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Expected P/E, Residual P/E, and Stock Return Reversal: Time-Varying Fundamentals or Investor Overreaction?

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Abstract

We decompose P/E ratios into a fundamental component and a residual component that cannot be explained by the firm or economic fundamentals. Purging the fundamental component from observed P/E ratios, we find that portfolios based on residual P/E ratios exhibit performance reversal only in overbid glamour stocks; hence over-optimism is more prevalent than over-pessimism.

Key words: P/E ratios; overreaction; market efficiency

JEL classification: G30

1. Introduction

The price-earnings (P/E) ratio, along with other valuation yardsticks, such as price-dividend ratio, price-sales ratio, book-to-market ratio, and price-to-cash flow ratio, are frequently used by financial analysts to evaluate stocks (Bodie et al., 2005). Conventional wisdom believes that there exists a relationship between a firm's P/E ratio and its fundamentals, such as its earnings prospect, risk, and dividend policy. When P/E ratios become excessively high or low, they are regarded as swinging away from fundamentals, and a correction, or a mean-reverting process is in order. Basu (1977, 1983) find that stocks with high (low) P/E ratios generate lower (higher) returns and conclude that investors overstate (understate) growth expectations, which leads to over-optimism (over-pessimism) for high (low) P/E stocks. Similar conclusions can be found in Cook and Rozeff (1984), Jaffe et al. (1989), and Peavy

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and Goodman (1983).

Based on this "investor overreaction hypothesis", other researchers broadened the scope to include contrarian investment strategies (Dreman, 1979; Dreman and Berry, 1995; Lakonishok et al., 1994; Shen, 2003). Furthermore, during the past decade of economic booms, the debate over whether the stock market is overvalued has intensified, and one of the most popular yardsticks to measure market overvaluation is the P/E ratio. The academic debate started in the early 1990s, when the aggregate market P/E ratio exceeded 18, and continued into the late 1990s as stock prices did not show any sign of abatement. Contrarian strategists believed that a correction was overdue. However, others believed that a "new economy" warrants a higher stock valuation ratio, a view supported by Glassman and Hassett (1999). Carlson et al. (2002) also find higher P/E ratios in the 1990s not alarming in light of lower transaction costs. In retrospect, however, Campbell and Shiller's (1998) prediction of market overvaluation and a significant correction based on P/E analysis proved to be correct as we witnessed bubble bursts. However, their prediction of a major correction was realized only after two straight years of strong market performance. Using P/E ratios to form contrarian investment strategies and to predict market correction is, therefore, of continued interest to academics as well as practitioners.

The objective of this study is to achieve a better understanding of the P/E enigma by re-examining the relationship between stock performance and P/E ratios. It differs from prior research in a number of aspects. First, rather than investigating the time series behavior of the aggregate market P/E (see, for example, Campbell and Shiller, 1998), we decompose P/E ratios for individual stocks and construct portfolios based on extreme P/E ratios and stocks that are mispriced due to overreaction. The behavior of these portfolios offers meaningful trading strategies and implications for market efficiency.

Second, instead of examining the relationship between observed P/E ratios and subsequent stock performances, we decompose observed P/E ratios into a fundamental component and a mispriced or residual component. The decomposition is appealing because the so-called P/E anomaly is not an anomaly if the mean reversion in P/E ratios is the result of predictable time-varying expected stock returns (Fama and French, 1995). Simply put, a high P/E ratio is not excessive if it is justifiable by firm and economic fundamentals. Only the component of the P/E that is not accounted for by the fundamentals captures investor over-optimism or over-pessimism. Analysis grounded on this decomposition may also have implications for market efficiency, as a reverting P/E in conjunction with a non-reverting residual component are still in line with the efficient market hypothesis.

Consistent with prior research, we detect mean-reverting behavior in stock performance when portfolios are sorted based on observed P/E ratios. However, when the fundamental component of the P/E ratio is purged from the observed P/E, the mean-reverting behavior in stock performance is found only in high residual P/E portfolios. In other words, mean reversion occurs when investors overbid stocks, which leads to overvaluation, as it cannot be justified by firm and economic

fundamentals. On the other hand, the lack of mean reversion in low residual P/E portfolios suggests that low P/E ratios for these stocks are justifiable by the poor firm or economic fundamentals. The subsequent higher stock returns for the low P/E portfolios are due to the improvement in these fundamentals. The fact that high residual P/E portfolios exhibit stronger performance reversal than low residual P/E portfolios indicates that over-optimism is more prevalent than over-pessimism.

