$ is the stock price obtained from I/B/E/S at the same time as the EPS estimates used to estimate implied risk premium. $EPS_1$ ($EPS_2$) is the consensus mean one-year-ahead (two-year-ahead) annual EPS estimate obtained 6 months after prior fiscal year-end. LTG is the consensus median long-term-growth estimate from I/B/E/S at the same time as EPS estimates. Payout is the historical dividend payout. MEDROE is the industry median return on equity (Net Income before extraordinary items (Compustat #18) scaled by lagged total shareholders' equity (Compustat #60), estimated over the previous 15 years, where industry is defined on the basis of the Fama and French (1997) classification. These inputs are used to estimate the four implied risk premium metrics: $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$ and $RP_{CT}$ using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures. Panel B(C) presents the means of all the implied risk premium metrics across time (industry)

**Table 3** Descriptive statistics for analysis variables

*Panel A: Statistical distribution of implied risk premium metrics, realized returns, and news variables (all in %)*

| | N | Mean | SD | 5th | 25th | 50th | 75th | 95th |
|---|---|---|---|---|---|---|---|---|
| $RP_{EP}$ | 42,600 | 2.2 | 2.9 | −1.8 | 0.4 | 1.9 | 3.5 | 7.3 |
| $RP_{OJ}$ | 42,600 | 5.2 | 2.5 | 1.4 | 3.6 | 4.9 | 6.4 | 9.7 |
| $RP_{PEG}$ | 42,600 | 3.5 | 2.8 | −0.9 | 1.8 | 3.4 | 5.2 | 8.4 |
| $RP_{GLS}$ | 42,600 | 4.0 | 3.1 | −0.7 | 2.1 | 3.8 | 5.7 | 9.4 |
| $RP_{CT}$ | 42,600 | 4.1 | 2.7 | 0.1 | 2.6 | 3.8 | 5.3 | 8.8 |
| $RP_{AVG}$ | 42,600 | 4.2 | 2.4 | 0.8 | 2.7 | 4.0 | 5.5 | 8.5 |
| $RET_1$ | 42,600 | 5.4 | 48.8 | −58.7 | −22.2 | 1.0 | 25.6 | 81.0 |
| CNEWS | 36,012 | −3.6 | 9.8 | −22.3 | −6.3 | −1.2 | 1.2 | 7.6 |
| $DNEWS_{EP}$ | 36,012 | 0.3 | 127.6 | −201.5 | −31.5 | 1.3 | 31.8 | 201.0 |
| $DNEWS_{OJ}$ | 36,012 | 7.1 | 103.0 | −159.0 | −21.9 | 2.7 | 30.0 | 191.3 |
| $DNEWS_{PEG}$ | 36,012 | 3.2 | 103.8 | −172.0 | −20.6 | 1.5 | 24.5 | 184.2 |
| $DNEWS_{GLS}$ | 36,012 | −7.0 | 87.1 | −166.7 | −27.0 | −0.9 | 20.4 | 129.3 |
| $DNEWS_{CT}$ | 36,012 | 4.1 | 100.8 | −160.8 | −23.3 | 2.3 | 27.1 | 181.1 |
| $DNEWS_{AVG}$ | 36,012 | 2.0 | 89.2 | −149.3 | −20.2 | 1.7 | 23.1 | 157.4 |

*Panel B: Correlations between implied risk premium metrics, realized returns, and cash flow news figure above/below diagonal represent Pearson/Spearman rank-order correlations*

| | $RP_{EP}$ | $RP_{OJ}$ | $RP_{PEG}$ | $RP_{GLS}$ | $RP_{CT}$ | $RP_{AVG}$ | $RET_1$ | CNEWS |
|---|---|---|---|---|---|---|---|---|
| $RP_{EP}$ | | 0.56 | 0.57 | 0.53 | 0.70 | 0.69 | 0.04 | −0.08 |
| $RP_{OJ}$ | 0.53 | | 0.84 | 0.37 | 0.80 | 0.87 | 0.02 | −0.13 |
| $RP_{PEG}$ | 0.51 | 0.82 | | 0.49 | 0.76 | 0.90 | 0.01 | −0.16 |
| $RP_{GLS}$ | 0.51 | 0.37 | 0.49 | | 0.47 | 0.72 | 0.06 | −0.15 |
| $RP_{CT}$ | 0.69 | 0.78 | 0.72 | 0.47 | | 0.87 | 0.01 | −0.24 |
| $RP_{AVG}$ | 0.65 | 0.85 | 0.88 | 0.72 | 0.85 | | 0.04 | −0.19 |
| $RET_1$ | 0.06 | 0.00 | −0.02 | 0.04 | 0.00 | 0.01 | | 0.30 |
| CNEWS | −0.06 | −0.14 | −0.13 | −0.15 | −0.20 | −0.17 | 0.35 | |

*Panel C: Correlations of discount rate news metrics with realized returns, expected returns, and cash flow news*

| | Average Pearson correlation | | | Average Spearman correlation | | |
|---|---|---|---|---|---|---|
| METRIC | $RET_1$ | RP | CFNEWS | $RET_1$ | RP | CFNEWS |
| $DNEWS_{EP}$ | 0.216 | 0.294 | −0.221 | 0.285 | 0.335 | −0.245 |
| $DNEWS_{OJ}$ | 0.168 | 0.351 | −0.200 | 0.225 | 0.375 | −0.189 |
| $DNEWS_{PEG}$ | 0.202 | 0.329 | −0.203 | 0.250 | 0.338 | −0.229 |
| $DNEWS_{GLS}$ | 0.479 | 0.246 | −0.074 | 0.558 | 0.262 | −0.070 |
| $DNEWS_{CT}$ | 0.254 | 0.332 | −0.197 | 0.288 | 0.348 | −0.219 |
| $DNEWS_{AVG}$ | 0.293 | 0.321 | −0.191 | 0.350 | 0.339 | −0.199 |

**Table 3** continued

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures while $RP_{EP}$ is a naïve implied risk premium metric based on the forward earnings to price ratio. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. $RET_1$ is the buy-and-hold return for 12 months following the calculation of the implied risk premium, less the risk-free rate. CNEWS is the measure of cash flow news from Easton and Monahan (2005). It 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 as follows: $CNEWS_{i,t+1} = LOG\_FERR_{i,t} + \Delta LOG\_FROE_{i,t} + \rho/(1 - \rho\omega)*\Delta LOG\_FROE_{i,t+2}$, where $LOG\_FERR_{it}$ is the realized forecast error on the $EPS_t$ forecast made at the end of fiscal year $t$, and revisions refer to changes in forecasts from the time of the estimation of implied risk premium to the end of the fiscal year. Forecasted ROE is defined as EPS forecast divided by book value of equity divided by number of shares used to calculate EPS. We use the $\rho$ estimates reported in Easton and Monahan (2005). Persistence coefficients $\omega t$ are estimated through a pooled time-series cross-sectional regression for each of the 48 Fama and French (1997) industries using 10 years of lagged data, that is, $LOG\_ROE_{i,t-\tau} = \omega_{0t} + \omega_t \times LOG\_ROE_{i,t-(\tau-1)}$, where $\tau$ is a number between zero and nine, and $ROE$ is return on equity DNEWS is the measure of discount rate news from Easton and Monahan (2005). For each of the risk premium metrics, DNEWS is measured as $DNEWS_{i,t+1} = -\rho/(1 - \rho)*(LOG\_ER_{i,t+1}-LOG\_ER_{i,t})$, where $LOG\_ER_{i,t}$ is the continuously compounded implied cost of equity estimate (that is, without subtracting out the risk-free rate) and $LOG\_ER_{i,t+1}$ is the one-year-ahead compounded implied cost of equity estimate. The number of observations for which DNEWS and CNEWS is available is slightly smaller (36,012) because of the requirement than one more year of data be available. Panel A presents the distribution for the risk premium measures, realized returns, and estimates of cash flow news and discount rate news. Panels B and C present the averages of annual cross-sectional correlations

(0.01 Pearson, −0.02 Spearman), and $RP_{CT}$ (0.01 Pearson, 0.00 Spearman). The proxy for cash flow shocks (CNEWS) is negatively correlated with all the risk premium metrics. Finally, the proxy for cash flow shocks (CNEWS) is strongly positively correlated with future returns (0.30 Pearson, 0.35 Spearman).

Panel C presents the correlations of the discount rate news proxies with the implied risk premium metric they are based on, future returns, and the cash flow news proxy. All the discount rate news proxies are positively correlated with future returns. Recall that a decline in the expected rate of return is positive discount rate news. Further, all the discount rate news proxies are also positively correlated with their underlying implied risk premium metrics, indicating mean reversion in the implied risk premium metrics across time (that is a high implied risk premium firm is more likely to see a lower implied risk premium in the next year which corresponds to positive discount rate news). Finally, the discount rate news proxies are negatively correlated with the cash flow news proxy. Most of the correlations reported in Table 3 are broadly consistent with Easton and Monahan. Moreover, the significant correlations between realized returns and the proxies for cash flow shocks and discount rate shocks highlights the need to control for these while evaluating the implied risk premium metrics.

## 4 The association between implied risk premium and returns

### 4.1 Association between implied cost of equity and realized returns

Table 4 analyzes the relationship between the implied risk premium metrics and future realized returns. We measure future realized returns as the buy-and-hold returns for the 12 months immediately after the calculation of implied risk premium. To mirror the definition of implied risk premium, we subtract the prevailing risk-free rate to arrive at our return measure ($RET_1$).

