The Return of Return Dominance: Decomposing the Cross-Section of Prices

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ABSTRACT

What explains cross-sectional dispersion in stock valuation ratios? We find that 75% of dispersion in price-earnings ratios is reflected in differences in future returns, while only 25% is reflected in differences in future earnings growth. This holds at both the portfolio-level and the firm-level. We reconcile these conclusions with previous literature which has found a strong relation between prices and future profitability. Our results support models in which the cross-section of price-earnings ratios is driven mainly by discount rates or mispricing rather than future earnings growth. Evaluating six models of the value premium, we find that most models struggle to match our results, however, models with long-lived differences in risk exposure or gradual learning about parameters perform the best. The lack of earnings growth differences at long horizons provides new evidence in favor of long-run return predictability. We also show a similar dominance of predicted returns for explaining the dispersion in return surprises.

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I. Introduction

A central feature of the aggregate stock market is the dominance of future returns in explaining price movements (Cochrane, 2011). Using prices scaled by cash flows, Campbell and Shiller (1988a,b), Cochrane (1992, 2008) show that most variation in aggregate price ratios is related to future returns rather than future cash flow growth.[1] Subsequent work (Fama and French 1995; Cohen, Polk, and Vuolteenaho 2003) focuses on the cross-section of value and growth portfolios and argues that the cross-section is quite different from the aggregate time series. They find that cross-sectional differences in future returns only explain a small portion of cross-sectional differences in price-book ratios.[2] This apparent contrast between the cross-section and the aggregate time series has supported a common view that stock markets are "micro-efficient but macro-inefficient."[3]

In this paper, we argue that the cross-section of prices is actually quite similar to the aggregate time series. Like the aggregate time series, differences in cross-sectional price-earnings ratios are primarily explained by differences in future returns, not future earnings growth. This observation holds both at the portfolio level, using value and growth portfolios, and at the individual firm level. These results indicate that risk premia and/or mispricing explain most cross-sectional differences in price-earnings ratios, which has important implications for cross-sectional asset pricing models. Using accounting identities, we show that the previous findings on price-book ratio differences are driven by the fact that scaling by book value introduces a large amount of additional dispersion that is not tied to future earnings growth or future returns. Additionally, we show that the well-documented relationship between price-book ratios and future profitability emerges from a contemporaneous correlation between price-book ratios and current profitability, rather than price-book ratios predicting future earnings growth.

[1] While there is debate whether future cash flow growth plays a zero or non-zero role in explaining aggregate price ratios, its role is consistently smaller than the role of future returns (Koijen and Nieuwerburgh, 2011).

[2] Vuolteenaho (2002) similarly provides evidence that cross-sectional differences in price-book ratios are more related to differences in future profitability than future returns.

[3] See Samuelson (1998); Jung and Shiller (2005).

Our analysis covers all US common stocks listed on NYSE, AMEX, and NASDAQ from 1963-2020. We study dispersion in price-earnings ratios across individual firms as well as across the classic growth and value portfolios. For the portfolios, we estimate a variant of the Campbell-Shiller decomposition and find that differences in future returns explain over 75% of the cross-sectional differences in price-earnings ratios, while differences in future earnings growth explain less than 25%. We then introduce a novel decomposition for price-earnings ratios which can be applied at the firm level and show that the estimated results are similar to the portfolio-level estimates. In other words, stocks with high price-earnings ratios are largely characterized by lower future returns rather than higher future earnings growth.

How does this finding fit with cross-sectional asset pricing models? We find that many standard models of cross-sectional risk premia and mispricing struggle to quantitatively match our results, such as models of growth options (Berk, Green, and Naik, 1999), costly reversibility of capital (Zhang, 2005), duration risk (Lettau and Wachter, 2007), and extrapolation with overconfidence (Alti and Tetlock, 2014). While these models do generate a short-term value premium, differences in future returns account for less than 10% of the dispersion in price-earnings ratios. Instead, these models predict that more than 90% of the dispersion in price-earnings ratios is explained by future earnings growth. To better match our findings, models can incorporate long-lived differences in risk exposure, such as the investment-specific technology risk of Kogan and Papanikolaou (2014), or substantial mispricing that is slowly resolved over time, such as the learning about firm-specific mean earnings growth model of Lewellen and Shanken (2002). Overall, Lewellen and Shanken (2002) is the closest to our empirical findings, as agents' incorrect beliefs about each firm's mean earnings growth allows the model to have a strong relationship between price-earnings ratios and future returns, while having little to no relationship between price-earnings ratios and realized future earnings growth.[4]

[4]This is similar to the empirical results of De la O and Myers (2021) for the aggregate stock market, where investors appear to believe that stock price-earnings ratios are related to future cash flow growth but mistakes in their expectations cause stock prices ratios to be objectively related to future returns.

Given the importance of these results for the cross-sectional asset pricing literature, we explicitly reconcile our conclusions with previous findings documenting a strong relationship between price-book ratios and future profitability. We show that future profitability is approximately equal to the sum of *future* earnings growth and the *current* earnings-book ratio. Intuitively, in order to have high future profitability, a firm must either increase its earnings or already have high current earnings relative to book (i.e., high current profitability). We then demonstrate that the documented relationship between the price-book ratio and future profitability is driven almost entirely by the correlation between the current price-book ratio and the current earnings-book ratio. In other words, the price-book ratio is related to future profitability not because it is informative about the future earnings of a stock, but instead because it is related to current profitability.

Throughout the paper, we incorporate several extensions that strengthen our conclusions. Our main price-earnings ratio decomposition uses buy-and-hold earnings growth and returns over a span of fifteen years. To project these results into an infinite horizon, we employ a VAR model and estimate an infinite horizon decomposition that supports the dominance of returns at longer horizons. To confirm that our conclusions are not influenced by fluctuations in earnings in the denominator of price-earnings ratio, we repeat our analysis normalizing prices with a three-year-smoothed measure of earnings, yielding similar outcomes. To ensure that our findings are not due to aggregating firms into portfolios, we provide a novel firm-level decomposition. Unlike the Campbell-Shiller decomposition, this new decomposition effectively handles negative firm-level earnings. The analysis confirms that firm-level earnings yields are largely explained by future returns rather than future earnings growth. Furthermore, we evaluate the evolution of return dominance over time via a rolling estimation approach. Despite the fluctuating nature of the return contribution to price-earnings ratio dispersion over time, it has consistently dominated the contribution of earnings growth.

While our primary focus is explaining the level of price-earnings ratios, our results also have direct implications for return predictability. We perform three exercises that illustrate the tight relation between price-earnings ratio dispersion and expected returns. These three exercises deal with cumulative long-term returns, non-cumulative long-term returns, and current return surprises. First, we test whether price-earnings ratios or price-book ratios are a stronger predictor of long-term cumulative results. While the price-book ratio is well established as the standard price ratio for predicting the cross-section of monthly returns (Fama and French, 1992), we find that it is dominated by the price-earnings ratio for predicting long-term returns. In multivariate regressions, the price-earnings ratio completely drives out the price-book ratio for predicting returns at horizons of 1 to 10 years. This occurs because the price-book ratio not only reflects future returns and future earnings growth, but also reflects the current earnings-book ratio.[5]

Second, we study the predictability of non-cumulative long-term returns. Consistent with Keloharju, Linnainmaa, and Nyberg (2021)'s findings, we cannot reject the null that non-cumulative returns are unpredictable at horizons beyond four years. However, in the spirit of Lewellen (2004) and Cochrane (2008), we show that imposing plausible bounds on the persistence of the price-earnings ratio substantially increases the significance of return predictability. So long as the price-earnings ratio has a persistence less than one, all mean-reversion in the price-earnings ratio must be reflected in non-cumulative returns or non-cumulative earnings growth. Because of this, the lack of predictable earnings growth provides strong evidence that returns are significantly predictable beyond four years.

Third, we decompose price-earnings ratio innovations and return surprises to measure the relative importance of changes in expected returns and changes in expected earnings growth.[6] Using a VAR model, we find that changes in expected future returns account for a substantially larger share of the variation in price-earnings ratio innovations and return

[5] This is consistent with the findings of Ball et al. (2020) and Golubov and Konstantinidi (2019), who argue that the price-book ratio only predicts returns because it is a noisy proxy for the ratio of price to retained earnings or the ratio of price to fundamental value.

[6] Just as the level of the price-earnings ratio is connected to the level of future returns and future earnings growth, innovations to the price-earnings ratio are related to changes in expected future returns and expected future earnings growth. Following Campbell (1991), return surprises (i.e., unexpected current returns) are also tightly connected to changes in expected future returns and expected future earnings growth.

surprises than changes in expected future earnings growth. Importantly, we reconcile our findings with the results of Vuolteenaho (2002) and Lochstoer and Tetlock (2020), who find a large role for cash flow news in return surprises. We show that their measure of cash flow news is equivalent to changes in expected future earnings growth *plus* the current earnings growth surprise. In line with the idea that earnings growth is volatile and difficult to predict, we find that current earnings growth surprises are volatile while changes in expected future earnings growth are not. Thus, almost all the variation in their measure of cash flow news comes from unexpected current earnings growth, rather than information about future earnings growth.

In summary, this paper contributes to a growing literature studying the cross-section of prices and price ratios. While there is a broad literature studying the cross-section of short-term returns,[7] relatively less attention has been paid to prices or price ratios.[8] Notable exceptions are Cohen et al. (2009); Cho et al. (2022, 2023); van Binsbergen et al. (2023) and Cho and Polk (2023). In particular, our analysis builds on Cohen, Polk, and Vuolteenaho (2003), who study cross-sectional differences in price-book ratios and find that they are largely explained by future profitability. As mentioned above, we reconcile our findings with them by extending their decomposition of price-book ratios and demonstrating that the cross-section of price-book ratios is not strongly related to future cash flow growth. Similarly, we reconcile with Vuolteenaho (2002) and Lochstoer and Tetlock (2020) by showing that their measure of cash flow news is largely unrelated to future cash flow growth and instead reflects unexpected *current* earnings growth.[9] Overall, our results indicate that cross-sectional variation in price ratios and aggregate time series variation in price ratios are similarly uninformative about cash flow growth, which runs counter to the idea that markets are micro-efficient and supports models in which a single mechanism drives both phenomena (Santos and Veronesi, 2006; Papanikolaou, 2011).

[7]See Nagel (2013) for a summary.

[8]See Cochrane (2011) for a discussion, "When did our field stop being 'asset pricing' and become 'asset expected returning?'"

[9]Hereafter, we refer to Fama and French (1995), Vuolteenaho (2002), Cohen, Polk, and Vuolteenaho (2003) as FF95, V02, and CPV.

The paper is organized as follows. Section II discusses the data used for our exercises. Section III derives and estimates the variance decomposition linking price-earnings ratios to future earnings growth and returns and reconciles our results with the previous literature on profitability. Section IV extends our results by (i) presenting a rolling estimation of the role of future returns and the role of future earnings growth and (ii) proposing and estimating a novel firm-level decomposition for earnings yields, and discusses how our results relate to the literature on duration. Section V shows how our results compare to the predictions of six asset pricing models. Section VI performs our three exercises on cumulative long-term returns, non-cumulative long-term returns, and return surprises. Section VII concludes.

II. Data

To understand the cross-section of stock prices, we study all US common stocks from 1963 to 2020. For the analysis involving portfolios, we focus on value and growth portfolios as this allows us to connect with the long literature on value versus growth stocks. Specifically, we sort stocks into portfolios based on their price-book ratios such that each portfolio has equal market value. We use five portfolios for our main analysis to reflect the classic value and growth portfolios, but we show in Appendix F that our results are robust to using a larger number of portfolios.[10] Further, we show in Section IV.B that our results can be extended to individual firms and, in Appendix Table AV, we show similar results for E/P-sorted portfolios. For the value and growth portfolios, we track buy-and-hold returns, earnings growth, profitability, the price-book ratio, and the price-earnings ratio. Below, we discuss the data construction in more detail.

The sample of stocks consists of all common stocks (share code 10 and 11) listed on NYSE, AMEX, and NASDAQ. The firm-level accounting variables are obtained from Compustat starting in 1963. We obtain monthly stock returns, prices, shares outstanding, dividends,

[10] These portfolios capture over 84% of the firm-level cross-sectional variation in price-book ratios. For our sample, the standard deviation across firms in the log price-book ratio is 0.92. For our five portfolios, the standard deviation of log price-book ratios is 0.77.

and returns from the Center for Research in Security Price (CRSP). Detailed data definitions are as follows. The total price for a firm is the price per share multiplied by the shares outstanding. Following Davis, Fama, and French (2000) and CPV, we define book value as stockholders' book equity, plus deferred taxes and investment tax credit if available, minus the book value of preferred stock. If stockholders' book equity is not available at Compustat, we define it as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities in that order. Depending on availability, we use redemption, liquidating, or par value for the book value of preferred stock. As in CPV, we drop firms where the ratio of price to book value is less than 0.01 or greater than 100 to remove likely data errors. We define earnings as Compustat net income (item NI) excluding extraordinary items and discontinued operations (item XIDO), special items (item SPI), and non-recurring income taxes (item NRTXT).[11]

With these variable definitions, we perform a portfolio-level decomposition, as well as a firm-level decomposition. Specifically, in each year t, we sort stocks based on the lagged ratio of price to book, where price is from December of calendar year t and book is from the fiscal year ending in calendar year $t-1$. Having sorted firms into portfolios, we track buy-and-hold returns, earnings growth, profitability, the price-book ratio, and the price-earnings ratio up to 15 years without rebalancing based on value-weighted returns and portfolio-level earnings, book, and market value. For firms who delist during our buy-and-hold periods, we reinvest them one year before they exit.[12] There is substantial variation across the portfolios in both log price-earnings ratios and log price-book ratios. The pooled standard deviation of price-earnings ratios (price-book ratios) is 0.50 (0.77). As one would expect, the log price-earnings ratios (pe_{it}) are significantly correlated with the log price-book ratios (pb_{it}), with a correlation of 0.85***.

[11]To account for possible data errors or extreme outliers, we winsorize earnings at the 1% level.

[12]In Table AIII we show that our results still hold if we reinvest in the portfolios according to the delisting returns of exiting firms.

III. Cross-section of price ratios

In this section, we use a variance decomposition to show that the cross-sectional dispersion in portfolio price-earnings ratios, $pe_{i,t}$, must be explained by future earnings growth or future returns. We then estimate the decompositions using long-term earnings growth and returns, as well a separate estimation using a VAR model, and consistently find that future returns explain over twice as much of the cross-sectional dispersion in $pe_{i,t}$ as differences in future earnings growth. Rephrased, $pe_{i,t}$ is largely informative about future returns rather than future earnings growth. Section IV shows similar results at the firm level.

We then reconcile our results with prior research that argued the cross-section of price-book ratios, $pb_{i,t}$, is largely informative about future cash flows rather than future returns. This literature has focused on future profitability, rather than future earnings growth to measure future cash flows. We first present a new variance decomposition for $pb_{i,t}$ that measures the importance of future earnings growth relative to future returns for explaining cross-sectional dispersion in $pb_{i,t}$. Analogous to our $pe_{i,t}$ results, we find that $pb_{i,t}$ dispersion is more informative about future returns than future earnings growth. We then connect this to the prior results on profitability by showing that future profitability can be decomposed into the current earnings-book ratio and future earnings growth, i.e., a current and a future component. We show that $pb_{i,t}$ is correlated with the current component and that this correlation is large enough to explain prior findings even though $pb_{i,t}$ is not informative about the future component.