The rest of the paper is organized as follows. In Section 2, we start with theoretical hypotheses on the conditional mean and the residual component of the P/E ratio, then discuss the discounted cash flow model and present the relevant variables. Descriptions of the dataset are also given. We examine the P/E model and analyze the empirical results in Section 3. Finally, Section 4 summarizes the main findings.

2. Model and Data

2.1 Theoretical Hypotheses

Fama and French (1988) and Poterba and Summers (1988) report negative serial correlations in long-term stock returns. Two major theories explain the stock return mean reversion. One theory argues that stock return mean reversion occurs because over time stock returns take a long swing away from their fundamental values (Poterba and Summers, 1988). Lakonishok et al. (1994) contends that stock return predictability is driven by investor overreaction to growth; hence stocks are mispriced, and mean reversion represents subsequent correction. Others point out that mean reversion in stock returns is consistent with the efficient market hypothesis if the risk premium of equity is time-varying (Fama and French, 1988, 1992, 1993, and 1996; Balvers et al., 1990). In other words, the observed mean reverting behavior in P/E ratios is not necessarily inconsistent with the efficient market hypothesis if the time-varying component of the P/E ratio is the main contributor of reverting P/E ratios. Based on this line of argument, contrarian investment strategies can be supported if the mean-reverting P/E still prevails after controlling for the fundamental component of the P/E ratio. Take the following equation as an example:

$$(\mathrm{P/E})_{it} = E\left[(\mathrm{P/E})_{it} \mid \Omega_{t-1}\right] + \xi_{it}, \tag{1}$$

where $(\mathrm{P/E})_{it}$ is the observed P/E of firm i at time t, $E\left[(\mathrm{P/E})_{it} \mid \Omega_{t-1}\right]$ is the expected P/E for firm i at time t conditional on the information set Ω at time $t-1$, and ξ is the residual P/E that is unexplained by the information set and is orthogonal to Ω.

According to (1), we believe that the observed P/E ratio can be broadly classified into two components, namely an expected P/E and a residual P/E. The expected component of the P/E ratio is determined by the firm and economic fundamentals. Consequently, factors that are unobservable to econometricians, such

as investor over-optimism or over-pessimism, are reflected in the residual component of the P/E ratio. Therefore, if the mean-reverting behavior in the performance of P/E sorted portfolios is due to the risk premium caused by the changing firm or economic fundamentals, performance of the residual P/E sorted portfolios should exhibit no mean reversion. But if the mean reversion in stock performance of P/E sorted portfolios arises from investor overreaction, residual P/E sorted portfolios should exhibit mean reversion. The mean reversion may be stronger than that in observed P/E sorted portfolios because the residual P/E is a cleaner measurement of investor overreaction after the fundamentals are removed from the observed P/Es. Finally, investor overreaction to good news versus bad news may not be symmetrical. Residual P/E sorted extreme portfolios allow us to examine this issue. We thus derive the following three research hypotheses.

***Hypothesis 1*:** Consistent with prior studies, stock returns of extreme P/E portfolios exhibit mean reversion.

***Hypothesis 2*:** Consistent with investor overreaction behavior, stock returns of extreme residual P/E portfolios exhibit mean reversion.

***Hypothesis 3*:** Investor overreaction is symmetrical; that is, investors are equally likely to be over-optimistic and over-pessimistic.