Table 4, Panel A presents mean $RET_1$ for quintiles based on risk premium, where quintiles are estimated annually and then pooled across the years. For the naïve measure, $RP_{EP}$, mean future returns increase monotonically across the quintiles, with the difference in returns between the top and bottom quintiles being 4.35 %. In comparison, the OJ based measures perform poorly. $RP_{OJ}$ performs the worst, with the return difference between the extreme quintiles of 2.34 %. $RP_{PEG}$ performs a little better, with a return difference of 2.86 %, but this pales in comparison to the return difference for the naïve $RP_{EP}$ measure. For all of these measures, the return spread is much smaller than the spread in risk premium. The only risk premium measure that performs well is $RP_{GLS}$, with a monotonic pattern in returns across the quintiles and a return difference of 6.08 % across the extreme quintiles as compared with a spread of 7.75 % in risk premium. Finally, the $RP_{AVG}$ measure performs modestly with a return difference of 4.32 %.

Table 4, Panel B, presents results of annual Fama and MacBeth (1973) regressions using the Easton and Monahan specification with $RET_1$ as the dependent variable and the risk premium metric, cash flow news proxy (CNEWS), and discount rate news proxy (DNEWS) as the independent variables.[8] Consistent with the results reported by Easton and Monahan, none of the risk premium metrics have significant coefficients. All the coefficients are significantly lower than the benchmark of "1." Consistent with the Vuolteenaho (2002) decomposition, the proxies for both cash flow news (CNEWS) and discount rate news (DNEWS) are significant in all the regressions. The results imply that, after controlling for cash flow news and discount rate news, none of the expected return proxies show a meaningful positive association with realized returns.

### 4.2 Measurement error in implied cost of equity metrics

Easton and Monahan estimate implied measurement errors for each of the proxies using a modified version of the approach developed in Garber and Klepper (1980). Specifically, they construct a statistic for the extent of the measurement error in risk premium proxies based on the covariance between the measurement errors for each of three variables in the regression (risk premium metric, cash flow news metric, and discount rate news metric). Easton and Monahan report a noise variable and

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[8] Easton and Monahan (2005) use continuously compounded expected returns [that is, log (1 + ret)], while we use the untransformed metrics. Results are virtually identical if we also continuously compound the implied RP metrics and realized returns.

**Table 4** Relationship between Risk Premium Metrics and One-Year-Ahead Returns

*Panel A: Means of risk premium (%) and $RET_1$ (%) by quintiles of risk premium metrics*

| Qtl. | $RP_{EP}$ | $RET_1$ | $RP_{OJ}$ | $RET_1$ | $RP_{PEG}$ | $RET_1$ | $RP_{GLS}$ | $RET_1$ | $RP_{CT}$ | $RET_1$ | $RP_{AVG}$ | $RET_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | – 1.24 | 3.60 | 2.16 | 4.12 | 0.34 | 3.84 | 0.43 | 2.09 | 1.19 | 3.03 | 1.55 | 2.87 |
| 2 | 0.79 | 4.02 | 3.96 | 5.16 | 2.25 | 5.26 | 2.52 | 4.64 | 2.53 | 5.42 | 3.01 | 4.58 |
| 3 | 1.98 | 5.21 | 4.94 | 5.37 | 3.33 | 5.51 | 3.82 | 5.31 | 3.88 | 5.96 | 3.96 | 6.15 |
| 4 | 3.19 | 6.45 | 6.05 | 6.13 | 4.55 | 5.92 | 5.24 | 7.02 | 4.97 | 6.38 | 5.02 | 6.46 |
| 5 | 6.16 | 7.95 | 8.72 | 6.46 | 7.20 | 6.71 | 8.19 | 8.17 | 7.73 | 6.44 | 7.44 | 7.19 |
| 5-1 | 7.40 | 4.35 | 6.56 | 2.34 | 6.86 | 2.86 | 7.75 | 6.08 | 6.54 | 3.40 | 5.89 | 4.32 |
| (t-stat) | | (5.22) | | (2.83) | | (3.50) | | (7.94) | | (4.20) | | (5.29) |

*Panel B: Regressions of $RET_1$ on risk premium metrics*

| RP Metric | Intercept | RP | CNEWS | DNEWS | Adj. $R^2$ (%) | Noise variable | Modified noise variable |
|---|---|---|---|---|---|---|---|
| $RP_{EP}$ | 0.1133 | $– 0.5186^{+++}$ | 1.2864 | 0.0881 | 14.1 | 0.00976*** | – 0.00001 |
| | (4.54) | (– 1.44) | (13.91) | (10.01) | | (9.74) | (– 0.05) |
| $RP_{OJ}$ | 0.1113 | $– 0.3266^{+++}$ | 1.2094 | 0.0825 | 11.5 | 0.00705*** | 0.00014 |
| | (3.87) | (– 1.01) | (13.92) | (7.78) | | (14.95) | (0.79) |
| $RP_{PEG}$ | 0.0985 | $– 0.1715^{+++}$ | 1.2354 | 0.0887 | 12.7 | 0.0076*** | 0.00028* |
| | (3.98) | (– 0.64) | (13.99) | (9.13) | | (11.25) | (1.68) |
| $RP_{GLS}$ | 0.1094 | $– 0.1564^{+++}$ | 1.2293 | 0.2382 | 34.3 | 0.00499*** | – 0.00017 |
| | (4.64) | (– 0.68) | (16.61) | (19.21) | | (4.90) | (– 0.77) |
| $RP_{CT}$ | 0.093 | $– 0.0201^{+++}$ | 1.3188 | 0.1156 | 16.6 | 0.00644*** | 0.00012 |
| | (3.59) | (– 0.06) | (14.29) | (10.6) | | (11.05) | (0.53) |
| $RP_{AVG}$ | 0.1049 | $– 0.2159^{+++}$ | 1.312 | 0.1468 | 18.5 | 0.00477*** | – 0.00005 |
| | (4.00) | (– 0.61) | (15.09) | (13.34) | | (9.84) | (– 0.27) |

*Panel C: Comparison of noise variables*

| | Noise variable | | | | | Modified noise variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| RP Metric | versus $RP_{OJ}$ | versus $RP_{PEG}$ | versus $RP_{GLS}$ | versus $RP_{CT}$ | versus $RP_{AVG}$ | versus $RP_{OJ}$ | versus $RP_{PEG}$ | versus $RP_{GLS}$ | versus $RP_{CT}$ | versus $RP_{AVG}$ |
| $RP_{EP}$ | 0.0027** | 0.0022* | 0.0048*** | 0.0033*** | 0.0050*** | −0.0002 | −0.0003 | 0.0002 | −0.0001 | 0.0000 |
| | (2.45) | (1.79) | (3.34) | (2.86) | (4.48) | (−0.45) | (– 0.89) | (0.43) | (– 0.37) | (0.11) |
| $RP_{OJ}$ | | −0.0005 | 0.0021* | 0.0006 | 0.0023*** | | −0.0001 | 0.0003 | 0.0000 | 0.0002 |
| | | (–0.66) | (1.84) | (0.81) | (3.36) | | (−0.60) | (1.09) | (0.06) | (0.72) |
| $RP_{PEG}$ | | | 0.0026** | 0.0012 | 0.0028*** | | | 0.0005 | 0.0002 | 0.0003 |
| | | | (2.14) | (1.30) | (3.39) | | | (1.63) | (0.58) | (1.30) |
| $RP_{GLS}$ | | | | −0.0015 | 0.0002 | | | | −0.0003 | −0.0001 |
| | | | | (−1.24) | (0.19) | | | | (−0.92) | (−0.41) |
| $RP_{CT}$ | | | | | 0.0017*** | | | | | 0.0002 |
| | | | | | (2.20) | | | | | (0.58) |

**Table 4** continued

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures, while $RP_{EP}$ is a naïve implied risk premium metric based on the forward earnings to price ratio. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. $RET_1$ is the buy-and-hold return for 12 months following the calculation of the implied risk premium, less the risk-free rate. Panel A presents the means for $RET_1$ and risk premium for each quintile based on each risk premium measure, where quintiles are estimated annually and then pooled across the years. T-statistics for differences between quintiles use a pooled estimate of standard error. Panel B presents regressions with $RET_1$ as the dependent variable. The regressions are based on Easton and Monahan (2005) and include the appropriate risk premium metric in addition to cash flow news proxy (CNEWS) and the discount rate news proxy (DNEWS) as additional independent variables. See the header to Table 3 for details on how CNEWS and DNEWS are estimated. The number of observations for the regressions is lower due to data requirements for discount rate news and cash flow news (36,012 instead of 42,600). Coefficients from annual regressions are averaged using the Fama and MacBeth (1973) procedure. The table presents average coefficients with t-statistics in parentheses. In addition, the table also presents and compares the average measurement error noise coefficient and modified noise coefficient using the methodology of Easton and Monahan (2005). See Table 5 (page 517) of Easton and Monahan (2005) for details on how they are computed. T-statistics for differences in measurement error use a pooled estimate of standard error. Significance of difference from 0.00 is denoted by *** 1 % level, ** 5 % level, * 10 % level. Significance of difference from 1.00 is denoted by $^{+++}$ 1 % level, $^{++}$ 5 % level, $^{+}$ 10 % level

modified noise variable (see Table 5, page 517, of Easton and Monahan for details). We present the annual averages of both the noise and modified noise variables in the last two columns of Table 4, Panel B. The unmodified noise variable is significant for each of the risk premium metrics, indicating significant measurement error. The coefficients for the modified noise variables are generally insignificant, with the exception of $RP_{PEG}$ where it is marginally significant.

