New Factors Wanted: Evidence from a Simple Specification Test*

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Abstract

We find a pricing-error reversal pattern for well-known asset pricing models: the CAPM, Fama-French, Hou-Xue-Zhang, Stambaugh-Yuan, and Daniel-Hirshleifer-Sun. A trading strategy that buys low pricing-error stocks and sells high pricing-error ones earns significant average and risk-adjusted returns, and it performs similarly across *all* the models. This is also true for statistical models with factors extracted from 105 anomalies. The pricing-error reversal is unexplained by investor sentiment, limits-to-arbitrage, prospect theory, and expectation extrapolation, suggesting that new factors are needed to better understand the cross section of stock returns.

JEL Classification: C53, G11, G12, G17

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1 Introduction

One of the central problems in finance is to explain why different assets have different average returns. To this end, the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) has long been the corner stone of asset pricing. However, the CAPM is found inadequate and alternative factor models are proposed, such as the most widely used Fama and French (FF3, 1993) three-factor model. To better summarize the cross section of stock returns, four new models have been recently proposed: Fama and French (FF5, 2015) five-factor model, Hou, Xue, and Zhang (HXZ, 2015) four-factor model, Stambaugh and Yuan (SY, 2017) four-factor model, and Daniel, Hirshleifer, and Sun (DHS, 2019) three-factor model.

In this paper, we provide a simple specification test on the ability of existing factor models in explaining the cross section of stock returns. Unlike the well recognized Gibbons, Ross, and Shanken (GRS, 1989) test and the recent pricing framework of Kozak, Nagel, and Santosh (2019) that can be used only at the portfolio level with a relatively small number of test assets, our test applies at the individual stock level and does not require the number of observations larger than the number of test assets.

Specifically, we examine the pricing error (PE) of any given asset pricing model at the stock level. The economic intuition is that, if the model is perfect, its PE should follow a white noise process and there should not exist any profitable trading strategy based on the PE. However, if we do find an exploitable pattern, it would indicate that the model has systematic mispricing and thus is not adequate for pricing all the stocks. Although this approach is different from the standard and formal parametric tests, it does provide a useful diagnosis on the pricing ability of any asset pricing model.

Based on six well-known factor models (i.e., the CAPM, FF3, FF5, HXZ, SY, and DHS), in this paper we document two main findings. The first finding is that there exists a systematic PE reversal pattern across all the six factor models. Stocks with low PEs earn significantly high returns whereas stocks with high PEs earn significantly low returns. A trading strategy that buys the bottom PE decile portfolio and sells the top PE decile portfolio yields a more than 0.60% average return per month for any of the factor models. Since these six pre-specified factor models may omit some important factors that are helpful to explain the cross section of stock returns, we also consider statistical models by extracting factors from 105 anomalies/factor proxies. By employing the most recently developed PCA methods that impose a mispricing restriction in the factor extracting procedure (Balvers and Stivers, 2018; Lettau and Pelger, 2018), we find that the PEs based on statistical factor models also display a reversal pattern, even when the number of factors increases to 15 (far larger than a number of 5 or 6 in the existing literature). These results suggest that the PE reversal pattern shows up for all the well-known factor models and statistical factor models.

The second main finding is that the PE spread portfolios across all the factor models perform virtually the same. The average returns of the PE spread portfolios range from 0.61% to 0.72% among both the pre-specified and statistical factor models; their differences in average returns are indifferent from zero. By using the six pre-specified factor models to adjust for risk exposures, the PE spread portfolios also have indistinguishable alphas.[1] This result suggests that the market factor is by far the most important factor. consistent with Harvey and Liu (2018). The non-market factors provide little incremental power for pricing individual stocks, although they are usually powerful for pricing portfolios. Together with the first main finding, we conclude that new factors are needed to better understand the cross section of stock returns.

The PE reversal is unlikely driven by data mining. Harvey, Liu, and Zhu (2016) raise a data mining issue on anomaly discovery and advocate the use of a t-value greater than 3 in testing whether the average return of a spread portfolio is zero, which is empirically supported by Chordia, Goyal, and Saretto (2019) in evaluating about 2.1 million trading strategies. In this paper, we show that the PE spread portfolios pass this higher hurdle rate with t-values always larger than 3, regardless which factor model is used.

The PE reversal is different from the short-term reversal, which is model *independent* and is constructed by buying prior month losers and selling prior month winners (see, e.g., Lehmann, 1990; Lo and MacKinlay, 1990; Jegadeesh, 1990). In contrast, the PE reversal we examine in this paper is model *specific*. Controlling for the short-term reversal, the average returns of PE portfolios still monotonically decrease, from 0.87% (t-value = 4.88) for the low PE portfolio to 0.48% (t-value = 2.88) for the high PE portfolio, with the difference between the low and high PE portfolios equal to 0.39% (t-value = 4.37).[2] The PE reversal is not subsumed by the long-term reversal either, and continues to exist in a sequential double sort on prior (13-60) return and PE. Moreover, the PE reversal is different from the idiosyncratic volatility (IVOL) effect (the correlation between PE and IVOL is 0.12). Although PE is normalized by its idiosyncratic volatility with past 5-year returns (an alternative estimation of IVOL), a double sort analysis shows that the PE reversal remains significant within each IVOL quintile.

From an investment perspective, a natural question is whether the PE spread portfolio has any

[1]For this reason, in the sequel we focus on the results based on the CAPM's PE in the main text, and report the results with other models in the Appendix.

[2]We find in the Appendix that the short-term reversal disappears after controlling for the PE reversal.

incremental investing value relative to extant risk factors. To examine this question, we carry out six mean-variance spanning tests under different distribution assumptions (see, e.g., Kan and Zhou, 2012), and find that the tests strongly reject the hypothesis that the PE spread portfolio is spanned by these benchmark assets. In another word, the PE spread portfolio lies outside the mean-variance frontier of the benchmark assets, and they can add substantially Share ratio gains to an investor.

We attribute the PE reversal to mispricing, but we are agnostic whether it is due to omitted risk factors. To strengthen our conclusion that new factors are needed, in the following we show that the PE reversal is unlikely to be explained by existing behavioral biases, or other frictions in the stock market.

In time series, the PE reversal seems unrelated to market-wide sentiment. According to Stambaugh, Yu, and Yuan (2012), if the PE reversal is driven by investor sentiment, its spread portfolio should be much stronger and its short-leg portfolio should be much lower when investor sentiment is high. However, we find that these two portfolios do not display such patterns and their average returns and alphas are indistinguishable between the high and low sentiment periods, where a month is defined as high if the Baker and Wurgler (2006) sentiment index in the previous month is above the median value and as low otherwise. For example, the PE spread portfolio has an average return of 0.72% (t-value $= 3.45$) in high sentiment periods and 0.61% (t-value $= 3.10$) in low sentiment periods, with an insignificant difference of 0.10% (t-value $= 0.37$). Moreover, the PE long-leg portfolio has significant average returns and alphas in both high and low sentiment periods, suggesting that the PE reversal is equally due to underpricing in the long-leg and overpricing in the short-leg.

Cross sectionally, we show that the PE reversal is unlikely to be explained by limits-to-arbitrage, prospect theory, and expectation extrapolation, which are three main drivers of mispricing (Barberis, 2018). First, limits-to-arbitrage seem not driving the PE reversal. In this paper, stocks with extreme PE tend to be those with high IVOL, which typically have high arbitrage costs (Pontiff, 2006). As a results, if arbitrage forces are limited, high PE stocks are likely overvalued whereas low PE stocks are likely undervalued, suggesting a negative relation between PE and subsequent returns. Following Nagel (2005) and Weber (2018), we use institutional ownership as the proxy of limits-to-arbitrage, and find little supportive evidence. The PE reversal is stronger among stocks with intermediate institutional ownership than that with extremely low or high institutional ownership. Controlling for institutional ownership has little effect on the PE reversal. Hence, the PE reversal seems beyond the limits-to-arbitrage.

Second, the PE reversal is unlikely driven by prospect theory. One important implication of prospect theory is that investors overweight the probabilities of extreme returns and mentally represent the stock by the distribution of its past returns (Barberis and Huang, 2008), which induces a strong preference for lottery-like assets. Empirically, Kumar (2009) and Han and Kumar (2013) show that lottery investors generate demand for stocks with high probabilities of large short-term up moves in the stock price. In the spirit of Barberis, Mukherjee, and Wang (2016), with probability overweighing, there would have a disproportionately high lottery demand for high PE stocks and a low lottery demand for low PE stocks, which push the prices of such stocks up and down further, and in turn generate decreasing and increasing future returns. Thus, the PE should be negatively related to future stock returns. Following Bali, Cakici, and Whitelaw (2011) and Barberis, Mukherjee, and Wang (2016), we proxy for lottery demand with MAX and prospect theory value. Sequential double sort analyses show that the PE reversal remains statistically significant and economically sizeable after controlling for MAX or prospect theory value, suggesting that investors' demand for lottery-like stocks is not a main driver of the PE reversal.

Finally, it is challenging to explain the PE reversal with expectation extrapolation. With survey data, Greenwood and Shleifer (2014) find that investors's return expectations are positively correlated with past returns and the level of the stock market, but negatively correlated with mode-based expected returns. If investors display such an extrapolation bias at the stock level, a high PE stock should have a high subjective expectation of expected returns whereas a low PE stock should have a low subjective expectation of expected returns, which is consistent with the main finding in this paper. To test this extrapolation hypothesis, we perform two tests. First, we follow Weber (2018) and look at analysts' implied return expectation (target price scaled by current actual price), which appears overly extrapolated (Asness, Frazzini, and Pedersen, 2019). We find that the PE reversal is not affected by analysts' implied return expectation. Second, we explore expectation extrapolation on fundamentals. Bordalo, Gennaioli, La Porta, and Shleifer (2019) and Weber (2018) show that, financial analysts, as representative investors, forecast fundamentals from observed earnings growth, but tend to overreact to good news, especially on long-term earnings growth forecasts. As stock returns and earnings are generally positively correlated, stocks with extreme PE are more likely to suffer from the extrapolation bias, and therefore are those with extreme forecasts on long-term earnings growth. Empirically, however, we find that long-term earnings growth forecasts do not have any effect on the PE reversal. Thus, it is hard to explain the PE reversal with expectation extrapolation.

The rest of the paper proceeds as follows. Section 2 introduces the methodology and data. Section 3 documents a systematic PE reversal pattern, which cannot be explained by state-of-the-art factor models. Section 4 shows that the PE reversal is unlikely to be driven by existing behavioral biases. Section 5 concludes.

2 Methodology and Data

This section introduces the main methodology and data used in this paper.

2.1 Defining PE

Following Cochrane (2005), we write a general asset pricing model in the stochastic discount factor (SDF) form,

$$\mathrm{E}_{t-1}(M_t R_{i,t}) = 0, \tag{1}$$

where M_t is the SDF, $R_{i,t}$ is the return of stock i in excess of the riskfree rate, and $\mathrm{E}_{t-1}(\cdot)$ is the conditional expectation operator. The pricing error of stock i at time t can be defined as:

$$e_{i,t} = R_{i,t} - \mathrm{E}_{t-1}(R_{i,t}), \tag{2}$$

where $E_{t-1}(R_{i,t})$ is the expected return from (1). If an asset pricing model is perfect, the time series $e_{i,t}$ should be a pure white noise over time for each stock i. Hence, one way to assess how the model performs is to examine the time series property of e_{it}. If abnormal returns can be achieved based on e_{it}, the SDF is clearly imperfect.

In this paper, we explore the property of PE in the cross section of stock returns. Specifically, given a K-factor model f, we calculate the PE of each stock in each month with two steps. In the first step, at the beginning of each month, we run a time-series regression for each stock with its past 60-month returns, from month $t-60$ to month $t-1$, with a requirement of at least 50 observations as:

$$R_{i,t-j} = \alpha_{i,t} + \beta_{i,1,t} f_{1,t-j} + \cdots + \beta_{i,K,t} f_{K,t-j} + \varepsilon_{i,t-j}, \quad j = 1, \cdots, 60, \tag{3}$$

where $R_{i,t-j}$ is the excess return of stock i in month $t-j$ and $f_{t-j} = (f_{1,t-j}, \cdots, f_{K,t-j})'$ are the factor returns, say the FF3. Then the expected return in month t is:

$$\hat{R}_{i,t} = \hat{\alpha}_{i,t} + \hat{\beta}'_{i,t}\bar{f}_t, \tag{4}$$

where $\hat{\alpha}_{i,t}$ and $\hat{\beta}_{i,t}$ are estimated by (3) and $\bar{f}_t$ are the averages of factor returns over the past 60 months. In the second step, we estimate $\hat{e}_{i,t}$ as $R_{i,t} - \hat{R}_{i,t}$, and define PE as the normalized price error:

$$\text{PE}_{i,t} = \frac{\hat{e}_{i,t}}{\text{Std}(\varepsilon_{i,t})}, \tag{5}$$

where $\text{Std}(\varepsilon_{i,t})$ is the standard deviation of the residuals from (3) and can be used as an alternative proxy for IVOL.[3] The reasons for this normalization is to adjust the IVOL effect and therefore mitigates the undue impact of high volatile stocks.

2.2 Factor models

We consider six recognized factor models, the CAPM, FF3, FF5, HXZ, SY, and DHS. Based on rational or behavioral economic theories, these models pre-specify factors as sorted portfolios according to established knowledge about the empirical pattern of stock returns. Pre-specified models are parsimonious and easy to interpret, but they require full understanding of the cross section of stock returns. When stock returns are partially understood, these models may be unable to do a fair job. For example, suppose that there is a given set of target assets/portfolios that represent the cross section of stock returns. Pre-specified factor models are likely to fail to price some of the target assets correctly, if not all. Then it is not surprising that they also fail to price some individual stocks.

As a complement, we also consider statistical factor models, which treat risk factors as latent and use statistical techniques, such as PCA, to estimate the factors (see, e.g., Connor and Korajczyk, 1986; Lettau and Pelger, 2018; Balvers and Stivers, 2018; Kelly, Pruitt, and Su, 2019). In contrast to pre-specified factor models, statistical factor models let data speak and extract factors with the goal of maximally explaining all the target assets.

[3] In a concurrent paper, Horenstein (2019) shows that alpha in (3) by using the CAPM reveals a reversal pattern and attributes it to the incentives for investors to tilt portfolios systematically away form low CAPM alpha stocks.

Specifically, suppose stock returns are governed by the following factor structure,

$$R_{i,t} = \alpha_i + \beta_{i,1} f_{1,t} + \cdots + \beta_{i,K} f_{K,t} + e_{it}, \quad i = 1, \cdots, N, \ t = 1, \cdots, T, \tag{6}$$

where $f_t = (f_{1,t}, \cdots, f_{K,t})'$ are latent and have to be estimated from data. Concurrently, Balvers and Stivers (2018) and Lettau and Pelger (2018) provide novel approaches to estimate f_t under arbitrary conditions on $\alpha'\alpha$, of which $\alpha = 0_N$ is a special case. While Balvers and Stivers (2018) solve the factors almost analytically for a general constrain on $\alpha'\alpha$, an explicit formula is available for the exact factors that price the target assets R_t with zero mispricing, and is demonstrated below.[4]

Assume that the target returns follow a stationary distribution. Denote by Σ the return covariance matrix, $\Sigma = \mathrm{E}(R_t - \mu)(R_t - \mu)'$, where μ is the mean of R_t. When α is unrestricted, it is estimated by (6) as

$$\alpha = (I - BQ')\mu, \tag{7}$$

where I is an N-dimensional identity matrix, $B = (\beta_1', \cdots, \beta_N')'$, and $Q = \Sigma^{-1/2} E$ with E, $N \times K$, as the K standardized eigenvectors of Σ corresponding to the K largest eigenvalues. The matrixes B and Q can be estimated by the following optimization problem,

$$\min \mathrm{E}[e_t' e_t] = \min_{B,Q} tr\left[(I - BQ')(I - BQ')\Sigma(I - BQ')\right]. \tag{8}$$

It is well known that the above solutions to B and Q are the standard PCA estimates (see, e.g., Balvers and Stivers, 2018), and the PCA factors for the target assets are

$$f_t = Q' R_t. \tag{9}$$

By design, f_t are the best to fit the model or explain the variation of the target returns. However, it does not impose any restriction on α, and so, f_t will not necessarily imply $\alpha = 0$ in the model.

Imposing a zero mispricing restriction, $\alpha = 0$, we have from (6) that

$$e_t^* = (I - BQ')R_t. \tag{10}$$

[4] As shown by Huang, Li, and Zhou (2019), one can also solve for such factors in a GMM framework.

Hence, minimizing the mean-squared residuals is to

$$\min \mathrm{E}[(e_t^*)'e_t^*] = \min_{B,Q} tr\left[(I-BQ')(I-BQ')(\Sigma+\mu\mu')(I-BQ')\right]. \quad (11)$$

In comparison with (8), we have now the same objective function as before except that $\Sigma+\mu\mu'$ plays the role of the previous Σ. Hence, the solution can be analytically obtained, and the factors with a zero mispricing restriction are

$$f_t^* = Q^{*\prime}R_t, \quad (12)$$

where $Q^{*\prime} = (\Sigma+\mu\mu')^{-1/2}E^{*\prime}$, with $E^{*\prime}$, $N\times K$, as the K standardized eigenvectors of $\Sigma+\mu\mu'$ corresponding to the K largest eigenvalues. Empirically, Lettau and Pelger (2018) show that a constraint with mild mispricing, by replacing $\Sigma+\mu\mu'$ with $\Sigma+\gamma\mu\mu'$, generates factors that perform better than the standard PCA factors in pricing portfolios and similarly in pricing individual stocks; they find $\gamma = 10$ yields the best result.

2.3 Data and key variables

We obtain monthly stock returns from the Center for Research in Security Prices (CRSP) over the period 1926:07–2018:12. We include all domestic common stocks listed on the NYSE, Amex, and Nasdaq exchanges, and exclude closed-end funds, real estate investment trusts (REITs), unit trusts, American depository receipts (ADRs), and foreign stocks (or stocks that do not have a CRSP share code of 10 or 11). Financial firms and firms with negative book equity are excluded. In addition, every month we exclude stocks without valid previous price (with the CRSP return code of "C"), not trading on the current exchange in that month (with the CRSP return code of "B"), and with missing return due to missing price in that month (with the CRSP return code of "-99.0"). If a stock is delisted with missing delisting return, we assume a return of -30% as Shumway (1997).

We also use daily stock returns from the CRSP, with filters similar to the monthly returns. Following Ang, Hodrick, Xing, and Zhang (2006), we measure IVOL by the standard deviation of the residual values from the time-series regression:

$$R_{i,t} = \alpha_i + b_i\mathrm{MKT}_t + s_i\mathrm{SMB}_t + h_i\mathrm{HML}_t + \varepsilon_{i,t}, \quad (13)$$

where $R_{i,t}$ is stock i's daily excess return on date t, and MKT_t, SMB_t, and HML_t are the returns of the market factor, size factor, and value factor on date t, respectively. We estimate (13) for each stock each month using daily returns with a minimum of 15 observations required. Following Bali, Cakici, and Whitelaw (2011), we proxy for lottery demand with MAX, defined as the average of the 5 highest daily returns of the given stock in a given month. We also use the prospect theory value, denoted by TK, and define it as Barberis, Mukherjee, and Wang (2016).

The factor returns of the first three models are from Ken French's website, and the returns of the last three models are from the authors. Due to data availability, CAPM and FF3 start from 1926:07, FF5 from 1963:07, HXZ from 1967:01, SY from 1963:01, and DHS from 1972:07, respectively. To estimate the latent PCA factors, we choose 105 anomaly spread portfolios as the target assets over the sample period 1967:06–2016:12.[5] In application, we consider K factors with $K = 1, 3, 5, 10$, and 15, respectively.

The data on institutional ownership are from the Thomson Reuters 13F database over the 1980:03–2015:12 sample period. These data include quarterly observations on long positions of mutual funds, hedge funds, insurance companies, banks, trusts, person funds, and other entities with holdings of more than $100 million of 13F assets. We calculate the institutional ownership ratio by first summing the holdings of all reporting institutions at the security level and then dividing by the total shares outstanding from CRSP. If a common stock is on CRSP but not in the 13F database, we assign an institutional ownership of 0. We use the CRSP cumulative adjustment factor to account for stocks splits and other distributions between the effective ownership data and the reporting data. The 13F database carries forward institutional reports up to eights quarters. We only keep the holding data as they first appear in the database in calculating the institutional ownership.

Since institutional ownership and size are strongly positively correlated, we follow Nagel (2005) to separate the size effect from the ownership with the following cross-sectional regression,

$$\log \frac{\text{INST}_{i,t}}{1 - \text{INST}_{i,t}} = \alpha + \beta_1 \log(\text{ME}_{i,t}) + \beta_2 (\log(\text{ME}_{i,t}))^2 + u_{i,t} \tag{14}$$

and use the residual $u_{i,t}$ as the institutional ownership (IO) measure, where INST represents the institutional holding and ME denotes the market value of equity. We replace the institutional holding ratios below 0.0001

[5]We thank Chen and Zimmermann (2019) for making the data available. We choose 105 out 156 anomalies as the rest start later than 1967. However, our results are robust to alternative choices by including more anomalies with later than 1967 sample periods.

and above 0.9999 with 0.0001 and 0.9999, respectively. Nagel (2005) shows that this method is effective in creating variation in institutional ownership while keeping size largely fixed.

The data on analyst forecasts on long-term growth in earnings (LTG) are from the Institutional Brokers Estimates System (IBES), where LTG is defined as expected annual increase in operating earnings over the company's next full business cycle, a period ranging from three to five years (Weber, 2018). The sample period is 1982:01–2018:12.

Target prices are also from the IBES database, which contains the projected price level forecasted by analysts within a specific time horizon. For our analysis, we follow Asness, Frazzini, and Pedersen (2019) and use the monthly mean consensus target price, which is defined over a 12-month time horizon. We measure the expectation of expected returns as analysts' consensus price target scaled by current actual price (PTP), over the sample period of 1999:03–2018:12.

3 Main Results

In this section, we show two main findings. First, the PEs of six well-known factor models display a systematic reversal pattern: a trading strategy that buys stocks with high PE and sell stocks with low PE earns significant average and risk-adjusted returns. This result applies to PCA factors. Second, in terms of average and risk-adjusted returns, the PE spread portfolios of all the factor models are virtually the same, suggesting that the CAPM is by far the most important factor model and that new factors are needed for explaining the cross section of stock returns.

3.1 PE decile portfolios

At the beginning of each month, we form decile portfolios sorted by PE, where PE1 refers to the portfolio with stocks in the bottom PE decile and PE10 refers to the portfolio with stocks in the top PE decile. PE1-10 refers to the spread portfolio that goes long PE1 and short PE10. All portfolios are value-weighted and monthly rebalanced throughout the paper. Since we need 61-month data to calculate the PE of each firm (i.e., the first 60 are used to estimate the expected return and the 61st is to calculate PE for portfolio sort), the PE portfolios start from the 62nd observation of each factor model. That is, the PE portfolios start from 1931:08 for the CAPM and FF3, from 1968:08 for the FF5, from 1972:02 for the HXZ, from 1968:02 for the SY, and from 1977:08 for the DHS model, respectively. All portfolios end in 2018:12.

Table 1 presents the first main finding in this paper: there is a systematic PE reversal pattern for all the factor models and the average returns of the PE decile portfolios monotonically decrease in PE.[6] For example, when the CAPM is used to calculate PE, the average returns decrease from 0.96% (t-value = 5.08) for PE1 to 0.24% (t-value = 1.43) for PE10, generating a spread of 0.72% with a 5.96 t-value. When the most recently developed DHS model is used, the average returns decrease from 0.88% (t-value = 3.55) for PE1 to 0.26% (t-value = 1.29) for PE10, yielding a spread of 0.62% with a t-value of 3.58.

Table 2 shows that the performance of the PE spread portfolios is robust to subsample periods. First, we consider the average returns in January and non-January separately, and find that while the PE spread portfolios seem revealing a January effect (Jegadeesh, 1990), the average returns in non-January months are close to that in the whole sample period, suggesting that the January effect is not likely the main driver of the PE reversal. In the finance literature, McLean and Pontiff (2016), Green, Hand, and Zhang (2017), Linnainmaa and Roberts (2018), and Wahal (2019), among others, show that most of anomalies attenuate or disappear dramatically before 1960 or after 1990. For this reason, we split our sample into three subsample periods, 1931–1960, 1961–1990, and 1991–2018. Interestingly, there is no downward trend at all. For example, over these three periods, the average returns of the CAPM's PE spread portfolios are 0.76% (t-value = 3.33), 0.74% (t-value = 3.95), and 0.65% (t-value = 3.11), respectively. These results are similar with other PE spread portfolios. For example, the HXZ's PE spread portfolio earns an average return of 0.53% (t-value = 2.16) over the 1961–1990 period and 0.66% (t-value = 3.20) over the 1991–2018 period.

The PE reversal pattern is robust to alternative rolling windows in calculating PE. For example, when the past 24-month returns are used to calculate the expected return of each stock, Table A1 shows that the PE portfolios generate almost the same average returns as those calculated with the past 60-month returns. Untabulated results with alternative rolling windows generate similar results. Also, in (5), we define PE without including the regression intercept in the numerator; Table A2 shows that including the intercept does not affect our result at all. Overall, PE is different from raw returns, which typically show short- and long-term reversal and medium-term momentum.

Table 3 reports alphas of the PE decile portfolios with the six factor models, and makes three observations. First, low PE stocks are undervalued whereas high PE stocks are overvalued. For example, in

[6] Throughout the paper, returns always refer to excess returns, unless otherwise stated.

Panel A, when decile portfolios are constructed by the CAPM's PE, their CAPM alpha decrease from 0.30% (t-value = 3.88) for PE1 to -0.41% (t-value = -6.69) for PE10, with the difference between the low and high PE portfolios equal to 0.71% (t-value = 6.18). This result reveals that stocks with low CAPM's PE are undervalued by the CAPM and stocks with high CAPM's PE are overvalued by the CAPM. Even when the DHS model is used to adjust the abnormal return, the low PE portfolio earns an alpha of 0.53% (t-value = 4.33) and the high PE portfolio earns an alpha of -0.55% (t-value = -5.32), with the difference between the low and high PE portfolios equal to 1.08% (t-value = 5.63).

Second, all the six factor models are unable to explain the PE decile portfolios, leaving the PE spread portfolios' alphas as large as, or even larger than, that of average returns. For example, the CAPM's PE spread portfolio has an average return of 0.72% (t-value = 5.96); its CAPM alpha is 0.71% (t-vlaue = 6.18), FF3 alpha is 0.78% (t-value = 6.07), and FF5 alpha is 0.57% (t-value = 3.66).

Finally, among the six factor models, the CAPM, FF3, FF5 and HXZ perform relatively better than the SY and DHS to explain a specific PE spread portfolio. When PE is based on the CAPM, the alphas of the six factor models are 0.71% (t-value = 6.18), 0.78% (t-value = 6.07), 0.57% (t-value = 3.66), 0.66% (t-value = 3.64), 0.87% (t-value = 5.39), and 1.08% (t-value = 5.63), respectively. When PE is base on DHS, the corresponding alphas are 0.49% (t-value = 2.86), 0.48% (t-value = 2.69), 0.53% (t-value = 2.75), 0.62% (t-value = 2.90), 0.82% (t-value = 4.09), and 1.01% (t-value = 5.03), respectively.

In sum, Tables 1 and 3 show that while existing factor models may do a fair job for pricing portfolios, they cannot price individual stocks well and their PEs display a systematic reversal pattern.

3.2 PE decile portfolios of statistical factor models

One natural question is whether statistical factor models perform better than the pre-specified factor models, as the latter may suffer from model misspecifications.

Based on the 105 anomalies in Chen and Zimmermann (2019), we extract PCA K factors by using a zero mispricing restriction (Balvers and Stivers, 2018), and report average returns of the PE decile portfolios in Table 4. As expected, when $K = 1$, the PCA factor performs similarly as the CAPM. The average returns monotonically decrease in PE, from 0.85% (t-value = 3.43) for PE1 to 0.20% (t-value = 1.05), with the difference being as large as 0.65% (t-value = 3.62). These values are extremely close to the case when PE is calculated based on the CAPM (the first row of Table 1). When $K = 5$, the PCA factors are the best five linear combinations of the 105 anomalies, and supposed to perform better, or at least as good as the six factor models we consider in the previous subsection. Empirically, however, the decile portfolios sorted by the PE of PCA five factors perform almost the same as those with PCA one factor. Ignoring estimation errors, this result implies that the second to fifth PCA factors explain do not explain individual stock returns at all. As a result, when we include more PCA factors, say $K = 15$, the average returns of the PE decile portfolios do not change either.