2.2 Determinants of P/E Ratios

To purge the fundamental component from the observed P/E ratios, in this section we attempt to assess the factors that help to determine the expected component of the P/E ratios. Let us begin with discussion of a traditional discounted dividend model, followed by modifications that contain other factors that potentially impact the P/E ratios. Derived from the basic discounted dividend valuation model (DDM), P/E ratios can be written as:

$$\text{P/E} = \frac{\text{D/E}}{k - g} = \frac{d}{k - g}, \tag{2}$$

where $\text{D/E} = d$ is the dividend payout ratio, k is the shareholders' required rate of return, and g is the firm's expected growth rate. Theoretically, the P/E ratio is positively related to the dividend payout ratio and the expected growth rate but negatively related to the shareholders' required return. Specifically, the variables used in the regression model to determine the fundamental component of the P/Es are defined as follows.

(a) The P/E ratio (P/E) is the ratio of a firm's year-end stock price to earnings per share in the last four quarters. Earnings per share exclude extraordinary items.
(b) The dividend payout ratio (D/E) is the ratio of annual dividends per share to earnings per share of the same year.
(c) There are various measures of the earnings growth rate in the literature. Some

use the historical growth rate to project the expected growth rate, but the proponents of "higgledy piggledy growth" find this measure unsatisfactory because earnings growth follows a random walk. Other studies concentrate on the analysts' consensus estimates. In this paper, we follow this latter approach using analysts' earnings growth rate forecasts obtained from the Institutional Brokers Estimate System (I/B/E/S) database. Two proxies of the expected growth rate are defined.

- Analysts' five-year growth rate forecast (G5).
- Analysts' one-year growth rate forecast (G1).

(d) We use two proxies for firm risks, with the first market-based and the second accounting-based.

- The market-based measure is the standard deviation of stock returns (Std), computed from the monthly stock prices for each year. We choose not to use the beta of a stock to measure risk for two reasons. First, systematic, total, and unsystematic risks are all highly correlated. Second, prior studies either find P/E ratios highly correlated with unsystematic risk (Basu, 1977; Cook and Rozeff, 1984; Constand and Freitas, 1991) or do not find the beta to be a significant factor in determining P/E ratios (see Cho, 1994).
- Our second measure of firm risk is a debt ratio (Debt) obtained by dividing total debt by total assets. Clearly, higher financial leverage means higher firm risk.

(e) We also consider firm size (Size). The basic discounted cash flow model obviously fails to consider other determinants that might contribute to P/E variations. For example, it has been found that small-cap stocks generate higher returns than large-cap stocks (Banz, 1981; Reinganum, 1981). Basu (1983) finds that the P/E effect tends to disappear when controlling for firm size. Therefore, we incorporate firm size, which is measured by the natural logarithm of the market value of equity, into the P/E model.

(f) Finally, we include the yield of Baa-rated bonds (Baa). It is well recognized that cross-sectional P/E models are not structurally stable over time: a model may work extremely well in a given year but may reverse its efficacy in another. In addition, business cycles, which are usually related to factors such as aggregate volume of debt issuance, budget equilibrium, and consumer confidence indicators, have potential long-term impacts on P/E ratios. It is important to control the instability issue by adding macroeconomic variables in the regression model. The next question is which macroeconomic variables constitute suitable proxies for measurement of economy-wide impact. It is believed that bond default risk and inflation risk are good indicators of macroeconomic risks in the economy. Relevant arguments can be found in Chen et al. (1986) and Gangopadhyay (1996). We employ the yield of Baa-rated corporate bonds with 30-year constant maturity to measure economic risks for two reasons. (1) The yield of Baa-rated corporate bonds consists of both a default premium and an inflation premium; therefore, it measures both

default and inflation risks. (2) 30-year T-bonds had dwindling liquidity in the 1990s and were phased out after 2000. It is impossible for us to calculate default premium separately.

2.3 Econometric Model of P/E Ratios

Our empirical regression model for P/E ratios can be written as:

$$(\mathrm{P/E})_{it} = \alpha + \beta_1 \mathrm{G1}_{it} + \beta_2 \mathrm{G5}_{it} + \beta_3 (\mathrm{D/E})_{it} + \beta_4 \mathrm{Size}_{it} + \beta_5 \mathrm{Debt}_{it} + \beta_6 \mathrm{Std}_{it} + \beta_7 \mathrm{Baa}_t + \xi_{it}. \quad (3)$$

As discussed earlier, the P/E ratio consists of two components. The first part, measuring the expected P/E, is $E\left[(\mathrm{P/E})_{it}\right] = (\mathrm{P/E})_{it} - \xi_{it}$. The second part, ξ_{it}, is the residual P/E after the fundamental component is subtracted from the observed P/E. Hence, one can expect that ξ_{it} is a better instrument to assess investor over-optimism or over-pessimism.