A. Decomposing cross-sectional variance

Movements in the price-earnings ratio must reflect changes in future earnings growth or future returns. This is a variant of the standard Campbell and Shiller (1988a) decomposition. We start from the approximate log-linearized return, which states the one-period return in terms of earnings growth Δe_{t+1} and the price-earnings ratio pe_t, all in logs:

$$r_{t+1} \approx \kappa + \Delta e_{t+1} + \rho pe_{t+1} - pe_t, \quad (1)$$

where κ and $\rho < 1$ are constants.[13]

To understand the cross-section of stock prices, let $\tilde{pe}_{i,t}$ be the cross-sectionally demeaned price-earnings ratio of portfolio i and let $\Delta\tilde{e}_{i,t+1}$ and $\tilde{r}_{i,t+1}$ be the cross-sectionally demeaned earnings growth and returns. Rearranging and iterating equation (1), we see that a higher than average price-earnings ratio must indicate higher than average future earnings growth, lower than average future returns, or a higher than average future price-earnings ratio,

$$\tilde{pe}_{i,t} \approx \sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{i,t+j} - \sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{i,t+j} + \rho^h \tilde{pe}_{i,t+h}. \quad (2)$$

Equation (2) shows that movements in $\tilde{pe}_{i,t}$ must represent information about future earnings growth, future returns, or the future price-earnings ratio. To measure the relative importance of these three components, we decompose the variance of $\tilde{pe}_{i,t}$ into its covariance with the three terms,

$$1 \approx \underbrace{\frac{Cov\left(\sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{i,t+j}, \tilde{pe}_{i,t}\right)}{Var\left(\tilde{pe}_{i,t}\right)}}_{CF_h} + \underbrace{\frac{Cov\left(-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{i,t+j}, \tilde{pe}_{i,t}\right)}{Var\left(\tilde{pe}_{i,t}\right)}}_{DR_h} + \rho^h \underbrace{\frac{Cov\left(\tilde{pe}_{i,t+h}, \tilde{pe}_{i,t}\right)}{Var\left(\tilde{pe}_{i,t}\right)}}_{FPE_h}. \quad (3)$$

Note that $Var\left(\tilde{pe}_{i,t}\right)$ is the average squared cross-sectionally demeaned price-earnings ratio, which means it measures the average cross-sectional dispersion in price-earnings ratios. As a result, the three terms in equation (3) tell us what portion of the cross-sectional dispersion in price ratios is explained by future earnings growth, future returns, and the future price-earnings ratio. Each component of equation (3) is simply the coefficient from a time fixed effects regression of future earnings growth, future returns, and the future price-earnings ratio on the current price-earnings ratio. Thus, we denote these three coefficients as cash

[13]Note that this approximation still holds even for non-dividend paying firms. Appendix A gives a full derivation of the log-linearization with both zero and positive dividends and discusses the role of the payout ratio.

flow news CF_h, discount rate news DR_h, and future price-earnings ratio news FPE_h, as these regression coefficients quantify exactly how much a one unit increase in $\tilde{pe}_{i,t}$ predicts higher future earnings growth, lower future returns, or a higher future price-earnings ratio.

Finally, by imposing a no-bubble condition, $\lim_{h\to\infty} \rho^h \tilde{pe}_{i,t+h} = 0$, the price-earnings ratio can be expressed solely in terms of future earnings growth and future returns,

$$\tilde{pe}_{i,t} \approx \sum_{j=1}^{\infty} \rho^{j-1} \Delta\tilde{e}_{i,t+j} - \sum_{j=1}^{\infty} \rho^{j-1} \tilde{r}_{i,t+j}. \tag{4}$$

Similarly, variation in the price-earnings ratio can be fully decomposed into cash flow news and discount rate news,

$$1 \approx CF_\infty + DR_\infty. \tag{5}$$

B. Empirical decomposition results

Table I and Figure 1 show the estimated values for cash flow news, discount rate news, and future price-earnings ratio news from equation (3).[14] A key benefit of equation (3) is that it can be estimated separately at many different horizons h. We estimate our results for horizons of one to fifteen years to align with CPV. Given that the longer horizon regressions involve overlapping observations, we report for every coefficient the Driscoll-Kraay standard errors, which account for very general forms of spatial and serial correlation, as well as the block-bootstrap standard errors, following the Martin and Wagner (2019) procedure. More importantly, rather than focusing on a single specific horizon, we emphasize broad patterns in cash flow news and discount rate news which hold across many horizons.

At every horizon, a higher price-earnings ratio predicts higher future earnings growth and lower future returns and these estimates are highly significant at nearly every horizon. However, lower returns tend to play a larger role in explaining the cross-sectional dispersion in price-earnings ratios. In other words, high price-earnings ratios are primarily predicting lower

[14] Throughout the paper, we use $\rho = 0.9751$, which is based on the average price-dividend ratio of the total stock market, as explained in Appendix A.

Table I

Decomposition of differences in price-earnings ratios

This table decomposes the cross-sectional dispersion of price-earnings ratios using equation (3). The first column describes the horizon h at which the decomposition is evaluated. For each period, we form five value-weighted portfolios and track their buy-and-hold earnings growth ($\sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{i,t+j}$), negative returns ($-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{i,t+j}$), and price-earnings ratio ($\tilde{pe}_{i,t+h}$) for every horizon up to fifteen years. The components CF_h, DR_h, and FPE_h are the coefficients from univariate regressions of earnings growth, negative returns and future price-earnings ratios on current price-earnings ratios. The final column shows the coefficient from regressing the approximation error $\tilde{pe}_{i,t} - \left(\sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{i,t+j} - \sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{i,t+j} + \rho^h \tilde{pe}_{i,t+h}\right)$ on $\tilde{pe}_{i,t}$, which shows the portion of price-earnings ratio dispersion that is accounted for by the approximation error. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. The last row shows the components of the infinite horizon decomposition and their block-bootstrap standard errors. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

Years ahead	CF_h	DR_h	FPE_h	η_h
1	0.100***	0.041	0.861***	-0.002
s.e.(D-K)	[0.024]	[0.034]	[0.026]	[0.004]
s.e.(boot)	[0.021]	[0.027]	[0.023]	[0.002]
3	0.097**	0.174***	0.735***	0.006
	[0.038]	[0.070]	[0.051]	[0.010]
	[0.038]	[0.065]	[0.049]	[0.010]
5	0.124***	0.264***	0.619***	0.007
	[0.037]	[0.091]	[0.071]	[0.016]
	[0.042]	[0.093]	[0.071]	[0.017]
8	0.161***	0.384***	0.463***	0.009
	[0.038]	[0.091]	[0.076]	[0.022]
	[0.038]	[0.091]	[0.075]	[0.027]
10	0.186***	0.436***	0.389***	0.011
	[0.035]	[0.077]	[0.069]	[0.025]
	[0.038]	[0.082]	[0.072]	[0.033]
13	0.189***	0.492***	0.331***	0.013
	[0.042]	[0.067]	[0.05]	[0.030]
	[0.045]	[0.079]	[0.058]	[0.041]
15	0.202***	0.516***	0.295***	0.013
	[0.039]	[0.056]	[0.043]	[0.034]
	[0.035]	[0.070]	[0.060]	[0.046]
∞	0.236***	0.787***	–	-0.023
s.e.(boot)	[0.078]	[0.082]	–	[0.066]

future returns. At horizons of five, ten, and fifteen years, lower future returns account for 26.4%, 43.6%, and 51.6% of differences in price-earnings ratios while higher future earnings growth only accounts for 12.4%, 18.6%, 20.2% respectively. As shown in Figure 1, for all horizons beyond three years, we consistently find that DR_h is more than twice as large as CF_h.

To gauge how well the approximate identity holds, the final column of Table I shows the portion of dispersion in $\tilde{pe}_{i,t}$ attributed to the approximation error for each horizon $\tilde{pe}_{i,t} - \left(\sum_{j=1}^{h} \rho^{j-1} \Delta \tilde{e}_{i,t+j} - \sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{i,t+j} + \rho^h \tilde{pe}_{i,t+h}\right)$. This error reflects any differences in payout ratios or higher order terms that are ignored in the first-order log linearization. At every horizon, we find that the approximation holds quite well, with the approximation error accounting for at most 2.3% of $\tilde{pe}_{i,t}$ variation.

In Tables II and AIII, we show that other price ratios, such as price-book ratios and price-to-three-year-smoothed-earnings ratios, also predict future returns with substantially larger coefficients than their coefficients for predicting earnings growth. We also show in Tables AII and III that our results are robust to using different numbers of portfolios and even individual firms. These results all indicate that differences in price ratios primarily predict differences in future returns rather than differences in future earnings growth.

By itself, the fact that the price-earnings ratio predicts future returns is not surprising. It has been well-documented that price ratios can predict the cross-section of returns. The surprising element is that the price-earnings ratio predicts future returns much more than it predicts future earnings growth. This dominance of future returns indicates that the cross-section is actually quite consistent with the aggregate time series findings of Campbell and Shiller (1988a,b), Cochrane (2008, 2011).

In order to calculate the infinite horizon decomposition, we estimate a VAR(1) model defined as

$$x_{i,t+1} = A x_{i,t} + \varepsilon_{i,t+1}, \tag{6}$$

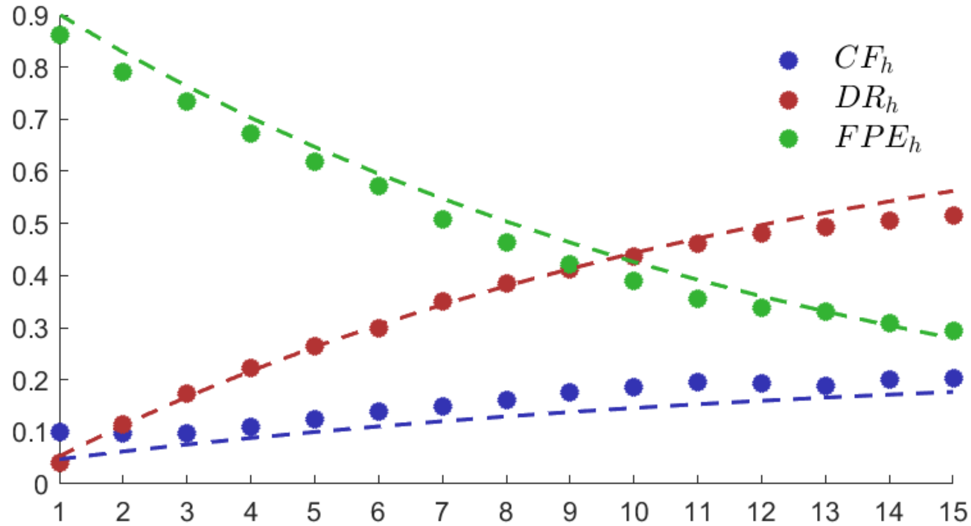

Figure 1. Decomposition of differences in price-earnings ratios. This figure visualizes the results of Table I for cash flow news (CF_h), discount rate news (DR_h), and future price-earnings ratio news (FPE_h) at different horizons h. The x-axis shows the horizon h in years. The dots show the exact estimates from Table I based on earnings growth, negative returns, and price-earnings ratios h years ahead. The dashed lines show the values implied by the estimated VAR model in equation (6).

where $x_{i,t} = \left(\Delta\tilde{e}_{i,t}, -\tilde{r}_{i,t}, \tilde{pe}_{i,t}, \tilde{pb}_{i,t}\right)'$ is a vector of the cross-sectionally demeaned earnings growth, return, price-earnings ratio, and price-book ratio for each portfolio i and Σ is the covariance matrix of the shocks.[15] Appendix B provides the estimation details and the full derivation of infinite-horizon cash flow news and discount rate news of equations (4) and (5) in terms of A and Σ.

Figure 1 and the final row of Table I show the results of the VAR model. The model estimates that cash flow news accounts for only 23.6% of all price-earnings ratio variation, while discount rate news accounts for 78.7% of all variation. This is consistent with our finding that discount rate news is more than twice as large as cash flow news at nearly every horizon. To understand how well this model matches the directly measured cash flow news and discount rate news, Figure 1 compares the VAR implied cash flow news, discount rate news, and future price-earnings ratio news (shown in dashed lines) with the directly

[15]We include both the price-earnings ratio and the price-book ratio in the vector so that the VAR model can speak to both the variance decomposition of the price-earnings ratio and the variance decomposition of the price-book ratio presented in Section III.C.

measured values from Table I (shown with dots). Despite the simplicity of the VAR model, the model quite closely matches the dynamics of cash flow news and discount rate news at longer horizons.

C. Reconciliation

Here, we reconcile our results with CPV and FF95. These papers study price-book ratios, returns, and profitability and argue that the cross-section of stock prices is very different from the aggregate time series findings of Campbell and Shiller (1988a) and Cochrane (1992). Specifically, they find that returns only account for a minority of cross-sectional variation in price-book ratios and that price-book ratios are strongly related to future profitability. We first reconcile with the finding about the role of returns in price-book ratio variation and then reconcile with the findings on profitability.

To start, we connect equation (4) to the price-book ratio by adding the earnings-book ratio, which is simply the difference between log earnings and log book. Specifically, the price-book ratio is

$$\tilde{pb}_{i,t} \approx \tilde{eb}_{i,t} + \sum_{j=1}^{\infty} \rho^{j-1} \Delta \tilde{e}_{i,t+j} - \sum_{j=1}^{\infty} \rho^{j-1} \tilde{r}_{i,t+j}. \tag{7}$$

We can then measure the relative importance of future earnings growth and future returns from

$$1 \approx \frac{Cov\left(\tilde{eb}_{i,t}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)} + \frac{Cov\left(\sum_{j=1}^{\infty} \rho^{j-1} \Delta \tilde{e}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)} + \frac{Cov\left(-\sum_{j=1}^{\infty} \rho^{j-1} \tilde{r}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)}. \tag{8}$$

The first term simply reflects correlation between the current earnings-book ratio and the current price-book ratio. More importantly, the second and third terms represent how much a one unit increase in the price-book ratio signals higher future earnings growth or lower future returns and determine whether cross-sectional dispersion in price-book ratios is more related to differences in future earnings growth or differences in future returns.

Table II shows the results of finite horizon estimates of the decomposition in equation (8). Similar to the results of Table I, future returns are over twice as important as future earnings growth for accounting for cross-sectional dispersion in price-book ratios. However, unlike in Table I, future returns only account for a minority of the total dispersion in price-book ratios. Why does this occur? It is because, as shown by the first term in equation (8), scaling prices by book value rather than cash flows introduces a substantial amount of additional variation to price-book ratios which is not tied to future earnings growth or future returns. This extra component, which reflects contemporaneous correlation between $\tilde{eb}_{i,t}$ and $\tilde{pb}_{i,t}$ rather than prices predicting future outcomes, accounts for the majority of dispersion in price-book ratios (51.0%).

In other words, the fact that returns only account for a minority of cross-sectional dispersion in price-book ratios is due to the choice to scale by book value, not by the cross-section of prices differing substantially from the aggregate findings of Cochrane (1992). As shown in Table I, when prices are not scaled by book, the cross-sectional findings are quite similar to the previous aggregate findings. Even when prices are scaled by book value, we still find that future returns play a much larger role than future earnings growth.