We also compare the magnitudes of the two noise variables across the different metrics in Table 4, Panel C. We focus on the differences in the noise variables; the differences in the modified noise variables are insignificant. The table presents the difference between the RP metric in the row as against each of the other RP metrics in the columns. The naïve measure $RP_{EP}$ has significantly higher measurement error than the four theoretically motivated implied RP metrics. $RP_{OJ}$ and $RP_{PEG}$ have relatively higher measurement error, significantly higher than that for $RP_{GLS}$. Interestingly, $RP_{AVG}$ has lower measurement error than any of the four RP metrics it is based on, suggesting that the common approach of averaging different risk premium metrics reduces measurement error. However, the noise variable for $RP_{AVG}$ continues to be significant, indicating that averaging reduces but does not eliminate measurement error. $RP_{GLS}$ performs almost as well as the average measure.

### 4.3 Understanding the weak association between implied risk premium metrics and future returns

We now probe why the risk premium measures are weakly correlated with future returns and why they have such significant measurement error. Is there a predictable trend in realized bad news that causes firms with high implied risk premia to have substantially lower realized returns? To examine this, we compare the realized earnings surprise across the five quintiles formed based on risk premium. We define $SURP_1$ as the difference between realized $EPS_1$ and expected $EPS_1$ scaled by stock price and $ASURP_1$ as the absolute value of $SURP_1$. $SURP_2$ and $ASURP_2$ are defined similarly using two-year-ahead forecasts. The results are presented in Table 5, Panel A. Across all the risk premium measures, there is a strong inverse trend between earnings surprise and implied risk premium, that is, firms with high implied risk premiums are more likely to have negative earnings surprises. Further, there is a strong positive relationship between absolute forecast accuracy $ASURP_1$ and implied risk premium, as firms with high implied risk premium are also likely to be based on forecasts that are, ex post, least likely to be accurate. In addition, for two-year-ahead forecasts, the relationship between implied risk premium and forecast accuracy ($ASURP_2$) persists.

Why do firms with high implied risk premium have strong negative surprises? Perhaps the market is inefficient and has unreasonably high growth expectations for firms that are perceived to be high risk. It may then be surprised when the firms do not meet those expectations, which will cause the realized return to be low. Another explanation, which we focus on, is that market expectations are measured with error. Analysts are predictably overly optimistic and markets correct for this, that is, market expectations are lower than I/B/E/S forecasts. For firms with predictably optimistic forecasts, the stock price will appear low relative to I/B/E/S earnings forecasts, which will inflate the implied cost of equity. These firms will have a negative earnings surprise rather than a higher realized return. Such firms will be in the higher risk premium quintiles because of the inflated earnings estimates but will have low realized returns.

### 4.4 Forecast accuracy and the association between implied risk premium and returns

Prior research has shown that when analyst forecasts are relatively accurate, implied risk premium is strongly related with realized returns (Easton and Monahan). We test this in our sample by using the realized absolute forecast error ($ASURP_1$) as our metric of forecast accuracy. Each year, we partition our sample into terciles based on absolute forecast error and study the relationship between risk premium and returns within each tercile. The results are presented in Table 5, Panel B.

The left columns show results for $RP_{OJ}$. For the most accurate tercile, we see a strong monotonic relationship between risk premium and future returns, with a return spread of 13.0 % as against a difference in $RP_{OJ}$ of 5.7 % across quintiles. For the middle tercile, the monotonic relationship persists with a return spread of 7.6 % as against a difference in $RP_{OJ}$ of 6.2 % across quintiles. For the least accurate tercile, the *relationship is inverted* with future returns declining almost monotonically from 5.3 % for firms with lowest risk premium to 0.0 % for firms with highest risk premium. Results for $RP_{PEG}$ are almost identical. The next set of columns present the results for terciles based on $RP_{GLS}$. Here, the positive relationship between risk premium and returns does not disappear completely for

**Table 5** Relationship between risk premium Metrics and Forecast Accuracy

| *Panel A: Forecast surprise (%) and absolute forecast error (%) by quintiles of risk premium* | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Qtl. | Quintiles based on $RP_{OJ}$ | | | | Quintiles based on $RP_{PEG}$ | | | | Quintiles based on $RP_{GLS}$ | | | | Quintiles based on $RP_{CT}$ | | | |
| | $Surp_1$ | $ASurp_1$ | $Surp_2$ | $ASurp_2$ | $Surp_1$ | $ASurp_1$ | $Surp_2$ | $ASurp_2$ | $Surp_1$ | $ASurp_1$ | $Surp_2$ | $ASurp_2$ | $Surp_1$ | $ASurp_1$ | $Surp_2$ | $ASurp_2$ |
| 1 | −0.7 | 1.6 | −1.6 | 3.2 | −0.6 | 1.4 | −1.4 | 2.8 | −0.2 | 0.7 | −0.7 | 1.7 | −0.5 | 1.3 | −1.1 | 2.4 |
| 2 | −0.4 | 1.1 | −1.2 | 2.3 | −0.5 | 1.1 | −1.3 | 2.4 | −0.4 | 1.0 | −1.2 | 2.3 | −0.5 | 1.1 | −1.3 | 2.4 |
| 3 | −0.6 | 1.3 | −1.6 | 2.7 | −0.6 | 1.2 | −1.5 | 2.6 | −0.7 | 1.3 | −1.8 | 2.9 | −0.5 | 1.2 | −1.4 | 2.6 |
| 4 | −1.0 | 1.6 | −2.5 | 3.6 | −1.0 | 1.7 | −2.5 | 3.7 | −1.1 | 1.9 | −2.7 | 4.1 | −1.0 | 1.6 | −2.4 | 3.6 |
| 5 | −2.4 | 3.2 | −4.8 | 6.3 | −2.5 | 3.4 | −5.1 | 6.6 | −2.8 | 3.9 | −5.3 | 7.2 | −2.7 | 3.6 | −5.6 | 7.2 |
| 5-1 | −1.7 | 1.6 | −3.2 | 3.1 | −1.9 | 1.9 | −3.7 | 3.9 | −2.6 | 3.1 | −4.6 | 5.6 | −2.2 | 2.3 | −4.5 | 4.7 |
| (t-stat) | (−2.02) | (21.3) | (−46.2) | (25.2) | (−2.28) | (25.9) | (−54.0) | (31.4) | (−3.45) | (42.1) | (−67.0) | (45.7) | (−2.68) | (30.8) | (−65.1) | (38.0) |

**Table 5** continued

*Panel B: Relationship between risk premium metrics (%) and one-year-ahead returns (%) conditioned on forecast accuracy*

| Accuracy Tercile | RP Quintile | N | $RP_{OJ}$ | $RET_1$ | N | $RP_{PEG}$ | $RET_1$ | N | $RP_{GLS}$ | $RET_1$ | N | $RP_{CT}$ | $RET_1$ | N | $RP_{AVG}$ | $RET_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2,926 | 2.5 | 1.2 | 3,098 | 0.5 | 2.9 | 4,230 | 0.4 | 1.9 | 3,484 | 1.4 | 0.9 | 3,677 | 1.6 | 1.0 |
| 1 | 2 | 3,738 | 4.0 | 5.3 | 3,648 | 2.2 | 4.9 | 3,564 | 2.5 | 6.1 | 3,806 | 2.6 | 5.7 | 3,692 | 3.0 | 5.2 |
| 1 | 3 | 3,298 | 4.9 | 7.2 | 3,343 | 3.3 | 6.6 | 2,915 | 3.8 | 9.1 | 3,123 | 3.8 | 8.5 | 3,089 | 3.9 | 8.4 |
| 1 | 4 | 2,659 | 6.0 | 11.8 | 2,593 | 4.5 | 10.5 | 2,145 | 5.2 | 11.5 | 2,392 | 4.8 | 10.6 | 2,383 | 4.9 | 12.1 |
| 1 | 5 | 1,569 | 8.2 | 14.2 | 1,508 | 6.6 | 16.4 | 1,336 | 8.0 | 14.6 | 1,385 | 7.0 | 17.3 | 1,349 | 6.9 | 17.0 |
|  | 5-1 |  | 5.7 | 13.0 |  | 6.1 | 13.5 |  | 7.6 | 12.7 |  | 5.6 | 16.4 |  | 5.2 | 16.0 |
|  | (t-stat) |  |  | (9.09) |  |  | (8.91) |  |  | (9.16) |  |  | (10.68) |  |  | (10.41) |
| 2 | 1 | 2,842 | 2.2 | 6.0 | 2,898 | 0.3 | 5.2 | 2,885 | 0.5 | 3.7 | 2,848 | 1.2 | 6.2 | 2,861 | 1.5 | 4.9 |
| 2 | 2 | 2,933 | 4.0 | 6.9 | 2,934 | 2.3 | 7.2 | 3,132 | 2.5 | 6.5 | 3,133 | 2.5 | 6.3 | 3,065 | 3.0 | 5.7 |
| 2 | 3 | 2,971 | 5.0 | 6.9 | 3,014 | 3.4 | 7.2 | 3,120 | 3.9 | 8.1 | 3,042 | 3.9 | 6.9 | 3,099 | 4.0 | 7.7 |
| 2 | 4 | 3,043 | 6.0 | 10.6 | 2,992 | 4.5 | 10.0 | 2,912 | 5.2 | 11.7 | 2,985 | 5.0 | 10.9 | 2,954 | 5.0 | 10.7 |
| 2 | 5 | 2,417 | 8.3 | 13.6 | 2,368 | 6.8 | 14.4 | 2,157 | 7.9 | 14.9 | 2,198 | 7.3 | 14.4 | 2,227 | 7.0 | 15.9 |
|  | 5-1 |  | 6.2 | 7.6 |  | 6.5 | 9.2 |  | 7.4 | 11.2 |  | 6.1 | 8.2 |  | 5.5 | 11.0 |
|  | (t-stat) |  |  | (5.45) |  |  | (6.62) |  |  | (8.14) |  |  | (5.57) |  |  | (7.61) |
| 3 | 1 | 2,739 | 1.8 | 5.3 | 2,511 | 0.2 | 3.4 | 1,391 | 0.3 | −0.7 | 2,117 | 0.9 | 2.3 | 1,969 | 1.4 | 3.4 |
| 3 | 2 | 1,854 | 4.0 | 2.2 | 1,944 | 2.3 | 3.0 | 1,834 | 2.5 | −1.5 | 1,932 | 2.3 | 3.4 | 1,768 | 3.0 | 1.3 |
| 3 | 3 | 2,256 | 5.0 | 0.8 | 2,167 | 3.3 | 1.4 | 2,485 | 3.8 | −2.6 | 2,182 | 3.9 | 1.0 | 2,337 | 4.0 | 1.0 |
| 3 | 4 | 2,823 | 6.1 | −4.0 | 2,940 | 4.6 | −2.3 | 3,467 | 5.3 | 0.3 | 3,037 | 5.1 | −1.4 | 3,188 | 5.1 | −1.7 |
| 3 | 5 | 4,532 | 9.1 | 0.0 | 4,642 | 7.6 | −0.4 | 5,027 | 8.3 | 3.6 | 4,936 | 8.2 | −0.1 | 4,942 | 7.8 | 0.6 |
|  | 5-1 |  | 7.3 | −5.3 |  | 7.4 | −3.8 |  | 8.0 | 4.3 |  | 7.2 | −2.4 |  | 6.4 | −2.8 |
|  | (t-stat) |  |  | (−3.65) |  |  | (−2.70) |  |  | (2.76) |  |  | (−1.71) |  |  | (−1.88) |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. $RET_1$ is the buy-and-hold return for 12 months following the calculation of the implied risk premium, less the risk-free rate. Panel A presents means of analyst forecast surprise and absolute forecast error by risk premium quintile. SURP1 (SURP2) is defined as the difference between realized and expected EPS1 scaled by price. ASURP1 (ASURP2) is the absolute value of SURP1 (SURP2). For Panel B, the sample is partitioned into quintiles based on each risk premium measure and independently into terciles based on absolute forecast accuracy, $ASURP_1$. The quintiles based on risk premium and the terciles based on $ASURP_1$ are estimated annually and then pooled. For each risk premium measure, the means of risk premium and $RET_1$ are presented for each tercile based on absolute forecast accuracy further partitioned into quintiles based on risk premium. T-statistics for differences between quintiles use a pooled estimate of standard error the least accurate tercile but ceases to be monotonic and weakens considerably. Finally, the last two sets of columns present the results for terciles based on $RP_{CT}$ and $RP_{AVG}$. Here again, the relationship between implied risk premium and future returns is essentially inverted for the most inaccurate forecasts.