The results in Table 4 may suffer from a look-ahead bias because the PCA factors are estimated with the full sample data. To construct real time PE decile portfolios, we use the first 30-year data to train the PCA weights and apply them to the rest to construct real time PCA factors. Specifically, we use data over the 1967:06–1997:05 period to estimate the PCA weights and construct the PE decile portfolios over the 1997:06–2016:12 period. Since we need 61-month of returns to construct the first PE, the PE decile portfolios start from 2002:07. Table A3 reports the results. Surprisingly, the average returns of the PE decile portfolios are quantitatively close to those where the PCA factors are estimated with the full sample. For example, the real time PE spread portfolios based on PCA 1- and 5-factor PEs earn average returns of 0.63% (t-value = 2.14) and 0.58% (t-value = 2.06), while the corresponding values in Table 4, with full sample, are 0.65% (t-value = 3.62) and 0.63% (t-value = 3.60), respectively. Thus, the PCA weights are stable over time and the look-ahead bias with full sample is negligible, which is also confirmed by Lettau and Pelger (2018) and Kozak, Nagel, and Santosh (2019). Also, consistent with Table 2, the PE portfolio performance is robust to alternative sample periods, which does not suffer from the concern in Green, Hand, and Zhang (2017) that most of return predictors lose their forecasting power after 2003.

Table A4 report their alphas by using the six factor models considered in this paper. Similar to Table 3, the PE decile portfolios cannot be explained by existing asset pricing models; stocks with low PE are undervalued whereas stocks with high PE are overvalued, making their alpha difference statistically and economically significant.

To show that our result is robust to alternative statistical methods, we also consider the standard PCA and Lettau and Pelger's (2018) risk premium-PCA. Specifically, the standard PCA does not impose any restriction on mispricing, where the risk premium-PCA allows the extracted factors to misprice some of the target assets. Table A5 report average returns of the PE decile portfolios, and the results are generally the same as that we report in Table 4.

Overall, statistical factors do not hep much to explain the PE reversal, although they are constructed by using more factor candidates. In this sense, the PE reversal is beyond existing factors, and therefor, calls for new factors for explaining the behavior.

3.3 Do multiple factor models outperform the CAPM?

A desired asset pricing model should hold for all assets, whether the assets are individual stocks or portfolios. When a new factor model is proposed, it is supposed to better describe the cross section of stock returns, which implies that its PE spread portfolio should have a smaller average return and alpha. To test this necessary condition, we examine the differences of average returns and alphas between the six models' PE spread portfolios in this subsection.

Table 5 reports the differences and the associated p-values that test whether the differences are zero. There are three interesting observations, First, all the PE spread portfolios have indistinguishable average returns and FF3 alphas, and their differences are not significant at the 5% significant level, which is contrast with Hou, Xue, and Zhang (2015) and Stambaugh and Yuan (2017) who show that the HXZ outperforms the FF3 and the SY outperforms the FF5 and HXZ in explaining extant anomalies at the portfolio level. Second, no model outperforms the CAPM in terms of having a less PE reversal. For example, the differences in average return between the CAPM' PE spread portfolio and the HXZ and SY's PE spread portfolios are 0.01% (p-value = 0.67) and 0.05% (p-value = 0.19). Their differences in FF3 alpha are also 0.01% (p-value = 0.70) and 0.05% (p-value = 0.19), respectively. Finally, the PE performance with the six well-known factor models is also indistinguishable from that with the PCA factor models, which remains true when non-FF3 factor models are used to calculate the alpha difference (Table A6). These results are surprising as all the multiple factor models supplement the CAPM with additional factors and are supposed to perform better.

In sum, our second main finding in this paper is that the CAPM seems by far the most important factor model in explaining the cross section of stock returns, and it performs qualitatively and quantitatively the same as all the well-known multifactor models. For this reason, in the sequel we report the results with the CAPM's PE in the main text and the results with other models' PEs in the appendix. That is, unless stated otherwise, PE will refer to the pricing error calculated based on the CAPM.

3.4 Controlling for prior returns

Since a stock's PE in month t is one component of its raw return, one natural question is whether the PE reversal is subsumed by the usually documented short-term reversal, which is based on the raw return (Lehmann, 1990; Lo and MacKinlay, 1990; Jegadeesh, 1990). In this section, we perform a sequential double sort analysis to explore whether the PE reversal is subsumed by the short-term reversal, and postpone the regression analysis until Section 4.4. We first sort all stocks into five groups based on short-term reversal (STR), i.e., previous month return, and within each quintile, we sort stocks into five groups based on PE. The intersections produce 25 portfolios.

Panel A of Table 6 reports average returns of the 25 valued-valued portfolios. Consistent with Jegadeesh (1990), the short-term reversal exists in our sample period. At the same time, the PE reversal also exist in general, and its spread portfolio earns increasing average return in in terms of the STR rank, from 0.19% (t-value = 1.24) for the low STR stocks t 0.68% (t-value = 4.38) for the high STR stocks, with the difference between the high and low STR stocks equal to 0.49% (t-value = 2.03). It should be mentioned that the insignificant average return in the first two quintiles of STR does not mean the PE reversal is not significant. Indeed, the PE spread portfolios' alphas are significant within each STR quintile. For example, in Table A7, within the first two STR quintile, the FF3 alphas are 0.43% (t-value = 2.74) and 0.38% (t-value = 2.49), respectively. This is also true when the other factor models are used to calculate the alphas, and, to save the space, the results are omitted.

In Panel A, we also report the average returns of the PE portfolios across the STR quintiles. That is, with sequential sort, each PE quintile contains stocks with similar STR characteristics and so we can construct five PE portfolios that do not suffer from the STR concern. The result shows that the average returns of the PE portfolios again monotonically decrease, from 0.87% (t-value = 4.88) for the low PE portfolio to 0.48% (t-value = 2.88) for the high PE portfolio, with their difference being as large as 0.39% (t-value = 4.37); the FF3 alpha is 0.44% (t-value = 5.14). Thus, this panel suggests that after controlling for the short-term reversal, the PE spread portfolio still generates statistically and economically significant abnormal returns.

To further support Panel A, Tables A8 and A9 show that the predictive power of the STR is fully subsumed by PE. Controlling for PE, the average return of the STR spread portfolio is -0.08% (t-value = -0.77) and its alpha has a wrong sign. This result is also confirmed by regression analyses in Section 4.4. Alternative, we run a univariate regression of $\hat{e}_{i,t}$ in (5) on STR and use the residual to construct a

STR-orthogonalized PE measure; Table A10 shows that this alternative PE measure yields quantitatively similar results. Thus, PE contains predictive information beyond STR.

De Bondt and Thaler (1985) show that there is a long-term reversal in the stock market; Stocks with high past 3- to 5-year returns earn low returns in the future. Since the PE is estimated with the past 5-year returns, its forecasting power may come from the long-term reversal. Panel B of Table 6 examines this possibility and shows that the PE reversal is not subsumed by long-term reversal. A sequential double sort shows that the PE reversal also exists after controlling for the long-term reversal, and the PE spread portfolio across the long-term reversal quintiles has a 0.54% average return with a t-value of 4.56. Table A11 reports alphas and further confirms our conclusion.

3.5 Controlling for IVOL

To mitigate the volatility effect, we normalize PE by its standard deviation when forming the decile portfolios, which is calculated by the residuals of regression (3) and can be an alternative proxy for IVOL. This normalization raises a concern whether the PE reversal is driven by IVOL, which has been shown negatively predicting future stock returns (see, e.g., Ang, Hodrick, Xing, and Zhang, 2006). If the predictive power of PE is from IVOL, stocks with small PE in magnitude are more likely to be stocks with extremely high IVOL, and therefore, are more likely to be mispriced. However, Table 3 does not support this inference and shows opposite results: stocks in the 4th, 5th, and 6th PE deciles are those with the least mispricing.

This subsection provides further evidence that the PE reversal is unrelated with IVOL. Specifically, Table 7 reports average returns of the 25 value-weighted portfolios with sequential double sort on IVOL and PE. The results show that the PE reversal is not driven by IVOL, and its spread portfolio remains significant within each IVOL quintile. Controlling for IVOL, the PE spread portfolio across the IVOL quintiles earns an average return of 0.50% (t-value $= 5.29$).

3.6 Mean-variance spanning

This section explores whether the PE spread portfolio adds any investing value from the perspective of an investor who holds a well-diversified portfolio, such as the market portfolio or a portfolio spanned by the FF5 factors. The mean-variance spanning test originally proposed by Huberman and Kandel (1987) provides the answer to this question.

The key idea of this test is to show that whether the PE spread portfolio lies outside the mean-variance frontier spanned by a set of benchmark assets. As such, we run a time-series regression of the PE spread portfolio returns on the factor returns in each asset pricing model over the whole sample period as follows:

$$R_t = \alpha + \sum_{j=1}^{K} \beta_j f_{f,j,t} + \varepsilon_t, \tag{15}$$

where $f_{f,j,t}$ is the jth factor return of model f in month t, β_j is the factor loading , and K is the number of risk factors in model f, such as $K = 5$ in the FF5. Huberman and Kandel (1987) show that the spanning test is equivalent to the test of the following restrictions:

$$H_0 : \alpha = 0 \text{ and } \beta_1 + \cdots + \beta_K = 1. \tag{16}$$

We follow Kan and Zhou (2012) and carry out six spanning tests with various distribution assumptions on the spread portfolio return: Wald test under conditional homoscedasticity, Wald test under independent and identically distributed (IID) elliptical distribution, Wald test under conditional heteroscedasticity, Bekerart-Urias spanning test with errors-in-variables (EIV) adjustment, Bekerart-Urias spanning test without the EIV adjustment, and DeSantis spanning test. All these six test statistics have asymptotic chi-squared distribution with 2 degrees of freedom.

Table 8 reports the test statistics and the associated p-values, where the benchmark assets are the risk factors of the six asset pricing models considered in this paper. The results are unanimous and all the six tests strongly reject the null hypothesis that the PE spread portfolio is within the mean-variance frontier of these benchmark assets. Therefore, the PE spread portfolio is clearly a unique trading strategy that is unexplained by extant factors, thereby providing incremental investing value.

4 Do Behavioral Biases Explain the PE Reversal?

In the previous section, we show that the PE reversal cannot be explained by state-of-the-art factor models and conclude that new factors are needed to better to understand the cross section of stock returns. In this section, we strengthen our argument by excluding existing behavioral explanations. Based on the asset pricing equation (1) and Barberis (2018), the mispricing of a stock may come from three sources, limits-to-arbitrage, exotic preference, and expectation bias, which all deter arbitragers to move the stock price toward the fundamental value. Thus, we attempt to show that the PE reversal cannot be explained by these three sources.

In time series, we investigate how the market-wide sentiment affects the PE reversal. According to Stambaugh, Yu, and Yuan (2012), if investor sentiment is the key driver, the PE spread portfolio should display three patterns: 1) the performance of the spread portfolio should be much stronger when sentiment is high, 2) the mispricing of the long-leg is negligible and is insensitive with investor sentiment, and 3) the mispricing of the spread portfolio is mainly from the short-leg.

Following Stambaugh, Yu, and Yuan (2012, 2015), we test the three hypotheses with the following time-series regressions:

$$R_{i,t} = a_H d_{H,t} + a_L d_{L,t} + \sum_{j=1}^{K} \beta_j f_{f,j,t} + \varepsilon_t, \tag{17}$$

where $d_{H,t}$ and $d_{L,t}$ are dummy variables indicating high and low sentiment periods, and $R_{i,t}$ is the PE spread portfolio return or its long- (short-) leg return in month t. We rely on the index of market-wide investor sentiment constructed by Baker and Wurgler (2006) and define a high (low) sentiment month if the value of the index at the end of the previous month is above (below) the median value for the 1965:07–2018:12 sample period, over which all the six factor models' returns are available.[7]

Table 9 presents the results. Panel A considers the PE spread portfolio return as the dependent variable and shows that the performance is insensitive with investor sentiment. The average return is 0.72% (t-value = 3.45) in high sentiment periods and 0.61% (t-value = 3.10) in low sentiment periods, generating a negligible difference of 0.10% (t-value = 0.37). The risk-adjusted returns display similar patterns. For example, over the high and low sentiment periods, the FF3 alphas are 0.65% (t-value = 3.18) and 0.51% (t-value = 2.72), making the difference as small as 0.20% (t-value = 0.72).

Panel B considers the long-leg portfolio and shows a similar pattern as Panel A. The average and risk-adjusted returns are not affected by investor sentiment. However, in contrast with Stambaugh, Yu, and Yuan (2012), the performance of this long-leg portfolio is statistically significant and economic sizeable, which cannot be explained by investor sentiment with impediments to short selling. Panel C considers the short-

[7] We thank Jeffrey Wurgler for making the most recently updated index available. It should be mentioned that while we use the orthoganalized sentiment index, the "raw" index without filtering out macro information generates similar results. Also, our result is robust to the aligned sentiment index in Huang, Jiang, Tu, and Zhou (2015).

leg portfolio and again shows that the mispricing from the extremely positive PE stocks seems unrelated with the market-wide sentiment. Although the average and risk-adjusted returns are more pronounced in high sentiment periods, the differences between the high and low sentiment periods are not statistically significant. Thus, the PE reversal seems unrelated with the market-wide sentiment, and its driving source appears to be different from those anomalies explored in Stambaugh, Yu, and Yuan (2012).

In the following, we show that the PE reversal is unlikely to be explained by existing behavioral biases from the perspective of cross section.

4.1 Limits-to-arbitrage

This subsection explores whether the PE reversal is driven by limits-to-arbitrage (Shleifer and Vishny, 1997). In the literature, limits-to-arbitrage are usually related to institutional ownership, which is often used as a measure of short-sale activities. When a stock's institutional ownership is low, stock loan supply tends to be sparse, and short selling is likely to be expensive. As a result, limits-to-arbitrage are a driver of overpricing. Empirically, D'avolio (2002) shows that institutional ownership is the most important cross-sectional determinant of stock loan supply and Nagel (2005) finds that mispricing is more likely to occur in stocks with lower institutional ownership.

Limits-to-arbitrage can be also a driver of underpricing, especially for stocks with low institutional ownership. When an asset becomes severely underpriced, arbitrageurs incur large losses. To meet investor redemptions and satisfy margin requirements or leverage targets, arbitrageurs are forced to sell the asset because of lack of funding liquidity (Coval and Stafford, 2007), leading to further underpricing. Key to this mechanism is the fact that arbitrageurs cannot raise external funding when they experience temporary losses. However, Hombert and Thesmar (2014) theoretically and empirically show that, while there are limits-to-arbitrage, institutional investors, such as hedge funds, can attenuate the effects by choosing a stronger capital structure, i.e., they do adjust their ex ante capital structure to avoid liquidating positions when their trades go against them temporarily. Thus, stocks with high institutional ownership are less likely to suffer from underpricing as they are more likely held by institution investors. Instead, stocks with low institutional ownership are more likely held be retail investors and less likely to overcome the limits-to-arbitrage.

In this paper, if the PE reversal is driven by limits-to-arbitrage, there are two implications. First, stocks with the lowest institutional ownership and lowest PE earn the highest returns, whereas stocks with the lowest institutional ownership and highest PE earn the lowest returns. Second, the PE spread portfolio performance should be stronger in stocks with low institutional ownership. To test these two implications, we proxy for limits-to-arbitrage with the residual institutional ownership (IO) as in Nagel (2005).

Panel A of Table 10 reports average returns of the 25 value-weighted portfolios sequentially sorted by IO and PE. The results provide little support to the two implications. First, within each IO quintile, the average returns of the PE portfolios decrease in general, and the difference in average return between the low and high PE portfolios is significant with the high IO quintile as an exception. However, within each PE quintile, the average returns of low IO portfolios are indistinguishable from those of high IO portfolios, for example, within the low PE quintile, the average return is 0.85% (t-value $= 3.06$) for low IO stocks and is 0.80% (t-value $= 2.61$) for high IO stocks, with the difference between the low and high IO portfolios equal to -0.05% (t-value $= -0.30$). The second PE quintile is an exception and yield the opposite result: stocks with high IO earn higher returns then stocks with low IO. That is, the low and high IO portfolios earns average returns of 0.44% (t-value $= -1.62$) and 0.85% (t-value $= 3.16$), with the difference equal to 0.42% (t-value $= 2.24$). These results are inconsistent with the first implication that stocks with low IO suffer from more constraints and consequently earn higher returns.

Second, the average returns of the PE spread portfolios across the IO quintile do not decrease, and instead, they are higher in the second to fourth quintile than that in the first and fifth quintile. Specifically, the average returns of the PE spread portfolios are 0.84% (t-value $= 3.49$), 0.69% (t-value $= 3.61$), and 0.57% (t-value $=$3.36) in the second to fourth IO quintiles, but they are only 0.48% (t-value $= 2.07$) and 0.33% (t-value $= 1.59$) in the first and last quintiles. This result is inconsistent with the second implication that the PE reversal is stronger among low IO stocks.

In the finance literature, firm size is usually used as a limits-to-arbitrage measure, and Fama and French (2015) and (Hou, Xue, and Zhang, 2019) show that most of anomalies only exist or concentrate in microcap stocks. For this reason, Panel B of Table 10 performs a sequential double sort on firm size and PE, which makes three observations. First, while the PE reversal is stronger in microcap stocks, but it also exists in megacap stocks. The average returns of the PE spread portfolios are 1.99% (t-value $= 11.60$) and 0.37% (t-value $= 3.32$) in the microcap and megacap stocks, respectively. Second, the typical pattern that large stocks earn low returns is true for low PE stocks, but it is not true for high PE stocks. For example, within the high PE quintile, the average return increases in firm size, from 0.08% (t-value $= 0.34$) for microcap stocks to 0.42% (t-value $= 2.48$) for megacap stocks, with the difference equal to 0.34% (t-value $= 2.12$). Finally, controlling for firm size, the average returns of the PE portfolios still monotonically decrease in PE, from 0.90% (t-value $= 5.14$) for PE1 to 0.39% (t-value $= 2.29$), with the difference between the low and high PE portfolios equal to 0.51% (t-value $= 4.92$). Thus, the PE reversal does not suffer from the size effect, which seems an issue for a lot of anomalies.

Together with Section 3.5 that the PE reversal survives the IVOL effect, Table 10 suggests that the PE reversal is unlikely to be driven by limits-to-arbitrage.

4.2 Prospect theory-based preference

In behavioral finance, prospect theory is widely viewed as the best available description of how people evaluate risk in decision making, from which one implication is probability weighting. Investors do not weight outcomes by their objective probabilities, but rather by transformed probabilities, which usually overweight low probabilities and underweight high probabilities of events (Barberis, 2013). On the other hand, investors also usually suffer from a mental representation bias. They mentally represent the distribution of a stock's future returns with its past return distribution (Barberis, Mukherjee, and Wang, 2016). Combining probability weighting and mental representation, Barberis and Huang (2008) show that in a financial market where investors evaluate risk according to prospect theory, probability weighting leads to a stronger preference for lottery-like assets. Empirically, Kumar (2009) and Han and Kumar (2013) show that lottery investors generate demand for stocks with high probabilities of large short-term up moves in the stock price. Bali, Cakici, and Whitelaw (2011) show that investors are willing to pay more for stocks that exhibit extreme positive returns and find a negative relation between the maximum daily return over the past one month and expected stock returns.

In terms of this paper, with probability overweighing, there would have a disproportionately high lottery demand for high PE stocks and a low lottery demand for low PE stocks, which push the prices of such stocks up and down further, and in turn generate decreasing and increasing future returns. As a result, the PE should be negatively related to future stock returns.

Following Bali, Cakici, and Whitelaw (2011) and Barberis, Mukherjee, and Wang (2016), we proxy for lottery demand with MAX and prospect theory value (TK). Panel A of Table 11 reports average returns of the value-weighted portfolios sequentially sorted by MAX and PE. The results show that the PE reversal is not affected by the MAX effect and within each MAX quintile, the average returns of the PE portfolios decrease, with the difference between the low and high PE portfolios always significant. Also, the PE reversal equally exists across the MAX quintile. For example, the average return of the PE spread portfolio is 0.68% (t-value $= 6.45$) among low MAX stocks and 0.76% (t-value $= 3.17$) among high MAX stocks, making their difference as small as 0.08% (t-value $=0.32$). Finally, controlling for MAX, the PE spread portfolio earns an average return of 0.56% with a 5.91 t-value.

Panel B of Table 11 performs a sequential double sort on TK and PE, and shows similar results as Panel A. Within each TK quintile, the average returns of the PE portfolios decrease and the spread between the low and high PE portfolios is always significant. Different from Panel A, the PE reversal is stronger among low TK stocks. The average return of the PE spread portfolio has an average return of 0.85% (t-value $= 4.46$) among low TK stocks and 0.49% (t-value $= 4.41$) among high TK stocks, with the difference between the low and high TK portfolios equal to -0.36% (t-value $= -1.87$). Controlling for TK, the PE spread portfolio earns an average return of 0.56% (t-value $= 5.63$).

Overall, although prospect theory has been successfully used to explain skewness and beta-related anomalies (see, e.g., Boyer, Mitton, and Vorkink, 2009; Bali, Brown, Murray, and Tang, 2017), it seems unable to explain the PE reversal.

4.3 Expectation extrapolation

After exploring the non-standard preference on the PE reversal in the previous section, this section examines the effect of non-standard beliefs, i.e., situations where investors deviate from Bayes' rule in forming their beliefs. Greenwood and Shleifer (2014) study stock market return expectations and find that survey expectations of investors are highly correlated with past overall stock market returns and with the level of the stock market. Andonov and Rauh (2019) show that extrapolating past returns to future expectations exists in institutional investors in a range of asset classes, such as public equity, real assets, private equity, and hedge funds.

If investors display such an extrapolation bias, a high PE stock should have a high subjective expectation of expected returns whereas a low PE stock should have a low subjective expectation of expected returns. To test this hypothesis, we perform two exercises. The first is constructing the expectation of expected return directly. Following Weber (2018), we look at analysts implied return expectation, i.e., target price scaled by current actual price (PTP), which has been shown suffering from the extrapolation bias (Asness, Frazzini, and Pedersen, 2019). Panel A of Table 12 presents average returns of the 25 value-weighted portfolios sequentially sorted by PTP and PE. The PE reversal exists in the first four PTP quintiles, but not in the highest PTP quintile, which is inconsistent with the hypothesis that the expectation bias is most pronounced among the highest PTP stocks. Controlling for PTP, the PE spread portfolio generates a 0.66% average return with a 3.23 t-value.

Our second exercise is about fundamental extrapolation. Bordalo, Gennaioli, La Porta, and Shleifer (2019) and Weber (2018) show that, financial analysts, as representative investors, forecast fundamentals from observed earnings growth, but tend to overreact to good news, especially on long-term earnings growth forecasts. As stock returns and earnings are generally positively correlated, stocks with extreme PE are more likely to suffer from the extrapolation bias, and, therefore, are those with extreme forecasts on long- term earnings growth.

Panel B of Table 12 performs a sequential double sort on LTG and PE. Again, the results are similar as Panel A. Within the first four LTG quintiles, the average returns of the PE portfolio decrease and the difference between the low and high PE portfolios are significantly positive. Within the fifth LTG quintile, the PE spread portfolio earns a negligible average return, which is in contrast to the hypothesis that extrapolation is stronger among high LTG stocks. Controlling for LTG, the average returns of the PE portfolio monotonically decrease, making the spread between the low and high PE portfolios as large as 0.63% (t-value $= 4.47$). Thus, expectation bias seems unlikely to explain the PE reversal.

4.4 Fama-MacBeth regressions

In this subsection, we perform Fama-MacBeth regressions to exclude the possibility that the PE reversal is driven by behavioral biases, with controls for firm specific characteristics. In contrast, if the PE reversal is driven by any of the three mispricing sources, the regression coefficient on the PE will be not significant while controlling for the variable of interest.

Since the sample periods vary dramatically with different variables, we report the results in Table 13 by using all available data regression by regression and in Table A25 by restricting the sample period to 1999:04–2018:12, over which all explanatory variables have non-missing observations (except IO that ends in 2015:12).

In general, Table 13 makes two statements. First, the predictive power of PE cannot be explained by limits-to-arbitrage, prospect theory, and extrapolation, and it is statistically significant and economically sizeable. For example, the coefficient of PE is -0.52% (t-value $= -8.79$) without controlling for explanatory variables weakly drops in magnitude to -0.37% (t-value $= -4.15$) with controlling for all explanatory variables. Economically, the regression coefficients can be interpreted as monthly returns on the long-sort strategy of trading on PE that is orthogonal to other explanatory variables, and are comparable with the spread portfolio returns in Table 1. The t-values are proportional to the Sharpe ratios of the spread portfolio, which equals to the annualized Sharpe ratio times $\sqrt{T}$, the number of years in the sample. So the t-value of -8.79 in the first column that do not control for the potential interpretations suggests that an investor by trading on PE can earn an annualized Sharpe ratio of 0.94 (i.e., $8.79/\sqrt{88}$), and the t-value of -4.15 in the last column that controls for all variables suggests that an investor can earn an annualized Sharpe ratio of 0.95 (i.e., $4.15/\sqrt{19}$), more than double of the market Sharpe ratio in this period, 0.36.

Second, the short-term reversal becomes insignificant after controlling for the PE reversal, suggesting that the PE is actually the driver of the usually documented short-term reversal. In sum, Table 13 confirms the previous subsections that the PE reversal is unlikely to be explained by the limits-to-arbitrage, prospect theory, and expectation bias.

5 Conclusion

Explaining and estimating expected stock returns are of interest in theory and practice. The capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) has long been used for capital budgeting decisions. However, the CAPM is problematic, and so there are improved factor models, such as Fama and French (1993, 2015), Hou, Xue, and Zhang (2015), Stambaugh and Yuan (2017), and Daniel, Hirshleifer, and Sun (2019). An important question is whether these models are adequate in pricing individual stocks.

In this paper, we examine the pricing errors (PEs) of the above six well-known factor models by providing a simple model specification test. We find that a spread portfolio that buys stocks with low PE and sells stocks with high PE earns significant average and risk-adjusted returns. Moreover, the PE spread portfolios constructed by using different factor models perform virtually the same as the CAPM, indicating that existing multiple factor models provide little incremental power in explaining individual stock returns, although they perform much better for pricing portfolios. Moreover, these findings also apply to statistical factor models with factors extracted from 105 anomalies. We show further that the systematic PE reversal pattern cannot be explained by investor sentiment, limits-to-arbitrage, prospect theory, and expectation extrapolation. Putting all together, our results suggest that new factors are needed to better understand the cross section of stock returns and to better make capital budgeting decisions. As future research, it will be of interest to apply our specification test to other markets such as foreign exchanges and commodities.

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Table 1 Average returns of PE decile portfolios

This table reports average returns of pricing error (PE) decile portfolios (Newey-West t-values in parentheses), where PE is based on the CAPM, FF3 (Fama and French, 1993), FF5 (Fama and French, 2015), HXZ (Hou, Xue, and Zhang, 2015), SY (Stambaugh and Yuan, 2017), and DHS (Daniel, Hirshleifer, and Sun, 2019) model, respectively. PE_{CAPM} refers to the CAPM's PE and PE_{FF3} to the FF3's PE, etc. Given a factor model, each month we calculate the PE of a firm as its realized return minus its expected return estimated with its past 60-month returns, normalized by its standard deviation, and form value-weighted decile portfolios in an ascending order of PE. The sample periods of PE portfolios all end in 2018:12, but start differently, from 1931:08 for the CAPM and FF3, 1968:08 for the FF5, 1972:02 for the HXZ, 1968:02 for the SY, and 1977:08 for the DHS, respectively.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
PE_{CAPM}	0.96	0.94	0.80	0.69	0.84	0.70	0.82	0.62	0.55	0.24	0.72
	(5.08)	(5.23)	(4.60)	(3.84)	(4.84)	(3.90)	(4.64)	(3.48)	(2.94)	(1.43)	(5.96)
PE_{FF3}	0.92	0.95	0.84	0.72	0.82	0.69	0.79	0.61	0.55	0.25	0.67
	(4.84)	(5.30)	(4.76)	(4.04)	(4.72)	(3.95)	(4.31)	(3.51)	(3.00)	(1.46)	(5.30)
PE_{FF5}	0.80	0.81	0.74	0.58	0.64	0.54	0.57	0.47	0.36	0.17	0.62
	(3.40)	(3.98)	(3.56)	(2.73)	(3.26)	(2.61)	(2.88)	(2.44)	(1.80)	(0.94)	(3.95)
PE_{HXZ}	0.79	0.85	0.77	0.60	0.65	0.60	0.66	0.50	0.45	0.18	0.61
	(3.34)	(4.09)	(3.78)	(2.75)	(3.36)	(2.85)	(3.30)	(2.60)	(2.21)	(0.97)	(3.83)
PE_{SY}	0.79	0.88	0.65	0.62	0.60	0.57	0.59	0.48	0.38	0.16	0.64
	(3.46)	(4.39)	(3.12)	(2.90)	(3.08)	(2.83)	(3.06)	(2.55)	(1.88)	(0.87)	(4.17)
PE_{DHS}	0.88	1.00	0.82	0.78	0.81	0.69	0.71	0.66	0.56	0.26	0.62
	(3.55)	(4.71)	(3.76)	(3.42)	(4.01)	(3.23)	(3.39)	(3.34)	(2.61)	(1.29)	(3.58)

Table 2 Average returns of PE spread portfolios over different sample periods

This table reports the subsample average returns and the associated t-values that test whether the average returns are different from zero. PE_{CAPM} refers to the spread portfolio based on the CAPM's PE, and PE_{FF3} to the spread portfolio based on the FF3's PE, etc. The sample period is the same as Table 1.