C.1. Connection to profitability

To fully reconcile with CPV and FF95, we analytically link the decomposition typically used for aggregate time series, which focuses on returns and cash flow growth, and the decomposition typically used in the cross-section, which focuses on returns and profitability. Profitability is $\pi_{t+1} \equiv \log\left(1 + \frac{E_{t+1}}{B_t}\right)$ where B_t is the book-value and E_{t+1} is the next-year earnings. Using the V02 identity, CPV show that cross-sectional differences in price-book ratios must predict cross-sectionally demeaned future profitability or cross-sectionally demeaned future returns,

$$\tilde{pb}_{i,t} \approx \sum_{j=1}^{\infty} \rho^{j-1}\tilde{\pi}_{i,t+j} - \sum_{j=1}^{\infty} \rho^{j-1}\tilde{r}_{i,t+j}. \tag{9}$$

Table II

Decomposition of book-market ratio differences

This table decomposes the variance of the price-book ratio using equation (8). The first column describes the horizon h at which the decomposition is evaluated. For each period, we form five value-weighted portfolios and track their buy-and-hold earnings growth ($\sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{t+j}$) and returns ($\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{t+j}$) for every horizon up to ten years. Consistent with equation (8), we also calculate the current earnings-book ratio. The decomposition states that variation in the current price-book ratio must be accounted for by the covariance of the price-book ratio with (i) the current earnings-book ratio, (ii) future earnings growth, or (iii) negative future returns. The table reports the coefficients from univariate regressions of the current earnings-book ratio, future earnings growth and negative future returns on the current price-book ratio. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. The last row shows the components of the infinite horizon decomposition and their block-bootstrap standard errors. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

Years ahead	$\tilde{eb}_t$	$\sum_{j=1}^{h} \rho^{j-1} \Delta\tilde{e}_{t+j}$	$-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{t+j}$
0	0.510***		
s.e.(D-K)	[0.035]		
s.e.(boot)	[0.026]		
1		0.042***	0.012
		[0.014]	[0.017]
		[0.013]	[0.013]
3		0.015	0.06*
		[0.025]	[0.039]
		[0.026]	[0.036]
5		0.024	0.104**
		[0.027]	[0.052]
		[0.024]	[0.052]
8		0.039**	0.164**
		[0.023]	[0.062]
		[0.015]	[0.063]
10		0.052***	0.197***
		[0.024]	[0.061]
		[0.017]	[0.069]
13		0.089***	0.238***
		[0.028]	[0.058]
		[0.02]	[0.065]
15		0.093***	0.264***
		[0.029]	[0.050]
		[0.019]	[0.058]
∞		0.103***	0.423***
s.e. (boot)		[0.041]	[0.067]

From equation (9), one can decompose the variation in the price-book ratio into the covariance of the price-book ratio with future profitability and the covariance of the price-book ratio with future negative returns,

$$1 \approx \frac{Cov\left(\sum_{j=1}^{\infty}\rho^{j-1}\tilde{\pi}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)} + \frac{Cov\left(-\sum_{j=1}^{\infty}\rho^{j-1}\tilde{r}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)}. \tag{10}$$

The first term in equation (10) is estimated to be much larger than the second term and we confirm in the Appendix Table AIV that our data replicates this finding.

Does this mean that the price-book ratio is informative about future cash flow growth? To understand how this exercise relates to our findings, we compare equations (7) and (9), which conveniently are both derived from the same Campbell-Shiller identity, use the same ρ, the same returns, and same price-book ratio. Rearranging terms, we find a useful expression for future profitability,

$$\sum_{j=1}^{\infty}\rho^{j-1}\tilde{\pi}_{i,t+j} \approx \tilde{eb}_{i,t} + \sum_{j=1}^{\infty}\rho^{j-1}\Delta\tilde{e}_{i,t+j}. \tag{11}$$

Equation (11) shows that future profitability can be split into a current component and a future component: the current earnings-book ratio and future earnings growth. Intuitively, a stock can have high future profitability either because it starts with high earnings relative to book or because its earnings grow quickly. Similarly, the connection to the price-book ratio is

$$\frac{Cov\left(\sum_{j=1}^{\infty}\rho^{j-1}\tilde{\pi}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)} \approx \frac{Cov\left(\tilde{eb}_{i,t}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)} + \frac{Cov\left(\sum_{j=1}^{\infty}\rho^{j-1}\Delta\tilde{e}_{i,t+j}, \tilde{pb}_{i,t}\right)}{Var\left(\tilde{pb}_{i,t}\right)}. \tag{12}$$

From Table II, we know that the first RHS term in equation (12) is large (0.510) while the second is small (0.093 to 0.103). Thus, the large estimated relationship between the price-book ratio and future profitability is not driven by price-book ratios predicting earnings growth but instead by correlation between the current price-book ratio and the current earnings-book ratio. Current price-book ratios are naturally correlated with current earnings-book ratios as both variables use current book value as their denominators.

As a stylized example, consider two firms that have identical prices and identical current and future earnings, but firm L has a low book value and firm H has a high book value. The differences in book value could be due to differences in capital intensity. Firm L will have a high price-book ratio and firm H will have a low price-book ratio. The firms have identical earnings growth, so differences in price-book ratios will not predict earnings growth. However, firm L will have high profitability because the denominator in $\log\left(1+\frac{E_{L,t+1}}{B_{L,t}}\right)$ is small. This means that a regression would find that differences in price-book ratios are strongly associated with differences in future profitability, not because price-book ratios are informative about future cash flow growth but because price-book ratios are informative about current profitability. Our focus on how well price-book ratios predict earnings growth is similar in spirit to the price informativeness measure of Bai et al. (2016), who measure price informativeness as how well price-book ratios predict future profitability *after controlling for current profitability.*

IV. Extending price ratio results

In this section, we provide two extensions of our price-earnings ratio decomposition and discuss how our results relate to recent papers using cross-sectional differences in duration to predict returns. First, we perform a rolling estimation that shows how cash flow news and discount rates news have changed over time. Second, we propose and estimate a novel decomposition for firm-level earnings yields. Third, we show that high price stocks will still be high duration even when there are no differences between firms in average cash flow growth.

A. The dominance of returns over time

The previous section shows that, over the 1963-2020 sample, discount rate news plays a much larger role than cash flow news for explaining the dispersion in price-earnings ratios. In recent years, several papers have documented a decline in one-month or one-year return differences between value and growth stocks (i.e., the value premium) (Fama and French, 2020; Eisfeldt, Kim, and Papanikolaou, 2022). This raises the question of how much the cross-sectional dominance of returns has changed over time. To answer this question, we estimate a time-varying price-earnings ratio decomposition. While returns are dominant in explaining price dispersion for all points in time, the degree of dominance (i.e., the difference between discount rate news and cash flow news) shows significant time-variation.

To show this, we estimate the fifteen-year components of equation (3) over time using a weighted, rolling regression. At each year, we include in the estimation all observations up to that year and weigh older observations with a geometric decay factor $\gamma = 0.87$. This decay rate implies a half-life of five years, which means that half of the weight in the regression is placed on the most recent five years.

Figure 2 shows the estimated values for CF_{15} and DR_{15} over time for those portfolios formed between 1963 and 2005, as well as the 95% confidence intervals based on the Driscoll-Kraay standard errors. Throughout the entire sample, the estimated DR_{15} is large, but there is notable variation, with DR_{15} ranging from 0.31 to 0.64. For example, DR_{15} begins to decline in the early 1980's, as growth stocks during this period went on to earn relatively high fifteen-year future returns (i.e., the dot-com bubble). However, this is followed by the dot-com bust, in which those growth stocks experienced much lower returns than value stocks, and we see DR_{15} subsequently rises. Overall, we find that DR_{15} is significantly larger than CF_{15} in the majority of sample. Most importantly, we do not find any period in which CF_{15} is larger than DR_{15}.

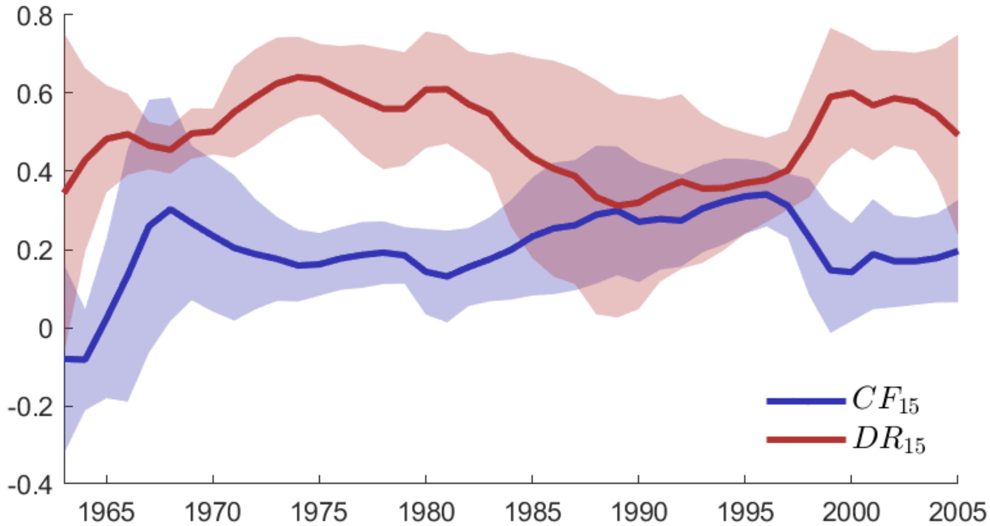

Figure 2. Movement over time of CF_{15} and DR_{15}. This figure shows rolling estimations of fifteen-year cash flow news (CF_{15}) and discount rate news (DR_{15}) from 1963-2020. At each year τ, CF_{15} shows the coefficient from a weighted regression of $\left\{\sum_{j=1}^{15} \rho^{j-1} \Delta\tilde{e}_{i,t+j}\right\}_{t=1963}^{\tau}$ on $\left\{\tilde{pe}_{i,t}\right\}_{t=1963}^{\tau}$. The regression weights are $\gamma^{\tau-t}$, i.e., the weight geometrically decreases for older observations, where $\gamma = 0.87$ ensures that half of the weight is placed on the most recent five years. The value for DR_{15} shows the coefficient from an analogous regression of negative fifteen-year returns on the price-earnings ratio. The 95% confidence intervals for CF_{15} and DR_{15} based on the Driscoll-Kraay standard errors are shown by the shaded regions.

B. *Firm-level decomposition*

The previous sections focus on decompositions for the classic value and growth portfolios. In this section, we extend our analysis to the firm level and show that cross-sectional variation in earnings yields continues to be dominated by future returns rather than by future earnings growth. Given that firm-level earnings may be negative, we cannot utilize the standard log-linearization in equation (2). To solve this issue, we propose a new decomposition for the level of the earnings yield which separates the role of earnings growth and returns.

Let $P_{i,t}$ and $E_{i,t}$ be the level price and earnings for a firm. Intuitively, changes in a firm's earnings yield ($E_{i,t}/P_{i,t}$) must be due to changes either in the earnings or the price. Specifically, we have the following identity:

$$\frac{E_{i,t}}{P_{i,t}} = \Delta^{(E)}_{i,t+h} + \Delta^{(P)}_{i,t+h} + \frac{E_{i,t+h}}{P_{i,t+h}} \tag{13}$$

where

$$\Delta^{(E)}_{i,t+h} = \left[\left(\frac{E_{i,t}}{P_{i,t}} - \frac{E_{i,t+h}}{P_{i,t}}\right) + \left(\frac{E_{i,t}}{P_{i,t+h}} - \frac{E_{i,t+h}}{P_{i,t+h}}\right)\right]/2 \tag{14}$$

$$\Delta^{(P)}_{i,t+h} = \left[\left(\frac{E_{i,t}}{P_{i,t}} - \frac{E_{i,t}}{P_{i,t+h}}\right) + \left(\frac{E_{i,t+h}}{P_{i,t}} - \frac{E_{i,t+h}}{P_{i,t+h}}\right)\right]/2. \tag{15}$$

The term $\Delta^{(E)}_{i,t+h}$ measures the change in the earnings yield from changing earnings and holding the price fixed. Note that $\Delta^{(E)}_{i,t+h}$ measures the effect when the price is fixed at $P_{i,t}$ and when the price is fixed at $P_{i,t+h}$ and then averages. This ensures that $\Delta^{(E)}_{i,t+h}$ treats the prices $P_{i,t}$ and $P_{i,t+h}$ symmetrically and only distinguishes positive versus negative changes in earnings. Similarly, the term $\Delta^{(P)}_{i,t+h}$ measures the change in the earnings yield from changing the price and holding earnings fixed. For legibility, let $\theta_{i,t} \equiv \frac{E_{i,t}}{P_{i,t}}$. A variance decomposition of equation (13) tells us that

$$1 = \frac{Cov\left(\tilde{\Delta}^{(E)}_{i,t+h}, \tilde{\theta}_{i,t}\right)}{Var\left(\tilde{\theta}_{i,t}\right)} + \frac{Cov\left(\tilde{\Delta}^{(P)}_{i,t+h}, \tilde{\theta}_{i,t}\right)}{Var\left(\tilde{\theta}_{i,t}\right)} + \frac{Cov\left(\tilde{\theta}_{i,t+h}, \tilde{\theta}_{i,t}\right)}{Var\left(\tilde{\theta}_{i,t}\right)} \tag{16}$$

where tildes denote cross-sectionally demeaned values.

Intuitively, dispersion in earnings yields must be explained by high earnings yield firms having a decrease in their earnings (high $\Delta^{(E)}_{i,t+h}$), an increase in price (high $\Delta^{(P)}_{i,t+h}$) or a high future earnings yield. This closely mirrors equation (3), where a high earnings yield ($-pe_{i,t}$) must be explained by low earnings growth, high returns, or a high future earnings yield. Similar to equation (3), we treat the first RHS term in (16) as a measure of cash flow news as it captures the effect of earnings growth, and we treat the second RHS term as discount rate news as it captures the effect of price growth. Note that price growth and returns for our sample are virtually identical, with a correlation of 0.998 at the one-year horizon and a correlation of 0.981 at the fifteen-year horizon. Finally, the third term captures the role of the future earnings yield, which reflects earnings movements and price movements more than h periods in the future.

One potential concern in the estimation of equation (16) is that some firms exit the

Table III

Decomposition of firm-level differences in earnings yields

This table decomposes the variance of earnings yields using equation (16). The first column describes the horizon h at which the decomposition is evaluated. The components CF_h, DR_h, and FPE_h are the coefficients from univariate regressions of firm-level earnings growth $\Delta^{(E)}_{i,t+h}$, price growth $\Delta^{(P)}_{i,t+h}$, and future earnings yields on current earnings yields. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

Years ahead	CF_h	DR_h	FPE_h
1	0.206***	0.075***	0.715***
s.e.(D-K)	[0.043]	[0.028]	[0.034]
s.e.(boot)	[0.055]	[0.024]	[0.037]
3	0.269***	0.216***	0.509***
	[0.073]	[0.055]	[0.048]
	[0.085]	[0.044]	[0.047]
5	0.23**	0.331***	0.438***
	[0.105]	[0.08]	[0.064]
	[0.106]	[0.059]	[0.053]
8	0.208*	0.435***	0.356***
	[0.098]	[0.084]	[0.065]
	[0.108]	[0.077]	[0.042]
10	0.145	0.528***	0.326***
	[0.113]	[0.099]	[0.066]
	[0.120]	[0.096]	[0.034]
13	0.14	0.612***	0.242***
	[0.114]	[0.093]	[0.055]
	[0.121]	[0.102]	[0.026]
15	0.098	0.687***	0.209***
	[0.122]	[0.103]	[0.044]
	[0.127]	[0.113]	[0.020]

sample. In other words, for some $\tilde{\theta}_{i,t}$, we may not observe $\tilde{\Delta}^{(E)}_{i,t+h}$, $\tilde{\Delta}^{(P)}_{i,t+h}$, $\tilde{\theta}_{i,t+h}$.[16] Given that our goal is to show that $\tilde{\Delta}^{(P)}_{i,t+h}$ accounts for more dispersion in earnings yields than $\tilde{\Delta}^{(E)}_{i,t+h}$, we consider a worst-case scenario in which we attribute all of the missing variation to cash flow news. Specifically, if $\tilde{\Delta}^{(E)}_{i,t+h}$, $\tilde{\Delta}^{(P)}_{i,t+h}$, $\tilde{\theta}_{i,t+h}$ are not observable, then we assume $\tilde{\Delta}^{(E)}_{i,t+h} = \tilde{\theta}_{i,t}$ and $\tilde{\Delta}^{(P)}_{i,t+h}, \tilde{\theta}_{i,t+h} = 0$. In other words, we assume that any deviation from the cross-sectional mean in the current earnings yield ($\tilde{\theta}_{i,t}$) is entirely explained by changes in future earnings ($\tilde{\Delta}^{(E)}_{i,t+h}$). This pushes the first coefficient in equation (16) towards 1 and pushes the second and third coefficients towards 0, meaning that our estimates are an upper bound on cash flow news and a lower bound on discount rate news.