## 5 Adjusting forecasts for predictable errors

### 5.1 Identifying factors to predict forecast errors

Prior research identifies several causes of predictable analyst forecast errors. Hughes et al. (2008) synthesize these results and classify the parameters used to predict forecast errors into two main categories—underreaction variables (recent returns, recent revisions in forecasts, recent forecast errors) and overreaction variables (accruals, sales growth, analyst LTG estimates, growth in PP&E, growth in other long term assets). In our model, we exclude recent forecast error because including it requires lagged forecasts, which reduces sample size significantly; results are robust to the inclusion of this variable.

The regression to predict forecast errors includes the following overreaction variables: ACCR—total accruals scaled by lagged assets,[9] SGR—sales growth from current and lagged sales (Compustat #12), LTG minus median analyst long-term growth estimate, ΔPPE minus growth in PP&E from current and lagged gross PP&E (Compustat #7), ΔOLA minus growth in other long term assets from current and lagged other long term assets (= Total Assets (Compustat #12) minus Current Assets (Compustat #4) minus Net PP&E (Compustat #8)).[10]

The underreaction variables are as follows: $RET_0$—annual buy-and-hold returns for the 12 months prior to the estimation of implied risk premium, and REV—difference between consensus mean analysts' 1-year ahead EPS forecast used for risk premium estimation and the corresponding forecast at the beginning of the year, scaled by price.

Our dependent variables are $SURP_1$, the difference between realized $EPS_1$ and expected $EPS_1$ and $SURP_2$, the difference between realized $EPS_2$ and expected $EPS_2$, both scaled by price. To reduce the influence of outliers, all variables are truncated at the 0.5 and 99.5 % level annually. Table 6, Panel A, presents correlations between $SURP_1$, $SURP_2$, and the prediction variables. $SURP_1$ and $SURP_2$ are strongly positively correlated with the underreaction variables ($RET_0$ and REV) and weakly negatively correlated with most overreaction variables (ACCR, SGR, LTG and ΔPPE).

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[9] Accruals are defined as earnings before extra-ordinary items (Compustat #18) minus cash from operations (Compustat #308) scaled by lagged total assets (Compustat #6). For years prior to 1988, we use the balance sheet approach to calculating accruals. See Sloan (1996) for details. Results are unchanged if we use the balance sheet approach for the entire period.

[10] Accruals may represent mispricing that neither markets (Sloan 1996) nor analysts (Bradshaw et al. 2001) understand. We hence rerun the error prediction regressions without accruals. Results are essentially unchanged.

**Table 6** Predicting forecast surprise from firm and analysts characteristics

*Panel A: Correlations between forecast surprise, firm characteristics, and risk premium metrics*

| | SURP$_1$ | SURP$_2$ | ACCR | SGR | LTG | ΔPPE | ΔOLA | RET$_0$ | REV |
|---|---|---|---|---|---|---|---|---|---|
| SURP$_1$ | | 0.58 | −0.05 | −0.02 | −0.02 | −0.04 | 0.00 | 0.25 | 0.36 |
| SURP$_2$ | 0.61 | | −0.06 | −0.06 | −0.06 | −0.04 | 0.00 | 0.22 | 0.30 |
| ACCR | −0.07 | −0.07 | | 0.23 | 0.13 | −0.04 | 0.10 | −0.04 | −0.06 |
| SGR | −0.02 | −0.06 | 0.24 | | 0.43 | 0.28 | 0.26 | 0.05 | 0.00 |
| LTG | −0.05 | −0.10 | 0.11 | 0.41 | | 0.17 | 0.05 | 0.14 | 0.01 |
| ΔPPE | −0.10 | −0.09 | −0.06 | 0.30 | 0.24 | | −0.02 | −0.01 | −0.04 |
| ΔOLA | 0.00 | 0.01 | 0.15 | 0.25 | 0.03 | −0.04 | | −0.01 | 0.01 |
| RET$_0$ | 0.32 | 0.28 | −0.05 | 0.03 | 0.04 | −0.02 | −0.01 | | 0.35 |
| REV | 0.37 | 0.28 | −0.06 | 0.04 | 0.03 | −0.05 | −0.01 | 0.43 | |

*Panel B: Summary of annual regression of forecast surprise on firm characteristics*

| Dependent variable | Intercept | ACCR | SGR | LTG | ΔPPE | ΔOLA | RET$_0$ | REV | Adj. $R^2$ (%) |
|---|---|---|---|---|---|---|---|---|---|
| SURP$_1$ | 0.009 | 0.002 | −0.001 | −0.051 | 0.000 | 0.011 | 0.018 | 0.987 | |
| | (3.31) | (0.36) | (−0.76) | (−10.23) | (0.08) | (1.99) | (6.36) | (20.78) | 19.8 |
| SURP$_2$ | 0.0241 | −0.019 | 0.008 | −0.127 | −0.036 | 0.0287 | 0.026 | 1.150 | |
| | (5.25) | (−1.24) | (0.60) | (−10.79) | (−1.14) | (1.73) | (5.43) | (21.11) | 16.1 |

*Panel C: Correlation between predicted surprise, actual surprise, and risk premium metrics*