	January		Non-January		1931–1960		1961–1990		1991–2018	
	Mean	t-value	Mean	t-value	Mean	t-value	Mean	t-value	Mean	t-value
PE_{CAPM}	1.99	4.34	0.60	4.91	0.76	3.33	0.74	3.95	0.65	3.11
PE_{FF3}	1.81	3.77	0.57	4.44	0.71	2.79	0.69	3.69	0.61	2.90
PE_{FF5}	1.44	2.16	0.55	3.51	–	–	0.65	2.95	0.59	2.70
PE_{HXZ}	1.68	2.34	0.51	3.22	–	–	0.53	2.16	0.66	3.20
PE_{SY}	1.38	2.08	0.57	3.78	–	–	0.67	3.08	0.61	2.86
PE_{DHS}	1.61	2.15	0.53	3.00	–	–	0.58	1.79	0.64	3.13

Table 3 Alphas of PE decile portfolios

This table reports alphas of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on the CAPM, FF3, FF5, HXZ, SY, and DHS model, respectively. PE_{CAPM} refers to the CAPM's PE and PE_{FF3} to the FF3's PE, etc. Given a factor model, each month we calculate the PE of a firm as its realized return minus its expected return estimated with its past 60-month returns, normalized by its standard deviation, and form value-weighted decile portfolios in an ascending order of PE. The sample period is the same as Table 1.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
Panel A: Portfolios sorted by PE_{CAPM}											
CAPM alpha	0.30	0.24	0.11	0.02	0.16	0.04	0.16	−0.06	−0.12	−0.41	0.71
	(3.88)	(4.43)	(1.87)	(0.34)	(3.05)	(0.74)	(3.14)	(−1.07)	(−1.86)	(−5.69)	(6.18)
FF3 alpha	0.32	0.24	0.10	0.03	0.15	0.05	0.15	−0.07	−0.14	−0.45	0.78
	(4.01)	(4.39)	(1.75)	(0.47)	(2.82)	(0.83)	(2.92)	(−1.17)	(−2.19)	(−5.89)	(6.07)
FF5 alpha	0.21	0.29	0.12	0.03	0.06	−0.04	0.09	−0.04	−0.14	−0.36	0.57
	(2.01)	(3.71)	(2.00)	(0.39)	(1.04)	(−0.55)	(1.34)	(−0.52)	(−1.54)	(−4.38)	(3.66)
HXZ alpha	0.30	0.37	0.12	0.03	0.06	−0.10	0.07	−0.07	−0.15	−0.36	0.66
	(2.52)	(4.05)	(1.51)	(0.33)	(0.89)	(−1.13)	(0.96)	(−0.76)	(−1.53)	(−3.84)	(3.64)
SY alpha	0.40	0.40	0.16	0.06	0.06	−0.04	0.07	−0.12	−0.21	−0.47	0.87
	(4.01)	(5.26)	(1.83)	(0.75)	(0.96)	(−0.53)	(0.98)	(−1.60)	(−2.57)	(−5.19)	(5.39)
DHS alpha	0.53	0.47	0.22	0.11	0.07	−0.03	0.07	−0.17	−0.27	−0.55	1.08
	(4.33)	(4.66)	(2.25)	(1.34)	(0.93)	(−0.38)	(0.80)	(−2.09)	(−2.83)	(−5.32)	(5.63)
Panel B: Portfolios sorted by PE_{FF3}											
CAPM alpha	0.25	0.26	0.13	0.06	0.14	0.04	0.11	−0.05	−0.11	−0.41	0.66
	(3.27)	(4.49)	(2.33)	(1.02)	(2.63)	(0.66)	(2.32)	(−0.97)	(−1.85)	(−5.63)	(5.66)
FF3 alpha	0.27	0.25	0.12	0.07	0.14	0.04	0.11	−0.05	−0.13	−0.46	0.73
	(3.35)	(4.56)	(2.14)	(1.14)	(2.59)	(0.72)	(2.08)	(−0.95)	(−2.19)	(−6.00)	(5.61)
FF5 alpha	0.18	0.29	0.15	0.01	0.09	−0.02	0.04	−0.04	−0.14	−0.36	0.53
	(1.77)	(3.69)	(2.53)	(0.18)	(1.29)	(−0.26)	(0.71)	(−0.53)	(−1.54)	(−4.29)	(3.42)
HXZ alpha	0.27	0.37	0.14	0.03	0.09	−0.08	0.04	−0.08	−0.14	−0.36	0.63
	(2.20)	(4.23)	(1.81)	(0.33)	(1.25)	(−0.87)	(0.54)	(−0.97)	(−1.44)	(−3.65)	(3.29)
SY alpha	0.37	0.40	0.18	0.06	0.05	−0.01	0.02	−0.12	−0.22	−0.46	0.83
	(3.73)	(5.38)	(2.35)	(0.72)	(0.77)	(−0.08)	(0.31)	(−1.76)	(−2.69)	(−4.81)	(4.94)
DHS alpha	0.48	0.48	0.25	0.15	0.07	−0.01	0.01	−0.17	−0.29	−0.53	1.02
	(3.91)	(4.94)	(2.64)	(1.72)	(0.92)	(−0.11)	(0.16)	(−2.14)	(−3.08)	(−4.87)	(5.05)
Panel C: Portfolios sorted by PE_{FF5}											
CAPM alpha	0.25	0.30	0.23	0.08	0.16	0.06	0.09	0.01	−0.11	−0.26	0.51
	(2.34)	(4.04)	(3.28)	(1.16)	(2.31)	(0.84)	(1.32)	(0.15)	(−1.41)	(−3.06)	(3.33)
FF3 alpha	0.21	0.29	0.21	0.05	0.14	0.02	0.08	0.02	−0.13	−0.31	0.52
	(1.86)	(3.77)	(3.33)	(0.66)	(2.00)	(0.27)	(1.11)	(0.24)	(−1.56)	(−3.76)	(3.13)
FF5 alpha	0.22	0.26	0.18	−0.01	0.09	−0.06	0.05	−0.04	−0.14	−0.34	0.56
	(1.89)	(3.11)	(2.67)	(−0.10)	(1.15)	(−0.83)	(0.81)	(−0.47)	(−1.44)	(−3.92)	(3.20)
HXZ alpha	0.29	0.33	0.16	0.01	0.09	−0.09	0.06	−0.06	−0.16	−0.35	0.64
	(2.22)	(3.83)	(2.00)	(0.15)	(1.17)	(−1.04)	(0.82)	(−0.66)	(−1.63)	(−3.64)	(3.23)
SY alpha	0.38	0.35	0.23	0.03	0.04	−0.03	0.05	−0.11	−0.23	−0.43	0.82
	(3.32)	(4.70)	(2.54)	(0.30)	(0.52)	(−0.39)	(0.67)	(−1.50)	(−2.74)	(−4.27)	(4.25)
DHS alpha	0.49	0.42	0.28	0.12	0.06	−0.06	0.06	−0.16	−0.32	−0.51	1.01
	(3.73)	(4.37)	(2.94)	(1.47)	(0.79)	(−0.75)	(0.81)	(−1.93)	(−3.65)	(−4.68)	(4.77)

Table 3 (continued)

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
Panel D: Portfolios sorted by PE_{HXZ}											
CAPM alpha	0.21	0.31	0.23	0.06	0.15	0.08	0.14	0.01	−0.05	−0.28	0.49
	(1.91)	(3.66)	(3.12)	(0.86)	(2.12)	(1.20)	(2.18)	(0.18)	(−0.62)	(−3.23)	(3.21)
FF3 alpha	0.17	0.29	0.20	0.03	0.12	0.05	0.13	0.01	−0.07	−0.32	0.49
	(1.62)	(3.34)	(3.02)	(0.37)	(1.69)	(0.74)	(2.02)	(0.14)	(−0.80)	(−3.77)	(3.08)
FF5 alpha	0.16	0.26	0.17	−0.02	0.07	−0.03	0.12	−0.05	−0.08	−0.35	0.51
	(1.45)	(2.85)	(2.47)	(−0.28)	(0.93)	(−0.41)	(1.82)	(−0.56)	(−0.82)	(−3.89)	(2.99)
HXZ alpha	0.26	0.32	0.16	0.00	0.08	−0.08	0.13	−0.07	−0.10	−0.36	0.63
	(2.12)	(3.28)	(1.91)	(0.02)	(1.12)	(−0.89)	(1.81)	(−0.74)	(−1.05)	(−3.70)	(3.29)
SY alpha	0.35	0.35	0.22	0.01	0.01	−0.02	0.10	−0.13	−0.17	−0.45	0.80
	(3.30)	(3.90)	(2.35)	(0.15)	(0.13)	(−0.20)	(1.43)	(−1.54)	(−1.95)	(−4.31)	(4.43)
DHS alpha	0.50	0.44	0.25	0.13	0.05	−0.03	0.09	−0.16	−0.29	−0.55	1.05
	(4.23)	(4.09)	(2.68)	(1.56)	(0.78)	(−0.43)	(1.19)	(−1.93)	(−3.25)	(−5.21)	(5.51)
Panel E: Portfolios sorted by PE_{SY}											
CAPM alpha	0.25	0.36	0.13	0.11	0.12	0.09	0.11	0.02	−0.10	−0.28	0.54
	(2.40)	(4.60)	(2.01)	(1.60)	(1.79)	(1.29)	(1.71)	(0.26)	(−1.23)	(−3.38)	(3.59)
FF3 alpha	0.20	0.35	0.11	0.09	0.09	0.06	0.10	0.02	−0.11	−0.33	0.53
	(1.84)	(4.41)	(1.79)	(1.25)	(1.41)	(0.83)	(1.54)	(0.25)	(−1.40)	(−4.10)	(3.31)
FF5 alpha	0.21	0.30	0.09	0.04	0.05	−0.02	0.08	−0.04	−0.12	−0.36	0.57
	(1.88)	(3.53)	(1.31)	(0.58)	(0.66)	(−0.32)	(1.34)	(−0.54)	(−1.30)	(−4.15)	(3.36)
HXZ alpha	0.29	0.37	0.09	0.06	0.06	−0.07	0.10	−0.07	−0.15	−0.36	0.65
	(2.26)	(3.98)	(1.05)	(0.75)	(0.83)	(−0.84)	(1.43)	(−0.80)	(−1.51)	(−3.78)	(3.37)
SY alpha	0.37	0.41	0.13	0.06	0.00	−0.00	0.07	−0.12	−0.21	−0.45	0.83
	(3.43)	(4.88)	(1.52)	(0.66)	(0.03)	(−0.03)	(1.09)	(−1.65)	(−2.48)	(−4.53)	(4.53)
DHS alpha	0.46	0.53	0.18	0.16	0.05	−0.02	0.09	−0.17	−0.30	−0.53	0.98
	(3.56)	(5.15)	(1.97)	(1.89)	(0.77)	(−0.30)	(1.18)	(−2.21)	(−3.25)	(−4.87)	(4.82)
Panel F: Portfolios sorted by PE_{DHS}											
CAPM alpha	0.19	0.35	0.17	0.14	0.20	0.08	0.10	0.07	−0.04	−0.30	0.49
	(1.62)	(4.22)	(2.26)	(1.68)	(2.57)	(1.00)	(1.28)	(0.91)	(−0.38)	(−2.98)	(2.86)
FF3 alpha	0.15	0.34	0.14	0.12	0.17	0.04	0.10	0.07	−0.06	−0.33	0.48
	(1.27)	(4.04)	(2.09)	(1.42)	(2.25)	(0.55)	(1.21)	(0.84)	(−0.58)	(−3.36)	(2.69)
FF5 alpha	0.14	0.32	0.10	0.05	0.12	−0.05	0.07	0.01	−0.09	−0.39	0.53
	(1.16)	(3.30)	(1.33)	(0.64)	(1.48)	(−0.56)	(0.85)	(0.10)	(−0.77)	(−3.74)	(2.75)
HXZ alpha	0.23	0.40	0.09	0.06	0.12	−0.10	0.06	−0.02	−0.11	−0.39	0.62
	(1.68)	(3.84)	(0.95)	(0.66)	(1.53)	(−1.00)	(0.72)	(−0.16)	(−0.91)	(−3.48)	(2.90)
SY alpha	0.34	0.43	0.15	0.07	0.07	−0.02	0.06	−0.10	−0.19	−0.48	0.82
	(2.90)	(4.54)	(1.61)	(0.73)	(0.84)	(−0.22)	(0.75)	(−1.10)	(−1.84)	(−4.15)	(4.09)
DHS alpha	0.46	0.49	0.20	0.16	0.10	−0.05	0.05	−0.13	−0.27	−0.55	1.01
	(3.74)	(4.79)	(2.00)	(1.76)	(1.29)	(−0.64)	(0.60)	(−1.56)	(−2.47)	(−4.89)	(5.03)

Table 4 Average returns of decile portfolios sorted by PEs of PCA factor models

This table reports average returns of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on PCA factor models. With 105 anomalies from Chen and Zimmermann (2019), we extract PCA factors by using the Balvers and Stivers (2018) method with zero mispricing constraint. PE_{PCA1} refers to the PE of PCA 1-factor model, and PE_{PCA3} to the PE of PCA 3-factor model, etc. Given a factor model, each month we calculate the PE of a firm as its realized return minus its expected return estimated with its past 60-month returns, normalized by its standard deviation, and form value-weighted decile portfolios in an ascending order of PE. The sample period of PE portfolios is 1972:07–2016:12.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
PE_{PCA1}	0.85	0.84	0.78	0.60	0.68	0.56	0.57	0.59	0.42	0.20	0.65
	(3.43)	(3.81)	(3.56)	(2.68)	(3.16)	(2.56)	(2.75)	(2.89)	(1.98)	(1.05)	(3.62)
PE_{PCA3}	0.85	0.84	0.75	0.61	0.71	0.53	0.60	0.57	0.41	0.22	0.63
	(3.37)	(3.85)	(3.43)	(2.68)	(3.29)	(2.41)	(2.92)	(2.78)	(1.94)	(1.14)	(3.57)
PE_{PCA5}	0.83	0.87	0.74	0.60	0.69	0.55	0.61	0.56	0.43	0.20	0.63
	(3.36)	(3.91)	(3.46)	(2.66)	(3.20)	(2.50)	(2.96)	(2.71)	(2.08)	(1.04)	(3.60)
PE_{PCA10}	0.83	0.86	0.79	0.60	0.68	0.56	0.60	0.52	0.46	0.20	0.63
	(3.33)	(3.89)	(3.69)	(2.60)	(3.21)	(2.54)	(2.88)	(2.54)	(2.20)	(1.02)	(3.55)
PE_{PCA15}	0.82	0.86	0.79	0.60	0.68	0.55	0.62	0.53	0.49	0.18	0.64
	(3.29)	(3.93)	(3.69)	(2.57)	(3.28)	(2.44)	(3.08)	(2.61)	(2.27)	(0.93)	(3.56)

Table 5 Difference between PE spread portfolios

This table reports the difference in average return (Panel A) and FF3 alpha (Panel B) between PE spread portfolios, with p-value in parenthesis. The value in (i, j) corresponds to the difference between the PE_i spread portfolio and the PE_j spread portfolio, where i and j denote factor models i and j. $\mathrm{PE}_{\mathrm{CAPM}}$ refers to the CAPM's PE, and $\mathrm{PE}_{\mathrm{FF3}}$ to the FF3's PE, etc. The sample period is 1977:07–2016:12 for all portfolios.

Panel A: Difference in average return

	$\mathrm{PE}_{\mathrm{CAPM}}$	$\mathrm{PE}_{\mathrm{FF3}}$	$\mathrm{PE}_{\mathrm{FF5}}$	$\mathrm{PE}_{\mathrm{HXZ}}$	$\mathrm{PE}_{\mathrm{SY}}$	$\mathrm{PE}_{\mathrm{DHS}}$	$\mathrm{PE}_{\mathrm{PCA1}}$	$\mathrm{PE}_{\mathrm{PCA3}}$	$\mathrm{PE}_{\mathrm{PCA5}}$	$\mathrm{PE}_{\mathrm{PCA10}}$	$\mathrm{PE}_{\mathrm{PCA15}}$
$\mathrm{PE}_{\mathrm{CAPM}}$	–	0.05	0.07	0.01	0.05	0.01	−0.01	0.01	0.02	0.01	0.00
		(0.15)	(0.11)	(0.67)	(0.19)	(0.72)	(0.84)	(0.79)	(0.72)	(0.75)	(0.93)
$\mathrm{PE}_{\mathrm{FF3}}$		–	0.02	−0.03	0.01	−0.04	−0.06	−0.04	−0.03	−0.03	−0.05
			(0.40)	(0.23)	(0.82)	(0.15)	(0.28)	(0.47)	(0.52)	(0.48)	(0.28)
$\mathrm{PE}_{\mathrm{FF5}}$			–	−0.05	−0.01	−0.06	−0.08	−0.06	−0.05	−0.05	−0.07
				(0.13)	(0.54)	(0.09)	(0.19)	(0.30)	(0.35)	(0.31)	(0.18)
$\mathrm{PE}_{\mathrm{HXZ}}$				–	0.04	−0.01	−0.02	0.00	0.00	0.00	−0.02
					(0.28)	(0.85)	(0.66)	(0.99)	(0.95)	(0.97)	(0.73)
$\mathrm{PE}_{\mathrm{SY}}$					–	−0.05	−0.06	−0.04	−0.04	−0.04	−0.06
						(0.19)	(0.32)	(0.46)	(0.52)	(0.49)	(0.32)
$\mathrm{PE}_{\mathrm{DHS}}$						–	−0.02	0.00	0.01	0.01	−0.01
							(0.74)	(0.93)	(0.86)	(0.88)	(0.81)
$\mathrm{PE}_{\mathrm{PCA1}}$							–	0.02	0.02	0.02	0.00
								(0.38)	(0.30)	(0.42)	(0.89)
$\mathrm{PE}_{\mathrm{PCA3}}$								–	0.00	0.00	−0.02
									(0.83)	(0.92)	(0.65)
$\mathrm{PE}_{\mathrm{PCA5}}$									–	0.00	−0.02
										(0.96)	(0.54)
$\mathrm{PE}_{\mathrm{PCA10}}$										–	−0.02
											(0.45)
$\mathrm{PE}_{\mathrm{PCA15}}$											–

Panel B: Difference in FF3 alpha

	$\mathrm{PE}_{\mathrm{CAPM}}$	$\mathrm{PE}_{\mathrm{FF3}}$	$\mathrm{PE}_{\mathrm{FF5}}$	$\mathrm{PE}_{\mathrm{HXZ}}$	$\mathrm{PE}_{\mathrm{SY}}$	$\mathrm{PE}_{\mathrm{DHS}}$	$\mathrm{PE}_{\mathrm{PCA1}}$	$\mathrm{PE}_{\mathrm{PCA3}}$	$\mathrm{PE}_{\mathrm{PCA5}}$	$\mathrm{PE}_{\mathrm{PCA10}}$	$\mathrm{PE}_{\mathrm{PCA15}}$
$\mathrm{PE}_{\mathrm{CAPM}}$	–	−0.01	0.08	0.02	0.08	0.02	0.00	0.03	0.03	0.03	0.01
		(0.77)	(0.04)	(0.54)	(0.06)	(0.43)	(0.97)	(0.52)	(0.53)	(0.58)	(0.83)
$\mathrm{PE}_{\mathrm{FF3}}$		–	0.02	−0.04	0.02	−0.04	−0.06	−0.03	−0.03	−0.04	−0.05
			(0.33)	(0.15)	(0.51)	(0.11)	(0.26)	(0.50)	(0.51)	(0.44)	(0.29)
$\mathrm{PE}_{\mathrm{FF5}}$			–	−0.07	−0.01	−0.07	−0.08	−0.06	−0.06	−0.06	−0.07
				(0.07)	(0.76)	(0.06)	(0.16)	(0.30)	(0.31)	(0.26)	(0.17)
$\mathrm{PE}_{\mathrm{HXZ}}$				–	0.06	0.00	−0.02	0.01	0.01	0.01	−0.01
					(0.12)	(0.95)	(0.74)	(0.83)	(0.83)	(0.87)	(0.88)
$\mathrm{PE}_{\mathrm{SY}}$					–	−0.06	−0.07	−0.05	−0.05	−0.05	−0.07
						(0.08)	(0.24)	(0.39)	(0.41)	(0.36)	(0.26)
$\mathrm{PE}_{\mathrm{DHS}}$						–	−0.01	0.01	0.01	0.01	−0.01
							(0.77)	(0.80)	(0.81)	(0.85)	(0.90)
$\mathrm{PE}_{\mathrm{PCA1}}$							–	0.03	0.03	0.02	0.01
								(0.29)	(0.28)	(0.42)	(0.82)
$\mathrm{PE}_{\mathrm{PCA3}}$								–	0.00	0.00	−0.02
									(1.00)	(0.93)	(0.62)
$\mathrm{PE}_{\mathrm{PCA5}}$									–	0.00	−0.02
										(0.96)	(0.54)
$\mathrm{PE}_{\mathrm{PCA10}}$										–	−0.02
											(0.54)
$\mathrm{PE}_{\mathrm{PCA15}}$											–

Table 6 Average returns of portfolios sorted by return reversal and $\mathrm{PE_{CAPM}}$

This table reports average returns of 25 value-weighted portfolios sequentially sorted by short- (or long-) term reversal and PE (Newey-West t-values in parentheses), where the short-term reversal is measured by the prior (1-1) return (STR) and the long-term reversal is measured by the prior (13-60) return (LTR). The sample period is 1931:08–2018:12.

Panel A: Sort on STR and $\mathrm{PE_{CAPM}}$	PE1	PE2	PE3	PE4	PE5	PE1-5
STR1	1.11	0.95	1.05	0.94	0.92	0.19
	(5.06)	(4.50)	(4.81)	(4.01)	(3.42)	(1.24)
STR2	0.89	0.87	0.79	0.67	0.65	0.23
	(5.28)	(4.55)	(3.94)	(3.37)	(2.86)	(1.51)
STR3	0.88	0.84	0.78	0.60	0.55	0.34
	(4.50)	(4.59)	(4.34)	(3.33)	(2.97)	(2.47)
STR4	0.99	0.83	0.77	0.60	0.40	0.59
	(4.49)	(3.97)	(3.98)	(3.02)	(2.34)	(4.26)
STR5	0.72	0.75	0.51	0.32	0.03	0.68
	(2.92)	(3.20)	(2.46)	(1.68)	(0.17)	(4.38)
STR5-1	−0.39	−0.20	−0.54	−0.62	−0.88	0.49
	(−2.02)	(−1.10)	(−3.47)	(−3.24)	(−4.55)	(2.03)
All stocks	0.87	0.82	0.74	0.56	0.48	0.39
	(4.88)	(4.53)	(4.15)	(3.32)	(2.88)	(4.37)

Panel B: Sort on LTR and $\mathrm{PE_{CAPM}}$	PE1	PE2	PE3	PE4	PE5	PE1-5
LTR1	1.16	0.97	0.95	0.72	0.37	0.80
	(5.00)	(5.11)	(4.55)	(3.51)	(1.87)	(5.53)
LTR2	1.09	0.95	0.88	0.71	0.38	0.71
	(5.27)	(5.52)	(4.77)	(3.97)	(2.13)	(5.68)
LTR3	1.14	0.79	0.69	0.71	0.42	0.72
	(5.94)	(4.50)	(4.19)	(4.28)	(2.30)	(5.65)
LTR4	1.04	0.80	0.84	0.64	0.29	0.74
	(5.63)	(4.25)	(4.62)	(3.66)	(1.56)	(5.72)
LTR5	0.85	0.85	0.69	0.58	0.44	0.40
	(3.82)	(3.96)	(3.13)	(2.77)	(2.13)	(2.70)
LTR5-1	−0.32	−0.13	−0.26	−0.14	0.07	−0.39
	(−1.51)	(−0.80)	(−1.48)	(−0.78)	(0.48)	(−2.07)
All stocks	0.93	0.79	0.78	0.63	0.39	0.54
	(5.33)	(4.74)	(4.54)	(3.84)	(2.27)	(5.41)

Table 7 Average returns of portfolios sorted by IVOL and $\mathrm{PE}_{\mathrm{CAPM}}$

This table reports average returns of 25 value-weighted portfolios sequentially sorted by IVOL and $\mathrm{PE}_{\mathrm{CAPM}}$ (Newey-West t-values in parentheses), where IVOL is estimated as Ang, Hodrick, Xing, and Zhang (2006). The sample period is 1931:08–2018:12.

	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.91	0.81	0.75	0.68	0.48	0.44
	(5.70)	(4.99)	(4.59)	(4.40)	(3.01)	(3.66)
IVOL2	1.06	0.86	0.65	0.71	0.41	0.65
	(5.71)	(4.60)	(3.58)	(3.85)	(2.39)	(5.53)
IVOL3	1.17	0.88	0.89	0.80	0.30	0.87
	(5.45)	(4.14)	(4.09)	(3.72)	(1.44)	(7.04)
IVOL4	1.02	0.91	0.80	0.74	0.45	0.56
	(4.21)	(3.51)	(3.44)	(3.04)	(1.91)	(3.34)
IVOL5	0.88	0.76	0.58	0.41	0.05	0.83
	(3.01)	(2.63)	(2.10)	(1.44)	(0.20)	(3.60)
IVOL5-1	−0.04	−0.05	−0.17	−0.27	−0.43	0.39
	(−0.16)	(−0.24)	(−0.83)	(−1.39)	(−2.20)	(1.50)
All Stocks	0.93	0.80	0.75	0.68	0.42	0.50
	(5.36)	(4.52)	(4.29)	(3.93)	(2.51)	(5.29)

Table 8 Mean-variance spanning tests

This table reports the Huberman and Kandel (1987) mean-variance spanning test statistics and the associated p-values of the PE_{CAPM} spread portfolio under different distribution assumptions, where W is the Wald test under conditional homoscedasticity, W_e is the Wald test under IID elliptical, W_a is the Wald test under the conditional heteroscedasticity, J_1 is the Bekerart-Urias test with the Errors-in-Variables (EIV) adjustment, J_2 is the Bekerart-Urias test without the EIV adjustment, and J_3 is the DeSantis test. The null hypothesis that the PE_{CAPM} spread portfolio is spanned by risk factors. The sample period is the same as Table 1.

Benchmark assets	W	W_e	W_a	J_1	J_2	J_3
CAPM	1538.76	886.25	180.94	122.63	120.49	484.58
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FF3	519.84	74.00	73.49	123.97	126.78	130.96
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FF5	32.05	16.47	14.02	12.24	12.48	14.18
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HXZ	45.03	23.98	18.20	15.33	15.54	17.05
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SY	107.46	70.46	36.54	26.55	25.37	44.06
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DHS	177.84	88.45	87.87	39.19	37.15	87.12
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table 9 $\mathbf{PE_{CAPM}}$ **portfolios in high and low sentiment periods**

This table reports average returns and alphas of the PE_{CAPM} portfolios in high and low sentiment periods, where a month is in high sentiment periods if the Baker and Wurgler (2006) sentiment index in the previous month is above the median value and in low sentiment periods otherwise. The sentiment sample period is 1965:07–2018:12.

	High sentiment	t-value	Low sentiment	t-value	High-Low sentiment	t-value
Panel A: PE_{CAPM} long-short spread portfolio						
Average return	0.72	3.45	0.61	3.10	0.10	0.37
CAPM alpha	0.65	3.18	0.51	2.72	0.20	0.72
FF3 alpha	0.69	3.15	0.48	2.53	0.22	0.82
FF5 alpha	0.68	2.80	0.48	2.40	0.20	0.73
HXZ alpha	0.84	3.07	0.50	2.25	0.28	1.00
SY alpha	1.05	4.03	0.70	3.20	0.37	1.36
DHS alpha	1.17	4.60	1.02	3.80	0.27	0.92
Panel B: PE_{CAPM} long-leg portfolio						
Average return	0.61	1.88	1.01	3.46	−0.40	−0.92
CAPM alpha	0.32	2.14	0.23	1.91	0.09	0.51
FF3 alpha	0.24	1.61	0.22	1.84	0.02	0.32
FF5 alpha	0.21	1.30	0.23	1.80	0.03	0.18
HXZ alpha	0.38	2.06	0.23	1.66	0.13	0.71
SY alpha	0.46	2.95	0.36	2.64	0.17	0.97
DHS alpha	0.61	3.64	0.47	2.96	0.13	0.63
Panel C: PE_{CAPM} short-leg portfolio						
Average return	−0.11	−0.40	0.40	1.82	−0.51	−1.47
CAPM alpha	−0.33	−2.68	−0.27	−2.79	−0.10	−0.67
FF3 alpha	−0.44	−3.81	−0.26	−2.64	−0.16	−1.14
FF5 alpha	−0.47	−3.62	−0.25	−2.39	−0.17	−1.17
HXZ alpha	−0.46	−3.14	−0.27	−2.35	−0.15	−0.97
SY alpha	−0.59	−3.85	−0.34	−2.94	−0.20	−1.34
DHS alpha	−0.56	−3.65	−0.54	−3.71	−0.15	−0.93

Table 10 Average returns of portfolios sorted by IO (or ME) and $\mathrm{PE}_{\mathrm{CAPM}}$

This table reports average returns of 25 value-weighted portfolios sequentially sorted by institutional ownership (IO) or market capitalization (ME) and $\mathrm{PE}_{\mathrm{CAPM}}$ (Newey-West t-values in parentheses), where IO is calculated as Nagel (2005). The sample period is 1980:03–2015:12 for Panel A and 1931:08–2018:12 for Panel B.