Table III shows the results of the firm-level decomposition. We use weighted regressions based on market size to assign more importance to larger firms. In line with the findings of Table I, we find that differences in earnings yields are primarily explained by discount rate news, rather than cash flow news. At the fifteen-year horizon, changes in prices explain 68.7% of earnings yield variation while changes in earnings explain 9.8%.

Comparing Tables I and III, we see that the values for discount rate news are quite similar for both decompositions. In both tables, cash flow news is relatively small, at most 26.8%. Interestingly, we find that cash flow news gradually increases with longer horizons in the decomposition of Table I, but gradually decreases with longer horizons in Table III. This means that high earnings yield stocks have slightly lower long horizon earnings growth (Table I) but have slightly higher long horizon earnings changes ($E_{i,t+h} - E_{i,t}$). Intuitively, for high earnings yield stocks, even a small amount of earnings growth can create a large level difference $E_{i,t+h} - E_{i,t}$, as these stocks already start with high earnings.

[16]Fortunately, on average, more than 90% of the market value remains listed after five years, more than 80% remains after ten years, and more than 70% remains after fifteen years, so we can directly observe the vast majority of $\tilde{\Delta}^{(E)}_{i,t+h}$, $\tilde{\Delta}^{(P)}_{i,t+h}$,$\tilde{\theta}_{i,t+h}$.

C. Connection to duration

How do our findings relate to the literature showing that differences in duration are helpful for explaining the cross-section of stock returns (Weber, 2018; Gonçalves, 2021; Chen and Li, 2023)? It is important to note that a stock's duration reflects not only the timing of its cash flows, but also its discount rate. Therefore, stocks can differ in duration even if they do not differ in average cash flow growth, and these differences in duration can negatively predict future returns.[17]

These papers focus on Macaulay duration, where a stock's price is

$$P_{i,t} = \sum_{j=1}^{\infty} \frac{E_t\left[X_{i,t+j}\right]}{\left(1+\delta_{i,t}\right)^j} \tag{17}$$

and the duration is a weighted average across horizons j,

$$Dur_{i,t} = \sum_{j=1}^{\infty} w_{i,t,j}\, j \tag{18}$$

$$w_{i,t,j} = \frac{E_t\left[X_{i,t+j}\right]/\left(1+\delta_{i,t}\right)^j}{P_{i,t}}. \tag{19}$$

$E_t\left[X_{i,t+j}\right]$ reflects a measure of average future cash flows (e.g., earnings or dividends) and $\delta_{i,t}$ is the discount rate for the stock. The weights reflect how much of the stock's current price comes from the value of its horizon j cash flows. A higher duration means that more of a stock's value comes from its longer horizon cash flows.

To stress that duration reflects more than just the timing of cash flows, consider the simple case where average cash flows are identical for all stocks, $E_t\left[X_{i,t+j}\right] = 1$ for all i, j. Thus, all differences in stock prices are due to differences in discount rates, $P_{i,t} = \delta_{i,t}^{-1}$. A low discount rate $\delta_{i,t}$ means that more of the stock's price comes from the value of its long horizon cash flows, which means stocks with low discount rates have high duration, $Dur_{i,t} = 1 + \delta_{i,t}^{-1}$. Because duration is negatively related to the discount rate, high duration stocks will have lower average future returns, in line with the empirical findings on duration and returns.

Thus, while we find that dispersion in price-earnings ratios and price-book ratios is more

[17] See Walter and Weber (2023) for a more thorough analysis distinguishing cash flow timing and duration.

related to future returns than to future cash flow growth, there may still be important differences in duration between stocks.[18] This is because duration depends on discount rates. Even in the simple setting where average cash flow growth is identical across stocks, low discount rate stocks will derive more of their value from longer horizon cash flows and their prices will be more sensitive to changes in interest rates due to standard convexity effects ($P_{i,t} = \frac{1}{\delta_{i,t}}$). To confirm this intuition, Appendix D shows that even in the setting where average observed cash flows are identical for all stocks, the methodologies used to measure duration in Dechow, Sloan, and Soliman (2004), Weber (2018), Gonçalves (2021), and Chen and Li (2023) would all estimate that high price stocks are high duration.

V. Evaluating Asset Pricing Models

How do our empirical results compare to asset pricing models? As shown in Table I, we find that cross-sectional differences in price-earnings ratios are largely explained by differences in future returns rather than differences in future earnings growth. This means that the cross-section of price-earnings ratios must be largely explained by risk premia or mispricing.

To test how well existing models can match our findings, we simulate six cross-sectional asset pricing models: four in which prices are affected by heterogeneous exposure to priced risks and two in which prices are affected by mispricing due to behavioral biases or learning. The four risk premia models are the growth options model of Berk, Green, and Naik (1999), the costly reversibility of capital model of Zhang (2005), the duration risk model of Lettau and Wachter (2007), and the investment-specific technology risk model of Kogan and Papanikolaou (2014). The two mispricing models are the Bayesian learning model of Lewellen and Shanken (2002) and the behavioral model of Alti and Tetlock (2014), which incorporates both extrapolation and overconfidence. Appendix C contains the details of the simulations, including how we sort firms into portfolios.

[18]For robustness, Table AVI shows that cross-sectional differences in $\tilde{pe}_{i,t}$ and $\tilde{pb}_{i,t}$ do not predict long-horizon dividend growth.

A. Broad results

Table IV shows the decomposition results for each model. Before discussing the details of each model, we first highlight some broad takeaways. First, many models imply that virtually all dispersion in price-earnings ratios is due to differences in future earnings growth. The first three risk premia models and the last mispricing model of Table IV imply that full-horizon discount rate news DR_∞ is close to 0, ranging from -0.04 to 0.07, while full-horizon cash flow news CF_∞ is close to 1. Even though these models are able to match the one-month or one-year value anomaly, they do not generate large differences in longer horizon returns and the overall difference in returns is small compared to the dispersion in price-earnings ratios.

In other words, simply matching the value anomaly is not sufficient to explain our decomposition results. This highlights the difference between explaining short-term fluctuations in prices and explaining the level of prices. Even if we focus on the finite-horizon decompositions, these four models all imply that we should observe only small differences in 15-year returns ($DR_{15} \leq 0.07$) and very large differences in 15-year earnings growth ($CF_{15} \geq 0.93$), both of which are clearly rejected in the data.

Second, the models which generate a non-trivial DR_∞ feature long-lived differences in risk exposure or mispricing. The fourth and fifth models of Table IV imply full-horizon discount rate news of 0.28 and 0.93, respectively. A portion of this comes from one-year returns, as shown by DR_1, but the majority of the discount rate news comes from longer horizon returns beyond one-year. For the risk premia model of Kogan and Papanikolaou (2014), this comes from long-lived differences in each firm's exposure to aggregate shocks. In the learning model of Lewellen and Shanken (2002), this comes from the fact that agents are solving a difficult learning problem and mispricing is only gradually resolved over time. In contrast to the models studied in Keloharju et al. (2021), this demonstrates that there are models in which firms have long-lived differences in average future returns and that incorporating these long-lived differences is important for realistically matching cross-sectional dispersion in price ratios.

Table IV

Variance Decomposition in Different Asset Pricing Models

This table calculates the variance decomposition for the price-earnings ratio from equation (3) in different asset pricing models and reports the implied one-year, fifteen-year year and full horizon discount rate news (DR_1, DR_{15}, DR_∞) and cash flow news (CF_1, CF_{15}, CF_∞). The first row shows the values measured in the data. The second, third, fourth, and fifth rows show the results for models of risk premia. These four models are the model of growth options in Berk, Green, and Naik (1999), the model of costly reversibility of capital in Zhang (2005), the model of duration risk in Lettau and Wachter (2007), and the model of IST risk of Kogan and Papanikolaou (2014). The sixth and seventh rows show the results for the model of learning about mean cash flow growth in Lewellen and Shanken (2002) and the model of extrapolation and overconfidence of Alti and Tetlock (2014). All models are solved and estimated using the original author calibrations and simulated over a 50-year sample.

		DR_1	DR_{15}	DR_∞	CF_1	CF_{15}	CF_∞
	Data	0.04	0.52	0.79	0.10	0.20	0.24
		[0.03]	[0.07]	[0.08]	[0.02]	[0.04]	[0.08]
Risk Premia	Growth Options	0.01	0.03	0.03	0.28	0.95	0.95
		[0.06]	[0.18]	[0.18]	[0.06]	[0.17]	[0.17]
	Costly Reversibility of Capital	-0.02	-0.03	-0.03	-0.31	1.06	1.06
		[0.01]	[0.03]	[0.03]	[0.09]	[0.04]	[0.04]
	Duration Risk	0.01	0.02	-0.04	0.03	1.35	1.04
		[0.01]	[0.03]	[0.03]	[0.01]	[0.05]	[0.03]
	Investment-Specific Technology Risk	0.05	0.27	0.28	0.01	0.68	0.72
		[0.03]	[0.11]	[0.12]	[0.01]	[0.10]	[0.10]
Mispricing	Learning	0.11	0.83	0.93	0.01	0.05	0.06
		[0.01]	[0.04]	[0.04]	[0.01]	[0.03]	[0.04]
	Extrapolation and Overconfidence	0.01	0.07	0.07	0.15	0.93	0.93
		[0.01]	[0.03]	[0.03]	[0.02]	[0.02]	[0.02]

B. Risk premia models

Below we discuss the key source of risk in each model and provide intuition for the decomposition results.

B.1. Growth options

In the model of Berk, Green, and Naik (1999), each firm has some existing projects which generate cash flows. Each period, the firm draws a new potential project, which it can pay a fixed cost to undertake. The value of the firm comes from its existing projects as well as the option to undertake future projects ("growth options"). As the term "growth options" implies, future earnings growth plays a key role in this model. The ratio of the firm's price to its current earnings reflects how much of the firm's value comes from existing projects versus growth options. Firms with high price-earnings ratios derive most of their value from their expected future projects rather than existing projects, and future earnings growth accounts for most dispersion in price-earnings ratios ($CF_{15} = 0.95$).

The key risk in the model is shocks to the risk-free rate. Compared to existing projects, the value of growth options is less sensitive to changes in the risk-free rate, as the firm can endogenously change its decision to exercise the option (i.e., it only undertakes the potential project if the risk-free rate is low). Because of this, the agent requires a lower risk premium for firms whose value largely comes from growth options rather than existing projects, which are firms with high price-earnings ratios. Quantitatively, the difference in risk premia is only a small part of the dispersion in price-earnings ratios ($DR_{15} = 0.03$).

Importantly, these differences in risk exposure are fairly short-lived. A firm can only be a "growth" firm (i.e., high price-earnings ratio) for a short amount of time. As soon as it begins to add new projects, its exposure to changes in the risk-free rate increases and the unusually low risk premium for the firm disappears.

B.2. Costly reversibility of capital

In the model of Zhang (2005), firms produce goods using capital and face adjustment costs for changing their capital. Each period, firms observe aggregate productivity as well their idiosyncratic productivity and then choose their optimal future capital subject to adjustment costs. Differences across firms are due to differences in their sequence of idiosyncratic productivity. Because idiosyncratic productivity is AR(1), future earnings growth is partly predictable and dispersion in price-earnings ratios largely predicts differences in future earnings growth ($CF_{15} = 1.06$).

The single priced risk in this model is shocks to aggregate productivity, which appear directly in the stochastic discount factor. Because of the adjustment costs to capital, firms with large amounts of capital are more exposed to negative aggregate shocks. Therefore, the agent requires a higher risk premium for firms with high capital relative to total firm value. Quantitatively, these differences in risk premia are small relative to the dispersion in price-earnings ratios ($DR_{10} = -0.03$).[19]

Like Berk, Green, and Naik (1999), differences in risk exposure are short-lived due to the optimal behavior of firms. A firm with a high price relative to its capital will optimally choose to increase capital. As this firm increases its capital, it increases its exposure to the aggregate shock and loses its low risk premium.

B.3. Duration risk

In the model of Lettau and Wachter (2007), each firm receives some share $s_{i,t}$ of the aggregate earnings. The value of $s_{i,t}$ goes through a fixed cycle, increasing from $\underline{s}$ to a peak value of $\bar{s}$ and then decreasing back to $\underline{s}$. The cross-section of firms is populated with firms at different

[19]In the model, high price-earnings ratio firms have *low* price-capital ratios. A 1% increase in idiosyncratic productivity does not change the current capital, increases the current earnings by 1%, and increases the current price by less than 1% since the increase in productivity is persistent but not permanent. Thus, an increase in idiosyncratic productivity raises the price-capital ratio and lowers the price-earnings ratio. This is why discount rate news is slightly negative, as the model predicts that high price-capital ratio firms will have lower future returns, which means that high price-earnings ratio firms will have *higher* future returns.

points in this share cycle.

The key priced risk is the shock to aggregate earnings. These aggregate earnings shocks are partly reversed over time, which means that long horizon earnings are less exposed to these aggregate shocks than short-horizon earnings. Because of this, firms with high price-earnings ratios (i.e., firms with a low current share $s_{i,t}$) initially have lower risk premia ($DR_1 = 0.01$). However, the overall contribution of discount rates to the price-earnings ratio is relatively small ($DR_{15} = 0.02$) as the firms that initially have low shares eventually become the firms with high shares and the relationship reverses.

The quantitatively larger component is that high price-earnings ratio firms experience higher earnings growth as their share increases. In fact, after 15 years, the firms with low initial shares have not only increased their shares back to a neutral value but have actually become the firms with high share values. Because of this, 15-year cash flow growth accounts for more than 100% of the initial dispersion in price-earnings ratios ($CF_{15} = 1.34$) as all firms have essentially reversed their place in the cycle.

B.4. Investment-specific technology risk

In the IST model of Kogan and Papanikolaou (2014), firms have existing projects which generate cash flows. New projects exogenously arrive to each firm and the firm chooses the optimal amount to invest in each project. Importantly, there are long-lived differences between firms in the arrival rate of new projects. The arrival rate for each firm depends on a permanent firm-specific parameter as well as a slow-moving idiosyncratic Markov process.

The key shock in the model is an aggregate shock to the cost of capital for new projects, which directly impacts the stochastic discount factor. A decrease in this cost does not change the value of existing projects but does increase the value of growth options (i.e., the value of the option to undertake new projects). Given that a decrease in this cost raises the stochastic discount factor, the agent requires a lower risk premium for firms whose value mainly comes from growth options rather than existing projects. Because of this, firms with high prices relative to current earnings have lower discount rates than their peers ($DR_{15} = 0.27$) and higher future earnings growth ($CF_{15} = 0.68$).

An important element that distinguishes this model from Berk, Green, and Naik (1999) and Zhang (2005) is that the differences in risk premia persist even after firms make their capital choices and invest in new projects. Firms differ in the arrival rate of new projects and this does not change when a firm invests in new projects. This helps to generate persistent differences in exposure to the aggregate shock.

C. Mispricing models

Below we discuss the key source of mispricing in each model and the main intuition.