| | SURP$_1$ | SURP$_2$ | PSURP$_1$ | PSURP$_2$ | RP$_{OJ}$ | RP$_{PEG}$ | RP$_{GLS}$ | RP$_{CT}$ |
|---|---|---|---|---|---|---|---|---|
| SURP$_1$ | | 0.58 | 0.40 | 0.38 | −0.10 | −0.13 | −0.24 | −0.20 |
| SURP$_2$ | 0.61 | | 0.36 | 0.35 | −0.15 | −0.19 | −0.25 | −0.26 |
| PSURP$_1$ | 0.40 | 0.34 | | 0.88 | −0.26 | −0.30 | −0.36 | −0.34 |
| PSURP$_2$ | 0.37 | 0.33 | 0.86 | | −0.38 | −0.42 | −0.40 | −0.45 |
| RP$_{OJ}$ | −0.11 | −0.15 | −0.32 | −0.42 | | 0.87 | 0.31 | 0.77 |
| RP$_{PEG}$ | −0.18 | −0.20 | −0.40 | −0.43 | 0.32 | | 1.00 | 0.41 |
| RP$_{GLS}$ | −0.11 | −0.17 | −0.34 | −0.45 | 0.84 | 1.00 | | 0.74 |
| RP$_{CT}$ | −0.16 | −0.22 | −0.38 | −0.47 | 0.75 | 0.70 | 0.44 | |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are RP$_{OJ}$, RP$_{PEG}$, RP$_{GLS}$, and RP$_{CT}$ estimated using the methodology outlined in Sect. 3. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. SURP$_1$ (SURP$_2$) is defined as the difference between realized and expected EPS$_1$ (EPS$_2$) scaled by price. The following variables are used for the prediction of forecast errors. ACCR is total accruals estimated as described in footnote 9. SGR is sales growth computed from current and lagged sales (Compustat #12). LTG is the median analyst long-term growth estimate. ΔPPE is growth in PP&E computed from current and lagged gross PP&E (Compustat #7). ΔOLA is growth in other long-term assets computed from current and lagged other long-term assets (Compustat #12–Compustat #4–Compustat #8). RET$_0$ is the annual buy-and-hold returns for the 12 months prior to the estimation of implied risk premium. REV is the difference between consensus mean analysts' one-year ahead EPS forecast used for risk premium estimation and the forecast at the start of the year, scaled by price. Panel A presents means of annual correlations between variables. Figure above/below diagonal represent Pearson/Spearman correlations. Panel B presents summary of annual regressions with SURP$_1$ (SURP$_2$) as the dependent variable and E/P, ACCR, SGR, LTG, ΔPPE, ΔOLA, RET$_0$, and REV as independent variables. T-statistics in parentheses are calculated using the Fama and MacBeth (1973) procedure. Coefficients from once-lagged (twice-lagged) regressions for SURP$_1$ (SURP$_2$) are multiplied with corresponding independent variables to estimate predicted forecast error, labeled PSURP$_1$ (PSURP$_2$). Panel C presents means of annual correlations between for actual surprise, predicted surprise, and implied risk premium metrics. Numbers above/below diagonal represent Pearson/Spearman rank-order correlations

### 5.2 Predicting forecast errors

To predict forecast error, we run annual regressions for $SURP_1$ and $SURP_2$. To avoid look-ahead bias, the regressions for $SURP_1$ and $SURP_2$ use independent variables from the time of the underlying forecast. Table 6, Panel B summarizes the results. Coefficients are mean coefficients from annual regressions, with t-statistics calculated using the Fama and MacBeth (1973) methodology. Overall, the average adjusted $R^2$ is high at 19.8 % for $SURP_1$ and 16.1 % for $SURP_2$. Among overreaction variables, analysts' long-term growth forecasts (LTG) loads strongly negatively as expected, but ACCR, ΔPPE, and ΔOLA are insignificant. Both underreaction variables, REV and $RET_0$, load strongly positively.

We multiply coefficients from one-year lagged regressions of $SURP_1$ with the realized values of the independent variables to arrive at predicted $SURP_1$ ($PSURP_1$).[11] To illustrate, we regress realized earnings forecast errors at the end of 1982 on the observable factors at the end of 1981. We then use these regression coefficients and the observable factors as of the end of 1982 to predict the forecast error for earnings expected at the end of 1983, and so on. Similarly, we use twice-lagged regressions to predict the forecast errors $PSURP_2$ in $EPS_2$.

Table 6, Panel C, summarizes the correlations between the predicted surprises, actual earnings surprises, and the risk premium metrics. $PSURP_1$ is strongly correlated with $SURP_1$ (Pearson 0.40, Spearman 0.43). Similarly, $PSURP_2$ is also strongly correlated with $SURP_2$ (Pearson 0.32, Spearman 0.33). In addition, the risk premium metrics are negatively correlated with the predicted surprises, hinting that removing predictable forecast errors may improve the relationship between the risk premium metrics and future returns.

### 5.3 Using adjusted forecasts to re-estimate implied risk premium

We now recompute the risk premium metrics after removing predicted errors from $EPS_1$ and $EPS_2$.[12] We first estimate adjusted $EPS_1$ as $EPS_1 + PSURP_1*PRICE$ and label it $AEPS_1$. Similarly, we estimate adjusted $EPS_2$ as $EPS_2 + PSURP_2*PRICE$ and label it $AEPS_2$.

Table 7, Panel A, shows descriptive statistics for the forecast adjustment. $PSURP_1$ and $PSURP_2$ have means of −1.0 and −2.1 %, respectively. These percentages appear small because the variables are scaled by price. While the mean $EPS_1$ for the sample is \$1.39, the mean $AEPS_1$ is substantially lower at \$1.24. Similarly, the mean $EPS_2$ is \$1.62 while mean $AEPS_2$ is \$1.30.

We use the adjusted EPS numbers to re-estimate the risk premium metrics. The adjusted implied risk premium metrics are prefixed with an "A." As discussed earlier, we also truncate the adjusted implied risk premium metrics at the 0.5 and

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[11] We reran the error prediction methodology with only the variables with significant coefficients. Results are essentially unchanged. We do not use this as our default approach as doing so might impose a look-ahead bias.

[12] To reduce the influence of outliers, we winsorize PSURP1 and PSURP2 at the 0.5 and 99.5% level annually. Results are unchanged if we truncate extreme values instead of winsorizing.

**Table 7** Using adjusted forecasts to calculate adjusted risk premium metrics

*Panel A: Descriptive statistics for adjustments to forecasts and adjusted risk premium metrics*

| | N | Mean | SD | 5th | 25th | 50th | 75th | 95th |
|---|---|---|---|---|---|---|---|---|
| $PSURP_1$ | 42,600 | −1.0 % | 1.9 % | −4.2 % | −1.7 % | −0.7 % | 0.0 % | 1.4 % |
| $PSURP_2$ | 42,600 | −2.1 % | 3.0 % | −7.1 % | −3.4 % | −1.7 % | −0.4 % | 1.5 % |
| $EPS_1$ | 42,600 | 1.39 | 1.38 | 0.22 | 0.60 | 1.08 | 1.77 | 3.50 |
| $EPS_2$ | 42,600 | 1.62 | 1.50 | 0.31 | 0.77 | 1.30 | 2.04 | 3.94 |
| $AEPS_1$ | 42,600 | 1.24 | 1.31 | 0.15 | 0.49 | 0.94 | 1.60 | 3.26 |
| $AEPS_2$ | 42,600 | 1.30 | 1.37 | 0.17 | 0.52 | 0.97 | 1.66 | 3.45 |
| $ARP_{EP}$ | 42,600 | −0.2 % | 2.9 % | −4.8 % | −2.1 % | −0.2 % | 1.5 % | 4.7 % |
| $ARP_{OJ}$ | 42,600 | 4.4 % | 2.3 % | 0.6 % | 3.0 % | 4.3 % | 5.6 % | 8.4 % |
| $ARP_{PEG}$ | 42,600 | 2.8 % | 2.7 % | −1.8 % | 1.2 % | 2.9 % | 4.4 % | 7.0 % |
| $ARP_{GLS}$ | 42,600 | 3.2 % | 3.0 % | −1.3 % | 1.4 % | 3.1 % | 4.7 % | 8.2 % |
| $ARP_{CT}$ | 42,600 | 2.2 % | 2.4 % | −2.7 % | 0.9 % | 2.4 % | 3.5 % | 5.8 % |
| $ARP_{AVG}$ | 42,600 | 3.6 % | 2.1 % | 0.4 % | 2.3 % | 3.5 % | 4.8 % | 7.2 % |

*Panel B: Correlations between original and adjusted risk premium metrics and future returns*

| | Average Pearson correlation | | | Average Spearman correlation | | |
|---|---|---|---|---|---|---|
| RP metric | $\rho$ (RP, ARP) | $\rho$ (RP, $RET_1$) | $\rho$ (ARP, $RET_1$) | $\rho$ (RP, ARP) | $\rho$ (RP, $RET_1$) | $\rho$ (ARP, $RET_1$) |
| $RP_{EP}$ | 0.834 | 0.042 | 0.072 | 0.813 | 0.060 | 0.108 |
| $RP_{OJ}$ | 0.822 | 0.016 | 0.031 | 0.790 | 0.001 | 0.020 |
| $RP_{PEG}$ | 0.819 | 0.014 | 0.032 | 0.802 | −0.021 | 0.010 |
| $RP_{GLS}$ | 0.830 | 0.058 | 0.061 | 0.817 | 0.042 | 0.055 |
| $RP_{CT}$ | 0.391 | 0.014 | 0.029 | 0.356 | −0.001 | 0.033 |
| $RP_{AVG}$ | 0.877 | 0.035 | 0.048 | 0.855 | 0.012 | 0.029 |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures while $RP_{EP}$ is a naïve implied risk premium metric based on the forward earnings to price ratio. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. $RET_1$ is the buy-and-hold return for 12 months following the calculation of the implied risk premium, less the risk-free rate. $EPS_1$ ($EPS_2$) is the unadjusted one-year-ahead (two-year-ahead) EPS forecast using to estimate implied risk premium. $PSURP_1$ ($PSURP_2$) is the predicted surprise in $EPS_1$ ($EPS_2$) estimated as outlined in the header to Table 6. $AEPS_1$ equals $EPS_1 + PSURP_1$* PRICE. $AEPS_2$ equals $EPS_2 + PSURP_2$*PRICE. $AEPS_1$ and $AEPS_2$ are used to re-estimate the implied risk premium metrics labeled as $ARP_{OJ}$, $ARP_{PEG}$, $ARP_{GLS}$, and $ARP_{CT}$. $ARP_{AVG}$ is the mean of the above four adjusted measures, while $ARP_{EP}$ is the naïve implied risk premium metric based on the adjusted forward earnings to price ratio. Panel A presents descriptive statistics for the adjustments, original and adjusted risk premium metrics. Panel B presents means of annual correlations between original and adjusted implied risk premium metrics and realized returns ($RET_1$)

99.5 % level annually.[13] Table 7, Panel A, also presents the statistics for the original and adjusted risk premium metrics. A comparison with the descriptive statistics in Table 3 suggests that the lowered forecasts lead to lower risk premium for all implied risk premium metrics. For instance, mean $RP_{OJ}$ declines from 5.2 to 4.4 %, while mean $RP_{GLS}$ declines from 4.0 to 3.2 %. The mean of the composite

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[13] Sometimes the adjusted estimates of two-year-ahead EPS are below the adjusted estimates of one-year-ahead EPS, that is, two-year growth is negative. In that case, we set the short-term growth rate (STG) used for $ARP_{OJ}$ and $ARP_{PEG}$ equal to the forecasted long-term growth rate (LTG).

measure $RP_{AVG}$ declines from 4.2 to 3.6 %. The decline in the average value of implied risk premium is consistent with the lowered aggregate risk premium estimated by Easton and Sommers (2007) after adjusting for ex post forecast bias.