Panel A: Sort on IO and $\mathrm{PE}_{\mathrm{CAPM}}$						
	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.85	0.44	0.81	0.58	0.37	0.48
	(3.06)	(1.62)	(3.47)	(2.43)	(1.55)	(2.07)
IO2	1.10	0.66	0.86	0.70	0.26	0.84
	(4.13)	(2.75)	(3.97)	(3.03)	(1.20)	(3.49)
IO3	1.02	0.81	0.77	0.86	0.33	0.69
	(3.92)	(3.03)	(3.29)	(3.65)	(1.43)	(3.61)
IO4	0.97	0.88	0.81	0.82	0.40	0.57
	(3.47)	(3.34)	(3.21)	(3.49)	(1.72)	(3.36)
IO5	0.80	0.85	0.73	0.72	0.47	0.33
	(2.61)	(3.16)	(2.68)	(2.88)	(1.78)	(1.59)
IO5-1	−0.05	0.42	−0.08	0.14	0.10	−0.15
	(−0.30)	(2.24)	(−0.42)	(0.80)	(0.49)	(−0.63)
All stocks	0.97	0.79	0.73	0.74	0.35	0.61
	(3.88)	(3.28)	(3.22)	(3.41)	(1.58)	(4.00)

Panel B: Sort on ME and $\mathrm{PE}_{\mathrm{CAPM}}$						
	PE1	PE2	PE3	PE4	PE5	PE1-5
ME1	2.07	1.29	1.19	0.92	0.08	1.99
	(7.81)	(5.15)	(5.07)	(3.61)	(0.34)	(11.60)
ME2	1.63	1.16	0.96	0.88	0.23	1.39
	(7.11)	(4.96)	(4.23)	(3.81)	(1.05)	(10.22)
ME3	1.50	1.15	1.01	0.80	0.38	1.12
	(6.76)	(5.50)	(4.71)	(3.61)	(1.86)	(9.69)
ME4	1.26	0.97	0.93	0.77	0.33	0.92
	(6.31)	(4.86)	(4.86)	(4.05)	(1.74)	(7.72)
ME5	0.79	0.74	0.70	0.61	0.42	0.37
	(4.57)	(4.40)	(4.24)	(3.55)	(2.48)	(3.32)
ME5-1	−1.28	−0.55	−0.50	−0.31	0.34	−1.62
	(−6.79)	(−3.40)	(−3.18)	(−2.10)	(2.12)	(−7.26)
All stocks	0.90	0.80	0.75	0.64	0.39	0.51
	(5.14)	(4.64)	(4.47)	(3.65)	(2.29)	(4.92)

Table 11 Average returns of portfolios sorted by MAX (or TK) and $\mathrm{PE_{CAPM}}$

This table reports average returns of 25 value-weighted portfolios sequentially sorted by MAX (or TK) and $\mathrm{PE_{CAPM}}$ (Newey-West t-values in parentheses), where MAX measures the lottery demand and is defined as the average of the 5 highest daily returns in the portfolio formation month (Bali, Cakici, and Whitelaw, 2011), and TK is prospect theory value and defined as Barberis, Mukherjee, and Wang (2016). The sample period is 1931:08–2018:12.

Panel A: Sort on MAX and $\mathrm{PE_{CAPM}}$

	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	1.08	0.79	0.72	0.66	0.40	0.68
	(7.18)	(5.20)	(4.46)	(4.55)	(2.73)	(6.45)
MAX2	1.01	0.87	0.82	0.80	0.44	0.56
	(5.40)	(4.86)	(4.44)	(4.95)	(2.70)	(5.04)
MAX3	1.14	0.89	0.89	0.74	0.45	0.69
	(5.17)	(4.28)	(4.29)	(3.67)	(2.61)	(5.69)
MAX4	1.05	0.94	0.90	0.77	0.36	0.68
	(3.95)	(3.76)	(3.78)	(3.45)	(1.77)	(4.18)
MAX5	0.76	0.72	0.75	0.59	0.01	0.76
	(2.50)	(2.40)	(2.97)	(2.20)	(0.02)	(3.17)
MAX5-1	−0.32	−0.07	0.03	−0.08	−0.40	0.08
	(−1.43)	(−0.34)	(0.15)	(−0.41)	(−2.08)	(0.32)
All stocks	0.96	0.80	0.77	0.74	0.40	0.56
	(5.27)	(4.49)	(4.35)	(4.39)	(2.49)	(5.91)

Panel B: Sort on TK and $\mathrm{PE_{CAPM}}$

	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	1.15	1.14	1.05	0.70	0.30	0.85
	(4.08)	(4.84)	(4.13)	(2.88)	(1.27)	(4.46)
TK2	1.21	0.91	0.89	0.78	0.26	0.95
	(5.63)	(4.14)	(4.39)	(3.56)	(1.39)	(6.54)
TK3	1.01	0.85	0.78	0.70	0.29	0.72
	(5.30)	(4.77)	(4.26)	(3.60)	(1.64)	(5.41)
TK4	0.99	0.67	0.76	0.65	0.36	0.63
	(5.39)	(3.68)	(4.32)	(3.79)	(2.00)	(5.28)
TK5	0.89	0.87	0.73	0.57	0.41	0.49
	(4.68)	(4.39)	(3.75)	(2.99)	(2.16)	(4.41)
TK5-1	−0.26	−0.27	−0.32	−0.13	0.11	−0.36
	(−1.20)	(−1.49)	(−1.81)	(−0.72)	(0.59)	(−1.87)
All stocks	0.94	0.79	0.78	0.65	0.38	0.56
	(5.33)	(4.55)	(4.52)	(3.81)	(2.26)	(5.63)

Table 12 Average returns of portfolios sorted by PTP (or LTG) and PE_{CAPM}

This table reports average returns of 25 value-weighted portfolios sorted by PTP and PE_{CAPM} (Newey-West t-values in parentheses), where PTP measures the expectation of expected returns and is defined as analysts' consensus price target scaled by current price (Weber, 2018), and LTG is analysts' long-term growth forecast on earnings as in Weber (2018). The sample period is 1999:03–2018:12 for Panel A and 1982:01–2018:12 for Panel B.

Panel A: Sort on PTP and PE_{CAPM}

	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	1.28	1.28	1.15	0.86	0.56	0.73
	(4.26)	(3.38)	(3.38)	(2.47)	(1.74)	(2.96)
PTP2	0.75	1.20	0.22	0.44	−0.05	0.80
	(2.51)	(4.34)	(0.70)	(1.39)	(−0.17)	(3.16)
PTP3	0.42	0.52	0.34	0.56	−0.17	0.59
	(1.35)	(1.60)	(1.08)	(1.85)	(−0.46)	(2.50)
PTP4	0.86	0.75	0.31	0.39	−0.00	0.87
	(2.34)	(2.19)	(0.77)	(0.99)	(−0.01)	(3.04)
PTP5	−0.17	0.25	0.27	0.29	0.22	−0.39
	(−0.28)	(0.50)	(0.48)	(0.51)	(0.42)	(−0.92)
PTP5-1	−1.45	−1.03	−0.88	−0.58	−0.34	−1.12
	(−3.29)	(−2.39)	(−2.19)	(−1.41)	(−0.97)	(−2.33)
All stocks	0.67	0.80	0.47	0.46	0.01	0.66
	(2.00)	(2.67)	(1.46)	(1.39)	(0.03)	(3.23)

Panel B: Sort on LTG and PE_{CAPM}

	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	1.07	1.01	0.87	0.63	0.46	0.61
	(4.74)	(5.22)	(5.15)	(3.66)	(2.03)	(3.21)
LTG2	0.91	0.87	0.71	0.71	0.35	0.56
	(3.49)	(3.95)	(3.09)	(3.50)	(1.43)	(2.79)
LTG3	1.25	0.91	0.78	0.57	0.20	1.05
	(4.98)	(3.57)	(3.35)	(2.42)	(0.87)	(6.20)
LTG4	1.01	0.94	0.86	0.67	0.28	0.73
	(3.76)	(3.56)	(3.44)	(2.45)	(1.13)	(3.81)
LTG5	0.70	1.15	0.74	1.01	0.74	−0.05
	(1.96)	(3.10)	(2.00)	(2.54)	(2.31)	(−0.20)
LTG5-1	−0.37	0.14	−0.13	0.38	0.29	−0.66
	(−1.19)	(0.44)	(−0.39)	(1.13)	(0.94)	(−2.30)
All stocks	0.97	0.89	0.80	0.67	0.34	0.63
	(4.12)	(3.97)	(3.82)	(3.22)	(1.50)	(4.47)

Table 13 Fama-MacBeth regressions

This table reports the coefficients from Fama-MacBeth regressions of one-month-ahead returns on PE and other variables, where IO refers to institutional ownership, MAX to lottery demand, TK to prospect theory value, PTP to analysts' implied return expectation, and LTG to analysts' long-term growth forecast on earnings. Newey-West t-statistics are reported in parentheses. Each regression uses all available data. Intercepts are included in all regressions but not reported for brevity.

	Dependent variable: one-month-ahead return (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PE_{CAPM}	−0.52	−0.47	−0.51	−0.48	−0.51	−0.44	−0.45	−0.37
	(−8.79)	(−8.62)	(−8.47)	(−8.71)	(−8.46)	(−4.83)	(−7.38)	(−4.15)
IVOL (%)		−0.19						−0.08
		(−4.98)						(−1.09)
IO			0.12					−0.09
			(0.55)					(−0.31)
MAX (%)				−0.05				0.00
				(−3.83)				(0.14)
TK					0.14			−0.20
					(1.42)			(−1.09)
PTP						−0.34		−0.14
						(−4.51)		(−3.06)
LTG/100							0.39	0.06
							(0.43)	(0.36)
Log(ME)	−0.02	−0.05	−0.03	−0.03	−0.03	−0.09	−0.04	−0.09
	(−0.72)	(−1.89)	(−0.92)	(−1.26)	(−0.98)	(−2.47)	(−1.19)	(−2.23)
Log(BM)	0.11	0.08	0.11	0.10	0.10	−0.09	0.04	−0.10
	(1.76)	(1.40)	(1.57)	(1.64)	(1.58)	(−0.98)	(0.55)	(−1.09)
STR (%)	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.01
	(1.05)	(0.49)	(1.56)	(1.17)	(0.89)	(1.66)	(1.21)	(0.93)
MOM (%)	0.08	0.08	0.08	0.08	0.07	0.01	0.06	0.01
	(3.44)	(3.59)	(2.86)	(3.55)	(3.06)	(0.13)	(2.24)	(0.28)
LTR (%)	−0.08	−0.07	−0.04	−0.07	−0.08	−0.07	−0.04	−0.08
	(−2.43)	(−2.23)	(−1.12)	(−2.26)	(−2.27)	(−1.25)	(−1.12)	(−1.48)
N	996,173	996,167	797,149	996,011	923,849	339,342	539,664	265,242

Appendix

Table A1 Average returns of PE decile portfolios: 24-month rolling window

This table reports average returns of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on the CAPM, FF3 (Fama and French, 1993), FF5 (Fama and French, 2015), HXZ (Hou, Xue, and Zhang, 2015), SY (Stambaugh and Yuan, 2017), and DHS (Daniel, Hirshleifer, and Sun, 2019) model, respectively. Given a factor model, each month we calculate the PE of a firm as its realized return minus its expected return estimated with its past 24-month returns, normalized by its standard deviation, and form value-weighted decile portfolios in an ascending order of PE.

Model	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
CAPM	0.91	0.89	0.81	0.79	0.64	0.71	0.65	0.61	0.48	0.18	0.72
	(4.90)	(4.67)	(4.53)	(4.22)	(3.50)	(4.06)	(3.67)	(3.42)	(2.66)	(0.97)	(5.99)
FF3	0.91	0.87	0.84	0.78	0.68	0.70	0.64	0.59	0.48	0.18	0.73
	(4.88)	(4.63)	(4.54)	(4.35)	(3.68)	(4.04)	(3.65)	(3.32)	(2.70)	(0.98)	(5.85)
FF5	0.86	0.80	0.63	0.66	0.66	0.51	0.58	0.44	0.32	0.13	0.73
	(3.96)	(3.87)	(3.15)	(3.26)	(3.43)	(2.48)	(3.08)	(2.38)	(1.74)	(0.69)	(5.26)
HXZ	0.83	0.78	0.64	0.74	0.61	0.52	0.58	0.41	0.37	0.09	0.73
	(3.63)	(3.65)	(3.07)	(3.58)	(2.93)	(2.54)	(2.91)	(2.12)	(1.86)	(0.48)	(5.01)
SY	0.87	0.74	0.71	0.63	0.59	0.55	0.59	0.38	0.39	0.07	0.80
	(4.11)	(3.56)	(3.55)	(3.26)	(3.02)	(2.82)	(3.08)	(2.09)	(2.10)	(0.41)	(5.63)
DHS	0.95	1.01	0.80	0.86	0.81	0.71	0.77	0.61	0.53	0.26	0.69
	(4.03)	(4.56)	(3.81)	(4.07)	(3.89)	(3.50)	(3.69)	(3.11)	(2.72)	(1.32)	(4.37)

Table A2 Average returns of PE decile portfolios: Alternative PE

This table reports average returns of pricing error (PE) decile portfolios (Newey-West t-values in parentheses), where PE is based on the CAPM, FF3 (Fama and French, 1993), FF5 (Fama and French, 2015), HXZ (Hou, Xue, and Zhang, 2015), SY (Stambaugh and Yuan, 2017), and DHS (Daniel, Hirshleifer, and Sun, 2019) model, respectively. Different from (5), we include $\hat{\alpha}_{i,t}$ in the numerator for defining PE. PE_{CAPM} refers to the CAPM's PE and PE_{FF3} to the FF3's PE, etc. Given a factor model, each month we calculate the PE of a firm as its realized return minus its expected return estimated with its past 60-month returns, normalized by its standard deviation, and form value-weighted decile portfolios in an ascending order of PE. The sample periods of PE portfolios all end in 2018:12, but start differently, from 1931:08 for the CAPM and FF3, 1968:08 for the FF5, 1972:02 for the HXZ, 1968:02 for the SY, and 1977:08 for the DHS, respectively.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
PE_{CAPM}	0.94	0.98	0.86	0.74	0.73	0.74	0.77	0.61	0.57	0.26	0.68
	(4.90)	(5.48)	(4.92)	(4.05)	(4.15)	(4.21)	(4.33)	(3.42)	(3.15)	(1.50)	(5.53)
PE_{FF3}	0.99	0.98	0.84	0.82	0.75	0.68	0.76	0.58	0.57	0.29	0.70
	(5.12)	(5.45)	(4.86)	(4.60)	(4.19)	(3.95)	(4.21)	(3.34)	(3.17)	(1.64)	(5.50)
PE_{FF5}	0.85	0.92	0.69	0.67	0.60	0.51	0.60	0.42	0.36	0.19	0.65
	(3.63)	(4.47)	(3.38)	(3.17)	(2.89)	(2.58)	(3.06)	(2.16)	(1.82)	(1.03)	(4.20)
PE_{HXZ}	0.85	0.91	0.74	0.68	0.62	0.53	0.67	0.50	0.42	0.21	0.64
	(3.60)	(4.41)	(3.65)	(3.22)	(3.04)	(2.65)	(3.29)	(2.50)	(2.08)	(1.10)	(3.91)
PE_{SY}	0.84	0.85	0.80	0.59	0.63	0.49	0.56	0.40	0.45	0.15	0.69
	(3.66)	(4.26)	(3.88)	(2.78)	(3.22)	(2.48)	(2.84)	(2.12)	(2.28)	(0.81)	(4.40)
PE_{DHS}	0.88	0.99	0.85	0.80	0.71	0.76	0.68	0.59	0.60	0.27	0.61
	(3.63)	(4.74)	(3.69)	(3.56)	(3.41)	(3.74)	(3.18)	(3.01)	(2.75)	(1.33)	(3.51)

Table A3 Average returns of decile portfolios sorted by PEs of PCA factor models: out-of-sample

This table reports the out-of-sample average returns of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on PCA factor models. With 105 anomalies from Chen and Zimmermann (2019), we extract PCA factors by using the Balvers and Stivers (2018) method with zero mispricing constraint. We use the first 30-years of data to train the PCA factor weights on the target assets and apply them to the rest sample. PE_{PCA1} refers to the PE of PCA 1-factor model, and PE_{PCA3} to the PE of PCA 3-factor model, etc. The training sample period is 1967:06–1997:05 and the out-of-sample period is 1997:06–2016:12.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
PE_{PCA1}	0.79	0.93	0.76	0.95	0.73	0.69	0.71	0.68	0.42	0.16	0.63
	(1.52)	(2.44)	(1.91)	(2.45)	(2.01)	(2.01)	(2.11)	(2.06)	(1.08)	(0.42)	(2.14)
PE_{PCA3}	0.80	0.90	0.76	0.95	0.74	0.66	0.73	0.67	0.43	0.17	0.63
	(1.56)	(2.20)	(1.96)	(2.47)	(2.01)	(2.01)	(2.14)	(2.01)	(1.11)	(0.45)	(2.22)
PE_{PCA5}	0.79	0.92	0.72	0.99	0.74	0.65	0.74	0.70	0.38	0.21	0.58
	(1.54)	(2.23)	(1.86)	(2.55)	(2.02)	(1.99)	(2.18)	(2.11)	(0.97)	(0.56)	(2.06)
PE_{PCA10}	0.79	0.88	0.75	0.97	0.77	0.64	0.70	0.72	0.41	0.18	0.61
	(1.49)	(2.26)	(1.93)	(2.48)	(2.23)	(1.85)	(2.11)	(2.11)	(1.09)	(0.49)	(2.06)
PE_{PCA15}	0.80	0.91	0.74	0.97	0.73	0.65	0.72	0.69	0.46	0.14	0.66
	(1.51)	(2.30)	(1.93)	(2.50)	(2.08)	(1.83)	(2.18)	(2.07)	(1.18)	(0.37)	(2.11)

Table A4 Alphas of decile portfolios formed by PEs of PCA factor models

This table reports alphas of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on PCA factor models. With 105 anomalies, we extract PCA factors by using the Balvers and Stivers (2018) method with zero mispricing constraint. PE_{PCA1} refers to the PE of PCA 1-factor model and PE_{PCA3} to the PE of PCA 3-factor model, etc.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
Panel A: portfolio sorted by PE_{PCA1}											
CAPM alpha	0.28	0.29	0.24	0.06	0.15	0.05	0.05	0.09	−0.08	−0.25	0.53
	(2.23)	(3.48)	(3.28)	(0.89)	(2.22)	(0.64)	(0.86)	(1.20)	(−1.07)	(−2.49)	(3.03)
FF3 alpha	0.23	0.26	0.22	0.03	0.10	0.02	0.03	0.09	−0.11	−0.29	0.53
	(1.83)	(3.14)	(3.15)	(0.46)	(1.50)	(0.30)	(0.37)	(1.12)	(−1.43)	(−3.00)	(2.83)
FF5 alpha	0.23	0.23	0.18	0.00	0.05	−0.04	−0.01	0.05	−0.16	−0.34	0.57
	(1.68)	(2.66)	(2.54)	(0.05)	(0.70)	(−0.50)	(−0.18)	(0.52)	(−1.80)	(−3.16)	(2.76)
HXZ alpha	0.31	0.33	0.19	0.01	0.06	−0.08	−0.01	0.02	−0.16	−0.38	0.69
	(2.08)	(3.39)	(2.26)	(0.09)	(0.81)	(−0.77)	(−0.20)	(0.16)	(−1.69)	(−3.25)	(3.01)
SY alpha	0.46	0.31	0.22	0.06	0.04	−0.02	−0.06	−0.05	−0.21	−0.47	0.93
	(3.60)	(3.22)	(2.55)	(0.78)	(0.48)	(−0.18)	(−0.80)	(−0.53)	(−2.52)	(−4.05)	(4.53)
DHS alpha	0.59	0.44	0.26	0.13	0.09	−0.02	−0.00	−0.13	−0.30	−0.63	1.22
	(4.19)	(3.97)	(2.68)	(1.70)	(1.21)	(−0.27)	(−0.03)	(−1.60)	(−3.43)	(−5.46)	(5.63)
Panel B: portfolio sorted by PE_{PCA3}											
CAPM alpha	0.28	0.29	0.21	0.07	0.18	0.01	0.09	0.07	−0.09	−0.24	0.51
	(2.17)	(3.39)	(2.99)	(0.95)	(2.79)	(0.18)	(1.53)	(0.91)	(−1.15)	(−2.41)	(2.98)
FF3 alpha	0.23	0.27	0.18	0.04	0.14	−0.01	0.06	0.08	−0.12	−0.28	0.51
	(1.78)	(3.08)	(2.65)	(0.54)	(2.10)	(−0.12)	(0.92)	(0.90)	(−1.46)	(−2.94)	(2.78)
FF5 alpha	0.22	0.25	0.14	0.00	0.09	−0.09	0.02	0.04	−0.18	−0.32	0.54
	(1.63)	(2.70)	(1.92)	(0.03)	(1.34)	(−0.96)	(0.38)	(0.48)	(−1.87)	(−3.09)	(2.69)
HXZ alpha	0.31	0.36	0.14	0.01	0.10	−0.12	0.03	0.02	−0.19	−0.34	0.65
	(2.05)	(3.45)	(1.57)	(0.10)	(1.39)	(−1.20)	(0.39)	(0.18)	(−1.92)	(−3.15)	(2.95)
SY alpha	0.44	0.34	0.17	0.06	0.08	−0.06	−0.03	−0.04	−0.25	−0.44	0.89
	(3.51)	(3.37)	(1.84)	(0.74)	(1.05)	(−0.62)	(−0.38)	(−0.40)	(−2.97)	(−3.85)	(4.37)
DHS alpha	0.59	0.45	0.22	0.14	0.13	−0.07	0.03	−0.15	−0.31	−0.59	1.18
	(4.21)	(3.92)	(2.30)	(1.80)	(1.78)	(−0.81)	(0.46)	(−1.84)	(−3.36)	(−5.33)	(5.62)
Panel C: portfolio sorted by PE_{PCA5}											
CAPM alpha	0.26	0.31	0.21	0.06	0.16	0.04	0.09	0.06	−0.06	−0.25	0.51
	(2.11)	(3.58)	(3.01)	(0.86)	(2.40)	(0.45)	(1.55)	(0.81)	(−0.80)	(−2.54)	(3.01)
FF3 alpha	0.21	0.30	0.17	0.03	0.12	0.02	0.07	0.08	−0.10	−0.30	0.51
	(1.71)	(3.21)	(2.68)	(0.36)	(1.75)	(0.22)	(0.99)	(0.90)	(−1.14)	(−3.12)	(2.84)
FF5 alpha	0.20	0.27	0.13	−0.01	0.07	−0.05	0.03	0.04	−0.15	−0.34	0.54
	(1.52)	(2.78)	(1.87)	(−0.11)	(1.08)	(−0.61)	(0.42)	(0.42)	(−1.52)	(−3.29)	(2.73)
HXZ alpha	0.29	0.38	0.13	0.00	0.08	−0.08	0.02	0.00	−0.15	−0.37	0.66
	(1.95)	(3.43)	(1.50)	(0.03)	(1.08)	(−0.78)	(0.32)	(0.03)	(−1.47)	(−3.35)	(3.01)
SY alpha	0.42	0.37	0.16	0.05	0.07	−0.02	−0.03	−0.04	−0.21	−0.46	0.89
	(3.43)	(3.49)	(1.77)	(0.59)	(0.89)	(−0.24)	(−0.46)	(−0.47)	(−2.39)	(−4.03)	(4.43)
DHS alpha	0.57	0.48	0.20	0.13	0.12	−0.04	0.04	−0.16	−0.28	−0.62	1.19
	(4.19)	(4.16)	(2.00)	(1.65)	(1.57)	(−0.46)	(0.52)	(−2.00)	(−2.91)	(−5.45)	(5.70)

Table A4 (continued)

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
Panel D: portfolio sorted by PE_{PCA5}											
CAPM alpha	0.25	0.30	0.25	0.06	0.16	0.05	0.09	0.03	−0.04	−0.26	0.51
	(2.07)	(3.73)	(3.52)	(0.79)	(2.40)	(0.59)	(1.36)	(0.35)	(−0.47)	(−2.60)	(2.98)
FF3 alpha	0.20	0.28	0.21	0.04	0.11	0.02	0.06	0.04	−0.07	−0.31	0.51
	(1.64)	(3.32)	(3.22)	(0.46)	(1.73)	(0.28)	(0.86)	(0.44)	(−0.83)	(−3.15)	(2.80)
FF5 alpha	0.19	0.25	0.17	0.01	0.07	−0.05	0.02	−0.01	−0.12	−0.34	0.54
	(1.46)	(2.89)	(2.36)	(0.09)	(1.02)	(−0.63)	(0.25)	(−0.07)	(−1.36)	(−3.31)	(2.70)
HXZ alpha	0.28	0.35	0.17	0.02	0.07	−0.08	0.01	−0.04	−0.13	−0.36	0.65
	(1.89)	(3.54)	(1.90)	(0.22)	(1.00)	(−0.88)	(0.09)	(−0.39)	(−1.29)	(−3.26)	(2.93)
SY alpha	0.42	0.34	0.19	0.07	0.07	−0.03	−0.03	−0.09	−0.19	−0.46	0.88
	(3.49)	(3.29)	(2.01)	(0.76)	(0.87)	(−0.31)	(−0.46)	(−1.10)	(−2.11)	(−3.91)	(4.35)
DHS alpha	0.56	0.46	0.24	0.14	0.12	−0.03	0.02	−0.19	−0.28	−0.61	1.17
	(4.13)	(4.02)	(2.32)	(1.62)	(1.60)	(−0.39)	(0.26)	(−2.34)	(−3.02)	(−5.16)	(5.54)
Panel E: portfolio sorted by PE_{PCA15}											
CAPM alpha	0.25	0.31	0.25	0.05	0.16	0.03	0.12	0.04	−0.01	−0.28	0.52
	(1.99)	(3.75)	(3.27)	(0.71)	(2.42)	(0.42)	(1.78)	(0.50)	(−0.15)	(−2.75)	(3.00)
FF3 alpha	0.19	0.29	0.21	0.03	0.12	0.01	0.08	0.05	−0.04	−0.33	0.52
	(1.53)	(3.38)	(3.07)	(0.40)	(1.73)	(0.11)	(1.11)	(0.67)	(−0.38)	(−3.40)	(2.84)
FF5 alpha	0.19	0.27	0.15	0.00	0.07	−0.06	0.04	0.00	−0.07	−0.37	0.57
	(1.47)	(3.00)	(2.09)	(0.05)	(1.07)	(−0.77)	(0.57)	(0.04)	(−0.62)	(−3.67)	(2.88)
HXZ alpha	0.28	0.37	0.14	0.02	0.08	−0.09	0.03	−0.03	−0.07	−0.39	0.66
	(1.86)	(3.78)	(1.64)	(0.26)	(1.02)	(−1.01)	(0.32)	(−0.37)	(−0.63)	(−3.58)	(3.08)
SY alpha	0.41	0.35	0.18	0.08	0.06	−0.04	−0.01	−0.09	−0.13	−0.48	0.90
	(3.40)	(3.33)	(1.96)	(1.00)	(0.80)	(−0.43)	(−0.18)	(−1.18)	(−1.29)	(−4.12)	(4.38)
DHS alpha	0.57	0.45	0.25	0.16	0.11	−0.04	0.02	−0.19	−0.22	−0.62	1.19
	(4.24)	(3.77)	(2.43)	(1.95)	(1.49)	(−0.50)	(0.20)	(−2.45)	(−2.14)	(−5.32)	(5.65)

Table A5 Average returns of decile portfolios sorted by PEs of alternative PCA factor models

This table reports average returns of PE decile portfolios (Newey-West t-values in parentheses), where PE is based on PCA factors, which are extracted from 105 anomalies in Chen and Zimmermann (2019). Panel A is about the standard PCA and Panel B is about the risk-premium PCA in Lettau and Pelger (2018).