C.1. Lewellen and Shanken 2002

We focus on their quantitative model with renewing parameter uncertainty. Each firm's earnings growth is normally distributed with an unknown firm-specific mean. Bayesian investors learn each firm's mean from past earnings growth. To ensure investors never completely learn the true parameters, the mean for each firm is redrawn every K years.[20]

The agent prices the firm based on her best guess of mean earnings growth and a constant discount rate. Because realized earnings growth is quite noisy, investors' guesses for each firm's mean earnings growth are often inaccurate and the connection between the price-earnings ratio and future earnings growth is small ($CF_{15} = 0.05$). Ex post, price-earnings ratios largely comove with future returns ($DR_{15} = 0.83$).

Importantly, agents' beliefs about mean earnings growth adjust slowly over time. Because of this, mispricing is slowly resolved. While this model does have a higher DR_1 than the other models, it is still the case that most discount rate news comes from longer horizon returns, $DR_1 = 0.11$ compared to $DR_{15} = 0.83$.

[20]To emphasize that cash flow news remains small even when agents have a non-trivial amount of time to observe the noisy process, we use $K = 38$, as this is the maximum value considered in the paper.

C.2. Alti and Tetlock 2014

In this model, firms' cash flows depend on their capital as well as their idiosyncratic productivity. Each firm's idiosyncratic productivity is equal to an unobservable latent AR(1) process plus noise. The agent infers the latent component of productivity from an imperfect exogenous signal and observed cash flows. The agent's beliefs are impact by two biases: (i) she overextrapolates, meaning that she believes the latent process has a higher persistence than it actually does and (ii) she is overconfident, meaning that she believes the exogenous signal is more precise than it actually is.

Given these biases, the agent prices each firm based on its capital, which is observable, and her inferred guess for the latent component of idiosyncratic productivity. These biases lead to mispricing, which accounts for some of the cross-sectional dispersion in price-earnings ratios ($DR_{15} = 0.07$). However, the majority of dispersion in price-earnings ratios is explained by future earnings growth ($CF_{15} = 0.93$).

What explains the differences in discount rate news between the two mispricing models? The key element is that the agent in Alti and Tetlock (2014) has much more information about the firm. In Lewellen and Shanken (2002), the agent sets the price-earnings ratio for each firm based entirely on her guess for the underlying mean growth parameter, and this guess is based solely on realized cash flows. In Alti and Tetlock (2014), the agent sets the price-earnings ratio for each firm based her guess for latent idiosyncratic productivity as well as the firm's capital. Because capital is observable, mistakes about latent productivity only comprise a portion of price-earnings ratio dispersion. Additionally, the agent knows the exogenous signal as well as the realized cash flows when forming her guess for latent productivity.

VI. Return predictability and return surprises

Tables I and II show the quantitative importance of differences in future returns for explaining price ratio dispersion through the decompositions (4) and (7). The other side of the coin for these decompositions is that if we are interested in understanding return predictability, then dispersion in prices ratios should be crucial. This section carries out three exercises to illustrate how our findings relate to return predictability and return surprises.

First, given the distinction between the price-earnings ratio decomposition and the price-book ratio decomposition, we focus on long-term cumulative returns and test whether price-earnings ratios or price-book ratios are a stronger predictor. While both variables significantly predict long-term cumulative returns in separate regressions, we show that the price-earnings ratio completely drives out the price-book ratio in joint regressions. Second, motivated by the recent findings of Keloharju, Linnainmaa, and Nyberg (2021), we evaluate the predictability of non-cumulative return differences at long horizons. As long as price-earnings ratios are mean-reverting, we demonstrate that the lack of earnings growth predictability provides substantial evidence of return predictability. Third, given our findings on the level of price-earnings ratios, we measure the importance of revisions in expected future returns and expected future earnings growth for explaining price-earnings ratio innovations and return surprises, similar to V02. Consistent with the previous sections, we find a larger role for information about future returns than information about future earnings growth.

A. Long-term cumulative returns

Equations (4) and (7) show that all dispersion in price-earnings ratios that is not related to future earnings growth must be related to future returns, whereas this is not true for dispersion in price-book ratios. This naturally raises the question whether the price-earnings ratio is a better predictor of returns than the price-book ratio. For cumulative returns, we first show that the price-earnings ratio predicts future returns with larger magnitude coefficients and higher R^2's than the price-book ratio. Next, we show that the price-earnings ratio drives out the price-book ratio when returns are regressed on both variables. Finally, we connect our results to the profitability anomaly by looking at the ability of the earnings-book ratio to predict returns.

Table V shows the results for the price-earnings ratio and the price-book ratio. Panel A shows separate univariate regressions of future returns on the price-earnings ratio and the price-book ratio. At every horizon, we see find that the price-earnings ratio predicts future returns with a larger magnitude coefficient and a higher R^2 than the price-book ratio. As shown in the final column of Panel A, nearly half (47.6%) of all variation in ten-year returns is explained by the price-earnings ratio.

Importantly, Panel B shows the results when future returns are regressed on both price ratios together. At every horizon, the price-earnings ratio almost completely drives out the price-book ratio. The coefficients for the price-book ratio in Panel B are all small and insignificant. In comparison, the coefficients for the price-earnings ratio are large and significant, particularly for longer horizons. Further, the R^2's and regression coefficients for the price-earnings ratio in Panel B are all almost identical to the values in the univariate regression of returns on the price-earnings ratio in Panel A. Rephrased, including the price-book ratio in the regression has almost no impact on the ability of the price-earnings ratio to explain future returns and provides almost no increase in the R^2. At the ten-year horizon, including the price-book ratio in the regression only marginally improves the R^2 from 47.56% to 47.58%, even reducing its adjusted R^2.

The results of Panel B are consistent with the price-earnings ratio being a less noisy predictor of future returns than the price-book ratio. This can naturally lead to a profitability anomaly if the price-book ratio, rather than the price-earnings ratio, is being used to predict returns. Cohen, Polk, and Vuolteenaho (2003) and Fama and French (2006) show that current profitability, i.e., a measure of current earnings relative to book value, is an additional

Table V

Long-term return predictability

This table shows the predictability of cumulative return $\sum_{j=1}^{h} \tilde{r}_{i,t+j}$ from one to ten years. The columns show the horizon h in years for the cumulative returns. Panel A show the coefficients from separate univariate regressions of cumulative stock returns on the price-earnings ratio ($\tilde{pe}_{i,t}$) and the price-book ratio ($\tilde{pb}_{i,t}$). Panel B show the coefficients of a joint linear regression of cumulative stock returns on both the price-earnings ratio ($\tilde{pe}_{i,t}$) and the price-book ratio ($\tilde{pb}_{i,t}$). Panel C show the coefficients of a joint linear regression of cumulative stock returns on both the earnings-book ratio ($\tilde{eb}_{i,t}$) and the price-book ratio ($\tilde{pb}_{i,t}$). All variables are cross-sectionally demeaned. For space limitation, only block-bootstrap standard errors are shown but we find virtually identical results using Driscoll-Kraay standard errors. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

Years ahead	1	2	3	4	5	6	7	8	9	10
Panel A: Individual regressions on price ratios										
pe	-0.04	-0.12**	-0.18***	-0.23***	-0.28***	-0.31***	-0.37***	-0.41***	-0.45***	-0.48***
	[0.03]	[0.05]	[0.06]	[0.08]	[0.1]	[0.1]	[0.09]	[0.09]	[0.08]	[0.08]
R^2	0.03	0.11	0.17	0.22	0.26	0.29	0.36	0.39	0.43	0.48
pb	-0.01	-0.04	-0.06*	-0.09*	-0.11**	-0.13**	-0.15**	-0.18**	-0.2***	-0.21***
	[0.01]	[0.03]	[0.03]	[0.04]	[0.05]	[0.06]	[0.07]	[0.07]	[0.07]	[0.07]
R^2	0.01	0.05	0.08	0.12	0.16	0.18	0.23	0.26	0.3	0.35
Panel B: Joint regression on price ratios										
pe	-0.08*	-0.18***	-0.27***	-0.31***	-0.35***	-0.39***	-0.46***	-0.48***	-0.49***	-0.49***
	[0.04]	[0.07]	[0.09]	[0.09]	[0.1]	[0.09]	[0.09]	[0.1]	[0.1]	[0.1]
pb	0.02	0.04	0.05	0.05	0.04	0.05	0.05	0.04	0.02	0.01
	[0.02]	[0.03]	[0.04]	[0.04]	[0.04]	[0.05]	[0.05]	[0.08]	[0.09]	[0.1]
R^2	0.04	0.12	0.19	0.23	0.26	0.3	0.37	0.4	0.43	0.48
Panel C: Joint regression on earnings-book ratio and price-book ratio										
eb	0.08*	0.18***	0.27***	0.31***	0.35***	0.39***	0.46***	0.48***	0.49***	0.49***
	[0.04]	[0.07]	[0.09]	[0.1]	[0.09]	[0.09]	[0.09]	[0.09]	[0.1]	[0.1]
pb	-0.06*	-0.14***	-0.21***	-0.26***	-0.3***	-0.35***	-0.41***	-0.44***	-0.46***	-0.48***
	[0.03]	[0.05]	[0.07]	[0.08]	[0.09]	[0.09]	[0.08]	[0.07]	[0.07]	[0.04]
R^2	0.04	0.12	0.19	0.23	0.26	0.3	0.37	0.4	0.43	0.48

factor on top of the Fama and French (1993) three factors that positively predicts future returns. The price-book ratio equals the price-earnings ratio plus the earnings-book ratio. Because the price-book ratio is a noisier predictor of future returns than the price-earnings ratio, including the difference between the two ratios as a separate regressor will improve the R^2. In other words, if the price-book ratio is being used as a factor, then the earnings-book ratio will be an additional factor that helps to predict returns. To demonstrate this, Panel C shows that when returns are regressed on both the price-book ratio and the earnings-book ratio, the earnings-book ratio positively and significantly predicts future returns. Comparing the R^2's of Panel A and Panel C, we see that including the earnings-book ratio improves the R^2's relative to only using the price-book ratio and that the R^2's of Panel C are similar to the R^2's of the univariate regressions in Panel A using the price-earnings ratio.

B. Non-cumulative returns

The results of Section III imply that high price ratio stocks have significantly lower cumulative returns than low price ratio stocks even at long horizons. However, recent findings of Keloharju, Linnainmaa, and Nyberg (2021) show that non-cumulative return differences across stocks are insignificant after only a few years. These two findings are not inconsistent with each other. Our decomposition results show that differences in price ratios are reflected in future returns at *some point* before horizon h, even if we can't tell at which exact horizon those returns are reflected.

Further, our decomposition can still illustrate some useful implications for non-cumulative return predictability. Consider a three-equation regression framework,

$$-\tilde{r}_{i,t+h} = \beta_h^r \tilde{pe}_{i,t} + \varepsilon_{i,t+h}^r \quad (20)$$

$$\Delta\tilde{e}_{i,t+h} = \beta_h^e \tilde{pe}_{i,t} + \varepsilon_{i,t+h}^e \quad (21)$$

$$\tilde{pe}_{i,t+h-1} - \rho\tilde{pe}_{i,t+h} = \phi^{h-1}\left(1-\rho\phi\right)\tilde{pe}_{i,t} + \varepsilon_{i,t+h}^{pe}. \quad (22)$$

Note that constants have been dropped from the regressions as all variables are cross-sectionally demeaned. The coefficients β_h^r and β_h^e capture how much an increase in the current price-earnings ratio is associated with lower year-h returns and higher year-h earnings growth. The coefficient ϕ is simply the persistence of the price-earnings ratio.

Table VI shows the results of regressions (20)-(22) for horizons of two to ten years.[21] The second rows of Panels A and B show the significance of the null hypotheses $\beta_h^r = 0$ and $\beta_h^e = 0$, respectively. We first note that the return coefficient is significant at the 5% level for horizons of two and three years but it is generally not significant at horizons beyond four years. In comparison, the earnings growth coefficient is insignificant at all horizons. For Panel C, we report the persistence ϕ implied at each horizon from the regression (22). The second row of Panel C shows the significance of the null hypothesis $\phi > 1/\rho$, which we can reject at nearly all horizons.

Because of the identity (1), so long as we assume that price-earnings ratios are mean-reverting, then we can construct more powerful tests for return predictability. Similar to Lewellen (2004) and Cochrane (2008), we show two methods for doing this. First, we exploit the positive correlation between $\varepsilon_{i,t+h}^r$ and $\varepsilon_{i,t+h}^{pe}$. Observations in which the price-earnings ratio quickly mean-reverts tend to also be observations in which price-earnings ratios strongly predict future returns and, conversely, observations with relatively little mean-reversion tend to be observations in which return predictability is weaker. Thus, while the p-value for β_h^r may be insignificant for longer horizons, the third row of Panel A shows that $\beta_h^r / \left[\phi^{h-1}(1-\rho\phi)\right]$ is significant at much longer horizons. Rephrased, we can confidently say that β_h^r is positive so long as $\phi < 1/\rho$ (i.e., price-earnings ratios do not explode).

Second, by placing plausible bounds on the persistence of the price-earnings ratio, we can show that the lack of earnings growth predictability provides evidence against the null hypothesis that returns are unpredictable. The return identity (1) implies that at every horizon h, we have

$$\beta_h^r + \beta_h^e \approx \phi^{h-1}(1-\rho\phi). \tag{23}$$

[21] Note that the one-year results for $\beta_1^r, \beta_1^e, \phi$ are simply DR_1, CF_1, and FPE_1/ρ from Table I.

Table VI

Non-cumulative returns, earnings growth, and price-earnings ratio mean reversion

This table shows the parameter estimates of equations (20)-(22) from two to ten years and specific significance tests. The columns show the horizon h in years at which the estimation is performed. Panel A shows the coefficient from regressing negative non-cumulative returns $-\tilde{r}_{i,t+h}$ on $\tilde{pe}_{i,t}$ and the p-values of the null hypotheses $\beta_h^r = 0$ and $\beta_h^r / \left[\phi^{h-1}(1-\rho\phi)\right] = 0$. Note that $\phi^{h-1}(1-\rho\phi)$ is positive if $0 < \phi < 1/\rho$. Panel B shows the coefficient from regressing non-cumulative earnings growth $\Delta\tilde{e}_{i,t+h}$ on $\tilde{pe}_{i,t}$ and the p-values of the null hypotheses $\beta_h^e = 0$ and $\beta_h^e / \left[\phi^{h-1}(1-\rho\phi)\right] = 0$. Panel C shows the inferred value of the persistence ϕ from regressing the price-earnings ratio mean reversion $\tilde{pe}_{t+h-1} - \rho\tilde{pe}_{t+h}$ on $\tilde{pe}_{i,t}$ and the p-value of the null hypothesis $\phi \geq 1/\rho$. All variables are cross-sectionally demeaned. Bootstrap standard errors are calculated for each coefficient. Superscripts indicate the coefficient is significantly different from 0 at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

Years ahead	2	3	4	5	6	7	8	9	10
Panel A: Returns									
β_h^r	0.060**	0.047**	0.041*	0.039*	0.031	0.046**	0.033*	0.026	0.017
$p : \beta_h^r = 0$	(0.033)	(0.036)	(0.060)	(0.070)	(0.133)	(0.010)	(0.050)	(0.158)	(0.366)
$p : \frac{\beta_h^r}{\phi^{h-1}(1-\rho\phi)} = 0$	(0.000)	(0.001)	(0.003)	(0.001)	(0.025)	(0.000)	(0.021)	(0.086)	(0.326)
Panel B: Earnings Growth									
β_h^e	0.002	0.004	0.017	0.016	0.019	0.020	0.017	0.020	0.013
$p : \beta_h^e = 0$	(0.919)	(0.806)	(0.243)	(0.183)	(0.165)	(0.149)	(0.271)	(0.243)	(0.506)
$p : \frac{\beta_h^e}{\phi^{h-1}(1-\rho\phi)} = 0$	(0.919)	(0.799)	(0.203)	(0.172)	(0.181)	(0.147)	(0.236)	(0.201)	(0.472)
Panel C: Persistence									
ϕ	0.961***	0.972***	0.959***	0.960***	0.966***	0.891***	0.956***	0.965***	0.993***
$p : \phi \geq \frac{1}{\rho}$	(0.002)	(0.010)	(0.009)	(0.028)	(0.039)	(0.000)	(0.020)	(0.032)	(0.124)