Table 7, Panel B, presents the correlations between the original risk premium metrics, the adjusted risk premium metrics, and realized returns. The first set of columns present the Pearson correlations, while the next set of columns present the Spearman correlations. Since the two are similar, we discuss only the former. The first column presents the correlation between the original risk premium metric and the adjusted risk premium metric and indicates that most of the adjusted risk premium metrics retain a strong correlation with the unadjusted metric, with the exception of $RP_{CT}$.

The next two columns present the correlations of the original and the adjusted metric with future returns. Comparing the correlation with $RET_1$ indicates that the adjustment improves the correlations for all metrics. For the naïve $RP_{EP}$, the Pearson correlation improves from 0.042 to 0.072. For $RP_{OJ}$, the Pearson correlation improves from 0.016 to 0.031. For $RP_{CT}$, the Pearson correlation improves from 0.014 to 0.029. Interestingly, the improvement is modest for $RP_{GLS}$, where the Pearson correlation improves from 0.058 to 0.061. We suggest two explanations for this. First, $RP_{GLS}$ relies on a reversion to industry median profitability, which implies that any perturbations to forecasted $EPS_1$ and $EPS_2$ are unlikely to significantly impact terminal value. This is unlike $RP_{OJ}$, $RP_{PEG}$ and $RP_{CT}$ for which lower short-term earnings forecast will lower terminal value which is based on growth in earnings. Second, the correlation of $RP_{GLS}$ with realized returns is quite robust to begin with. Trends with Spearman rank-order correlations are similar.

## 6 Assessing the performance of adjusted implied risk premium metrics

### 6.1 Association between adjusted implied cost of equity measures and realized returns

We now assess the association of adjusted risk premium metrics with future returns. We repeat the analysis in Table 4 with the adjusted risk premium metrics. The results are presented in Table 8. Table 8, Panel A, presents mean $RET_1$ for quintiles based on adjusted risk premium. For the naïve measure, $ARP_{EP}$, mean future returns increase monotonically across the quintiles, with the difference in returns between the top and bottom quintiles being 6.15 %. This represents a considerable improvement from the 4.35 % return difference across quintiles based on unadjusted $RP_{EP}$ (Table 4, Panel A). Similar improvements also occur for $ARP_{OJ}$ (return difference of 4.68 vs. 2.34 % for unadjusted) and $ARP_{PEG}$ (return difference of 5.21 vs. 2.86 % for unadjusted). The two RIV-based metrics show more modest improvements: $ARP_{CT}$ (return difference of 4.66 vs. 3.40 % for unadjusted) and especially $ARP_{GLS}$ (return difference of 6.28 vs. 6.08 % for unadjusted). Finally, the composite measure $ARP_{AVG}$ also shows a stronger relationship with realized returns (return difference of 6.09 vs. 4.32 % for unadjusted).

Table 8, Panel B, presents results of annual Fama and MacBeth (1973) regressions using the Easton and Monahan specification. We recompute the proxies

**Table 8** Relationship between adjusted risk premium metrics and future returns

*Panel A: Means of adjusted risk premium (%) and RET$_1$ (%) by quintiles of adjusted risk premium metrics*

| Qtl. | ARP$_{EP}$ | RET$_1$ | ARP$_{OJ}$ | RET$_1$ | ARP$_{PEG}$ | RET$_1$ | ARP$_{GLS}$ | RET$_1$ | ARP$_{CT}$ | RET$_1$ | ARP$_{AVG}$ | RET$_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | −2.02 | 3.00 | 1.59 | 3.40 | −0.21 | 3.36 | −0.07 | 2.39 | −0.66 | 3.45 | 1.35 | 2.03 |
| 2 | 0.02 | 3.70 | 3.38 | 4.59 | 1.69 | 4.61 | 1.83 | 4.02 | 1.07 | 5.31 | 2.63 | 4.46 |
| 3 | 1.14 | 4.56 | 4.26 | 4.97 | 2.66 | 5.40 | 2.97 | 5.77 | 2.34 | 4.62 | 3.42 | 5.28 |
| 4 | 2.20 | 6.83 | 5.21 | 6.20 | 3.71 | 5.29 | 4.23 | 6.38 | 3.19 | 5.72 | 4.29 | 7.36 |
| 5 | 4.61 | 9.15 | 7.52 | 8.08 | 5.99 | 8.57 | 7.03 | 8.67 | 5.04 | 8.12 | 6.32 | 8.11 |
| 5-1 | 6.63 | 6.15 | 5.93 | 4.68 | 6.20 | 5.21 | 7.11 | 6.28 | 5.70 | 4.66 | 4.97 | 6.09 |
| (t-stat) | | (7.69) | | (5.61) | | (6.18) | | (8.21) | | (5.66) | | (7.62) |

*Panel B: Summary of annual regressions of RET$_1$ on adjusted risk premium metrics*

| RP metric | Intercept | ARP | ACNEWS | ADNEWS | Adj. R$^2$ (%) | Noise variable | Modified noise variable |
|---|---|---|---|---|---|---|---|
| ARP$_{EP}$ | 0.0973 | −0.0945$^{++}$ | 1.4727 | 0.0013 | 8.85 | 0.02849*** | 0.00057** |
| | (4.17) | (−0.19) | (15.21) | (0.36) | | (6.41) | (2.09) |
| ARP$_{OJ}$ | 0.0273 | 1.9446***$^{,++}$ | 1.3189 | −0.0628 | 10.62 | 0.00615*** | 0.0001 |
| | (1.43) | (4.81) | (13.86) | (−6.60) | | (19.18) | (1.00) |
| ARP$_{PEG}$ | 0.0604 | 1.9675***$^{,++}$ | 1.3328 | −0.0511 | 10.66 | 0.00697*** | 0.00016 |
| | (2.78) | (5.06) | (13.8) | (−6.05) | | (12.68) | (1.44) |
| ARP$_{GLS}$ | 0.0836 | 0.8616*** | 1.4068 | 0.0208 | 10.48 | 0.00576*** | −0.00002 |
| | (3.5) | (2.81) | (15.25) | (1.53) | | (3.89) | (−0.19) |
| ARP$_{CT}$ | 0.0458 | 2.5569***$^{,+++}$ | 1.1806 | −0.1164 | 17.06 | 0.00924*** | 0.00037 |
| | (2.02) | (4.89) | (13.83) | (−8.33) | | (3.76) | (1.47) |
| ARP$_{AVG}$ | 0.0582 | 1.8223*** | 1.4699 | −0.0002 | 9.84 | 0.00278*** | −0.0001 |
| | (2.73) | (3.55) | (14.49) | (−0.01) | | (13.15) | (−0.91) |

*Panel C: Comparison of noise variables across adjusted risk premium metrics*

| | Noise variable | | | | | Modified noise variable | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ARP metric | versus ARP$_{OJ}$ | versus ARP$_{PEG}$ | versus ARP$_{GLS}$ | versus ARP$_{CT}$ | versus ARP$_{AVG}$ | versus ARP$_{OJ}$ | versus ARP$_{PEG}$ | versus ARP$_{GLS}$ | versus ARP$_{CT}$ | versus ARP$_{AVG}$ |
| ARP$_{EP}$ | 0.0223*** | 0.0215*** | 0.0227*** | 0.0192*** | 0.0257*** | 0.0005 | 0.0004 | 0.0006 | 0.0002 | 0.0007** |
| | (5.01) | (4.81) | (4.85) | (3.79) | (5.78) | (1.62) | (1.37) | (1.96) | (0.54) | (2.28) |
| ARP$_{OJ}$ | | −0.0008 | 0.0004 | −0.0031 | 0.0034*** | | −0.0001 | 0.0001 | −0.0003 | 0.0002 |
| | | (−1.29) | (0.25) | (−1.25) | (8.76) | | (−0.43) | (0.75) | (−1.00) | (1.35) |
| ARP$_{PEG}$ | | | 0.0012 | −0.0023 | 0.0042*** | | | 0.0002 | −0.0002 | 0.0003* |
| | | | (0.76) | (−0.90) | (7.10) | | | (1.09) | (−0.74) | (1.67) |
| ARP$_{GLS}$ | | | | −0.0035 | 0.0030** | | | | −0.0004 | 0.0001 |
| | | | | (−1.21) | (1.99) | | | | (−1.39) | (0.44) |
| ARP$_{CT}$ | | | | | 0.0065*** | | | | | 0.0005** |
| | | | | | (2.62) | | | | | (1.71) |