Model	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
Panel A: Standard PCA											
PE_{PCA1}	0.91	0.92	0.81	0.69	0.73	0.64	0.64	0.68	0.50	0.26	0.65
	(3.62)	(4.22)	(3.66)	(3.01)	(3.34)	(2.97)	(3.03)	(3.38)	(2.31)	(1.27)	(3.53)
PE_{PCA3}	0.91	0.93	0.79	0.68	0.77	0.62	0.64	0.68	0.50	0.26	0.65
	(3.59)	(4.17)	(3.54)	(2.94)	(3.52)	(2.86)	(3.04)	(3.36)	(2.34)	(1.28)	(3.56)
PE_{PCA5}	0.91	0.91	0.79	0.69	0.73	0.64	0.63	0.69	0.48	0.26	0.64
	(3.59)	(4.04)	(3.57)	(3.03)	(3.35)	(2.99)	(3.02)	(3.44)	(2.23)	(1.33)	(3.50)
PE_{PCA10}	0.92	0.89	0.81	0.68	0.76	0.65	0.65	0.68	0.47	0.26	0.66
	(3.61)	(3.99)	(3.67)	(2.92)	(3.50)	(3.00)	(3.09)	(3.37)	(2.18)	(1.32)	(3.60)
PE_{PCA15}	0.91	0.92	0.78	0.71	0.71	0.67	0.65	0.70	0.47	0.26	0.65
	(3.63)	(4.08)	(3.55)	(3.10)	(3.22)	(3.12)	(3.11)	(3.43)	(2.19)	(1.32)	(3.51)
Panel B: Risk-premium PCA											
PE_{PCA1}	0.86	0.84	0.78	0.62	0.68	0.57	0.57	0.57	0.43	0.20	0.66
	(3.45)	(3.85)	(3.52)	(2.76)	(3.15)	(2.59)	(2.75)	(2.84)	(2.01)	(1.05)	(3.67)
PE_{PCA3}	0.86	0.86	0.75	0.62	0.71	0.53	0.61	0.57	0.40	0.21	0.65
	(3.45)	(3.91)	(3.43)	(2.73)	(3.28)	(2.44)	(2.94)	(2.81)	(1.92)	(1.12)	(3.72)
PE_{PCA5}	0.84	0.86	0.76	0.61	0.69	0.55	0.61	0.54	0.44	0.20	0.64
	(3.38)	(3.88)	(3.50)	(2.72)	(3.19)	(2.52)	(2.97)	(2.65)	(2.12)	(1.02)	(3.65)
PE_{PCA10}	0.83	0.87	0.78	0.60	0.67	0.59	0.58	0.54	0.45	0.20	0.63
	(3.32)	(3.96)	(3.61)	(2.67)	(3.18)	(2.66)	(2.82)	(2.65)	(2.18)	(1.01)	(3.59)
PE_{PCA15}	0.84	0.85	0.79	0.60	0.68	0.56	0.62	0.53	0.48	0.17	0.66
	(3.36)	(3.89)	(3.68)	(2.61)	(3.30)	(2.50)	(3.05)	(2.64)	(2.26)	(0.90)	(3.67)

Table A6 Alpha difference between PE spread portfolios

This table reports the difference in alpha between PE spread portfolios, with p-value in parenthesis. The value in (i, j) corresponds to the difference between the PE_i spread portfolio and the PE_j spread portfolio, where i and j denote factor models i and j. PE_{CAPM} refers to the CAPM's PE, and PE_{FF3} to the FF3's PE, etc. The sample period is 1977:08–2016:12 for all portfolios.

Panel A: Difference in CAPM alpha

	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}	PE_{PCA1}	PE_{PCA3}	PE_{PCA5}	PE_{PCA10}	PE_{PCA15}
PE_{CAPM}	–	0.06	0.08	0.02	0.06	0.01	−0.00	0.02	0.02	0.02	0.00
		(0.07)	(0.05)	(0.40)	(0.14)	(0.52)	(0.93)	(0.68)	(0.59)	(0.67)	(0.94)
PE_{FF3}		–	0.02	−0.04	−0.00	−0.05	−0.06	−0.04	−0.04	−0.04	−0.06
			(0.35)	(0.22)	(0.99)	(0.09)	(0.22)	(0.40)	(0.47)	(0.39)	(0.24)
PE_{FF5}			–	−0.06	−0.02	−0.07	−0.09	−0.06	−0.06	−0.06	−0.08
				(0.12)	(0.36)	(0.06)	(0.14)	(0.24)	(0.29)	(0.23)	(0.14)
PE_{HXZ}				–	0.04	−0.01	−0.03	−0.01	−0.00	−0.00	−0.02
					(0.34)	(0.68)	(0.57)	(0.90)	(0.99)	(0.93)	(0.68)
PE_{SY}					–	−0.05	−0.06	−0.04	−0.04	−0.04	−0.06
						(0.18)	(0.31)	(0.46)	(0.54)	(0.47)	(0.34)
PE_{DHS}						–	−0.02	0.00	0.01	0.01	−0.01
							(0.73)	(0.91)	(0.83)	(0.89)	(0.84)
PE_{PCA1}							–	0.02	0.03	0.02	0.01
								(0.35)	(0.25)	(0.41)	(0.83)
PE_{PCA3}								–	0.01	0.00	−0.01
									(0.77)	(0.95)	(0.68)
PE_{PCA5}									–	−0.00	−0.02
										(0.87)	(0.54)
PE_{PCA10}										–	−0.02
											(0.52)
PE_{PCA15}											–

Panel B: Difference in FF5 alpha

	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}	PE_{PCA1}	PE_{PCA3}	PE_{PCA5}	PE_{PCA10}	PE_{PCA15}
PE_{CAPM}	–	0.04	0.05	0.01	0.05	0.01	−0.02	0.01	0.02	0.02	−0.02
		(0.26)	(0.20)	(0.70)	(0.19)	(0.78)	(0.63)	(0.78)	(0.72)	(0.71)	(0.67)
PE_{FF3}		–	0.02	−0.03	0.01	−0.03	−0.06	−0.03	−0.02	−0.02	−0.06
			(0.48)	(0.38)	(0.53)	(0.26)	(0.25)	(0.60)	(0.66)	(0.66)	(0.23)
PE_{FF5}			–	−0.04	−0.00	−0.05	−0.08	−0.04	−0.04	−0.04	−0.07
				(0.25)	(0.95)	(0.19)	(0.19)	(0.43)	(0.49)	(0.48)	(0.17)
PE_{HXZ}				–	0.04	−0.01	−0.03	0.00	0.00	0.01	−0.03
					(0.27)	(0.84)	(0.49)	(0.98)	(0.92)	(0.90)	(0.53)
PE_{SY}					–	−0.05	−0.08	−0.04	−0.04	−0.04	−0.07
						(0.18)	(0.23)	(0.47)	(0.53)	(0.52)	(0.21)
PE_{DHS}						–	−0.03	0.01	0.01	0.01	−0.03
							(0.57)	(0.89)	(0.83)	(0.81)	(0.60)
PE_{PCA1}							–	0.04	0.04	0.04	0.00
								(0.16)	(0.11)	(0.17)	(0.94)
PE_{PCA3}								–	0.00	0.00	−0.03
									(0.83)	(0.85)	(0.35)
PE_{PCA5}									–	0.00	−0.04
										(0.95)	(0.26)
PE_{PCA10}										–	−0.04
											(0.12)
PE_{PCA15}											–

Table A6 (continued)

Panel C: Difference in HXZ alpha

	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}	PE_{PCA1}	PE_{PCA3}	PE_{PCA5}	PE_{PCA10}	PE_{PCA15}
PE_{CAPM}	–	0.04	0.06	−0.01	0.06	0.00	−0.03	0.01	0.01	0.02	−0.01
		(0.27)	(0.17)	(0.82)	(0.13)	(0.99)	(0.47)	(0.75)	(0.78)	(0.61)	(0.86)
PE_{FF3}		–	0.02	−0.04	0.02	−0.04	−0.07	−0.02	−0.03	−0.01	−0.05
			(0.37)	(0.12)	(0.31)	(0.18)	(0.16)	(0.62)	(0.60)	(0.75)	(0.33)
PE_{FF5}			–	−0.07	0.00	−0.06	−0.09	−0.04	−0.05	−0.04	−0.07
				(0.07)	(0.91)	(0.11)	(0.11)	(0.40)	(0.39)	(0.49)	(0.21)
PE_{HXZ}				–	0.07	0.01	−0.03	0.02	0.02	0.03	−0.00
					(0.06)	(0.79)	(0.57)	(0.65)	(0.68)	(0.53)	(0.97)
PE_{SY}					–	−0.06	−0.10	−0.05	−0.05	−0.04	−0.07
						(0.07)	(0.12)	(0.39)	(0.39)	(0.48)	(0.22)
PE_{DHS}						–	−0.03	0.01	0.01	0.02	−0.01
							(0.49)	(0.77)	(0.80)	(0.62)	(0.86)
PE_{PCA1}							–	0.05	0.05	0.06	0.03
								(0.05)	(0.06)	(0.05)	(0.48)
PE_{PCA3}								–	−0.00	0.01	−0.02
									(0.92)	(0.72)	(0.53)
PE_{PCA5}									–	0.01	−0.02
										(0.61)	(0.52)
PE_{PCA10}										–	−0.03
											(0.19)
PE_{PCA15}											–

Panel D: Difference in SY alpha

	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}	PE_{PCA1}	PE_{PCA3}	PE_{PCA5}	PE_{PCA10}	PE_{PCA15}
PE_{CAPM}	–	0.04	0.07	0.02	0.07	0.00	−0.08	−0.03	−0.02	−0.02	−0.04
		(0.20)	(0.11)	(0.59)	(0.08)	(0.81)	(0.11)	(0.50)	(0.57)	(0.59)	(0.37)
PE_{FF3}		–	0.02	−0.03	0.03	−0.04	−0.12	−0.07	−0.07	−0.07	−0.09
			(0.20)	(0.47)	(0.18)	(0.28)	(0.02)	(0.14)	(0.18)	(0.16)	(0.08)
PE_{FF5}			–	−0.05	0.00	−0.06	−0.14	−0.10	−0.09	−0.09	−0.11
				(0.16)	(0.87)	(0.08)	(0.01)	(0.07)	(0.09)	(0.07)	(0.04)
PE_{HXZ}				–	0.06	−0.01	−0.09	−0.05	−0.04	−0.04	−0.06
					(0.14)	(0.68)	(0.06)	(0.32)	(0.37)	(0.40)	(0.23)
PE_{SY}					–	−0.07	−0.15	−0.10	−0.10	−0.10	−0.11
						(0.05)	(0.02)	(0.07)	(0.10)	(0.08)	(0.05)
PE_{DHS}						–	−0.08	−0.03	−0.03	−0.03	−0.05
							(0.10)	(0.45)	(0.52)	(0.52)	(0.33)
PE_{PCA1}							–	0.05	0.05	0.05	0.03
								(0.06)	(0.03)	(0.07)	(0.34)
PE_{PCA3}								–	0.00	0.01	−0.01
									(0.78)	(0.84)	(0.70)
PE_{PCA5}									–	0.00	−0.02
										(0.99)	(0.57)
PE_{PCA10}										–	−0.02
											(0.45)
PE_{PCA15}											–

Table A6 (continued)

Panel E: Difference in DHS alpha

	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}	PE_{PCA1}	PE_{PCA3}	PE_{PCA5}	PE_{PCA10}	PE_{PCA15}
PE_{CAPM}	–	0.05	0.07	0.01	0.10	0.00	−0.11	−0.07	−0.07	−0.05	−0.09
		(0.10)	(0.07)	(0.77)	(0.01)	(0.88)	(0.02)	(0.13)	(0.09)	(0.26)	(0.07)
PE_{FF3}		–	0.02	−0.05	0.04	−0.05	−0.17	−0.12	−0.13	−0.11	−0.14
			(0.38)	(0.12)	(0.06)	(0.06)	(0.00)	(0.01)	(0.01)	(0.02)	(0.00)
PE_{FF5}			–	−0.07	0.02	−0.07	−0.19	−0.14	−0.15	−0.13	−0.16
				(0.07)	(0.34)	(0.04)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
PE_{HXZ}				–	0.09	−0.01	−0.12	−0.08	−0.08	−0.06	−0.09
					(0.02)	(0.84)	(0.01)	(0.08)	(0.06)	(0.19)	(0.05)
PE_{SY}					–	−0.10	−0.21	−0.17	−0.17	−0.15	−0.18
						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
PE_{DHS}						–	−0.12	−0.07	−0.08	−0.05	−0.09
							(0.02)	(0.12)	(0.09)	(0.23)	(0.07)
PE_{PCA1}							–	0.05	0.04	0.06	0.03
								(0.05)	(0.09)	(0.04)	(0.43)
PE_{PCA3}								–	−0.01	0.02	−0.02
									(0.74)	(0.54)	(0.60)
PE_{PCA5}									–	0.02	−0.01
										(0.33)	(0.69)
PE_{PCA10}										–	−0.03
											(0.16)
PE_{PCA15}											–

Table A7 FF3 alphas of portfolios sorted by short-term reversal and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by short-term reversal (STR) and PE, where STR is measured by the prior (1-1) return.

	Panel A: Sort on STR and PE_{CAPM}						Panel B: Sort on STR and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
STR1	0.37	0.13	0.20	0.04	−0.13	0.51	0.34	0.17	0.15	0.10	−0.08	0.43
	(3.38)	(1.28)	(2.33)	(0.34)	(−1.01)	(3.59)	(3.00)	(1.65)	(1.57)	(0.98)	(−0.58)	(2.74)
STR2	0.28	0.11	0.06	−0.11	−0.19	0.47	0.27	0.09	0.06	−0.11	−0.11	0.38
	(3.71)	(1.44)	(0.68)	(−1.30)	(−1.71)	(3.19)	(3.56)	(1.12)	(0.72)	(−1.29)	(−0.90)	(2.49)
STR3	0.21	0.09	0.08	−0.07	−0.16	0.37	0.21	0.09	0.09	−0.08	−0.18	0.39
	(2.60)	(1.16)	(1.10)	(−0.82)	(−1.75)	(2.77)	(2.65)	(1.19)	(1.29)	(−0.97)	(−1.99)	(2.95)
STR4	0.27	0.07	0.04	−0.14	−0.23	0.49	0.28	0.04	0.06	−0.15	−0.23	0.51
	(2.73)	(0.79)	(0.44)	(−1.83)	(−2.85)	(3.78)	(3.03)	(0.48)	(0.73)	(−1.88)	(−2.88)	(3.98)
STR5	−0.03	−0.08	−0.27	−0.44	−0.63	0.60	0.06	−0.15	−0.29	−0.42	−0.66	0.72
	(−0.27)	(−0.77)	(−3.38)	(−4.55)	(−6.08)	(4.33)	(0.50)	(−1.57)	(−3.70)	(−4.18)	(−6.36)	(4.88)
All stocks	0.26	0.08	0.03	−0.14	−0.18	0.44	0.27	0.06	0.03	−0.12	−0.17	0.44
	(5.33)	(2.24)	(0.76)	(−3.12)	(−3.29)	(5.14)	(5.51)	(1.50)	(0.68)	(−2.51)	(−3.01)	(5.01)

	Panel C: Sort on STR and PE_{FF5}						Panel D: Sort on STR and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
STR1	0.17	0.12	−0.07	−0.03	−0.31	0.48	0.24	0.02	−0.03	0.02	−0.33	0.57
	(1.02)	(0.84)	(−0.65)	(−0.22)	(−1.90)	(2.14)	(1.48)	(0.18)	(−0.28)	(0.15)	(−1.93)	(2.67)
STR2	0.36	0.18	0.11	−0.24	−0.26	0.62	0.33	0.24	0.04	−0.17	−0.23	0.56
	(4.20)	(1.89)	(1.03)	(−2.22)	(−1.95)	(3.48)	(3.73)	(2.34)	(0.35)	(−1.46)	(−1.73)	(3.27)
STR3	0.33	0.22	0.06	−0.15	−0.27	0.60	0.27	0.23	0.10	−0.14	−0.23	0.50
	(3.53)	(2.52)	(0.70)	(−1.67)	(−2.21)	(3.62)	(2.77)	(2.46)	(1.04)	(−1.55)	(−1.78)	(2.88)
STR4	0.38	0.23	0.09	−0.08	−0.21	0.59	0.39	0.21	0.16	−0.05	−0.19	0.58
	(3.35)	(2.29)	(0.89)	(−0.89)	(−1.99)	(3.58)	(3.30)	(2.03)	(1.53)	(−0.51)	(−1.82)	(3.52)
STR5	0.16	0.01	−0.10	−0.26	−0.51	0.67	0.18	0.05	−0.08	−0.31	−0.44	0.61
	(1.05)	(0.08)	(−0.87)	(−2.96)	(−4.17)	(3.77)	(1.09)	(0.40)	(−0.66)	(−3.26)	(−3.45)	(3.28)
All stocks	0.34	0.17	0.01	−0.16	−0.24	0.58	0.32	0.15	0.03	−0.16	−0.23	0.55
	(5.56)	(3.35)	(0.22)	(−3.18)	(−3.32)	(5.08)	(5.53)	(2.82)	(0.60)	(−3.29)	(−2.95)	(4.80)

	Panel E: Sort on STR and PE_{SY}						Panel F: Sort on STR and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
STR1	0.19	0.11	−0.02	0.02	−0.35	0.54	0.08	0.01	−0.05	−0.06	−0.33	0.40
	(1.12)	(0.83)	(−0.19)	(0.13)	(−2.26)	(2.36)	(0.44)	(0.08)	(−0.42)	(−0.41)	(−1.78)	(1.69)
STR2	0.37	0.14	0.13	−0.22	−0.22	0.60	0.38	0.21	0.12	−0.05	−0.27	0.66
	(4.38)	(1.45)	(1.25)	(−2.00)	(−1.59)	(3.26)	(4.09)	(1.94)	(1.03)	(−0.44)	(−1.99)	(3.67)
STR3	0.34	0.17	0.08	−0.13	−0.26	0.60	0.28	0.26	0.11	0.01	−0.22	0.50
	(3.63)	(1.87)	(0.92)	(−1.41)	(−2.30)	(3.73)	(2.74)	(2.50)	(1.20)	(0.12)	(−1.63)	(2.72)
STR4	0.36	0.20	0.05	−0.03	−0.22	0.58	0.39	0.14	0.15	0.08	−0.14	0.54
	(3.06)	(1.87)	(0.47)	(−0.30)	(−2.11)	(3.46)	(3.04)	(1.18)	(1.38)	(0.82)	(−1.19)	(2.87)
STR5	0.14	0.01	−0.09	−0.28	−0.47	0.61	0.10	0.04	−0.09	−0.37	−0.41	0.51
	(0.93)	(0.11)	(−0.86)	(−3.03)	(−3.74)	(3.53)	(0.61)	(0.28)	(−0.69)	(−3.51)	(−2.82)	(2.66)
All stocks	0.35	0.12	0.02	−0.14	−0.23	0.58	0.29	0.15	0.03	−0.11	−0.23	0.51
	(5.85)	(2.35)	(0.41)	(−2.83)	(−3.21)	(5.18)	(4.77)	(2.64)	(0.60)	(−1.99)	(−2.58)	(4.05)

Table A8 Average returns of portfolios sorted by $\mathrm{PE_{CAPM}}$ and short-term reversal

This table reports average returns of 25 value-weighted portfolios sequentially sorted by PE and short-term reversal (Newey-West t-values in parentheses), where the short-term reversal is measured by the prior (1-1) return (STR). The sample period is 1931:08–2018:12.

Panel A: Sort on STR and $\mathrm{PE_{CAPM}}$	STR1	STR2	STR3	STR4	STR5	STR1-5
PE1	1.05	1.01	0.97	1.06	0.87	0.18
	(3.96)	(4.46)	(4.64)	(5.63)	(5.02)	(0.92)
PE2	0.82	0.69	0.80	0.80	0.90	−0.07
	(3.34)	(3.33)	(4.10)	(4.11)	(4.45)	(−0.40)
PE3	0.75	0.80	0.76	0.83	0.94	−0.20
	(3.25)	(4.14)	(3.98)	(4.35)	(4.09)	(−0.99)
PE4	0.59	0.67	0.73	0.84	0.78	−0.19
	(3.01)	(3.57)	(3.50)	(3.88)	(3.26)	(−0.98)
PE5	0.46	0.37	0.38	0.32	0.15	0.31
	(2.75)	(1.99)	(1.94)	(1.53)	(0.69)	(1.87)
PE1-5	0.59	0.64	0.59	0.74	0.72	−0.13
	(3.12)	(3.97)	(3.89)	(5.35)	(3.95)	(−0.49)
All stocks	0.66	0.65	0.71	0.77	0.74	−0.08
	(3.80)	(3.77)	(4.00)	(4.30)	(4.04)	(−0.77)

Table A9 FF3 alphas of portfolios sorted by PE and short-term reversal

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by PE and short-term reversal (STR), where STR is measured by the prior (1-1) return.

	Panel A: Sort on PE_{CAPM} and STR						Panel B: Sort on PE_{FF3} and STR					
	STR1	STR2	STR3	STR4	STR5	STR1-5	STR1	STR2	STR3	STR4	STR5	STR1-5
PE1	0.13	0.17	0.20	0.34	0.27	−0.13	0.13	0.15	0.21	0.32	0.27	−0.14
	(0.87)	(1.54)	(1.92)	(4.39)	(3.59)	(−0.74)	(0.83)	(1.35)	(2.00)	(4.18)	(3.63)	(−0.78)
PE2	−0.19	−0.14	0.07	0.04	0.21	−0.40	−0.09	−0.12	0.09	0.08	0.19	−0.29
	(−1.72)	(−1.46)	(0.77)	(0.50)	(2.53)	(−2.68)	(−0.86)	(−1.31)	(1.03)	(1.10)	(2.31)	(−1.92)
PE3	−0.13	0.00	0.01	0.09	0.25	−0.38	−0.19	−0.12	0.06	0.09	0.23	−0.41
	(−0.97)	(0.01)	(0.18)	(1.07)	(2.40)	(−1.96)	(−1.35)	(−1.39)	(0.73)	(1.10)	(2.27)	(−2.18)
PE4	−0.13	−0.06	−0.03	0.04	0.03	−0.16	−0.08	−0.09	−0.03	0.04	0.01	−0.09
	(−1.15)	(−0.69)	(−0.35)	(0.48)	(0.26)	(−0.88)	(−0.62)	(−1.16)	(−0.37)	(0.42)	(0.10)	(−0.46)
PE5	−0.15	−0.33	−0.34	−0.48	−0.67	0.53	−0.13	−0.31	−0.35	−0.46	−0.68	0.55
	(−2.01)	(−4.11)	(−4.18)	(−5.18)	(−4.57)	(3.07)	(−1.75)	(−3.90)	(−4.20)	(−4.93)	(−4.60)	(3.15)
All stocks	−0.04	−0.07	0.01	0.03	0.08	−0.13	−0.04	−0.09	0.02	0.04	0.08	−0.12
	(−0.69)	(−1.50)	(0.18)	(0.77)	(1.64)	(−1.29)	(−0.63)	(−2.08)	(0.40)	(1.03)	(1.48)	(−1.18)
	Panel C: Sort on PE_{FF5} and STR						Panel D: Sort on PE_{HXZ} and STR					
	STR1	STR2	STR3	STR4	STR5	STR1-5	STR1	STR2	STR3	STR4	STR5	STR1-5
PE1	−0.23	0.00	0.05	0.33	0.38	−0.61	−0.24	−0.03	0.05	0.29	0.36	−0.60
	(−1.05)	(0.01)	(0.36)	(3.13)	(4.37)	(−2.61)	(−1.01)	(−0.18)	(0.35)	(2.71)	(4.05)	(−2.41)
PE2	−0.09	−0.05	0.03	0.17	0.25	−0.34	−0.10	−0.02	0.07	0.11	0.22	−0.32
	(−0.63)	(−0.48)	(0.31)	(1.97)	(2.35)	(−1.70)	(−0.66)	(−0.15)	(0.65)	(1.29)	(2.09)	(−1.54)
PE3	−0.44	−0.14	0.04	0.21	0.40	−0.84	−0.39	−0.11	0.04	0.21	0.42	−0.81
	(−3.11)	(−1.28)	(0.46)	(2.24)	(3.47)	(−4.13)	(−2.73)	(−1.04)	(0.41)	(2.20)	(3.69)	(−3.99)
PE4	−0.25	−0.09	−0.03	0.21	0.17	−0.42	−0.21	−0.07	0.02	0.20	0.22	−0.43
	(−2.14)	(−0.81)	(−0.35)	(2.02)	(1.09)	(−1.96)	(−1.69)	(−0.65)	(0.15)	(1.83)	(1.39)	(−1.96)
PE5	−0.17	−0.32	−0.28	−0.29	−0.20	0.03	−0.11	−0.33	−0.26	−0.28	−0.18	0.07
	(−1.72)	(−3.47)	(−2.73)	(−2.52)	(−1.19)	(0.16)	(−1.24)	(−3.52)	(−2.35)	(−2.38)	(−1.06)	(0.35)
All stocks	−0.16	−0.15	−0.04	0.12	0.25	−0.41	−0.13	−0.16	−0.01	0.09	0.25	−0.37
	(−2.32)	(−3.04)	(−1.03)	(2.70)	(4.89)	(−4.13)	(−1.91)	(−3.13)	(−0.32)	(1.94)	(4.74)	(−3.89)
	Panel E: Sort on PE_{SY} and STR						Panel F: Sort on PE_{DHS} and STR					
	STR1	STR2	STR3	STR4	STR5	STR1-5	STR1	STR2	STR3	STR4	STR5	STR1-5
PE1	−0.21	−0.04	0.08	0.32	0.38	−0.59	−0.42	−0.09	−0.02	0.30	0.44	−0.85
	(−0.99)	(−0.25)	(0.56)	(3.07)	(4.36)	(−2.59)	(−1.66)	(−0.48)	(−0.12)	(2.54)	(4.63)	(−3.29)
PE2	−0.07	−0.11	0.01	0.15	0.28	−0.35	−0.11	−0.06	0.05	0.14	0.26	−0.38
	(−0.48)	(−0.98)	(0.13)	(1.79)	(2.76)	(−1.75)	(−0.66)	(−0.43)	(0.41)	(1.44)	(2.40)	(−1.63)
PE3	−0.49	−0.17	0.06	0.14	0.38	−0.86	−0.40	0.01	0.09	0.25	0.40	−0.80
	(−3.43)	(−1.48)	(0.64)	(1.47)	(3.26)	(−4.14)	(−2.52)	(0.10)	(0.90)	(2.36)	(3.28)	(−3.73)
PE4	−0.24	−0.11	−0.01	0.18	0.19	−0.42	−0.14	0.05	0.07	0.19	0.13	−0.27
	(−1.99)	(−1.06)	(−0.06)	(1.71)	(1.32)	(−2.08)	(−1.02)	(0.45)	(0.68)	(1.58)	(0.79)	(−1.13)
PE5	−0.16	−0.34	−0.27	−0.30	−0.22	0.06	−0.05	−0.25	−0.35	−0.32	−0.21	0.16
	(−1.60)	(−3.64)	(−2.64)	(−2.64)	(−1.31)	(0.30)	(−0.45)	(−2.34)	(−2.92)	(−2.40)	(−1.12)	(0.75)
All stocks	−0.16	−0.17	−0.02	0.09	0.25	−0.41	−0.14	−0.10	−0.03	0.11	0.25	−0.39
	(−2.43)	(−3.22)	(−0.42)	(2.08)	(4.88)	(−4.26)	(−1.81)	(−1.89)	(−0.66)	(2.12)	(4.60)	(−3.54)

Table A10 Average returns of STR-orthogonalized PE decile portfolios

This table reports average returns of pricing error (PE) decile portfolios (Newey-West t-values in parentheses) with the consideration of STR, where PE is based on the CAPM, FF3 (Fama and French, 1993), FF5 (Fama and French, 2015), HXZ (Hou, Xue, and Zhang, 2015), SY (Stambaugh and Yuan, 2017), and DHS (Daniel, Hirshleifer, and Sun, 2019) model, respectively. PE_{CAPM} refers to the CAPM's PE and PE_{FF3} to the FF3's PE, etc. To separate the STR effect, we run a cross-sectional regression of PE in (5) on STR and use the residual to construct a STR-orthogonalized PE measure. The sample periods of PE portfolios all end in 2018:12, but start differently, from 1931:08 for the CAPM and FF3, 1968:08 for the FF5, 1972:02 for the HXZ, 1968:02 for the SY, and 1977:08 for the DHS, respectively.