Intuitively, this condition says that all mean-reversion in the price-earnings ratio must be due to a high price-earnings ratio predicting higher earnings growth (β_h^e) or lower returns (β_h^r). Since Table VI shows that we can reject $\phi > 1/\rho$ at almost all horizons, we can conclude that the sum $\beta_h^r + \beta_h^e$ is significant even though β_h^r and β_h^e may not be individually significant at horizons beyond three years (i.e., they cannot both be zero). Under the null hypothesis that $\beta_h^r = 0$, all mean-reversion must be due to the price-earnings ratio predicting earnings growth ($\beta_h^e \approx \phi^{h-1}(1 - \rho\phi)$). We test this null hypothesis using a persistence for the price-earnings ratio taken from the data as well as an upper bound on the persistence of nearly 1 (0.999).[22]

Specifically, we utilize a wild bootstrap procedure to simulate earnings growth, returns and prices under the null conditions that $\beta_h^r = 0$ and price-earnings ratios have persistence ϕ. The wild bootstrap procedure not only allows each simulation to preserve general forms of conditional heteroskedasticity in equations (20)-(22), but it also captures any contemporaneous correlation structure between price-earnings ratios, lagged returns, and lagged earnings growth. For our main simulation, we set $\phi = 0.953$ based on the average value of ϕ across all horizons after adjusting for Stambaugh (1999) small-sample bias. We run 1,000 simulations and, for each one of them, we estimate the parameters β_h^r, β_h^e and their respective t-statistics.[23]

Figure 3 shows for each of the ten horizons how the simulated t-statistics under the null hypothesis compare to the observed t-statistics. The red line shows the probability that one would spuriously estimate a t-statistic for returns with a magnitude *greater than or equal to* the t-statistic we observe for β_h^r in the data. Consistent with the p-values in Table VI, the probability is small, but larger than 5% after the first three years. On the other hand, the blue line shows the probability that one would estimate a t-statistic with a magnitude *less*

[22] To account for any approximation error in equation (23), we repeat our exercise using observed returns, observed price-earnings ratios, and the earnings growth implied by the identity (1). This ensures that equation (23) holds exactly. We find that the results are almost identical to our results using the observed earnings growth.

[23] Appendix E contains a detailed description of this procedure.

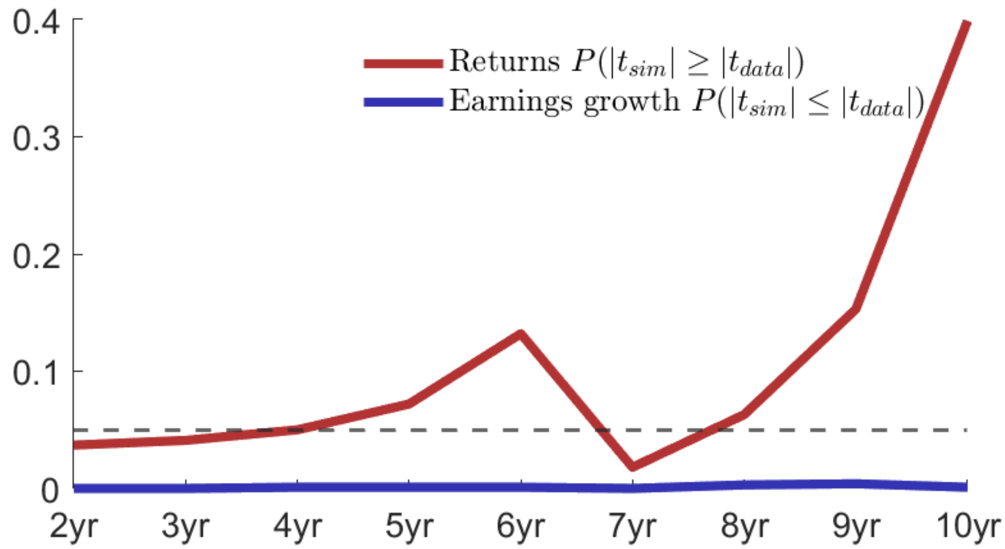

Figure 3. Testing the predictability of non-cumulative returns. This figure visualizes the probabilities of observing the results of Table VI under the absence of return predictability. For 1,000 wild bootstrap simulations, the red line shows for every horizon the share of simulated β_h^r t-statistics greater than the observed t-statistic in the data. The blue line shows for every horizon the share of simulated β_h^e t-statistics smaller than the observed t-statistic in the data.

than or equal to the observed t-statistic of β_h^e in Table VI. For all horizons after the first year, that probability is less than 1%. While the red line by itself does not reject the null hypothesis, the blue line is strong evidence for rejecting it at all horizons $h \geq 2$. Rephrased, the lack of clear earnings growth predictability is strong evidence against the null hypothesis. Intuitively, if price-earnings ratios mean-revert and returns are unpredictable, then we should observe highly predictable earnings growth. Appendix E shows that these results continue to hold for the entire range of values estimated through equation (22), which spans the interval $\phi = (0.888, 0.993)$ after adjusting for Stambaugh (1999) small-sample bias, as well as an upper bound of 0.999.[24]

C. Innovations and return surprises

While the main focus on our paper is on the level of price ratios, we can extend our results to changes in price ratios and current returns. This is similar to the analysis of V02. Consistent

[24]The lower bound of 0.888 comes from the persistence at the one-year horizon of FPE_1/ρ.

with the previous sections, we find a larger role for information about future returns than information about future earnings growth.

Applying conditional expectations to equation (4) and taking the difference from $t-1$ to t, we see that innovations to the price-earnings ratio must represent revisions in expected future earnings growth or revisions in expected future returns. Specifically,

$$\tilde{pe}_t - E_{t-1}\left[\tilde{pe}_t\right] \approx Rev_t^e - Rev_t^r \tag{24}$$

where

$$Rev_t^e = (E_t - E_{t-1})\sum_{j=1}^{\infty} \rho^{j-1}\Delta\tilde{e}_{t+j} \tag{25}$$

$$Rev_t^r = (E_t - E_{t-1})\sum_{j=1}^{\infty} \rho^{j-1}\tilde{r}_{t+j}. \tag{26}$$

We can decompose the cross-sectional dispersion in innovations to the price-ratio into:

$$Var\left(\tilde{pe}_t - E_{t-1}\left[\tilde{pe}_t\right]\right) \approx Var\left(Rev_t^e\right) + Var\left(Rev_t^r\right) - 2Cov\left(Rev_t^e, Rev_t^r\right). \tag{27}$$

Table VII shows the results of the decomposition using the VAR model of Section III.B. First, we see that the dispersion in future return revisions is almost twice as large as the dispersion in future earnings growth revisions (0.15 compared to 0.08). This is similar to the results of Section III, in which future returns accounted for more than twice as much of the dispersion in the level of the price-earnings ratio as future earnings growth.

Our decomposition of price-earnings ratio innovations is closely related to the literature on return surprises. For example, V02 finds that return surprises are largely driven by shocks to cash flows. To understand the difference in these results, we use equation (1), which shows that return surprises simply add an additional term relative to equation (24) which is the current earnings growth surprise,

$$\tilde{r}_t - E_{t-1}\left[\tilde{r}_t\right] \approx \left(\Delta\tilde{e}_t - E_{t-1}\left[\Delta\tilde{e}_t\right]\right) + \rho Rev_t^e - \rho Rev_t^r. \tag{28}$$

Table VII

Decomposition of price-earnings ratio and return surprises

This table estimates the surprise decompositions in equations (27) and (29). Using the VAR model of Section III, the return revisions and earnings growth revisions are defined as $Rev_t^r = (E_t - E_{t-1}) \sum_{j=1}^{\infty} \rho^j \tilde{r}_{t+j}$ and $Rev_t^e = (E_t - E_{t-1}) \sum_{j=1}^{\infty} \rho^j \Delta\tilde{e}_{t+j}$. The earnings growth surprise is defined as $Surp_t^e = \Delta\tilde{e}_t - E_{t-1}[\Delta\tilde{e}_t]$. All numbers are scaled by 100. Appendix B gives the full equations for measuring the revisions and surprises from the estimated VAR model.

Panel A: Price-earnings surprise decomposition			
$Var(\tilde{pe}_t - E_{t-1}[\tilde{pe}_t])$	$Var(Rev_t^e)$	$Var(Rev_t^r)$	$-2Cov(Rev_t^e, Rev_t^r)$
0.44	0.08	0.15	0.21
Panel B. Return surprise decomposition			
$Var(\tilde{r}_t - E_{t-1}[\tilde{r}_t])$	$Var(Surp_t^e + \rho Rev_t^e)$	$\rho^2 Var(Rev_t^r)$	$-2Cov(Surp_t^e + \rho Rev_t^e, \rho Rev_t^r)$
0.57	0.36	0.14	0.06

Table VII Panel B shows the results of the return surprise decomposition,

$$\begin{aligned} Var(\tilde{r}_t - E_{t-1}[\tilde{r}_t]) &\approx Var(\Delta\tilde{e}_t - E_{t-1}[\Delta\tilde{e}_t] + \rho Rev_t^e) + \rho^2 Var(Rev_t^r) \\ &- 2Cov(\Delta\tilde{e}_t - E_{t-1}[\Delta\tilde{e}_t] + \rho Rev_t^e, \rho Rev_t^r). \end{aligned} \tag{29}$$

Consistent with V02, we find that the dispersion of $\Delta\tilde{e}_t - E_{t-1}[\Delta\tilde{e}_t] + \rho Rev_t^e$ is quite large and is more than double the dispersion in future return revisions. However, this does not indicate that revisions in future earnings growth play a large role in return surprises. From Panel A, we already know that the dispersion of future earnings growth revisions is relatively small, which means that the large dispersion for $\Delta\tilde{e}_t - E_{t-1}[\Delta\tilde{e}_t] + \rho Rev_t^e$ comes from the inclusion of the current earnings growth surprise. Intuitively, if earnings growth is volatile and difficult to predict, then current earnings growth surprises will be volatile while revisions for future earnings growth will be small. Thus, we find that return surprises are mainly explained by the current earnings growth surprise and future return revisions, while future earnings growth revisions play only a minor role. This is similar to the results of Section III.B, which show that variation in price-book ratios is explained by a current cash flow variable (the earnings-book ratio) and future returns, while future earnings growth plays only a small role.

VII. Conclusion

A key question in understanding the cross-section of stock prices is whether price ratios are more related to future cash flow growth or future returns. This determines if stocks should be modeled as being primarily heterogeneous in their future growth or if differences in risk exposure and/or mispricing are the primary factors driving price differences. Our results support the latter interpretation. We find that both price-earnings ratios and price-book ratios primarily predict future returns rather than future earnings growth. Using variance decompositions, we estimate that cross-sectional differences in future returns are over twice as important as cross-sectional differences in future earnings growth for explaining the cross-section of price-earnings ratios and price-book ratios.

Alternative decompositions focusing on return surprises and innovations to price ratios, rather than the level of price ratios, similarly show that future returns play a larger role than future earnings growth. These results imply large amounts of long-term return predictability, particularly for the price-earnings ratio, and we document that price-earnings ratios explain nearly half of all dispersion in future ten-year returns. While the price-book ratio is well-established as the standard price ratio for predicting monthly returns, we find that the price-earnings ratio completely drives out the price-book ratio for predicting returns at longer horizons of 1-10 years.

Our results indicate that the cross-section of stock price ratios is broadly consistent with the time-series of aggregate price ratios, in the sense that both the cross-section and the aggregate time-series are primarily related to future returns rather than future cash flow growth. This raises the prospect that a single mechanism may be driving both the cross-sectional and aggregate variation in price ratios. Given the importance of this conclusion, we reconcile our findings with previous work which argues that the cross-section is distinct from aggregate time-series variation due to a strong relationship between price-book ratios and future profitability. Using accounting identities, we demonstrate that future profitability can be split into the current earnings-book ratio and future earnings growth. We then document that the relationship between price-book ratios and future profitability is driven by correlation between price-book ratios and current earnings-book ratios rather than price-book ratios being informative about future cash flow growth.

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Appendix

A. Connecting returns, earnings growth, and price-earnings ratios

First, we discuss the case where dividends are zero. In this case, the return is simply equal to the price growth which means we have an exact relationship

$$r_{t+1} \quad = \quad \Delta e_{t+1} - pe_t + pe_{t+1}. \tag{A1}$$

In other words, by focusing on earnings growth rather than dividend growth, we ensure that our relationships hold even for firms that do not pay dividends. A high price-earnings ratio pe_t must be followed by low future returns r_{t+1}, high future earnings growth Δe_{t+1}, or a high future price-earnings ratio pe_{t+1}.

Now, we consider the case where dividends are non-zero. For all of the portfolios studied in this paper, portfolio-level dividends are always positive. This makes the non-zero dividend case the relevant scenario for our analysis. We start with the one-year return identity

$$R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} = \frac{\left(\frac{P_{t+1}}{D_{t+1}} + 1\right)\frac{D_{t+1}}{D_t}}{\frac{P_t}{D_t}},$$

where P_t and D_t represent the current price and dividends. Log-linearizing around the point $\bar{pd}$, we can state the price-dividend ratio pd_t in terms of future dividend growth, Δd_{t+1}, future returns, r_{t+1}, and the future price-dividend ratio, pd_{t+1}, all in logs:

$$r_{t+1} \quad \approx \quad \kappa^d + \Delta d_{t+1} - pd_t + \rho pd_{t+1}, \tag{A2}$$

where κ^d is a constant, $\rho = e^{\bar{pd}} / \left(1 + e^{\bar{pd}}\right) < 1$. Using the log payout ratio de_t, we then insert the identity $pe_t = pd_t + de_t$ into (A2) to obtain

$$r_{t+1} \quad \approx \quad \kappa + \Delta e_{t+1} - pe_t + \rho pe_{t+1} \tag{A3}$$

where we approximate $(1 - \rho)\, de_{t+1}$ as 0 given that $1 - \rho$ is close to 0.[25] Note that $\bar{pd}$ does not need to be the mean price-dividend ratio of this specific stock or portfolio, so we can

[25] The zero dividend relationship in equation (A1) is simply a special case of equation (A3) as $\bar{pd}$ goes to infinity.

study cross-sectional variation without using portfolio-specific approximation parameters. Following Cochrane (2011), we use the average price-dividend ratio of the market for $\bar{pd}$.

While it is true that this is only an approximation, empirically this approximation (A3) holds quite tightly. For all horizons of 1 to 15 years, Table I shows that a one unit increase in pe_t is associated with almost exactly a one unit increase in $\sum_{j=1}^{h} \rho^{j-1} \Delta e_{t+j} - \sum_{j=1}^{h} \rho^{j-1} r_{t+j} + \rho^h pe_{t+h}$. Further, the final column of Table I shows the portion of price-earnings ratio dispersion that is accounted for by the approximation error. We find that the approximation error from ignoring the payout ratio and using a single value for ρ accounts for only 1.3% of all price-earnings ratio dispersion for horizons of 1 to 15 years.

B. *VAR model*

The key elements of the VAR model are the matrices A and Σ, where

$$x_{t+1} = Ax_t + \varepsilon_{t+1}, \tag{A4}$$

$x_t = \left(\Delta\tilde{e}_t, -\tilde{r}_t, \tilde{pe}_t, \tilde{pb}_t\right)'$, and Σ is the covariance matrix of shocks. Using the estimated model, shown in Table AI, we can derive the variance decomposition in equation (3).