**Table 8** continued

*Panel D: Comparison of noise variables between original and adjusted risk premium metric*

| | Noise variable | | | Modified noise variable | | |
|---|---|---|---|---|---|---|
| RP metric | Original | Adjusted | Adjusted–original | Original | Adjusted | Adjusted–original |
| $RP_{EP}$ | 0.00976 | 0.02849 | 0.01873*** | –0.00001 | 0.00057 | 0.00058 |
| | | | (4.11) | | | (1.47) |
| $RP_{OJ}$ | 0.00705 | 0.00615 | −0.0009* | 0.00014 | 0.00010 | −0.00004 |
| | | | (−1.68) | | | (−0.20) |
| $RP_{PEG}$ | 0.00760 | 0.00697 | −0.00063 | 0.00028 | 0.00016 | −0.00012 |
| | | | (−0.72) | | | (−0.59) |
| $RP_{GLS}$ | 0.00499 | 0.00576 | 0.00078 | –0.00017 | –0.00002 | 0.00015 |
| | | | (0.43) | | | (0.57) |
| $RP_{CT}$ | 0.00644 | 0.00924 | 0.0028 | 0.00012 | 0.00037 | 0.00025 |
| | | | (1.11) | | | (0.73) |
| $RP_{AVG}$ | 0.00477 | 0.00278 | −0.00199*** | –0.00005 | –0.00010 | −0.00005 |
| | | | (−3.76) | | | (−0.21) |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures, while $RP_{EP}$ is a naïve implied risk premium metric based on the forward earnings to price ratio. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. $RET_1$ is the buy-and-hold return for 12 months following the calculation of the implied risk premium, less the risk-free rate. Panel A presents the means for $RET_1$ and risk premium for each quintile based on each risk premium measure computed using adjusted forecasts as described in Table 7. T-statistics for differences between quintiles use a pooled estimate of standard error. Panel B presents regressions with $RET_1$ as the dependent variable. The regressions are based on Easton and Monahan (2005) and include the appropriate adjusted risk premium metric in addition to the adjusted cash flow news proxy (ACNEWS) and the discount rate news proxy (ADNEWS) as additional independent variables. ACNEWS and ADNEWS are estimated identically to CNEWS and DNEWS (see header to Table 3 for details) but use adjusted forecasts and adjusted future book values based on the adjusted forecasts. The number of observations for the regressions is lower due to data requirements for discount rate news and cash flow news (36,012 instead of 42,600). Panel B presents regressions with $RET_1$ as the dependent variable. The first set of regressions are univariate regressions with each of the adjusted implied risk premium metrics as the sole independent variable. The next set of regressions are based on Easton and Monahan (2005) and include the cash flow news proxy (CNEWS) and the discount rate news proxy (DNEWS) as additional independent variables. (37,687 instead of 42,600). See the header to Table 3 for details on how CNEWS and DNEWS are estimated. Coefficients from annual regressions are averaged using the Fama and MacBeth (1973) procedure. The table presents average coefficients with t-statistics in parentheses. In addition, the table also presents the measurement error noise coefficient and modified noise coefficient using the methodology of Easton and Monahan (2005). See Table 5 (page 517) of Easton and Monahan (2005) for details on how they are computed. Significance of difference from 0.00 denoted by *** 1 % level, ** 5 % level, * 10 % level. Significance of difference from 1.00 denoted by $^{+++}$ 1 % level, $^{++}$ 5 % level, $^{+}$ 10 % level

for cash flow news and discount rate news using the adjusted forecasts and the other financial numbers derived from the forecasts (for example, future book values used in the estimation of cash flow news). We regress realized returns ($RET_1$) on the adjusted risk premium metric, adjusted cash flow news proxy (ACNEWS) and adjusted discount rate news proxy (ADNEWS). The regressions confirm the key result from Panel A: removing predictable forecast errors strengthens the relationship between expected and realized returns. With the exception of the naïve $ARP_{EP}$ measure, all the theoretically motivated implied risk premium metrics have significant positive coefficients. The results imply that, after controlling for cash flow news and discount rate news shocks, the expected return proxies show a meaningful positive association with realized returns. For two of the metrics, $ARP_{GLS}$ and $ARP_{AVG}$, the average coefficient is insignificantly different from the theoretical benchmark of 1. Hence, removing predictable forecast errors improves the association between implied risk premium and realized returns after controlling for cash flow news and discount rate news.

## 6.2 Measurement error in adjusted implied cost of equity metrics

Does the improved association with future returns come at the expense of increased measurement error? We examine this issue next. The last two columns of Table 8, Panel B present both the noise and modified noise variables for the adjusted risk premium metrics. The unmodified noise variable is significant for each of the risk premium metrics, indicating that the adjustment for predictable errors does not eliminate measurement error. The coefficients for the modified noise variables are generally insignificant, with the exception of the naïve $ARP_{EP}$ measure.

We compare the magnitudes of the two noise variables across the different metrics in Table 8, Panel C. We begin with the differences in the noise variables presented in the left columns. The naïve measure $ARP_{EP}$ continues to have significantly higher measurement error than the four theoretically motivated implied risk premium metrics, similar to the results presented in Table 4 for the unadjusted risk premium metrics. Among the four theoretically motivated metrics, none of the differences in the noise variable is significant. $ARP_{AVG}$ has lower measurement error than any of the four risk premium metrics it is based on, suggesting that the common approach of averaging different risk premium metrics reduces measurement error even after adjusting for predictable forecast errors. The differences in the modified noise variables, presented in the right columns of Table 8, Panel C, are either insignificant or marginally significant.

To test whether the improved correlation with realized returns comes at the cost of increased measurement error, we compare the error variables for the adjusted implied risk premium metrics with the error variables for the unadjusted implied risk premium metrics (from Table 4). The results are presented in Table 8, Panel D. The naïve measure, $ARP_{EP}$, has significantly greater measurement error than its unadjusted counterpart. For the OJ model, the noise variable declines significantly from 0.00705 for $RP_{OJ}$ to 0.00615 for $ARP_{OJ}$. Similarly, for PEG model, the noise variable declines from 0.00760 to 0.00697; however the decline is not significant. For the GLS model, the noise variable has an insignificant increase from 0.00499 to 0.00576. For the CT model, the noise variable sees an insignificant increase from 0.00644 to 0.00924. Finally, we turn our attention to $ARP_{AVG}$. Recall that $RP_{AVG}$ had the lowest noise variable prior to adjustment. Post-adjustment, the noise declines even further as the noise variable almost halves from 0.00477 for $RP_{AVG}$ to 0.00278 for $APR_{AVG}$, the difference being highly significant. Similar trends are also observed using the modified noise variable; the results are however not statistically significant.

The strong performance of $ARP_{AVG}$, both in terms of correlation with realized returns, and in terms of lowered measurement error, suggests an important methodological contribution. Researchers ought to first purge analyst forecasts of predictable errors and then average across multiple proxies to obtain reliable estimates for implied cost of capital.

### 6.3 Impact of adjustment on relationship between implied risk premium metrics and risk factors

Prior research has evaluated implied risk premium metrics either by evaluating their correlation with realized returns or by analyzing their correlation with risk proxies such as systematic risk, idiosyncratic risk, size, book-to-market, and growth (Gebhardt et al. 2001; Gode and Mohanram 2003; Botosan and Plumlee 2005). Easton and Monahan (2010) argue that the latter approach is logically inconsistent as implied risk premium metrics are estimated precisely because of flaws in conventional measures of risk that often rely on ex post returns. However, to test the robustness of our methodology, we test whether we can replicate prior findings regarding the relationship between the implied risk premium metrics and risk factors, for the original as well as the adjusted risk premium metrics. We also check whether the improved correlation with realized returns (for all proxies) and lower measurement error (for some proxies and crucially for $ARP_{AVG}$) come at the expense of a weaker correlation with risk factors.

We use the following risk factors from prior research: (1) systematic risk as measured by $\beta$ calculated using monthly returns over the lagged 5 years (ensuring that at least 12 months returns are available); (2) idiosyncratic risk calculated as the standard deviation of the prior year's monthly returns ($\sigma_{RET}$); (3) firm size as measured by the log of market capitalization (LMCAP) at the time of the analyst forecasts; (4) the book-to-market ratio (BM); (5) momentum, as measured by raw contemporaneous returns ($RET_0$). We expect implied risk premium to be positively related to $\beta$, $\sigma_{RET}$, BM, and $RET_0$ and negatively related to LMCAP.

Table 9, Panel A, shows multivariate regressions with the unadjusted risk premium metrics as the dependent variables and risk factors as independent variables using annual Fama and Macbeth (1973) regressions. All the six implied risk premium metrics show an anomalous negative relationship with current returns ($RET_0$). The naïve measure ($RP_{EP}$) is anomalously negatively correlated with $\beta$ and uncorrelated with $\sigma_{RET}$, LMCAP, and BM. $RP_{OJ}$, $RP_{PEG}$ and $RP_{CT}$ show appropriate correlations with $\beta$, $\sigma_{RET}$ and LMCAP but are uncorrelated with BM. $RP_{GLS}$ shows the strongest correlation with BM and also a positive correlation with $\sigma_{RET}$ but is uncorrelated with $\beta$ and LMCAP. The $RP_{AVG}$ measure performs the best, showing appropriate and significant correlations with all risk factors except $RET_0$.