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE1-10
PE_{CAPM}	0.87	0.90	0.85	0.85	0.76	0.73	0.64	0.57	0.51	0.43	0.44
	(5.19)	(4.95)	(4.23)	(4.38)	(3.77)	(3.69)	(3.26)	(2.84)	(2.84)	(2.55)	(4.12)
PE_{FF3}	0.86	0.88	0.84	0.82	0.79	0.70	0.63	0.60	0.54	0.43	0.43
	(5.09)	(4.76)	(4.49)	(4.25)	(3.78)	(3.55)	(3.26)	(3.09)	(2.88)	(2.58)	(3.98)
PE_{FF5}	0.81	0.77	0.70	0.58	0.64	0.60	0.43	0.46	0.35	0.18	0.63
	(4.19)	(3.53)	(3.13)	(2.54)	(2.83)	(2.53)	(1.96)	(2.05)	(1.66)	(1.00)	(5.43)
PE_{HXZ}	0.83	0.73	0.77	0.66	0.67	0.66	0.53	0.50	0.41	0.19	0.63
	(4.27)	(3.33)	(3.37)	(2.94)	(3.04)	(2.81)	(2.37)	(2.34)	(1.87)	(1.08)	(5.38)
PE_{SY}	0.80	0.73	0.76	0.65	0.59	0.58	0.49	0.42	0.34	0.19	0.61
	(4.18)	(3.35)	(3.51)	(2.82)	(2.64)	(2.49)	(2.29)	(1.89)	(1.65)	(1.09)	(5.31)
PE_{DHS}	0.93	0.83	0.90	0.83	0.83	0.70	0.72	0.63	0.49	0.27	0.65
	(4.73)	(3.62)	(3.68)	(3.43)	(3.43)	(2.84)	(3.22)	(2.78)	(2.18)	(1.46)	(5.10)

Table A11 FF3 alphas of portfolios sorted by long-term reversal and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by long-term reversal (LTR) and PE, where LTR is measured by the prior (13-60) return.

	Panel A: Sort on LTR and PE_{CAPM}						Panel B: Sort on LTR and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTR1	0.26	0.19	0.11	−0.18	−0.37	0.63	0.26	0.25	0.12	−0.18	−0.37	0.63
	(1.94)	(1.96)	(1.19)	(−1.71)	(−3.79)	(4.28)	(1.88)	(2.62)	(1.24)	(−1.95)	(−3.80)	(4.08)
LTR2	0.32	0.27	0.14	0.01	−0.29	0.61	0.34	0.26	0.12	0.03	−0.29	0.62
	(3.44)	(3.75)	(1.54)	(0.10)	(−2.93)	(5.09)	(3.70)	(3.42)	(1.43)	(0.43)	(−2.94)	(5.26)
LTR3	0.45	0.15	0.07	0.10	−0.27	0.73	0.46	0.16	0.09	0.07	−0.25	0.71
	(5.23)	(1.82)	(0.96)	(1.42)	(−3.10)	(5.56)	(5.29)	(1.92)	(1.34)	(0.91)	(−2.88)	(5.45)
LTR4	0.40	0.14	0.16	−0.01	−0.37	0.77	0.37	0.14	0.19	−0.02	−0.36	0.73
	(4.57)	(1.66)	(2.05)	(−0.21)	(−4.23)	(5.68)	(4.12)	(1.69)	(2.41)	(−0.29)	(−4.24)	(5.41)
LTR5	0.19	0.14	−0.02	−0.10	−0.23	0.42	0.20	0.12	−0.03	−0.14	−0.23	0.43
	(1.86)	(1.65)	(−0.26)	(−1.12)	(−2.41)	(2.87)	(1.93)	(1.40)	(−0.29)	(−1.49)	(−2.30)	(2.90)
All stocks	0.28	0.16	0.12	−0.01	−0.26	0.54	0.28	0.17	0.13	−0.03	−0.25	0.53
	(4.94)	(3.68)	(2.60)	(−0.24)	(−4.28)	(5.48)	(4.84)	(4.01)	(3.08)	(−0.67)	(−4.26)	(5.33)
	Panel C: Sort on LTR and PE_{FF5}						Panel D: Sort on LTR and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTR1	0.08	0.28	0.04	−0.11	−0.29	0.37	0.12	0.16	0.09	−0.10	−0.27	0.38
	(0.40)	(2.34)	(0.33)	(−1.08)	(−2.79)	(1.72)	(0.58)	(1.24)	(0.63)	(−0.95)	(−2.49)	(1.81)
LTR2	0.26	0.25	−0.01	0.08	−0.24	0.50	0.23	0.25	0.00	0.11	−0.18	0.42
	(2.24)	(2.93)	(−0.17)	(0.70)	(−2.20)	(3.23)	(2.00)	(2.80)	(0.02)	(0.96)	(−1.65)	(2.72)
LTR3	0.51	0.16	0.02	0.10	−0.15	0.67	0.43	0.09	0.05	0.14	−0.15	0.58
	(4.39)	(1.84)	(0.21)	(1.02)	(−1.39)	(3.85)	(3.97)	(0.99)	(0.54)	(1.36)	(−1.29)	(3.38)
LTR4	0.39	0.12	0.25	−0.05	−0.33	0.72	0.46	0.13	0.20	−0.01	−0.33	0.79
	(3.47)	(1.11)	(2.28)	(−0.66)	(−3.28)	(4.56)	(3.91)	(1.21)	(1.70)	(−0.12)	(−3.24)	(4.79)
LTR5	0.22	0.18	0.12	−0.18	−0.19	0.41	0.17	0.27	0.19	−0.14	−0.15	0.32
	(1.89)	(1.59)	(1.01)	(−1.74)	(−1.62)	(2.46)	(1.45)	(2.36)	(1.55)	(−1.36)	(−1.24)	(1.83)
All stocks	0.28	0.16	0.10	−0.04	−0.23	0.51	0.26	0.14	0.11	−0.03	−0.22	0.48
	(3.69)	(3.05)	(1.75)	(−0.83)	(−3.43)	(4.17)	(3.40)	(2.47)	(1.81)	(−0.45)	(−3.08)	(3.80)
	Panel E: Sort on LTR and PE_{SY}						Panel F: Sort on LTR and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTR1	0.07	0.24	0.04	−0.11	−0.30	0.37	−0.04	0.27	0.03	−0.04	−0.30	0.26
	(0.39)	(2.05)	(0.32)	(−1.08)	(−2.94)	(1.82)	(−0.18)	(2.03)	(0.18)	(−0.35)	(−2.40)	(1.05)
LTR2	0.24	0.27	0.02	0.08	−0.27	0.51	0.23	0.24	0.05	0.16	−0.15	0.38
	(2.11)	(3.09)	(0.27)	(0.72)	(−2.42)	(3.27)	(1.83)	(2.39)	(0.53)	(1.28)	(−1.27)	(2.36)
LTR3	0.52	0.18	0.01	0.08	−0.17	0.68	0.36	0.15	0.07	0.26	−0.12	0.48
	(4.43)	(2.06)	(0.08)	(0.82)	(−1.56)	(3.95)	(3.24)	(1.64)	(0.74)	(2.32)	(−0.96)	(2.66)
LTR4	0.41	0.09	0.22	−0.05	−0.34	0.75	0.51	0.20	0.19	0.04	−0.39	0.90
	(3.62)	(0.80)	(1.99)	(−0.58)	(−3.49)	(4.73)	(3.92)	(1.61)	(1.43)	(0.41)	(−3.45)	(5.00)
LTR5	0.20	0.20	0.19	−0.24	−0.18	0.38	0.22	0.32	0.20	−0.18	−0.18	0.40
	(1.72)	(1.71)	(1.55)	(−2.46)	(−1.55)	(2.23)	(1.68)	(2.58)	(1.46)	(−1.54)	(−1.31)	(1.98)
All stocks	0.28	0.15	0.12	−0.06	−0.24	0.52	0.26	0.17	0.11	0.02	−0.23	0.49
	(3.73)	(3.07)	(2.08)	(−1.12)	(−3.53)	(4.20)	(3.02)	(2.95)	(1.68)	(0.31)	(−2.90)	(3.46)

Table A12 FF3 alphas of portfolios sorted by IVOL and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by IVOL and PE, where IVOL is estimated as Ang, Hodrick, Xing, and Zhang (2006).

	Panel A: Sort on IVOL and PE_{CAPM}						Panel B: Sort on IVOL and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.41	0.23	0.17	0.14	−0.10	0.51	0.41	0.23	0.16	0.15	−0.11	0.52
	(5.82)	(3.51)	(2.50)	(2.26)	(−1.36)	(4.73)	(5.82)	(3.24)	(2.40)	(2.51)	(−1.53)	(4.89)
IVOL2	0.34	0.18	−0.06	−0.00	−0.28	0.62	0.31	0.20	−0.03	−0.04	−0.26	0.57
	(4.24)	(2.52)	(−0.92)	(−0.06)	(−3.96)	(5.38)	(3.87)	(2.77)	(−0.52)	(−0.54)	(−3.74)	(4.99)
IVOL3	0.34	0.05	0.03	−0.05	−0.48	0.81	0.30	0.10	0.02	−0.03	−0.49	0.80
	(3.84)	(0.64)	(0.38)	(−0.66)	(−5.98)	(6.47)	(3.56)	(1.21)	(0.21)	(−0.31)	(−6.03)	(6.36)
IVOL4	0.11	−0.09	−0.13	−0.20	−0.46	0.57	0.08	−0.09	−0.15	−0.21	−0.44	0.52
	(1.00)	(−1.00)	(−1.43)	(−2.18)	(−4.39)	(3.30)	(0.72)	(−1.07)	(−1.70)	(−2.26)	(−4.24)	(3.10)
IVOL5	−0.20	−0.30	−0.42	−0.62	−0.88	0.68	−0.22	−0.31	−0.45	−0.62	−0.90	0.68
	(−1.34)	(−2.32)	(−3.13)	(−5.50)	(−5.61)	(2.90)	(−1.51)	(−2.30)	(−3.41)	(−5.49)	(−5.60)	(2.91)
All stocks	0.29	0.14	0.08	0.02	−0.24	0.54	0.28	0.15	0.08	0.02	−0.25	0.53
	(5.40)	(3.23)	(1.93)	(0.50)	(−4.76)	(5.86)	(5.26)	(3.34)	(1.97)	(0.46)	(−4.87)	(5.84)

	Panel C: Sort on IVOL and PE_{FF5}						Panel D: Sort on IVOL and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.48	0.24	0.15	0.11	−0.26	0.74	0.48	0.24	0.15	0.13	−0.26	0.74
	(5.95)	(2.72)	(1.58)	(1.15)	(−2.91)	(6.04)	(5.83)	(2.71)	(1.58)	(1.35)	(−2.79)	(5.86)
IVOL2	0.28	0.20	−0.07	−0.06	−0.20	0.48	0.26	0.20	−0.11	−0.02	−0.19	0.45
	(2.73)	(2.41)	(−0.91)	(−0.70)	(−2.31)	(3.30)	(2.47)	(2.28)	(−1.35)	(−0.19)	(−2.18)	(3.07)
IVOL3	0.20	0.08	0.12	0.01	−0.34	0.53	0.14	0.07	0.13	0.00	−0.30	0.44
	(1.68)	(0.79)	(1.14)	(0.10)	(−2.83)	(2.80)	(1.17)	(0.74)	(1.23)	(0.03)	(−2.42)	(2.28)
IVOL4	−0.02	−0.10	−0.06	−0.06	−0.16	0.14	−0.05	−0.09	−0.01	−0.05	−0.12	0.07
	(−0.12)	(−0.80)	(−0.50)	(−0.46)	(−1.36)	(0.60)	(−0.28)	(−0.72)	(−0.06)	(−0.44)	(−0.99)	(0.28)
IVOL5	−0.58	−0.62	−0.64	−0.51	−0.34	−0.24	−0.60	−0.57	−0.59	−0.40	−0.31	−0.29
	(−3.14)	(−3.85)	(−4.06)	(−3.82)	(−2.08)	(−1.02)	(−3.11)	(−3.28)	(−3.46)	(−3.04)	(−1.91)	(−1.17)
All stocks	0.27	0.14	0.07	0.00	−0.22	0.49	0.25	0.13	0.07	0.03	−0.22	0.46
	(3.87)	(2.57)	(1.44)	(0.05)	(−3.50)	(4.13)	(3.47)	(2.36)	(1.32)	(0.56)	(−3.27)	(3.79)

	Panel E: Sort on IVOL and PE_{SY}						Panel F: Sort on IVOL and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.45	0.26	0.16	0.09	−0.25	0.70	0.52	0.35	0.20	0.23	−0.24	0.76
	(5.64)	(3.17)	(1.69)	(1.04)	(−2.89)	(5.80)	(5.77)	(4.01)	(1.81)	(2.20)	(−2.28)	(5.32)
IVOL2	0.28	0.18	−0.09	−0.04	−0.22	0.50	0.28	0.15	−0.05	−0.06	−0.18	0.46
	(2.78)	(2.11)	(−1.08)	(−0.46)	(−2.68)	(3.57)	(2.51)	(1.60)	(−0.55)	(−0.63)	(−1.82)	(3.04)
IVOL3	0.17	0.11	0.13	0.03	−0.32	0.49	0.09	0.04	0.09	0.05	−0.29	0.38
	(1.41)	(0.98)	(1.33)	(0.21)	(−2.80)	(2.67)	(0.68)	(0.32)	(0.84)	(0.38)	(−2.29)	(1.90)
IVOL4	0.01	−0.16	−0.09	−0.06	−0.12	0.13	−0.08	−0.15	−0.04	−0.06	−0.11	0.03
	(0.04)	(−1.30)	(−0.78)	(−0.47)	(−1.00)	(0.54)	(−0.40)	(−1.07)	(−0.29)	(−0.41)	(−0.86)	(0.12)
IVOL5	−0.58	−0.60	−0.63	−0.51	−0.40	−0.18	−0.73	−0.63	−0.71	−0.48	−0.30	−0.43
	(−3.14)	(−3.78)	(−3.96)	(−3.81)	(−2.47)	(−0.75)	(−3.39)	(−3.33)	(−3.75)	(−3.29)	(−1.70)	(−1.52)
All stocks	0.25	0.15	0.07	0.01	−0.22	0.47	0.25	0.15	0.07	0.06	−0.20	0.46
	(3.70)	(2.72)	(1.49)	(0.24)	(−3.56)	(4.07)	(3.22)	(2.40)	(1.24)	(0.95)	(−2.69)	(3.38)

Table A13 Alphas of portfolios sorted by IVOL and $\mathrm{PE}_{\mathbf{CAPM}}$

This table reports alphas of 25 value-weighted portfolios sequentially sorted by IVOL and $\mathrm{PE}_{\mathrm{CAPM}}$ (Newey-West t-values in parentheses), where IVOL is estimated as Ang, Hodrick, Xing, and Zhang (2006).

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.37	0.23	0.18	0.13	−0.08	0.45	0.41	0.23	0.17	0.14	−0.10	0.51
	(5.17)	(3.15)	(2.35)	(1.94)	(−1.06)	(4.34)	(5.82)	(3.51)	(2.50)	(2.26)	(−1.36)	(4.73)
IVOL2	0.36	0.18	−0.04	0.03	−0.25	0.61	0.34	0.18	−0.06	−0.00	−0.28	0.62
	(4.39)	(2.80)	(−0.56)	(0.41)	(−3.50)	(5.44)	(4.24)	(2.52)	(−0.92)	(−0.06)	(−3.96)	(5.38)
IVOL3	0.37	0.08	0.09	−0.00	−0.43	0.80	0.34	0.05	0.03	−0.05	−0.48	0.81
	(4.03)	(0.89)	(1.14)	(−0.03)	(−5.24)	(6.40)	(3.84)	(0.64)	(0.38)	(−0.66)	(−5.98)	(6.47)
IVOL4	0.16	−0.02	−0.09	−0.14	−0.39	0.55	0.11	−0.09	−0.13	−0.20	−0.46	0.57
	(1.42)	(−0.20)	(−0.84)	(−1.37)	(−3.76)	(3.29)	(1.00)	(−1.00)	(−1.43)	(−2.18)	(−4.39)	(3.30)
IVOL5	−0.07	−0.18	−0.32	−0.52	−0.77	0.70	−0.20	−0.30	−0.42	−0.62	−0.88	0.68
	(−0.39)	(−1.07)	(−2.15)	(−4.02)	(−4.75)	(3.01)	(−1.34)	(−2.32)	(−3.13)	(−5.50)	(−5.61)	(2.90)
All stocks	0.27	0.12	0.08	0.02	−0.22	0.49	0.29	0.14	0.08	0.02	−0.24	0.54
	(5.31)	(2.97)	(2.00)	(0.49)	(−4.32)	(5.88)	(5.40)	(3.23)	(1.93)	(0.50)	(−4.76)	(5.86)
	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.36	0.14	0.05	0.03	−0.36	0.73	0.36	0.16	0.01	−0.00	−0.39	0.75
	(4.77)	(1.88)	(0.52)	(0.33)	(−4.86)	(6.62)	(4.42)	(1.70)	(0.09)	(−0.02)	(−4.18)	(6.36)
IVOL2	0.22	0.06	−0.23	−0.19	−0.30	0.52	0.21	0.04	−0.34	−0.18	−0.31	0.52
	(2.30)	(0.71)	(−2.63)	(−2.18)	(−3.47)	(3.67)	(1.87)	(0.34)	(−3.37)	(−1.88)	(−3.22)	(3.33)
IVOL3	0.12	0.13	0.07	−0.03	−0.40	0.52	0.20	0.19	−0.02	−0.00	−0.42	0.63
	(1.03)	(1.36)	(0.71)	(−0.34)	(−3.50)	(2.81)	(1.38)	(1.75)	(−0.22)	(−0.02)	(−3.52)	(2.92)
IVOL4	0.05	−0.01	−0.01	0.08	−0.12	0.17	0.24	−0.00	0.00	0.08	−0.13	0.37
	(0.29)	(−0.06)	(−0.05)	(0.78)	(−1.00)	(0.76)	(1.18)	(−0.03)	(0.01)	(0.71)	(−0.97)	(1.30)
IVOL5	−0.41	−0.30	−0.43	−0.27	−0.18	−0.22	−0.32	−0.22	−0.38	−0.08	−0.13	−0.20
	(−2.19)	(−1.83)	(−3.08)	(−2.03)	(−1.19)	(−0.86)	(−1.58)	(−1.26)	(−2.27)	(−0.54)	(−0.73)	(−0.64)
All stocks	0.22	0.12	0.02	−0.00	−0.28	0.49	0.28	0.14	−0.03	−0.01	−0.29	0.57
	(3.30)	(2.35)	(0.33)	(−0.06)	(−4.26)	(4.18)	(3.46)	(2.20)	(−0.45)	(−0.15)	(−3.85)	(4.04)
	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IVOL1	0.35	0.13	−0.01	−0.06	−0.41	0.76	0.42	0.14	−0.10	−0.10	−0.52	0.94
	(4.06)	(1.49)	(−0.13)	(−0.73)	(−5.06)	(6.15)	(3.88)	(1.61)	(−0.89)	(−1.07)	(−5.64)	(6.32)
IVOL2	0.33	0.09	−0.26	−0.21	−0.35	0.69	0.44	0.13	−0.21	−0.12	−0.47	0.91
	(2.90)	(0.78)	(−2.28)	(−2.02)	(−4.08)	(4.72)	(3.57)	(1.07)	(−2.09)	(−1.23)	(−4.64)	(5.40)
IVOL3	0.34	0.23	0.12	−0.02	−0.44	0.78	0.49	0.34	0.18	0.01	−0.52	1.01
	(2.84)	(2.07)	(1.10)	(−0.21)	(−3.60)	(4.06)	(3.29)	(2.83)	(1.50)	(0.11)	(−3.76)	(4.38)
IVOL4	0.29	0.09	0.08	0.14	−0.18	0.46	0.47	0.30	0.33	0.25	−0.17	0.64
	(1.69)	(0.71)	(0.65)	(1.29)	(−1.37)	(1.97)	(2.26)	(2.09)	(2.11)	(1.62)	(−1.23)	(2.40)
IVOL5	−0.03	−0.11	−0.38	−0.09	−0.25	0.22	0.19	0.28	−0.00	0.24	−0.08	0.27
	(−0.19)	(−0.68)	(−2.31)	(−0.60)	(−1.57)	(0.94)	(0.96)	(1.35)	(−0.01)	(1.24)	(−0.42)	(1.07)
All stocks	0.32	0.17	0.01	−0.04	−0.35	0.67	0.43	0.20	−0.01	−0.04	−0.46	0.89
	(4.49)	(2.87)	(0.15)	(−0.68)	(−5.41)	(5.45)	(4.72)	(3.17)	(−0.19)	(−0.65)	(−5.88)	(5.84)

Table A14 Mean-variance spanning tests

This table reports the Huberman and Kandel (1987) mean-variance spanning test statistics and the associated p-values of PE spread portfolios, where PE_{CAPM} refers to the spread portfolio based on the CAPM's PE, and PE_{FF3} to the spread portfolio based on the FF3's PE, etc. The null hypothesis is that the PE spread portfolios are spanned by risk factors by using the Wald test under conditional homoscedasticity.

Benchmark assets	PE_{CAPM}	PE_{FF3}	PE_{FF5}	PE_{HXZ}	PE_{SY}	PE_{DHS}
CAPM	1538.76	1492.17	469.14	427.46	511.63	349.59
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FF3	519.84	504.37	64.02	57.47	66.58	40.45
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FF5	32.05	32.05	30.99	25.45	31.25	23.14
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HXZ	45.03	45.03	44.78	42.97	45.54	35.06
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SY	107.46	107.46	86.80	83.22	90.33	69.28
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DHS	177.84	173.18	168.82	174.84	162.17	149.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table A15 FF3 alphas of portfolios sorted by IO and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by institutional ownership (IO) and PE, where IO is calculated as Nagel (2005). The sample period is 1980:03–2015:12.

	Panel A: Sort on IO and PE_{CAPM}						Panel B: Sort on IO and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.24	−0.21	0.23	0.01	−0.17	0.42	0.24	−0.14	0.24	0.04	−0.18	0.42
	(1.19)	(−1.20)	(1.70)	(0.07)	(−1.05)	(1.60)	(1.19)	(−0.81)	(1.76)	(0.26)	(−1.05)	(1.61)
IO2	0.41	0.08	0.28	0.15	−0.30	0.71	0.40	0.03	0.25	0.15	−0.29	0.69
	(2.06)	(0.56)	(2.35)	(1.06)	(−2.19)	(2.91)	(2.04)	(0.20)	(2.12)	(1.08)	(−2.10)	(2.84)
IO3	0.32	0.17	0.11	0.24	−0.25	0.58	0.35	0.09	0.10	0.22	−0.22	0.57
	(2.48)	(1.55)	(1.09)	(2.08)	(−2.09)	(2.89)	(2.57)	(0.80)	(1.04)	(1.97)	(−1.75)	(2.80)
IO4	0.20	0.16	0.12	0.14	−0.22	0.42	0.17	0.19	0.09	0.14	−0.19	0.36
	(1.64)	(1.54)	(1.11)	(1.55)	(−2.04)	(2.36)	(1.39)	(1.77)	(0.86)	(1.64)	(−1.74)	(2.00)
IO5	−0.04	0.05	−0.04	−0.04	−0.20	0.15	−0.05	0.08	−0.07	−0.03	−0.20	0.14
	(−0.28)	(0.44)	(−0.37)	(−0.43)	(−1.58)	(0.68)	(−0.34)	(0.72)	(−0.61)	(−0.39)	(−1.59)	(0.64)
All stocks	0.26	0.11	0.09	0.12	−0.25	0.51	0.24	0.12	0.08	0.11	−0.23	0.47
	(2.67)	(1.72)	(1.37)	(1.72)	(−2.80)	(3.13)	(2.44)	(1.84)	(1.35)	(1.58)	(−2.58)	(2.85)
	Panel C: Sort on IO and PE_{FF5}						Panel D: Sort on IO and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.24	−0.12	0.25	−0.04	−0.15	0.39	0.27	−0.20	0.27	0.03	−0.18	0.45
	(1.17)	(−0.73)	(1.75)	(−0.31)	(−0.89)	(1.49)	(1.28)	(−1.15)	(1.93)	(0.24)	(−1.09)	(1.69)
IO2	0.38	0.08	0.25	0.15	−0.30	0.69	0.44	0.03	0.24	0.16	−0.31	0.75
	(2.04)	(0.56)	(2.05)	(1.03)	(−2.20)	(2.92)	(2.19)	(0.23)	(2.09)	(1.11)	(−2.21)	(3.09)
IO3	0.31	0.15	0.10	0.18	−0.19	0.50	0.31	0.12	0.15	0.23	−0.24	0.55
	(2.30)	(1.43)	(0.95)	(1.66)	(−1.51)	(2.46)	(2.34)	(1.17)	(1.36)	(1.96)	(−1.86)	(2.63)
IO4	0.16	0.19	0.08	0.17	−0.21	0.37	0.17	0.20	0.10	0.16	−0.21	0.38
	(1.33)	(1.82)	(0.77)	(1.93)	(−1.94)	(2.08)	(1.43)	(1.92)	(0.92)	(1.79)	(−1.93)	(2.17)
IO5	−0.04	0.05	−0.06	−0.01	−0.21	0.17	−0.07	0.08	−0.05	−0.02	−0.20	0.13
	(−0.29)	(0.46)	(−0.59)	(−0.16)	(−1.70)	(0.74)	(−0.47)	(0.74)	(−0.50)	(−0.26)	(−1.64)	(0.57)
All stocks	0.24	0.13	0.07	0.12	−0.23	0.47	0.25	0.12	0.07	0.12	−0.26	0.51
	(2.44)	(1.93)	(1.08)	(1.67)	(−2.63)	(2.87)	(2.50)	(1.83)	(1.23)	(1.76)	(−2.95)	(3.10)
	Panel E: Sort on IO and PE_{SY}						Panel F: Sort on IO and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.23	−0.10	0.28	0.01	−0.18	0.41	0.25	−0.19	0.26	0.01	−0.16	0.42
	(1.11)	(−0.55)	(2.01)	(0.06)	(−1.06)	(1.57)	(1.23)	(−1.12)	(1.96)	(0.07)	(−0.98)	(1.60)
IO2	0.43	0.04	0.28	0.11	−0.26	0.69	0.41	0.05	0.22	0.15	−0.31	0.72
	(2.17)	(0.28)	(2.43)	(0.76)	(−1.95)	(2.87)	(2.08)	(0.36)	(1.89)	(1.03)	(−2.27)	(3.05)
IO3	0.36	0.10	0.12	0.21	−0.21	0.57	0.32	0.16	0.15	0.20	−0.24	0.56
	(2.59)	(0.96)	(1.14)	(1.97)	(−1.69)	(2.72)	(2.39)	(1.47)	(1.36)	(1.84)	(−1.95)	(2.78)
IO4	0.19	0.17	0.11	0.15	−0.22	0.41	0.19	0.15	0.11	0.16	−0.21	0.40
	(1.58)	(1.62)	(1.03)	(1.75)	(−2.01)	(2.29)	(1.59)	(1.45)	(1.04)	(1.79)	(−2.02)	(2.31)
IO5	−0.10	0.09	−0.06	−0.01	−0.21	0.11	−0.07	0.07	−0.03	−0.03	−0.21	0.15
	(−0.60)	(0.82)	(−0.57)	(−0.07)	(−1.66)	(0.48)	(−0.42)	(0.59)	(−0.27)	(−0.32)	(−1.74)	(0.65)
All stocks	0.25	0.12	0.08	0.11	−0.24	0.49	0.25	0.11	0.09	0.12	−0.25	0.50
	(2.49)	(1.88)	(1.39)	(1.54)	(−2.71)	(2.95)	(2.59)	(1.75)	(1.50)	(1.73)	(−2.86)	(3.12)

Table A16 Alphas of portfolios sorted by IO and $\mathrm{PE}_{\mathrm{CAPM}}$

This table reports alphas of 25 value-weighted portfolios sequentially sorted by institutional ownership (IO) and $\mathrm{PE}_{\mathrm{CAPM}}$ (Newey-West t-values in parentheses), where IO is calculated as Nagel (2005) and $\mathrm{PE}_{\mathrm{CAPM}}$ is the CAPM's estimated with the past 60-month returns with a requirement of at least 50 observations.