Let e_1, e_2, e_3, e_4 be defined such that e_j is a vector where the j^{th} element is 1 and all other elements are 0. Additionally, let the matrix W be

$$W = A\left(I - \rho A\right)^{-1}. \tag{A5}$$

The matrices A and Σ determine the covariance matrix Γ of x_t. Specifically, we have

$$\text{vec}\left(\Gamma\right) = \left(I - A \otimes A\right)^{-1} \text{vec}\left(\Sigma\right) \tag{A6}$$

where $\otimes$ is the Kronecker product. Given this covariance matrix, cash flow news and discount rate news at finite horizons are

$$CF_h = \frac{e_1'\left[A\left(I - \rho^h A^h\right)\left(I - \rho A\right)^{-1}\right]\Gamma e_3}{e_3'\Gamma e_3} \tag{A7}$$

$$DR_h = \frac{e_2'\left[A\left(I - \rho^h A^h\right)\left(I - \rho A\right)^{-1}\right]\Gamma e_3}{e_3'\Gamma e_3} \tag{A8}$$

Table AI

Estimated transition matrix

This table shows the estimated transition matrix and shock covariance matrix. The VAR model $x_{t+1} = Ax_t + \varepsilon_{t+1}$ where $x_t = \left(\Delta\tilde{e}_t, -\tilde{r}_t, \tilde{pe}_t, \tilde{pb}_t\right)'$ is estimated to evaluate the infinite-horizon decomposition in equation (5).

Panel A: Transition matrix A

	Δe_t	$-r_t$	pe_t	pb_t
Δe_{t+1}	-0.033	-0.131	0.058	-0.020
$-r_{t+1}$	0.073	0.081	0.071	-0.008
pe_{t+1}	-0.035	0.057	0.869	0.044
pb_{t+1}	-0.092	0.059	-0.043	0.966

Panel B. Error covariance matrix Σ

	Δe_t	$-r_t$	pe_t	pb_t
Δe_{t+1}	0.005	-0.002	-0.002	0.002
$-r_{t+1}$	-0.002	0.005	-0.003	-0.005
pe_{t+1}	-0.002	-0.003	0.006	0.003
pb_{t+1}	0.002	-0.005	0.003	0.008

where $e_3'\Gamma e_3$ is $Var\left(\tilde{pe}_t\right)$ and $e_1'\left[A\left(I-\rho^h A^h\right)(I-\rho A)^{-1}\right]\Gamma e_3$ and $e_2'\left[A\left(I-\rho^h A^h\right)(I-\rho A)^{-1}\right]\Gamma e_3$ represent the covariance of the price-earnings ratio with future earnings growth and negative future returns. At the infinite horizon, this simplifies to

$$CF_\infty = \frac{e_1' W \Gamma e_3}{e_3' \Gamma e_3} \tag{A9}$$

$$DR_\infty = \frac{e_2' W \Gamma e_3}{e_3' \Gamma e_3}. \tag{A10}$$

Similarly, to obtain the infinite-horizon estimates for the price-book ratio in Table II we have that

$$\frac{Cov\left(\sum_{j=1}^{\infty}\rho^{j-1}\Delta\tilde{e}_{t+j},\tilde{pb}_t\right)}{Var\left(\tilde{pb}_t\right)} = \frac{e_1'W\Gamma e_4}{e_4'\Gamma e_4} \tag{A11}$$

$$\frac{Cov\left(-\sum_{j=1}^{\infty}\rho^{j-1}\tilde{r}_{t+j},\tilde{pb}_t\right)}{Var\left(\tilde{pb}_t\right)} = \frac{e_2'W\Gamma e_4}{e_4'\Gamma e_4}. \tag{A12}$$

Finally, the revisions in expected future earnings growth and returns observed in Table VII are defined as $e_1'W\varepsilon_t$ and $-e_2'W\varepsilon_t$, which means that

$$Var\left(Rev_t^e\right) = e_1'W\Sigma W'e_1 \tag{A13}$$

$$Var\left(Rev_t^r\right) = e_2'W\Sigma W'e_2. \tag{A14}$$

C. Model simulations

For each model, we simulate the cross-section of firms. We set the number of firms based on the original calculations in each paper. Specifically, we use 50, 2,500, 5,000, 200, 1,000, and 2,500 firms for Berk et al. (1999), Lewellen and Shanken (2002), Zhang (2005), Lettau and Wachter (2007), Alti and Tetlock (2014), and Kogan and Papanikolaou (2014) respectively. We set every sample to a length of 50 years to align with our empirical exercise and we run 1,000 simulations for each model. All parameter values are taken from the original papers.

For Lewellen and Shanken (2002) and Lettau and Wachter (2007), the only firm variables are prices and dividends, so we treat dividends as our measure of earnings and sort firms into five portfolios based on their price-dividend ratios. For the two models based on firms exogenously receiving new projects (Berk et al. 1999; Kogan and Papanikolaou 2014), we treat cash flows from existing projects as our measure of earnings and sort firms into five portfolios based on their price-book ratios. For the two models based on firms producing with capital subject to adjustment costs (Zhang 2005; Alti and Tetlock 2014), we measure earnings as profits from existing capital minus any costs to maintain or adjust capital, and we sort firms into portfolios based on their price-book ratios. We then estimate the finite-horizon decomposition in equation (3) as well as the full horizon decomposition in equation (5) for each model.

C.1. Details for Lewellen and Shanken 2002

We focus on their quantitative model with renewing parameter uncertainty. For each firm, earnings growth is objectively

$$\Delta e_{i,t} = g_i + \varepsilon_{i,t}$$

where g_i is an unknown parameter to the agent. To ensure the agent does not fully learn the parameters, the values for g_i are redrawn every K periods. After t periods in the current regime, her best guess of the mean growth is

$$m_{i,t} = \frac{h}{t+h} g^* + \frac{t}{t+h} \bar{g}_{i,t}$$

where $\bar{g}_{i,t}$ is the average realized earnings growth over the last t periods, g^* is the unconditional mean of the distribution from which g_i is drawn, and h is a parameter controlling the strength of the agent's prior.

The paper considers multiple values for K and h, as well as s which controls the distribution from which g_i is drawn. We use $h = s = 25$ for our simulations, as this is the middle of the distribution of h and s values considered in the paper. To emphasize that cash flow news remains small even when agents have a non-trivial amount of time to observe the noisy process, we use $K = 38$, as this is the maximum value considered in the paper.

C.2. Details for models with adjustment costs

In the model of Zhang 2005, firm earnings are

$$E_{i,t} = e^{x_t + z_{i,t} + p_t} k_{i,t}^{\alpha} - f - i_{i,t} - h\left(i_{i,t}, k_{i,t}\right)$$

where x_t is aggregate productivity, $z_{i,t}$ is idiosyncratic productivity, p_t is the aggregate price level, $k_{i,t}$ is firm-level capital, f is a fixed cost, $i_{i,t}$ is investment in capital, and $h\left(i_{i,t},k_{i,t}\right)$ is an adjustment cost. In the model of Alti and Tetlock 2014, firm earnings are

$$E_{i,t}dt \quad = \quad \left(f_{i,t}dt+\sigma_h d\omega_{i,t}^h\right)m_t^{1-\alpha}K_{i,t}^{\alpha}-I_{i,t}dt-\Psi\left(I_{i,t},K_{i,t}\right)dt$$

where $f_{i,t}$ is idiosyncratic productivity, $d\omega_{i,t}^h$ is a white noise shock, m_t is aggregate productivity, $K_{i,t}$ is firm-level capital, $I_{i,t}$ is investment in capital, and $\Psi\left(I_{i,t},K_{i,t}\right)$ is an adjustment cost.

In order to calculate cash flow news and discount rate news for these two models, we have to address the issue that model earnings are sometimes negative, even at the portfolio level, due to the quadratic adjustment costs. In these models, this can be thought of as the firm raising additional funds. These negative cash flows (i.e., raising new funds) are not compatible with the Campbell-Shiller log-linearized decomposition. To use the decomposition, we want to think about an investor that makes a one-time payment to buy a claim to the company, never pays anything more in the future, and receives some cash flows in the future.

Thus, we will think of an investor that holds some share $\chi_{i,t}$ of the company. When the company has positive cash flows, the investor does not change her share in the company and receives these cash flows. When the company has negative cash flows, we assume the investor sells a part of her stake in the company to cover this. Specifically, this investor receives cash flows $\hat{E}_{i,t}\equiv\chi_{i,t}\max\left\{E_{i,t},0\right\}$, where $\chi_{i,t}=\chi_{i,t-1}\left(1+\min\left\{E_{i,t},0\right\}/P_{i,t}\right)$ and $P_{i,t}$ is the market value of the firm. Intuitively, rather than receiving a negative cash flow, this investor dilutes her claim to the future (on average positive) cash flows. This investor receives the same return as someone who owned the entire firm and received the negative cash flows, $\frac{\chi_{i,t}P_{i,t}+\hat{E}_{i,t}}{\chi_{i,t-1}P_{i,t-1}}\equiv\frac{P_{i,t}+E_{i,t}}{P_{i,t-1}}$. Therefore, this adjustment has no effect on the return differences between value and growth stocks and simply acts to smooth out the earnings differences.

D. *Methodologies for measuring duration*

In order to ensure that the weights $w_{i,t,j}$ in equation (19) sum to 1, papers measuring Macaulay duration must ensure that their estimates of discount rates $\delta_{i,t}$ and future average cash flows $E_t\left[X_{i,t+j}\right]$ match the current price,

$$P_{i,t} \;=\; \sum_{j=1}^{\infty} \frac{E_t\left[X_{i,t+j}\right]}{\left(1+\delta_{i,t}\right)^j}. \tag{A15}$$

In Dechow, Sloan, and Soliman (2004), Weber (2018), and Chen and Li (2023), this is done by assuming a constant discount rate δ, estimating cash flows $E_t\left[X_{i,t+j}\right]$ for horizons $j = 1, ..., H$ and then inferring cash flows beyond horizon H from the current price. In Gonçalves (2021), this is done by estimating cash flows for all horizons $j = 1, ..., \infty$ and then setting the discount rate $\delta_{i,t}$ to satisfy equation (A15).

Both methods imply that stocks whose price is high relative to their estimated future cash flows will be high duration. In the first method, a stock with a high price relative to the estimated $\left\{E_t\left[X_{i,t+j}\right]\right\}_{j=1}^{H}$ will be inferred to have high long horizon cash flows, which raises its duration. In the second method, a stock with a high price relative to the estimated $\left\{E_t\left[X_{i,t+j}\right]\right\}_{j=1}^{\infty}$ will be inferred to have a low discount rate, which raises its duration.

We start with the first method. In Dechow, Sloan, and Soliman (2004), Weber (2018), and Chen and Li (2023), duration is measured as

$$Dur_{i,t} \;=\; \frac{1}{P_{i,t}}\left[\sum_{j=1}^{H} \frac{E_t\left[X_{i,t+j}\right]}{(1+\delta)^j} j + (H + c_1)\left(P_{i,t} - \sum_{j=1}^{H} \frac{E_t\left[X_{i,t+j}\right]}{(1+\delta)^j}\right)\right].$$

Any portion of the firm value that is not explained by the constant discount rate and the first H periods of cash flows, $P_{i,t} - \sum_{j=1}^{H} \frac{E_t[X_{i,t+j}]}{(1+\delta)^j}$, is assumed to be explained by unobserved long horizon cash flows. The parameter c_1 depends on the assumptions about the unobserved long horizon cash flows. In Dechow, Sloan, and Soliman (2004) and Weber (2018), $c_1 = \frac{1+\delta}{\delta}$ as firms are assumed to pay out a perpetuity after horizon H. In Chen and Li (2023), $c_1 = \frac{1+\delta}{\delta - g} > 0$ as firm cash flows are assumed to grow at a common rate $g < \delta$.

In the simple case where $E_t\left[X_{i,t+j}\right]=1$, this reduces to

$$\begin{aligned} Dur_{i,t} &= \frac{1}{P_{i,t}}\left[\sum_{j=1}^{H}\frac{1}{(1+\delta)^j}j+(H+c_1)\left(P_{i,t}-\sum_{j=1}^{H}\frac{1}{(1+\delta)^j}\right)\right] \\ &= H+c_1-c_2P_{i,t}^{-1} \end{aligned}$$

where $c_2\equiv\sum_{j=1}^{H}\frac{1}{(1+\delta)^j}\left(H+c_1-j\right)$ is constant across all firms. Since $c_1>0$, we know that $c_2>0$. Thus, we have that duration is strictly increasing in $P_{i,t}$. This demonstrates that even if the estimated cash flows for horizons 1 to H are identical for all firms, firms with higher prices would be measured as having higher duration.

Next, we discuss the second method. In Gonçalves (2021), firms are allowed to differ in their discount rates. Cash flows for all horizons $j=1,...,\infty$ are estimated and the discount rate $\delta_{i,t}$ is set to satisfy equation (A15). In the simple case where $E_t\left[X_{i,t+j}\right]=1$, this reduces to $\delta_{i,t}=P_{i,t}^{-1}$ and

$$\begin{aligned} Dur_{i,t} &= \frac{1}{P_{i,t}}\sum_{j=1}^{\infty}\frac{1}{(1+\delta_{i,t})^j}j \\ &= 1+\frac{1}{\delta_{i,t}}=1+P_{i,t}. \end{aligned}$$

We again have that the duration is strictly increasing in $P_{i,t}$. Even though the expected cash flows are identical, the high price stocks are inferred to have low discount rates which increases their duration.

E. *Wild bootstrap procedure*

This section describes the wild bootstrap procedure underlying the empirical p-values in Section VI.B. The resampling process is based on Cavaliere, Rahbek, and Taylor (2012) and Huang et al. (2015) and it is adapted to a multi-horizon framework.

The main persistence value of $\hat{\phi}=0.953$ is calculated by taking the average of the implied persistences estimated in equation (22) across all horizons after adjustment for Stambaugh (1999) small-sample bias. The reduced-bias estimate is obtained by adjusting the OLS estimate with the analytical expression for its small-sample bias following Amihud, Hurvich, and Wang (2009). For each portfolio i and for each horizon h, we construct the estimated residuals under the null hypothesis as:

$$
\begin{aligned}
\widehat{\varepsilon^{e}_{i,t+h}} &= \Delta\tilde{e}_{i,t+h} - \hat{\phi}^{h-1}\left(1-\rho\hat{\phi}\right)\tilde{pe}_{i,t} \\
\widehat{\varepsilon^{r}_{i,t+h}} &= -\tilde{r}_{i,t+h} \\
\widehat{\varepsilon^{pe}_{i,t+h}} &= \left(\tilde{pe}_{i,t+h-1} - \rho\tilde{pe}_{i,t+h}\right) - \hat{\phi}^{h-1}\left(1-\rho\hat{\phi}\right)\tilde{pe}_{i,t}
\end{aligned}
$$

where the null hypothesis is imposed in $\hat{\beta}^{e}_{h} = \hat{\phi}^{h-1}\left(1-\rho\hat{\phi}\right)$ and $\hat{\beta}^{r}_{h} = 0$.