Table 9, Panel B, reruns the regressions with the adjusted risk premium metrics as the dependent variables. The correlation with risk factors is qualitatively unchanged. For instance, $ARP_{PEG}$ continues to be positively associated with $\beta$, $\sigma_{RET}$, negatively associated with LMCAP and uncorrelated with BM. While the magnitude of the coefficients for the regressions with the adjusted risk premium metrics is often slightly lower, one must also consider the fact that the dependent variables all have lower average values after adjustment. Further, all of the six implied risk premium metrics now show a positive relationship with current returns ($RET_0$) as expected, as

**Table 9** Relationship between implied risk premium metrics and risk factors

*Panel A: Summary of annual regressions of risk premium metrics on risk proxies*

| RP metric | Intercept | $\beta$ | $\sigma_{RET}$ | LMCAP | BM | $RET_0$ | Adj. $R^2$ (%) |
|---|---|---|---|---|---|---|---|
| $RP_{EP}$ | 0.0278<br>(6.19) | −0.0024<br>(−2.10) | −0.0105<br>(−1.09) | −0.0000<br>(−0.07) | −0.003<br>(−0.83) | −0.0128<br>(−7.36) | 13.6 |
| $RP_{OJ}$ | 0.056<br>(16.28) | 0.0020<br>(2.23) | 0.0331<br>(3.20) | −0.0018<br>(−4.46) | −0.0006<br>(−0.49) | −0.0084<br>(−7.84) | 9.8 |
| $RP_{PEG}$ | 0.0356<br>(6.95) | 0.0063<br>(4.48) | 0.0931<br>(8.96) | −0.0031<br>(−6.84) | −0.0013<br>(−1.20) | −0.0086<br>(−7.59) | 20.4 |
| $RP_{GLS}$ | 0.0134<br>(2.5) | 0.0015<br>(1.60) | 0.0727<br>(4.59) | −0.0006<br>(−0.83) | 0.0375<br>(27.33) | −0.0107<br>(−8.79) | 32.4 |
| $RP_{CT}$ | 0.0423<br>(8.49) | 0.0018<br>(1.78) | 0.0735<br>(6.33) | −0.002<br>(−4.37) | 0.001<br>(0.64) | −0.0079<br>(−4.97) | 13.5 |
| $RP_{AVG}$ | 0.0368<br>(8.01) | 0.0029<br>(3.02) | 0.0681<br>(6.74) | −0.0019<br>(−3.96) | 0.0089<br>(8.67) | −0.0089<br>(−8.32) | 19.6 |

*Panel B: Summary of annual regressions of adjusted risk premium metrics on risk proxies*

| RP metric | Intercept | $\beta$ | $\sigma_{RET}$ | LMCAP | BM | $RET_0$ | Adj. $R^2$ (%) |
|---|---|---|---|---|---|---|---|
| $ARP_{EP}$ | 0.0135<br>(3.59) | −0.0034<br>(−3.6) | −0.0353<br>(−3.29) | 0.0008<br>(2.25) | −0.0064<br>(−1.71) | 0.0119<br>(4.26) | 15.5 |
| $ARP_{OJ}$ | 0.0426<br>(13.45) | 0.0013<br>(1.88) | 0.0074<br>(0.87) | −0.001<br>(−3.51) | 0.0009<br>(0.76) | 0.0105<br>(6.78) | 10.5 |
| $ARP_{PEG}$ | 0.0219<br>(4.33) | 0.0051<br>(4.51) | 0.0576<br>(6.82) | −0.0021<br>(−6.4) | −0.0001<br>(−0.12) | 0.0117<br>(6.49) | 19.5 |
| $ARP_{GLS}$ | −0.0015<br>(−0.35) | 0.0006<br>(0.94) | 0.0321<br>(2.3) | 0.0007<br>(1.15) | 0.0388<br>(19.21) | 0.0058<br>(2.91) | 29.2 |
| $ARP_{CT}$ | 0.0216<br>(6.62) | −0.0008<br>(−1.2) | 0.0014<br>(0.13) | 0.0002<br>(0.54) | −0.0098<br>(−3.65) | 0.0173<br>(6.75) | 23.8 |
| $ARP_{AVG}$ | 0.0263<br>(6.55) | 0.0022<br>(2.99) | 0.0427<br>(5.19) | −0.0011<br>(−2.97) | 0.0101<br>(10.74) | 0.005<br>(3.90) | 16.0 |

Sample consists of 42,600 observations from 1983 to 2008 for which estimates of implied risk premium could be estimated. The four implied risk premium metrics are $RP_{OJ}$, $RP_{PEG}$, $RP_{GLS}$, and $RP_{CT}$ estimated using the methodology outlined in Sect. 3. In addition, $RP_{AVG}$ is the mean of the above four measures, while $RP_{EP}$ is a naïve implied risk premium metric based on the forward earnings to price ratio. All implied risk premium metrics are adjusted by subtracting the prevailing risk-free rate from the implied cost of equity estimate. Each of the risk premium metrics is regressed on risk factors identified by prior research. The risk factors used are as follows: systematic risk ($\beta$, idiosyncratic risk ($\sigma_{RET}$), book-to-market (BM), size (MCAP), and momentum ($RET_0$). B is systematic risk, determined using at least 12 and up to 60 months of lagged monthly returns. $\sigma_{RET}$ is the standard deviation of the past year's monthly returns. BM is the book to market ratio, and MCAP is the market capitalization; both measured 6 months after prior fiscal year-end. $RET_0$ is contemporaneous raw buy-and-hold return for the 12 months ending at 6 months after prior fiscal year-end. Regressions are run annually using the Fama and MacBeth (1973) procedure with t-statistics in parentheses. Panel A (Panel B) presents the regressions for the risk premium measures using unadjusted (adjusted) analysts forecasts

current returns is one of the prediction variables used to correct for the partial adjustment by analysts to recent information. $ARP_{AVG}$ performs the best, showing appropriate and significant correlations with all risk factors including $RET_0$.

The strong correlation of $\mathrm{ARP}_{\mathrm{AVG}}$ with both realized returns as well as multiple risk measures suggests an important methodological contribution. By adjusting analyst forecasts for predictable error and averaging across multiple methods, researchers can obtain a measure of implied risk premium that is strongly associated with future returns and appropriately correlated with risk factors as well. The averaging process reduces measurement error in implied risk premium.

### 6.4 Corroboration from concurrent research

Recent research using implied cost of equity has used the methodology developed in this paper to refine the estimation of implied risk premium. Barth et al. (2010) study the relationship between earnings transparency and cost of equity. After adjusting for predictable errors in analyst forecasts using our methodology, they find a significant relation between earnings transparency and implied cost of equity. These results confirm that adjusting forecasts for predictable errors increases the power of tests using implied risk premium metrics.

Nekrasov and Ogneva (2011) develop a new approach to estimate implied cost of equity that relies on endogenously determined long-term earnings growth rates. They use our methodology to adjust for predictable errors in analysts' forecasts and find that most implied risk premium proxies that are insignificantly correlated with future returns become strongly correlated with future returns post-adjustment. They also document a reduction in measurement error, corroborating our findings.

Finally, Larocque (2013) tests whether correcting for predictable forecast errors provides analysts forecasts that are better estimates of the market's true expectations and whether these expectations lead to better implied cost of capital estimates. She uses an error correction methodology that is much more parsimonious than the approach used in this paper, relying only on lagged forecast errors and recent stock returns as explanatory variables. Using earnings response coefficient (ERC) tests, she shows that the adjusted forecasts are indeed better proxies for market expectations. Larocque (2013) also corroborates the findings in Easton and Sommers (2007) by showing that the implied cost of estimates are indeed lower once one controls for the predictable optimism in analysts' forecasts. Larocque does not address the correlation between realized returns and the implied cost of capital estimates from the adjusted forecasts, nor does she address the measurement errors in the unadjusted or adjusted forecasts.

## 7 Conclusions

Research in accounting and finance has increasingly used implied cost of equity estimates as proxies for expected returns. However, these proxies have weak correlations with realized returns that become insignificant after one controls for cash flow and discount rate news. Easton and Monahan (2005) warn that all implied risk premium metrics are inherently unreliable because of considerable measurement error, and caution against relying on evidence presented in the accounting literature based on these metrics.

We show that predictable forecast errors are the primary cause of weak association between implied cost of equity and realized returns. We draw upon the research on the predictability of analyst forecast errors to build a comprehensive model to remove predictable forecast errors. We then show that removing predictable forecast errors improves the association between implied cost of equity and realized returns. We also show that the commonly used approach of averaging across multiple methods reduces measurement error.

We compute implied cost of equity in four ways: $RP_{OJ}$ and $RP_{PEG}$ are based on the OJ model from Ohlson and Juettner-Nauroth (2005) and $RP_{GLS}$ and $RP_{CT}$ are based on the residual income valuation model. In addition, we also evaluate a composite metric, $RP_{AVG}$, which is the average of these four measures and a naïve benchmark, $RP_{EP}$, based on the E/P ratio. Consistent with prior research, we find that all risk premium metrics are essentially uncorrelated with realized returns after we control for cash flow and discount rate news. All metrics have significant measurement error.

We find that removing predictable errors from analyst forecasts using our methodology significantly improves the correlation between implied risk premium and realized returns. This improved association persists after we control for cash flow and discount rate news. Adjusting for predictable errors either reduces measurement error for some of the implied risk premium metrics or increases it insignificantly for other risk premium metrics. $ARP_{AVG}$, the composite risk premium metric based on adjusted forecasts, shows a strong correlation with future returns as well as significantly lower measurement error than $RP_{AVG}$, the composite risk premium metric based on unadjusted forecasts.

Our paper makes the following contributions. First, we identify that the weak correlation between risk premium metrics and future returns is driven by the predictable errors in analyst forecasts. It is reassuring that the expected relationship between implied risk premium and realized returns is validated with better proxies for market expectations. Second, we show that our comprehensive methodology to remove predictable forecast errors has the potential to reduce measurement error in implied risk premium metrics. Third, we show that once the forecasts are adjusted for predictable errors, averaging metrics from different methodologies yields implied risk premium estimates with the lowest measurement error.

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