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.33	−0.13	0.34	0.09	−0.10	0.43	0.24	−0.21	0.23	0.01	−0.17	0.42
	(1.59)	(−0.70)	(2.21)	(0.55)	(−0.60)	(1.80)	(1.19)	(−1.20)	(1.70)	(0.07)	(−1.05)	(1.60)
IO2	0.54	0.13	0.34	0.23	−0.24	0.78	0.41	0.08	0.28	0.15	−0.30	0.71
	(2.43)	(0.92)	(2.86)	(1.60)	(−1.79)	(3.20)	(2.06)	(0.56)	(2.35)	(1.06)	(−2.19)	(2.91)
IO3	0.38	0.16	0.17	0.26	−0.19	0.57	0.32	0.17	0.11	0.24	−0.25	0.58
	(2.82)	(1.38)	(1.56)	(2.30)	(−1.61)	(2.94)	(2.48)	(1.55)	(1.09)	(2.08)	(−2.09)	(2.89)
IO4	0.25	0.21	0.19	0.18	−0.18	0.44	0.20	0.16	0.12	0.14	−0.22	0.42
	(1.89)	(2.04)	(1.84)	(1.86)	(−1.62)	(2.51)	(1.64)	(1.54)	(1.11)	(1.55)	(−2.04)	(2.36)
IO5	0.04	0.11	0.01	0.02	−0.18	0.22	−0.04	0.05	−0.04	−0.04	−0.20	0.15
	(0.26)	(1.03)	(0.07)	(0.17)	(−1.54)	(1.08)	(−0.28)	(0.44)	(−0.37)	(−0.43)	(−1.58)	(0.68)
All stocks	0.30	0.13	0.12	0.13	−0.22	0.52	0.26	0.11	0.09	0.12	−0.25	0.51
	(2.90)	(1.98)	(1.99)	(1.93)	(−2.56)	(3.35)	(2.67)	(1.72)	(1.37)	(1.72)	(−2.80)	(3.13)

	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.14	−0.14	0.15	−0.04	−0.08	0.22	0.27	−0.12	0.14	−0.12	−0.22	0.49
	(0.70)	(−0.77)	(1.06)	(−0.23)	(−0.47)	(0.78)	(1.22)	(−0.58)	(0.86)	(−0.80)	(−1.22)	(1.54)
IO2	0.32	0.08	0.20	0.11	−0.35	0.67	0.38	0.10	0.19	0.10	−0.35	0.73
	(1.68)	(0.61)	(1.54)	(0.64)	(−2.30)	(2.50)	(1.54)	(0.67)	(1.34)	(0.52)	(−2.33)	(2.33)
IO3	0.35	0.21	0.02	0.20	−0.21	0.57	0.50	0.24	0.01	0.19	−0.16	0.66
	(2.56)	(1.83)	(0.16)	(1.64)	(−1.65)	(2.66)	(3.27)	(1.91)	(0.11)	(1.64)	(−1.12)	(2.76)
IO4	0.15	0.05	0.03	0.07	−0.31	0.46	0.25	0.09	−0.01	0.09	−0.32	0.56
	(1.11)	(0.43)	(0.25)	(0.73)	(−2.90)	(2.36)	(1.65)	(0.72)	(−0.08)	(0.86)	(−2.90)	(2.68)
IO5	−0.14	−0.04	−0.09	−0.06	−0.19	0.06	−0.06	−0.07	−0.11	−0.09	−0.22	0.17
	(−0.79)	(−0.32)	(−0.81)	(−0.56)	(−1.13)	(0.20)	(−0.30)	(−0.52)	(−0.96)	(−0.83)	(−1.32)	(0.53)
All stocks	0.22	0.06	0.01	0.05	−0.29	0.51	0.30	0.07	−0.03	0.04	−0.29	0.59
	(2.02)	(0.91)	(0.18)	(0.74)	(−2.79)	(2.65)	(2.23)	(0.86)	(−0.37)	(0.47)	(−2.74)	(2.72)

	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
IO1	0.30	−0.18	0.16	−0.24	−0.41	0.70	0.51	0.04	0.35	0.01	−0.19	0.70
	(1.46)	(−0.90)	(1.05)	(−1.61)	(−2.32)	(2.77)	(2.44)	(0.19)	(1.94)	(0.03)	(−1.10)	(2.57)
IO2	0.46	0.05	0.07	−0.15	−0.51	0.97	0.67	0.15	0.20	−0.02	−0.49	1.15
	(2.38)	(0.33)	(0.52)	(−1.03)	(−3.05)	(3.50)	(2.45)	(0.98)	(1.31)	(−0.13)	(−3.64)	(3.50)
IO3	0.51	0.25	0.10	0.17	−0.23	0.74	0.62	0.24	0.00	0.13	−0.44	1.06
	(3.56)	(1.97)	(0.76)	(1.50)	(−1.75)	(3.20)	(3.77)	(1.96)	(0.04)	(1.08)	(−3.19)	(4.19)
IO4	0.40	0.09	0.04	0.08	−0.32	0.72	0.47	0.24	0.05	0.05	−0.47	0.95
	(2.86)	(0.61)	(0.31)	(0.79)	(−2.99)	(3.80)	(3.52)	(1.95)	(0.46)	(0.57)	(−4.11)	(5.37)
IO5	0.09	0.01	−0.07	−0.12	−0.38	0.47	0.30	0.14	0.06	−0.00	−0.31	0.60
	(0.63)	(0.06)	(−0.61)	(−1.10)	(−2.75)	(2.17)	(1.91)	(1.21)	(0.62)	(−0.04)	(−1.91)	(2.44)
All stocks	0.39	0.10	0.00	−0.01	−0.36	0.75	0.48	0.15	0.01	−0.02	−0.49	0.97
	(3.55)	(1.14)	(0.04)	(−0.11)	(−3.69)	(4.07)	(3.95)	(1.95)	(0.20)	(−0.26)	(−4.90)	(4.91)

Table A17 FF3 alphas of portfolios sorted by MAX and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by MAX and PE, where MAX measures the lottery demand and is defined as the average of the 5 highest daily returns in the portfolio formation month (Bali, Cakici, and Whitelaw, 2011).

	Panel A: Sort on MAX and PE_{CAPM}						Panel B: Sort on MAX and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.60	0.25	0.20	0.19	−0.09	0.69	0.60	0.24	0.21	0.17	−0.09	0.69
	(7.27)	(3.82)	(2.39)	(2.70)	(−1.16)	(6.67)	(7.05)	(3.52)	(2.63)	(2.35)	(−1.15)	(6.48)
MAX2	0.29	0.21	0.11	0.21	−0.17	0.46	0.29	0.20	0.11	0.21	−0.19	0.48
	(3.82)	(2.75)	(1.49)	(3.15)	(−2.59)	(4.09)	(3.78)	(2.81)	(1.50)	(3.26)	(−2.77)	(4.26)
MAX3	0.30	0.05	0.05	−0.07	−0.25	0.55	0.31	0.04	0.06	−0.07	−0.24	0.55
	(3.31)	(0.56)	(0.53)	(−0.86)	(−3.27)	(4.55)	(3.45)	(0.50)	(0.67)	(−0.90)	(−3.19)	(4.65)
MAX4	0.05	−0.03	−0.09	−0.15	−0.41	0.46	0.06	−0.07	−0.06	−0.16	−0.40	0.46
	(0.40)	(−0.28)	(−0.96)	(−1.54)	(−4.38)	(2.83)	(0.53)	(−0.75)	(−0.61)	(−1.71)	(−4.31)	(2.87)
MAX5	−0.32	−0.41	−0.20	−0.42	−0.90	0.58	−0.33	−0.39	−0.16	−0.43	−0.88	0.56
	(−2.13)	(−3.33)	(−1.76)	(−3.80)	(−6.14)	(2.57)	(−2.20)	(−3.23)	(−1.37)	(−3.96)	(−5.98)	(2.47)
All stocks	0.29	0.10	0.09	0.10	−0.23	0.53	0.30	0.09	0.12	0.09	−0.23	0.52
	(4.84)	(2.50)	(2.15)	(2.65)	(−4.53)	(5.34)	(4.99)	(2.21)	(2.79)	(2.30)	(−4.53)	(5.41)
	Panel C: Sort on MAX and PE_{FF5}						Panel D: Sort on MAX and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.52	0.18	0.17	0.01	−0.24	0.76	0.51	0.19	0.14	0.02	−0.23	0.74
	(5.43)	(2.05)	(1.52)	(0.11)	(−2.55)	(5.79)	(5.13)	(2.24)	(1.20)	(0.25)	(−2.30)	(5.47)
MAX2	0.28	0.33	0.15	0.11	−0.25	0.54	0.24	0.32	0.14	0.11	−0.26	0.50
	(2.62)	(3.89)	(1.56)	(1.42)	(−3.26)	(3.52)	(2.19)	(3.79)	(1.45)	(1.34)	(−3.26)	(3.23)
MAX3	0.31	0.05	0.08	−0.04	−0.15	0.45	0.30	0.05	0.09	−0.02	−0.12	0.42
	(2.50)	(0.44)	(0.81)	(−0.37)	(−1.61)	(2.79)	(2.31)	(0.50)	(0.90)	(−0.17)	(−1.30)	(2.51)
MAX4	0.03	0.07	−0.01	0.07	−0.25	0.29	0.02	0.00	−0.00	0.11	−0.20	0.21
	(0.20)	(0.51)	(−0.05)	(0.56)	(−2.17)	(1.31)	(0.10)	(0.00)	(−0.01)	(0.86)	(−1.67)	(0.96)
MAX5	−0.59	−0.55	−0.09	−0.30	−0.35	−0.24	−0.62	−0.46	−0.05	−0.21	−0.34	−0.28
	(−2.88)	(−3.82)	(−0.65)	(−2.41)	(−2.49)	(−0.91)	(−2.83)	(−2.66)	(−0.34)	(−1.63)	(−2.52)	(−1.08)
All stocks	0.26	0.12	0.12	0.06	−0.23	0.49	0.23	0.13	0.11	0.07	−0.21	0.45
	(3.26)	(2.71)	(2.29)	(1.10)	(−3.61)	(3.78)	(2.84)	(2.83)	(1.96)	(1.20)	(−3.31)	(3.41)
	Panel E: Sort on MAX and PE_{SY}						Panel F: Sort on MAX and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.51	0.19	0.20	0.00	−0.24	0.74	0.53	0.30	0.24	0.06	−0.13	0.66
	(5.27)	(2.08)	(1.84)	(0.02)	(−2.49)	(5.60)	(5.00)	(3.46)	(1.98)	(0.63)	(−1.26)	(4.62)
MAX2	0.29	0.35	0.10	0.08	−0.26	0.56	0.23	0.32	0.24	0.13	−0.18	0.41
	(2.66)	(4.16)	(1.17)	(0.98)	(−3.51)	(3.73)	(2.00)	(3.31)	(2.31)	(1.39)	(−2.05)	(2.52)
MAX3	0.32	−0.00	0.09	−0.02	−0.13	0.45	0.31	0.04	0.09	0.01	−0.16	0.48
	(2.60)	(−0.03)	(0.88)	(−0.24)	(−1.48)	(2.81)	(2.24)	(0.33)	(0.80)	(0.07)	(−1.56)	(2.64)
MAX4	0.07	0.03	−0.04	0.05	−0.25	0.32	−0.05	−0.04	−0.05	0.06	−0.22	0.17
	(0.42)	(0.22)	(−0.31)	(0.44)	(−2.22)	(1.53)	(−0.24)	(−0.27)	(−0.39)	(0.45)	(−1.68)	(0.67)
MAX5	−0.57	−0.52	−0.06	−0.26	−0.41	−0.17	−0.77	−0.57	−0.01	−0.19	−0.35	−0.43
	(−2.80)	(−3.07)	(−0.43)	(−2.04)	(−2.97)	(−0.67)	(−3.15)	(−2.95)	(−0.08)	(−1.35)	(−2.39)	(−1.45)
All stocks	0.27	0.12	0.12	0.05	−0.22	0.49	0.21	0.14	0.17	0.06	−0.19	0.41
	(3.35)	(2.62)	(2.37)	(0.89)	(−3.67)	(3.88)	(2.39)	(2.45)	(2.88)	(0.92)	(−2.54)	(2.79)

Table A18 Alphas of portfolios sorted by MAX and PE_{CAPM}

This table reports alphas of 25 value-weighted portfolios sequentially sorted by MAX and PE_{CAPM} (Newey-West t-values in parentheses), where MAX measures the lottery demand and is defined as the average of the 5 highest daily returns in the portfolio formation month (Bali, Cakici, and Whitelaw, 2011).

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.57	0.25	0.20	0.19	−0.08	0.64	0.60	0.25	0.20	0.19	−0.09	0.69
	(7.49)	(3.82)	(2.25)	(2.64)	(−0.93)	(6.54)	(7.27)	(3.82)	(2.39)	(2.70)	(−1.16)	(6.67)
MAX2	0.30	0.20	0.14	0.20	−0.15	0.45	0.29	0.21	0.11	0.21	−0.17	0.46
	(3.92)	(2.55)	(1.86)	(3.04)	(−2.17)	(4.02)	(3.82)	(2.75)	(1.49)	(3.15)	(−2.59)	(4.09)
MAX3	0.32	0.08	0.11	−0.02	−0.21	0.53	0.30	0.05	0.05	−0.07	−0.25	0.55
	(3.51)	(0.97)	(1.25)	(−0.27)	(−2.75)	(4.65)	(3.31)	(0.56)	(0.53)	(−0.86)	(−3.27)	(4.55)
MAX4	0.12	0.02	−0.01	−0.08	−0.38	0.50	0.05	−0.03	−0.09	−0.15	−0.41	0.46
	(1.01)	(0.24)	(−0.06)	(−0.89)	(−4.07)	(3.16)	(0.40)	(−0.28)	(−0.96)	(−1.54)	(−4.38)	(2.83)
MAX5	−0.22	−0.30	−0.17	−0.33	−0.79	0.57	−0.32	−0.41	−0.20	−0.42	−0.90	0.58
	(−1.34)	(−1.98)	(−1.28)	(−2.85)	(−5.36)	(2.44)	(−2.13)	(−3.33)	(−1.76)	(−3.80)	(−6.14)	(2.57)
All stocks	0.28	0.10	0.10	0.10	−0.21	0.49	0.29	0.10	0.09	0.10	−0.23	0.53
	(4.97)	(2.51)	(2.18)	(2.55)	(−4.11)	(5.39)	(4.84)	(2.50)	(2.15)	(2.65)	(−4.53)	(5.34)

	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.35	0.09	−0.05	−0.05	−0.36	0.71	0.35	0.10	−0.04	−0.12	−0.36	0.71
	(4.03)	(1.07)	(−0.50)	(−0.55)	(−4.38)	(6.03)	(3.55)	(0.89)	(−0.29)	(−1.00)	(−3.39)	(5.52)
MAX2	0.19	0.24	−0.05	−0.03	−0.38	0.57	0.23	0.23	−0.07	−0.07	−0.38	0.61
	(1.95)	(2.71)	(−0.55)	(−0.31)	(−5.00)	(4.12)	(2.04)	(2.26)	(−0.60)	(−0.68)	(−4.56)	(3.95)
MAX3	0.35	−0.00	−0.00	−0.09	−0.23	0.58	0.52	0.01	−0.09	−0.08	−0.26	0.78
	(2.71)	(−0.01)	(−0.02)	(−1.00)	(−2.58)	(3.26)	(3.12)	(0.11)	(−0.92)	(−0.77)	(−2.67)	(3.60)
MAX4	0.13	0.17	−0.01	0.11	−0.27	0.40	0.25	0.18	−0.06	0.09	−0.30	0.55
	(0.74)	(1.41)	(−0.10)	(1.05)	(−2.28)	(1.87)	(1.22)	(1.36)	(−0.53)	(0.73)	(−2.30)	(2.24)
MAX5	−0.36	−0.34	0.18	−0.05	−0.29	−0.06	−0.24	−0.29	0.23	0.06	−0.25	0.02
	(−1.82)	(−2.31)	(1.44)	(−0.47)	(−2.14)	(−0.25)	(−1.16)	(−1.84)	(1.58)	(0.51)	(−1.59)	(0.05)
All stocks	0.23	0.13	0.01	0.05	−0.30	0.53	0.31	0.14	−0.01	0.04	−0.32	0.63
	(2.82)	(2.58)	(0.25)	(0.95)	(−4.84)	(4.06)	(3.37)	(2.22)	(−0.23)	(0.52)	(−4.35)	(4.21)

	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
MAX1	0.44	0.10	−0.07	−0.14	−0.46	0.90	0.57	0.08	−0.03	−0.23	−0.51	1.08
	(4.43)	(1.02)	(−0.57)	(−1.23)	(−5.12)	(6.90)	(5.77)	(0.74)	(−0.20)	(−2.21)	(−5.30)	(7.84)
MAX2	0.28	0.24	−0.04	−0.08	−0.44	0.72	0.41	0.30	0.06	−0.07	−0.51	0.92
	(2.32)	(2.15)	(−0.30)	(−0.80)	(−5.49)	(4.93)	(3.09)	(2.52)	(0.56)	(−0.73)	(−5.65)	(5.37)
MAX3	0.57	0.10	0.04	−0.13	−0.33	0.90	0.85	0.23	0.11	−0.07	−0.34	1.19
	(4.73)	(0.89)	(0.36)	(−1.27)	(−3.65)	(5.20)	(4.85)	(1.87)	(0.98)	(−0.62)	(−3.39)	(5.27)
MAX4	0.40	0.27	0.05	0.05	−0.30	0.71	0.56	0.52	0.05	0.02	−0.37	0.93
	(2.51)	(2.07)	(0.37)	(0.49)	(−2.48)	(3.31)	(2.73)	(3.52)	(0.39)	(0.21)	(−2.51)	(3.72)
MAX5	−0.13	−0.14	0.27	0.03	−0.37	0.24	0.02	0.21	0.49	0.19	−0.36	0.37
	(−0.66)	(−0.92)	(1.85)	(0.23)	(−2.41)	(0.90)	(0.07)	(1.08)	(2.84)	(1.13)	(−2.07)	(1.35)
All stocks	0.38	0.18	0.03	−0.02	−0.40	0.77	0.51	0.23	0.06	−0.04	−0.48	1.00
	(4.79)	(3.06)	(0.55)	(−0.33)	(−6.32)	(6.07)	(5.35)	(3.32)	(1.02)	(−0.60)	(−6.53)	(6.57)

Table A19 FF3 alphas of portfolios sorted by prospect theory value and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by TK and PE, where TK is prospect theory value and defined as Barberis, Mukherjee, and Wang (2016).

	Panel A: Sort on TK and PE_{CAPM}						Panel B: Sort on TK and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	0.05	0.18	0.04	−0.26	−0.63	0.68	0.05	0.18	0.05	−0.30	−0.60	0.65
	(0.34)	(1.55)	(0.37)	(−1.98)	(−5.42)	(3.54)	(0.33)	(1.52)	(0.40)	(−2.29)	(−5.06)	(3.37)
TK2	0.42	0.06	0.07	−0.11	−0.45	0.87	0.44	0.02	0.06	−0.10	−0.47	0.91
	(3.49)	(0.66)	(0.75)	(−1.08)	(−5.20)	(5.67)	(3.55)	(0.22)	(0.63)	(−0.94)	(−5.40)	(5.80)
TK3	0.30	0.10	0.08	−0.04	−0.43	0.73	0.30	0.12	0.04	−0.01	−0.43	0.72
	(3.26)	(1.30)	(1.17)	(−0.50)	(−5.06)	(5.35)	(3.24)	(1.63)	(0.53)	(−0.18)	(−5.10)	(5.39)
TK4	0.34	0.00	0.11	0.02	−0.27	0.61	0.33	0.06	0.10	0.00	−0.25	0.58
	(4.09)	(0.02)	(1.57)	(0.27)	(−3.55)	(5.26)	(4.10)	(0.92)	(1.47)	(0.03)	(−3.25)	(4.97)
TK5	0.28	0.20	0.12	−0.03	−0.21	0.50	0.28	0.16	0.13	−0.03	−0.18	0.46
	(3.34)	(2.41)	(1.34)	(−0.38)	(−2.54)	(4.18)	(3.24)	(1.98)	(1.49)	(−0.36)	(−2.19)	(3.94)
All stocks	0.29	0.11	0.14	−0.01	−0.27	0.57	0.30	0.12	0.12	−0.01	−0.27	0.56
	(4.98)	(2.56)	(3.21)	(−0.33)	(−5.08)	(5.80)	(5.16)	(2.72)	(2.79)	(−0.20)	(−4.87)	(5.83)

	Panel C: Sort on TK and PE_{FF5}						Panel D: Sort on TK and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	−0.35	0.25	−0.12	−0.07	−0.49	0.14	−0.39	0.17	−0.06	−0.11	−0.52	0.12
	(−1.60)	(1.67)	(−0.79)	(−0.45)	(−3.60)	(0.57)	(−1.74)	(1.08)	(−0.41)	(−0.65)	(−3.75)	(0.47)
TK2	0.26	0.15	0.09	−0.02	−0.37	0.63	0.21	0.09	0.09	−0.03	−0.34	0.55
	(1.55)	(1.09)	(0.76)	(−0.16)	(−3.34)	(2.85)	(1.18)	(0.65)	(0.72)	(−0.22)	(−3.09)	(2.50)
TK3	0.29	0.24	0.09	−0.05	−0.36	0.65	0.29	0.16	0.13	−0.00	−0.33	0.62
	(2.43)	(2.74)	(1.05)	(−0.52)	(−3.70)	(3.65)	(2.40)	(1.79)	(1.58)	(−0.05)	(−3.24)	(3.42)
TK4	0.26	0.03	0.08	0.03	−0.26	0.52	0.23	0.06	0.08	0.09	−0.23	0.46
	(2.30)	(0.30)	(0.88)	(0.34)	(−2.63)	(3.13)	(1.93)	(0.60)	(0.83)	(0.93)	(−2.27)	(2.73)
TK5	0.40	0.19	0.13	−0.06	−0.08	0.48	0.37	0.18	0.14	−0.01	−0.10	0.47
	(4.15)	(2.17)	(1.38)	(−0.72)	(−0.91)	(3.72)	(4.02)	(2.13)	(1.42)	(−0.16)	(−1.22)	(3.70)
All stocks	0.27	0.14	0.07	−0.01	−0.22	0.49	0.25	0.12	0.09	0.01	−0.21	0.46
	(3.42)	(2.86)	(1.41)	(−0.25)	(−3.44)	(3.88)	(3.02)	(2.34)	(1.66)	(0.11)	(−3.08)	(3.48)

	Panel E: Sort on TK and PE_{SY}						Panel F: Sort on TK and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	−0.32	0.21	−0.11	−0.08	−0.51	0.18	−0.51	0.22	−0.05	−0.01	−0.42	−0.09
	(−1.50)	(1.44)	(−0.71)	(−0.50)	(−3.77)	(0.72)	(−1.96)	(1.27)	(−0.27)	(−0.06)	(−2.68)	(−0.30)
TK2	0.25	0.14	0.07	−0.08	−0.35	0.60	0.09	0.13	0.08	0.07	−0.25	0.34
	(1.50)	(1.06)	(0.58)	(−0.67)	(−3.16)	(2.78)	(0.47)	(0.95)	(0.54)	(0.48)	(−2.04)	(1.44)
TK3	0.29	0.19	0.09	−0.04	−0.36	0.65	0.26	0.26	0.17	0.04	−0.31	0.57
	(2.48)	(2.05)	(1.10)	(−0.40)	(−3.65)	(3.66)	(2.09)	(2.55)	(1.83)	(0.36)	(−2.84)	(2.94)
TK4	0.26	0.06	0.07	0.05	−0.29	0.55	0.25	0.06	0.17	0.16	−0.23	0.48
	(2.28)	(0.65)	(0.80)	(0.61)	(−2.96)	(3.41)	(2.01)	(0.60)	(1.54)	(1.60)	(−2.04)	(2.66)
TK5	0.38	0.21	0.18	−0.08	−0.08	0.46	0.36	0.22	0.14	−0.02	−0.12	0.48
	(3.96)	(2.43)	(1.88)	(−0.86)	(−0.95)	(3.65)	(3.68)	(2.10)	(1.51)	(−0.25)	(−1.22)	(3.39)
All stocks	0.26	0.14	0.10	−0.02	−0.22	0.49	0.21	0.17	0.12	0.04	−0.21	0.42
	(3.27)	(2.92)	(1.88)	(−0.32)	(−3.51)	(3.85)	(2.48)	(2.97)	(2.04)	(0.66)	(−2.71)	(2.97)

Table A20 Alphas of portfolios sorted by prospect theory value and PE_{CAPM}

This table reports alphas of 25 value-weighted portfolios sequentially sorted by TK and PE_{CAPM}, where TK is prospect theory value and defined as Barberis, Mukherjee, and Wang (2016).

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	0.22	0.31	0.21	−0.12	−0.48	0.70	0.05	0.18	0.04	−0.26	−0.63	0.68
	(1.27)	(2.39)	(1.63)	(−0.90)	(−3.85)	(3.54)	(0.34)	(1.55)	(0.37)	(−1.98)	(−5.42)	(3.54)
TK2	0.48	0.14	0.15	0.01	−0.39	0.87	0.42	0.06	0.07	−0.11	−0.45	0.87
	(3.95)	(1.53)	(1.54)	(0.06)	(−4.41)	(5.80)	(3.49)	(0.66)	(0.75)	(−1.08)	(−5.20)	(5.67)
TK3	0.31	0.15	0.12	0.02	−0.37	0.68	0.30	0.10	0.08	−0.04	−0.43	0.73
	(3.30)	(1.92)	(1.60)	(0.27)	(−4.56)	(5.37)	(3.26)	(1.30)	(1.17)	(−0.50)	(−5.06)	(5.35)
TK4	0.33	−0.00	0.11	0.01	−0.26	0.59	0.34	0.00	0.11	0.02	−0.27	0.61
	(4.06)	(−0.04)	(1.48)	(0.15)	(−3.36)	(5.14)	(4.09)	(0.02)	(1.57)	(0.27)	(−3.55)	(5.26)
TK5	0.23	0.15	0.07	−0.09	−0.25	0.48	0.28	0.20	0.12	−0.03	−0.21	0.50
	(2.89)	(1.86)	(0.89)	(−0.99)	(−3.04)	(4.39)	(3.34)	(2.41)	(1.34)	(−0.38)	(−2.54)	(4.18)
All stocks	0.28	0.11	0.14	−0.01	−0.26	0.54	0.29	0.11	0.14	−0.01	−0.27	0.57
	(4.98)	(2.41)	(3.26)	(−0.24)	(−5.00)	(5.96)	(4.98)	(2.56)	(3.21)	(−0.33)	(−5.08)	(5.80)

	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	−0.19	0.12	−0.12	−0.08	−0.48	0.29	0.11	0.39	0.09	0.09	−0.32	0.43
	(−0.84)	(0.86)	(−0.84)	(−0.54)	(−3.85)	(1.08)	(0.37)	(2.37)	(0.54)	(0.51)	(−2.05)	(1.23)
TK2	0.29	0.14	0.00	−0.13	−0.32	0.61	0.55	0.30	0.07	0.01	−0.27	0.82
	(1.72)	(1.15)	(0.00)	(−1.04)	(−3.04)	(2.83)	(2.32)	(2.42)	(0.53)	(0.08)	(−2.31)	(2.87)
TK3	0.31	0.07	0.04	−0.20	−0.45	0.75	0.49	0.15	0.09	−0.21	−0.41	0.90
	(2.67)	(0.77)	(0.52)	(−2.01)	(−4.81)	(4.52)	(3.69)	(1.22)	(0.92)	(−1.75)	(−3.75)	(4.82)
TK4	0.22	−0.05	−0.06	−0.09	−0.35	0.57	0.27	−0.11	−0.12	−0.10	−0.42	0.69
	(1.98)	(−0.59)	(−0.66)	(−1.00)	(−3.75)	(3.70)	(1.86)	(−1.23)	(−1.21)	(−1.03)	(−3.84)	(3.67)
TK5	0.26	0.20	0.10	−0.04	−0.14	0.40	0.30	0.10	−0.02	−0.21	−0.25	0.55
	(2.85)	(2.04)	(1.09)	(−0.44)	(−1.51)	(2.93)	(2.69)	(0.96)	(−0.16)	(−2.01)	(−2.42)	(3.38)
All stocks	0.22	0.09	0.05	−0.04	−0.25	0.48	0.33	0.08	0.03	−0.06	−0.28	0.61
	(2.85)	(1.75)	(0.94)	(−0.78)	(−3.95)	(3.74)	(3.34)	(1.18)	(0.59)	(−1.03)	(−3.80)	(3.94)

	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
TK1	0.19	0.33	0.00	−0.02	−0.32	0.52	0.55	0.87	0.43	0.32	−0.01	0.56
	(0.99)	(2.15)	(0.01)	(−0.10)	(−1.82)	(1.73)	(1.83)	(4.29)	(2.09)	(1.59)	(−0.04)	(1.48)
TK2	0.53	0.26	0.09	−0.04	−0.37	0.89	0.81	0.49	0.34	0.17	−0.25	1.06
	(3.16)	(2.07)	(0.65)	(−0.34)	(−3.74)	(4.21)	(3.37)	(3.51)	(2.30)	(1.21)	(−1.97)	(3.89)
TK3	0.51	0.21	0.11	−0.17	−0.45	0.95	0.73	0.49	0.22	−0.02	−0.40	1.12
	(4.18)	(2.01)	(1.15)	(−1.60)	(−4.11)	(5.80)	(4.89)	(4.78)	(1.94)	(−0.18)	(−3.39)	(5.47)
TK4	0.38	−0.01	−0.07	−0.12	−0.39	0.77	0.42	0.03	−0.00	−0.10	−0.48	0.90
	(3.61)	(−0.05)	(−0.72)	(−1.23)	(−4.08)	(4.91)	(2.99)	(0.23)	(−0.02)	(−0.91)	(−3.96)	(4.53)
TK5	0.35	0.17	0.01	−0.11	−0.32	0.67	0.48	0.08	−0.19	−0.30	−0.56	1.03
	(3.48)	(1.67)	(0.06)	(−1.19)	(−4.08)	(4.92)	(4.57)	(0.66)	(−1.82)	(−2.70)	(−5.46)	(6.94)
All stocks	0.37	0.14	0.02	−0.06	−0.35	0.72	0.49	0.20	−0.01	−0.11	−0.45	0.95
	(4.91)	(2.01)	(0.35)	(−1.14)	(−5.59)	(5.87)	(5.20)	(2.80)	(−0.22)	(−1.88)	(−6.09)	(6.31)

Table A21 FF3 alphas of portfolios sorted by PTP and PE

This table reports FF3 alphas of 25 value-weighted portfolios sequentially sorted by PTP and PE, where PTP measures the expectation of expected returns and is defined as analysts' consensus price target scaled by the current price Weber (2018). The sample period is 1999:03–2018:12.