Based on this estimate, for each simulation we draw an i.i.d. sequence $w_{i,t}$ from the two-point Rademacher distribution:

$$
w_{i,t} = \begin{cases} -1 & \text{with probability } 1/2 \\ 1 & \text{with probability } 1/2 \end{cases}
$$

We then construct a pseudosample of prices

$$
\tilde{pe}_{i,t+1} = \hat{\phi}\tilde{pe}_{i,t} + \widehat{\varepsilon^{pe}_{i,t+1}} \cdot w_{i,t+1}
$$

and a pseudosample of earnings growth and returns

$$
\begin{aligned}
\Delta\tilde{e}_{i,t+h} &= \hat{\beta}^{e}_{h}\tilde{pe}_{i,t} + \widehat{\varepsilon^{e}_{i,t+h}} \cdot w_{i,t+h} \\
-\tilde{r}_{i,t+h} &= \widehat{\varepsilon^{r}_{i,t+h}} \cdot w_{i,t+h}
\end{aligned}
$$

Note that, on each simulation, we multiply the fitted residuals with the same component $w_{i,t}$ used to generate the price-earnings ratios. This way, the methodology not only captures general forms of conditional heteroskedasticity, but it also preserves any correlation structure between the endogenous predictor, the price-earnings ratio, and the lagged returns and earnings growth. After the pseudosample is constructed, we estimate the regressions (20)-(22) and their corresponding t-statistics. We repeat this process 1000 times. The empirical p-value shown in Figure 3 is the proportion of the bootstrapped t-statistics greater (less) than the t-statistic for the original sample.

We test whether the conclusion of this inference changes using different values for the

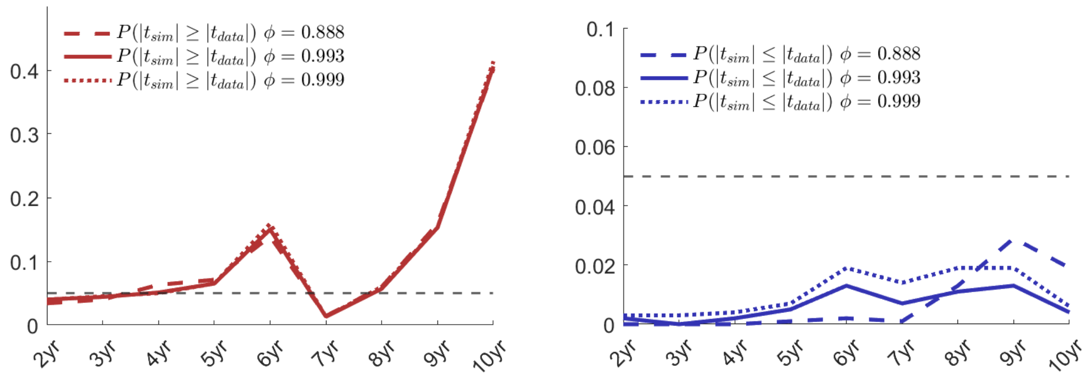

Figure A1. Predictability of non-cumulative returns and earnings growth. This figure visualizes the probabilities of observing the results of Table VI in the absence of return predictability under different persistences of the price-earnings ratio. For 1000 wild bootstrap simulations, the red line shows for every horizon the share of simulated β_h^r t-statistics greater than the observed t-statistic in the data. The blue line shows for every horizon the share of simulated β_h^e t-statistics smaller than the observed t-statistic in the data.

persistence $\hat{\phi}$. Figure A1 shows the results of the simulation using three different values of $\hat{\phi}$: the two extreme values of the interval $\phi = (0.888, 0.993)$, which covers all estimated values of equation (22) after adjusting for Stambaugh small-sample bias, as well as an extreme upper bound value of $\hat{\phi} = 0.999$.

F. Robustness tests

Table AII

Decomposition of differences in price-earnings ratios: Different number of portfolios

This table decomposes the variance of price-earnings ratios using equation (3) for different numbers of portfolios. The first column describes the horizon h in years at which the decomposition is evaluated. For each period, we form value-weighted portfolios and track their buy-and-hold earnings growth ($\sum_{j=1}^{h} \rho^{j-1} \Delta \tilde{e}_{t+j}$), negative returns ($-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{t+j}$), , and price-earnings ratio ($\tilde{pe}_{t+h}$) for every horizon up to fifteen years. The components CF_h, DR_h, and FPE_h are the coefficients from univariate regressions of earnings growth, negative returns and future price-earnings ratios on current price-earnings ratios. Within each panel, we show the results using 10, 20, and 30 portfolios. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

	Panel A: Cash Flow News CF_h			Panel B: Discount Rate News DR_h			Panel C: Future P/E News FPE_h		
Num. Port	10	20	30	10	20	30	10	20	30
$h=1$	0.081***	0.064***	0.059***	0.045**	0.046***	0.043**	0.871***	0.880***	0.886***
s.e. (D-K)	[0.015]	[0.012]	[0.012]	[0.026]	[0.020]	[0.019]	[0.022]	[0.021]	[0.02]
s.e. (boot)	[0.011]	[0.008]	[0.008]	[0.022]	[0.017]	[0.017]	[0.019]	[0.018]	[0.018]
$h=3$	0.084***	0.056***	0.059***	0.172***	0.147***	0.134***	0.737***	0.769***	0.772***
	[0.023]	[0.018]	[0.018]	[0.058]	[0.046]	[0.044]	[0.044]	[0.039]	[0.039]
	[0.023]	[0.018]	[0.017]	[0.055]	[0.044]	[0.041]	[0.042]	[0.037]	[0.036]
$h=5$	0.090***	0.054**	0.053**	0.252***	0.213***	0.196***	0.644***	0.686***	0.691***
	[0.031]	[0.024]	[0.025]	[0.077]	[0.06]	[0.057]	[0.055]	[0.051]	[0.044]
	[0.032]	[0.026]	[0.026]	[0.078]	[0.062]	[0.056]	[0.053]	[0.051]	[0.045]
$h=8$	0.105***	0.057*	0.061*	0.349***	0.298***	0.287***	0.520***	0.568***	0.56***
	[0.03]	[0.028]	[0.027]	[0.08]	[0.059]	[0.058]	[0.062]	[0.053]	[0.049]
	[0.037]	[0.036]	[0.034]	[0.083]	[0.059]	[0.056]	[0.061]	[0.052]	[0.047]
$h=10$	0.115***	0.062	0.067*	0.395***	0.345***	0.331***	0.458***	0.500***	0.491***
	[0.033]	[0.03]	[0.029]	[0.071]	[0.055]	[0.051]	[0.054]	[0.048]	[0.044]
	[0.04]	[0.04]	[0.039]	[0.076]	[0.056]	[0.053]	[0.054]	[0.05]	[0.045]
$h=13$	0.131***	0.069	0.054	0.445***	0.397***	0.388***	0.383***	0.421***	0.425***
	[0.036]	[0.03]	[0.031]	[0.065]	[0.054]	[0.05]	[0.047]	[0.044]	[0.034]
	[0.047]	[0.045]	[0.044]	[0.076]	[0.057]	[0.054]	[0.053]	[0.047]	[0.036]
$h=15$	0.146***	0.078*	0.063	0.476***	0.427***	0.426***	0.331***	0.369***	0.364***
	[0.033]	[0.027]	[0.027]	[0.057]	[0.05]	[0.043]	[0.044]	[0.043]	[0.038]
	[0.046]	[0.041]	[0.044]	[0.067]	[0.049]	[0.051]	[0.050]	[0.040]	[0.039]

Table AIII

Decomposition of differences in price-earnings ratios: Alternative specifications

This table decomposes the variance of price-earnings ratios under two alternative specifications. The first specification estimates equation (3) using three-year smoothed earnings instead of annual earnings to form the valuation ratio. Let s_t be the five-year smoothed average of earnings. For each period, we form value-weighted portfolios and track their buy-and-hold smoothed earnings growth ($\sum_{j=1}^{h} \rho^{j-1} \Delta \tilde{s}_{t+j}$), negative returns ($-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{t+j}$), and price-to-smoothed-earnings ratio ($\tilde{ps}_{t+h}$) for every horizon up to fifteen years. The columns show the coefficients from univariate regressions of earnings growth, negative returns and future price-to-smoothed-earnings ratios on current price-to-smoothed-earnings ratios. The second specification reinvests the delisting returns of exiting firms in the corresponding portfolio. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

	Price-to-smoothed earnings			Delisting returns		
	CF_h	DR_h	FPE_h	CF_h	DR_h	FPE_h
1	0.121***	0.041*	0.839***	0.100***	0.043	0.859***
s.e. (D-K)	[0.019]	[0.028]	[0.026]	[0.024]	[0.034]	[0.026]
s.e. (boot)	[0.014]	[0.024]	[0.021]	[0.021]	[0.029]	[0.022]
3	0.206***	0.155**	0.644***	0.092**	0.181***	0.733***
	[0.036]	[0.062]	[0.043]	[0.039]	[0.07]	[0.051]
	[0.035]	[0.057]	[0.039]	[0.041]	[0.067]	[0.047]
5	0.201***	0.236***	0.568***	0.115***	0.275***	0.617***
	[0.037]	[0.081]	[0.056]	[0.038]	[0.091]	[0.07]
	[0.037]	[0.081]	[0.054]	[0.04]	[0.091]	[0.07]
8	0.229***	0.341***	0.437***	0.146***	0.402***	0.461***
	[0.037]	[0.083]	[0.061]	[0.04]	[0.091]	[0.076]
	[0.037]	[0.083]	[0.058]	[0.042]	[0.091]	[0.078]
10	0.252***	0.385***	0.37***	0.167***	0.457***	0.387***
	[0.035]	[0.073]	[0.057]	[0.038]	[0.077]	[0.069]
	[0.038]	[0.081]	[0.055]	[0.042]	[0.078]	[0.066]
13	0.281***	0.431***	0.298***	0.164***	0.518***	0.329***
	[0.044]	[0.067]	[0.048]	[0.044]	[0.068]	[0.05]
	[0.05]	[0.074]	[0.05]	[0.049]	[0.081]	[0.059]
15	0.283***	0.455***	0.272***	0.173***	0.545***	0.294***
	[0.045]	[0.057]	[0.040]	[0.040]	[0.057]	[0.043]
	[0.045]	[0.068]	[0.048]	[0.042]	[0.073]	[0.057]

Table AIV

Decomposition of the price-book ratio into future profitability and return differences

This table decomposes the variance of price-book ratios using the finite version of equation (10) (Vuolteenaho, 2002). The first column describes the horizon h in years at which the decomposition is evaluated. For each period, we form value-weighted portfolios and track their buy-and-hold profitability ($\sum_{j=1}^{h} \rho^{j-1} \tilde{\pi}_{t+j}$), negative returns ($-\sum_{j=1}^{h} \rho^{j-1} \tilde{r}_{t+j}$), , and price-book ratio ($\tilde{pb}_{t+h}$) for every horizon up to fifteen years. The table reports the coefficients from univariate regressions of the future profitability, future negative returns, and the future price-book ratio on the current price-book ratio. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

$\frac{Cov(\tilde{pb}_t,\cdot)}{Var(\tilde{pb}_t)}$	$\sum_{j=1}^{\infty} \rho^{j-1} \tilde{\pi}_{t+j}$	$-\sum_{j=1}^{\infty} \rho^{j-1} \tilde{r}_{t+j}$	$\rho^j \tilde{pb}_{t+j}$
$h = 1$	0.068***	0.012	0.89***
s.e. (D-K)	[0.006]	[0.017]	[0.019]
s.e. (boot)	[0.004]	[0.013]	[0.015]
$h = 3$	0.168***	0.06*	0.731***
	[0.018]	[0.039]	[0.034]
	[0.015]	[0.035]	[0.029]
$h = 5$	0.233***	0.104**	0.617***
	[0.026]	[0.052]	[0.038]
	[0.024]	[0.050]	[0.033]
$h = 8$	0.302***	0.164**	0.507***
	[0.032]	[0.062]	[0.039]
	[0.03]	[0.066]	[0.033]
$h = 10$	0.337***	0.197***	0.45***
	[0.032]	[0.061]	[0.036]
	[0.025]	[0.066]	[0.028]
$h = 13$	0.381***	0.238***	0.379***
	[0.031]	[0.058]	[0.032]
	[0.024]	[0.061]	[0.024]
$h = 15$	0.409***	0.264***	0.349***
	[0.031]	[0.050]	[0.027]
	[0.022]	[0.059]	[0.025]

Table AV

Decomposition of differences in earnings yields for E/P-sorted portfolios

This table decomposes the variance of earnings yields for E/P-sorted portfolios. To most closely align with the exercise in CPV, we sort all firms into 40 equal value portfolios based on their earnings yields. Given that earnings for these portfolios can be negative, we utilize the exact identity in equation (16) which allows for negative earnings. For any firms that exit, we assume a worst-case scenario, which is that all dispersion in earnings yields associated with missing firms is attributed entirely to the cash flow news component ($\tilde{\Delta}^{(E)}_{i,t+h}$). All portfolio-level variables are the value-weighted average of the firm-level values ($\tilde{\theta}_{i,t}, \tilde{\Delta}^{(E)}_{i,t+h}, \tilde{\Delta}^{(P)}_{i,t+h}, \tilde{\theta}_{i,t+h}$). The columns show the coefficients from univariate regressions of the change in earnings yield due to changes in earnings ($\tilde{\Delta}^{(E)}_{i,t+h}$), the change in earnings yield due to changes in price ($\tilde{\Delta}^{(P)}_{i,t+h}$), and the future earnings yield ($\tilde{\theta}_{i,t+h}$) on the current earnings yield ($\tilde{\theta}_{i,t}$). All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

	CF_h	DR_h	FPE_h
$h = 1$	0.204***	0.073***	0.72***
s.e. (D-K)	[0.032]	[0.029]	[0.029]
s.e. (boot)	[0.041]	[0.019]	[0.026]
$h = 3$	0.292***	0.206***	0.497***
	[0.052]	[0.051]	[0.038]
	[0.063]	[0.036]	[0.037]
$h = 5$	0.26***	0.313***	0.425***
	[0.079]	[0.069]	[0.05]
	[0.089]	[0.048]	[0.048]
$h = 8$	0.237**	0.416***	0.346***
	[0.073]	[0.069]	[0.053]
	[0.095]	[0.063]	[0.041]
$h = 10$	0.19*	0.497***	0.311***
	[0.08]	[0.074]	[0.054]
	[0.104]	[0.081]	[0.034]
$h = 13$	0.194*	0.572***	0.226***
	[0.078]	[0.065]	[0.044]
	[0.103]	[0.083]	[0.028]
$h = 15$	0.162	0.637***	0.195***
	[0.088]	[0.074]	[0.033]
	[0.118]	[0.097]	[0.021]

Table AVI

Predicting dividend growth

This table tests whether cross-sectional differences in price-earnings ratios or price-book ratios are informative about future dividend growth. The first column describes the horizon h in years at which the regression is run. The second column shows the coefficient from a regression of future dividend growth $\sum_{j=1}^{h} \Delta\tilde{d}_{i,t+j}$ on the current price-earnings ratio $\tilde{pe}_{i,t}$. The final column shows the coefficient from a regression of future dividend growth $\sum_{j=1}^{h} \Delta\tilde{d}_{i,t+j}$ on the current price-book ratio $\tilde{pb}_{i,t}$. All variables are cross-sectionally demeaned. Driscoll-Kraay standard errors and block-bootstrap standard errors are calculated for each coefficient. Superscripts indicate block-bootstrap significance at the 1% (***), 5% (**), and 10% (*) level. The sample period is 1963 to 2020.

	$\tilde{pe}_{i,t}$	$\tilde{pb}_{i,t}$
$h = 1$	0.000	0.029**
s.e. (D-K)	[0.009]	[0.012]
s.e. (boot)	[0.008]	[0.013]
$h = 3$	-0.003	0.073***
	[0.019]	[0.026]
	[0.020]	[0.028]
$h = 5$	-0.019	0.089
	[0.035]	[0.055]
	[0.032]	[0.054]
$h = 8$	-0.052	0.058
	[0.045]	[0.054]
	[0.037]	[0.052]
$h = 10$	-0.077	0.057
	[0.055]	[0.059]
	[0.042]	[0.054]
$h = 13$	-0.122*	0.017
	[0.070]	[0.053]
	[0.049]	[0.056]
$h = 15$	-0.15*	0.023
	[0.088]	[0.060]
	[0.056]	[0.060]