	Panel A: Sort on PTP and PE_{CAPM}						Panel B: Sort on PTP and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.87	0.89	0.77	0.39	0.18	0.69	0.89	0.86	0.80	0.45	0.15	0.74
	(5.02)	(3.24)	(3.87)	(1.76)	(1.00)	(2.93)	(5.03)	(3.25)	(4.08)	(2.19)	(0.81)	(3.05)
PTP2	0.37	0.78	−0.22	0.15	−0.49	0.86	0.40	0.63	−0.18	0.25	−0.53	0.92
	(2.13)	(3.72)	(−1.07)	(0.92)	(−2.63)	(3.11)	(2.25)	(3.41)	(−0.86)	(1.44)	(−2.80)	(3.21)
PTP3	0.03	0.13	0.13	0.16	−0.59	0.63	0.03	0.08	0.20	0.13	−0.59	0.62
	(0.22)	(0.96)	(1.03)	(0.82)	(−3.28)	(2.60)	(0.18)	(0.52)	(1.66)	(0.66)	(−3.19)	(2.61)
PTP4	0.45	0.29	−0.14	−0.20	−0.37	0.82	0.42	0.26	−0.04	−0.24	−0.34	0.76
	(2.56)	(1.75)	(−0.58)	(−1.07)	(−1.70)	(2.80)	(2.49)	(1.58)	(−0.18)	(−1.41)	(−1.59)	(2.70)
PTP5	−1.04	−0.40	−0.40	−0.36	−0.42	−0.62	−1.07	−0.36	−0.42	−0.33	−0.44	−0.63
	(−3.47)	(−1.38)	(−1.43)	(−1.31)	(−1.52)	(−1.42)	(−3.45)	(−1.06)	(−1.71)	(−1.22)	(−1.61)	(−1.42)
All stocks	0.25	0.33	0.08	0.05	−0.40	0.64	0.24	0.26	0.13	0.09	−0.43	0.67
	(2.11)	(2.92)	(0.77)	(0.44)	(−2.91)	(2.96)	(2.03)	(2.46)	(1.31)	(0.77)	(−3.22)	(3.07)

	Panel C: Sort on PTP and PE_{FF5}						Panel D: Sort on PTP and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.92	0.84	0.84	0.39	0.14	0.78	0.88	0.90	0.87	0.34	0.18	0.70
	(5.19)	(3.18)	(4.25)	(1.88)	(0.77)	(3.27)	(4.95)	(3.45)	(4.28)	(1.56)	(1.00)	(2.90)
PTP2	0.43	0.61	−0.19	0.24	−0.52	0.95	0.42	0.70	−0.20	0.22	−0.51	0.93
	(2.30)	(3.44)	(−0.83)	(1.33)	(−2.77)	(3.12)	(2.26)	(3.73)	(−0.95)	(1.31)	(−2.82)	(3.13)
PTP3	0.07	0.05	0.23	0.06	−0.56	0.63	0.05	0.07	0.23	0.10	−0.62	0.67
	(0.44)	(0.35)	(1.64)	(0.31)	(−3.23)	(2.71)	(0.34)	(0.43)	(1.90)	(0.50)	(−3.50)	(2.84)
PTP4	0.40	0.24	0.00	−0.29	−0.30	0.70	0.42	0.26	−0.05	−0.27	−0.30	0.71
	(2.35)	(1.54)	(0.01)	(−1.55)	(−1.43)	(2.50)	(2.46)	(1.61)	(−0.23)	(−1.48)	(−1.39)	(2.53)
PTP5	−1.11	−0.43	−0.35	−0.38	−0.44	−0.66	−1.02	−0.46	−0.37	−0.38	−0.39	−0.63
	(−3.47)	(−1.20)	(−1.41)	(−1.41)	(−1.61)	(−1.50)	(−3.29)	(−1.34)	(−1.39)	(−1.31)	(−1.43)	(−1.45)
All stocks	0.25	0.23	0.18	0.03	−0.41	0.66	0.25	0.28	0.15	0.01	−0.39	0.64
	(2.10)	(2.28)	(1.74)	(0.28)	(−3.10)	(3.02)	(2.07)	(2.70)	(1.52)	(0.09)	(−2.99)	(2.90)

	Panel E: Sort on PTP and PE_{SY}						Panel F: Sort on PTP and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.93	0.81	0.76	0.48	0.13	0.79	0.84	0.90	0.84	0.43	0.13	0.71
	(5.15)	(3.11)	(3.77)	(2.37)	(0.75)	(3.22)	(4.82)	(3.36)	(4.16)	(2.06)	(0.70)	(2.88)
PTP2	0.41	0.67	−0.21	0.17	−0.47	0.87	0.33	0.78	−0.26	0.14	−0.45	0.78
	(2.32)	(3.54)	(−0.92)	(1.09)	(−2.44)	(3.04)	(1.88)	(4.08)	(−1.23)	(0.89)	(−2.39)	(2.73)
PTP3	0.02	0.11	0.26	0.10	−0.61	0.62	0.03	0.07	0.18	0.12	−0.58	0.61
	(0.13)	(0.71)	(1.92)	(0.54)	(−3.35)	(2.65)	(0.18)	(0.51)	(1.50)	(0.63)	(−3.25)	(2.59)
PTP4	0.40	0.24	−0.03	−0.22	−0.35	0.75	0.39	0.30	−0.01	−0.25	−0.32	0.71
	(2.32)	(1.49)	(−0.14)	(−1.14)	(−1.59)	(2.53)	(2.37)	(1.81)	(−0.06)	(−1.31)	(−1.49)	(2.50)
PTP5	−1.12	−0.42	−0.46	−0.25	−0.44	−0.67	−1.12	−0.27	−0.50	−0.40	−0.40	−0.72
	(−3.68)	(−1.37)	(−1.74)	(−0.99)	(−1.59)	(−1.53)	(−3.54)	(−0.88)	(−1.83)	(−1.54)	(−1.46)	(−1.58)
All stocks	0.24	0.25	0.13	0.06	−0.41	0.65	0.21	0.32	0.11	0.04	−0.39	0.60
	(1.98)	(2.54)	(1.29)	(0.59)	(−3.05)	(2.93)	(1.85)	(2.99)	(1.06)	(0.41)	(−2.94)	(2.83)

Table A22 Alphas of portfolios sorted by PTP and PE_{CAPM}

This table reports alphas of 25 value-weighted portfolios sequentially sorted by PTP and PE_{CAPM} (Newey-West t-values in parentheses), where PTP measures the expectation of expected returns and is defined as analysts' consensus price target scaled by current price (Weber, 2018). The sample period is 1999:03–2018:12.

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.92	0.95	0.86	0.45	0.26	0.66	0.87	0.89	0.77	0.39	0.18	0.69
	(4.71)	(3.32)	(4.20)	(1.94)	(1.36)	(2.68)	(5.02)	(3.24)	(3.87)	(1.76)	(1.00)	(2.93)
PTP2	0.41	0.81	−0.25	0.20	−0.42	0.83	0.37	0.78	−0.22	0.15	−0.49	0.86
	(2.22)	(3.85)	(−1.18)	(1.26)	(−2.11)	(3.02)	(2.13)	(3.72)	(−1.07)	(0.92)	(−2.63)	(3.11)
PTP3	0.06	0.15	0.14	0.16	−0.60	0.66	0.03	0.13	0.13	0.16	−0.59	0.63
	(0.39)	(0.99)	(0.99)	(0.71)	(−2.97)	(2.74)	(0.22)	(0.96)	(1.03)	(0.82)	(−3.28)	(2.60)
PTP4	0.46	0.26	−0.12	−0.20	−0.39	0.86	0.45	0.29	−0.14	−0.20	−0.37	0.82
	(2.38)	(1.50)	(−0.52)	(−1.16)	(−1.63)	(2.88)	(2.56)	(1.75)	(−0.58)	(−1.07)	(−1.70)	(2.80)
PTP5	−1.00	−0.35	−0.38	−0.30	−0.32	−0.69	−1.04	−0.40	−0.40	−0.36	−0.42	−0.62
	(−3.42)	(−1.29)	(−1.39)	(−1.09)	(−1.11)	(−1.59)	(−3.47)	(−1.38)	(−1.43)	(−1.31)	(−1.52)	(−1.42)
All stocks	0.25	0.34	0.08	0.04	−0.39	0.64	0.25	0.33	0.08	0.05	−0.40	0.64
	(2.01)	(2.90)	(0.87)	(0.32)	(−2.64)	(3.00)	(2.11)	(2.92)	(0.77)	(0.44)	(−2.91)	(2.96)
	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.62	0.71	0.65	0.23	0.12	0.50	0.66	0.68	0.62	0.27	0.11	0.55
	(3.50)	(2.32)	(2.58)	(0.80)	(0.53)	(1.89)	(3.68)	(2.62)	(2.76)	(1.06)	(0.57)	(2.30)
PTP2	0.25	0.68	−0.35	0.06	−0.63	0.88	0.30	0.72	−0.33	0.08	−0.61	0.91
	(1.48)	(3.19)	(−1.63)	(0.35)	(−3.67)	(3.53)	(1.66)	(3.33)	(−1.46)	(0.49)	(−3.45)	(3.41)
PTP3	0.00	−0.02	−0.09	−0.03	−0.57	0.57	−0.07	0.05	−0.11	0.01	−0.56	0.49
	(0.00)	(−0.13)	(−0.71)	(−0.20)	(−3.61)	(2.75)	(−0.46)	(0.31)	(−0.81)	(0.06)	(−3.08)	(2.04)
PTP4	0.34	0.19	−0.25	−0.13	−0.50	0.85	0.43	0.26	−0.17	−0.13	−0.38	0.80
	(2.16)	(1.13)	(−1.02)	(−0.68)	(−1.94)	(2.75)	(2.07)	(1.38)	(−0.61)	(−0.68)	(−1.50)	(2.56)
PTP5	−0.81	−0.23	−0.26	−0.22	−0.32	−0.49	−0.81	−0.01	−0.20	−0.19	−0.28	−0.53
	(−2.37)	(−0.67)	(−0.88)	(−0.86)	(−1.11)	(−1.09)	(−2.32)	(−0.02)	(−0.71)	(−0.68)	(−0.95)	(−1.12)
All stocks	0.19	0.25	−0.00	0.01	−0.42	0.61	0.22	0.29	−0.00	0.02	−0.39	0.60
	(1.67)	(2.33)	(−0.01)	(0.07)	(−3.46)	(3.08)	(1.54)	(2.67)	(−0.02)	(0.15)	(−2.83)	(2.64)
	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
PTP1	0.69	0.56	0.57	0.02	−0.09	0.78	0.76	0.63	0.61	0.03	−0.09	0.86
	(3.71)	(2.05)	(2.57)	(0.06)	(−0.45)	(3.26)	(4.07)	(2.40)	(2.80)	(0.15)	(−0.49)	(3.20)
PTP2	0.32	0.66	−0.34	−0.07	−0.70	1.02	0.35	0.67	−0.46	−0.06	−0.66	1.01
	(1.58)	(2.93)	(−1.44)	(−0.42)	(−4.12)	(3.22)	(1.41)	(2.87)	(−2.14)	(−0.40)	(−4.45)	(3.31)
PTP3	0.03	0.04	−0.04	−0.10	−0.51	0.54	−0.03	0.04	−0.09	−0.06	−0.75	0.72
	(0.14)	(0.30)	(−0.29)	(−0.53)	(−2.82)	(1.93)	(−0.18)	(0.24)	(−0.67)	(−0.32)	(−3.79)	(2.76)
PTP4	0.48	0.33	−0.01	−0.00	−0.26	0.74	0.51	0.32	−0.06	−0.08	−0.34	0.86
	(2.35)	(1.74)	(−0.02)	(−0.01)	(−1.17)	(2.33)	(2.40)	(1.86)	(−0.24)	(−0.48)	(−1.52)	(2.74)
PTP5	−0.44	0.22	−0.01	−0.03	−0.09	−0.35	−0.54	0.21	0.01	0.08	−0.05	−0.49
	(−1.31)	(0.69)	(−0.04)	(−0.09)	(−0.32)	(−0.73)	(−1.53)	(0.70)	(0.04)	(0.32)	(−0.15)	(−0.92)
All stocks	0.32	0.28	0.04	−0.03	−0.46	0.78	0.30	0.29	0.00	−0.10	−0.50	0.80
	(2.05)	(2.18)	(0.39)	(−0.27)	(−3.23)	(2.88)	(1.91)	(2.69)	(0.03)	(−0.95)	(−3.64)	(3.16)

Table A23 FF3 alphas of portfolios sorted by LTG and PE

This table reports FF3 alphas of 25 value-weighted portfolios sorted by LTG and PE, where LTG is analysts' long-term growth forecast on earnings as in (Weber, 2018). The sample period is 1982:01–2018:12.

	Panel A: Sort on LTG and PE_{CAPM}						Panel B: Sort on LTG and PE_{FF3}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.28	0.37	0.26	0.07	−0.17	0.45	0.25	0.32	0.26	0.09	−0.19	0.44
	(1.99)	−2.78	(2.74)	(0.65)	(−1.31)	(2.29)	(1.65)	−2.37	(2.81)	(0.74)	(−1.43)	(2.11)
LTG2	0.15	0.15	0.00	0.03	−0.37	0.52	0.17	0.1	0.05	0.02	−0.37	0.53
	(1.08)	−1.43	(0.01)	(0.27)	(−2.63)	(2.38)	(1.22)	−0.9	(0.43)	(0.15)	(−2.57)	(2.46)
LTG3	0.53	0.18	0.06	−0.13	−0.42	0.95	0.56	0.13	0.09	−0.14	−0.43	1.00
	(4.22)	−1.56	(0.57)	(−1.31)	(−3.86)	(5.33)	(4.51)	−1.11	(0.80)	(−1.38)	(−3.84)	(5.34)
LTG4	0.28	0.21	0.22	0.02	−0.37	0.65	0.26	0.2	0.21	−0.00	−0.36	0.63
	(1.79)	−1.55	(1.91)	(0.19)	(−3.23)	(3.15)	(1.78)	−1.41	(1.79)	(−0.01)	(−3.11)	(3.10)
LTG5	−0.06	0.4	0.08	0.37	0.10	−0.16	−0.04	0.34	0.14	0.38	0.09	−0.14
	(−0.36)	−2.12	(0.43)	(1.59)	(0.57)	(−0.69)	(−0.26)	−1.96	(0.71)	(1.71)	(0.52)	(−0.59)
All stocks	0.25	0.2	0.14	0.04	−0.30	0.54	0.26	0.18	0.15	0.03	−0.31	0.56
	(2.79)	−3.17	(2.21)	(0.58)	(−3.45)	(3.79)	(2.91)	−2.67	(2.64)	(0.43)	(−3.45)	(3.79)

	Panel C: Sort on LTG and PE_{FF5}						Panel D: Sort on LTG and PE_{HXZ}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.25	0.32	0.25	0.08	−0.19	0.44	0.22	0.41	0.24	0.07	−0.18	0.40
	(1.68)	−2.42	(2.55)	(0.68)	(−1.41)	(2.12)	(1.50)	−3.03	(2.53)	(0.64)	(−1.36)	(1.94)
LTG2	0.16	0.11	0.05	−0.01	−0.34	0.50	0.18	0.1	−0.01	0.01	−0.38	0.56
	(1.16)	−0.98	(0.40)	(−0.07)	(−2.40)	(2.30)	(1.27)	−0.94	(−0.12)	(0.11)	(−2.63)	(2.45)
LTG3	0.54	0.13	0.14	−0.15	−0.44	0.98	0.52	0.18	0.11	−0.15	−0.43	0.94
	(4.10)	−1.07	(1.33)	(−1.52)	(−3.88)	(5.10)	(4.07)	−1.39	(1.03)	(−1.51)	(−3.85)	(5.09)
LTG4	0.25	0.2	0.26	−0.01	−0.35	0.60	0.27	0.21	0.24	0.02	−0.38	0.65
	(1.64)	−1.43	(2.31)	(−0.09)	(−2.99)	(2.91)	(1.76)	−1.51	(2.14)	(0.18)	(−3.40)	(3.19)
LTG5	−0.03	0.29	0.15	0.42	0.06	−0.10	−0.00	0.31	0.08	0.43	0.08	−0.09
	(−0.20)	−1.64	(0.80)	(1.90)	(0.36)	(−0.43)	(−0.00)	−1.79	(0.44)	(1.83)	(0.48)	(−0.37)
All stocks	0.26	0.16	0.18	0.02	−0.30	0.55	0.26	0.18	0.15	0.03	−0.31	0.57
	(2.86)	−2.3	(3.19)	(0.22)	(−3.39)	(3.73)	(2.88)	−2.48	(2.59)	(0.44)	(−3.53)	(3.82)

	Panel E: Sort on LTG and PE_{SY}						Panel F: Sort on LTG and PE_{DHS}					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.29	0.32	0.26	0.08	−0.17	0.46	0.25	0.39	0.27	0.08	−0.17	0.42
	(2.01)	−2.27	(2.73)	(0.69)	(−1.28)	(2.27)	(1.71)	−2.99	(2.94)	(0.69)	(−1.33)	(2.08)
LTG2	0.19	0.09	0.04	−0.03	−0.34	0.52	0.17	0.09	0.06	−0.01	−0.35	0.51
	(1.37)	−0.78	(0.29)	(−0.21)	(−2.35)	(2.37)	(1.22)	−0.76	(0.53)	(−0.07)	(−2.46)	(2.32)
LTG3	0.59	0.08	0.13	−0.18	−0.41	1.00	0.51	0.21	0.06	−0.16	−0.42	0.93
	(4.54)	−0.63	(1.16)	(−1.86)	(−3.63)	(5.20)	(3.97)	−1.75	(0.55)	(−1.56)	(−3.86)	(5.08)
LTG4	0.32	0.19	0.26	0.02	−0.40	0.73	0.28	0.19	0.23	0.01	−0.36	0.64
	(2.07)	−1.37	(2.31)	(0.16)	(−3.44)	(3.43)	(1.78)	−1.36	(2.02)	(0.08)	(−3.15)	(3.10)
LTG5	−0.07	0.37	0.06	0.38	0.09	−0.17	−0.08	0.44	0.03	0.40	0.10	−0.18
	(−0.45)	−2.12	(0.31)	(1.69)	(0.53)	(−0.72)	(−0.46)	−2.47	(0.16)	(1.74)	(0.58)	(−0.76)
All stocks	0.28	0.15	0.17	0.00	−0.29	0.57	0.24	0.21	0.15	0.02	−0.28	0.53
	(3.09)	−2.2	(3.03)	(0.04)	(−3.25)	(3.77)	(2.77)	−3.07	(2.60)	(0.30)	(−3.24)	(3.62)]

Table A24 Alphas of portfolios sorted by LTG and $\mathrm{PE}_{\mathrm{CAPM}}$

This table reports alphas of 25 value-weighted portfolios sorted by LTG and $\mathrm{PE}_{\mathrm{CAPM}}$ (Newey-West t-values in parentheses), where LTG is analysts' long-term growth forecast on earnings as in Weber (2018).

	Panel A: CAPM alpha						Panel B: FF3 alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.53	0.53	0.45	0.20	0.01	0.53	0.28	0.37	0.26	0.07	−0.17	0.45
	(2.83)	(3.62)	(3.25)	(1.76)	(0.03)	(2.56)	(1.99)	(2.78)	(2.74)	(0.65)	(−1.31)	(2.29)
LTG2	0.28	0.27	0.12	0.14	−0.23	0.50	0.15	0.15	0.00	0.03	−0.37	0.52
	(1.73)	(2.31)	(0.80)	(1.09)	(−1.40)	(2.40)	(1.08)	(1.43)	(0.01)	(0.27)	(−2.63)	(2.38)
LTG3	0.55	0.22	0.11	−0.07	−0.40	0.95	0.53	0.18	0.06	−0.13	−0.42	0.95
	(4.07)	(1.91)	(1.01)	(−0.57)	(−3.37)	(5.23)	(4.22)	(1.56)	(0.57)	(−1.31)	(−3.86)	(5.33)
LTG4	0.26	0.19	0.18	−0.05	−0.40	0.66	0.28	0.21	0.22	0.02	−0.37	0.65
	(1.67)	(1.24)	(1.49)	(−0.33)	(−3.48)	(3.28)	(1.79)	(1.55)	(1.91)	(0.19)	(−3.23)	(3.15)
LTG5	−0.26	0.18	−0.15	0.12	−0.09	−0.18	−0.06	0.40	0.08	0.37	0.10	−0.16
	(−1.29)	(0.93)	(−0.67)	(0.48)	(−0.42)	(−0.79)	(−0.36)	(2.12)	(0.43)	(1.59)	(0.57)	(−0.69)
All stocks	0.27	0.22	0.17	0.05	−0.27	0.55	0.25	0.20	0.14	0.04	−0.30	0.54
	(2.98)	(3.40)	(2.47)	(0.90)	(−2.88)	(3.74)	(2.79)	(3.17)	(2.21)	(0.58)	(−3.45)	(3.79)

	Panel C: FF5 alpha						Panel D: HXZ alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.20	0.24	0.11	−0.07	−0.24	0.44	0.25	0.31	0.12	−0.05	−0.21	0.46
	(1.38)	(1.82)	(1.17)	(−0.61)	(−1.76)	(2.12)	(1.37)	(2.12)	(0.96)	(−0.46)	(−1.34)	(2.23)
LTG2	−0.07	−0.04	−0.22	−0.17	−0.56	0.49	−0.02	−0.07	−0.27	−0.12	−0.50	0.48
	(−0.54)	(−0.36)	(−1.85)	(−1.61)	(−3.97)	(2.33)	(−0.17)	(−0.53)	(−2.02)	(−1.00)	(−2.86)	(2.13)
LTG3	0.37	0.03	−0.10	−0.29	−0.57	0.94	0.40	0.01	−0.21	−0.32	−0.56	0.96
	(3.03)	(0.24)	(−0.93)	(−2.86)	(−4.69)	(4.75)	(3.21)	(0.08)	(−1.86)	(−2.86)	(−4.39)	(4.80)
LTG4	0.21	0.18	0.12	0.08	−0.36	0.58	0.33	0.15	0.07	0.05	−0.39	0.72
	(1.31)	(1.23)	(1.00)	(0.65)	(−2.83)	(2.45)	(1.53)	(0.94)	(0.64)	(0.41)	(−2.74)	(2.40)
LTG5	0.11	0.55	0.28	0.67	0.39	−0.28	0.15	0.51	0.30	0.61	0.33	−0.18
	(0.59)	(2.71)	(1.59)	(2.87)	(2.23)	(−1.08)	(0.79)	(2.46)	(1.43)	(2.32)	(1.43)	(−0.59)
All stocks	0.19	0.15	0.06	−0.02	−0.33	0.52	0.24	0.14	0.01	−0.02	−0.32	0.56
	(2.20)	(2.18)	(1.03)	(−0.23)	(−3.54)	(3.46)	(2.32)	(1.88)	(0.23)	(−0.31)	(−3.18)	(3.25)

	Panel E: SY alpha						Panel F: DHS alpha					
	PE1	PE2	PE3	PE4	PE5	PE1-5	PE1	PE2	PE3	PE4	PE5	PE1-5
LTG1	0.21	0.32	0.14	−0.05	−0.19	0.41	0.46	0.38	0.10	−0.09	−0.38	0.84
	(1.17)	(2.14)	(1.17)	(−0.37)	(−1.30)	(1.94)	(2.42)	(2.89)	(0.85)	(−0.78)	(−2.39)	(3.37)
LTG2	0.10	−0.01	−0.21	−0.13	−0.50	0.60	0.23	0.05	−0.18	−0.12	−0.59	0.82
	(0.68)	(−0.07)	(−1.63)	(−1.21)	(−3.21)	(2.52)	(1.38)	(0.39)	(−1.58)	(−1.19)	(−3.87)	(3.28)
LTG3	0.41	0.10	−0.13	−0.27	−0.59	1.00	0.58	0.07	−0.06	−0.25	−0.61	1.19
	(3.19)	(0.80)	(−1.08)	(−2.29)	(−4.63)	(4.89)	(4.33)	(0.64)	(−0.48)	(−2.38)	(−4.86)	(6.01)
LTG4	0.39	0.06	0.12	0.01	−0.50	0.89	0.48	0.26	0.23	0.13	−0.51	1.00
	(2.11)	(0.32)	(0.85)	(0.08)	(−3.71)	(3.48)	(2.79)	(1.55)	(1.85)	(1.03)	(−3.74)	(4.06)
LTG5	0.43	0.53	0.32	0.58	0.22	0.21	0.52	0.62	0.27	0.42	0.16	0.36
	(2.25)	(2.38)	(1.60)	(2.33)	(1.27)	(0.84)	(2.83)	(3.21)	(1.46)	(1.93)	(0.87)	(1.54)
All stocks	0.30	0.16	0.05	−0.03	−0.40	0.71	0.43	0.18	0.06	−0.05	−0.50	0.93
	(2.99)	(1.98)	(0.75)	(−0.42)	(−3.82)	(3.91)	(3.91)	(2.37)	(0.90)	(−0.75)	(−5.00)	(5.13)

Table A25 Fama-MacBeth regressions

This table reports the coefficients from Fama-MacBeth regressions of one-month-ahead returns on PE and other variables, where IO refers to institutional ownership, MAX to lottery demand, TK to prospect theory value, PTP to analysts' implied return expectation, and LTG to analysts' long-term growth forecast on earnings. Newey-West t-statistics are reported in parentheses. The sample period is 1999:04–2018:12, over which all variables have observations. Intercepts are included in all regressions but not reported for brevity.

	Dependent variable: one-month-ahead return (%)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PE_{CAPM}	−0.46	−0.41	−0.43	−0.40	−0.47	−0.46	−0.45	−0.37
	(−4.64)	(−4.17)	(−4.47)	(−4.26)	(−4.79)	(−4.63)	(−4.68)	(−4.15)
IVOL (%)		−0.06						−0.08
		(−0.81)						(−1.09)
IO			−0.05					−0.09
			(−0.17)					(−0.31)
MAX (%)				−0.01				0.00
				(−0.57)				(0.14)
TK					−0.14			−0.20
					(−0.69)			(−1.09)
PTP						−0.14		−0.14
						(−2.97)		(−3.06)
LTG/100							0.54	0.06
							(0.30)	(0.36)
Log(ME)	−0.09	−0.10	−0.09	−0.10	−0.09	−0.09	−0.09	−0.09
	(−2.17)	(−2.39)	(−2.11)	(−2.35)	(−2.27)	(−2.19)	(−2.09)	(−2.23)
Log(BM)	−0.11	−0.11	−0.11	−0.11	−0.11	−0.10	−0.10	−0.10
	(−1.12)	(−1.18)	(−1.12)	(−1.16)	(−1.13)	(−1.09)	(−1.06)	(−1.09)
STR (%)	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.01
	(1.98)	(1.48)	(1.64)	(1.51)	(2.06)	(1.92)	(1.84)	(0.93)
MOM (%)	−0.00	0.00	0.00	0.00	0.01	−0.00	−0.00	0.01
	(−0.03)	(0.10)	(0.06)	(0.05)	(0.12)	(−0.09)	(−0.10)	(0.28)
LTR (%)	−0.10	−0.08	−0.09	−0.08	−0.10	−0.10	−0.10	−0.08
	(−1.55)	(−1.45)	(−1.53)	(−1.42)	(−1.57)	(−1.55)	(−1.77)	(−1.48)
N	265,242	265,242	265,242	265,242	265,242	265,242	265,242	265,242