If the overreaction argument of the P/E anomaly holds, we anticipate a negative relationship between P/E ratios and subsequent stock performance to persist through the residual component of the P/E ratio. However, if there is no evidence of a negative relationship between the residual P/E and subsequent stock performance, prior findings of the P/E anomaly could be attributed to time-varying expected P/E ratios, confirming market efficiency. Contrarian trading strategies, therefore, should be based on residual P/E sorted portfolios instead of on observed P/E sorted portfolios.

2.4 Data Descriptions

We collect data on stock returns from the Center for Research in Security Prices, and data on earnings, year-end stock prices, dividends, company size, total debt, and total assets from the COMPUSTAT database. Average analysts' earnings growth forecasts are obtained from I/B/E/S. Corporate bond yields are gathered from the Federal Reserve Bank of St. Louis. Our research sample is limited to firms listed publicly on the NYSE between 1982 and 2002. We also eliminate firms with more than 30% missing data in COMPUSTAT and those that experienced negative earnings (see Lakonishok et al., 1994) for a given year. The filtering procedure yields an uneven number of firms in a given year depending on the variables used. The maximum number of observations in a given year is 526, and the minimum number of observations is 375 for G5 in 1982. The total number of useful firm-year observations for the regression analysis is 9,327. Table 1 presents descriptive statistics for each variable from 1982 to 2002, including median values and the number of observations. It can be seen that the lowest median P/E ratio (10.68) occurred in 1984, while the highest (22.97) occurred in 2001. Also note that since the yield of a Baa bond is the aggregate market value, it has only one observation per year.

Table 1. Descriptive Statistics

Year	**Variable**								
	P/E	Return	G1	G5	Std	Size	D/E	Debt	Baa
1982	11.64	37.01	0.54	13.67	8.75	6.23	37.96	43.21	16.11
	(418)	(432)	(399)	(375)	(431)	(436)	(426)	(444)	(1)
1983	12.80	24.4	0.51	13.55	7.74	6.42	36.9	41.2	13.55
	(433)	(448)	(417)	(382)	(447)	(448)	(438)	(455)	(1)
1984	10.68	7.87	0.59	13.80	7.50	6.39	33.6	42.5	14.19
	(448)	(459)	(443)	(407)	(459)	(460)	(453)	(464)	(1)
1985	14.56	32.3	0.61	12.80	7.19	6.60	36.1	42.6	12.71
	(443)	(466)	(453)	(424)	(466)	(466)	(450)	(474)	(1)
1986	15.63	22.2	0.54	12.43	8.45	6.73	37.9	43.3	10.39
	(436)	(475)	(463)	(444)	(474)	(475)	(438)	(477)	(1)
1987	13.22	10.8	0.58	12.34	12.07	6.71	33.7	43.7	10.58
	(459)	(479)	(475)	(464)	(479)	(479)	(468)	(490)	(87)
1988	13.07	17.4	0.68	12.5	6.77	6.79	32.3	43.9	10.83
	(471)	(490)	(480)	(451)	(490)	(490)	(472)	(489)	(1)
1989	14.97	27.3	0.77	12.36	6.57	6.96	34.5	44.7	10.18
	(475)	(498)	(491)	(470)	(498)	(499)	(483)	(505)	(1)
1990	13.61	1.79	0.78	12.40	8.66	6.79	37.9	44.5	10.35
	(486)	(512)	(507)	(487)	(512)	(511)	(493)	(511)	(1)
1991	19.26	33.7	0.70	12.4	8.1	7.17	40.1	44.6	9.8
	(482)	(519)	(518)	(504)	(519)	(519)	(488)	(519)	(1)
1992	19.69	16.3	0.76	12.44	6.93	7.25	38.9	43.3	8.98
	(480)	(526)	(526)	(521)	(526)	(526)	(480)	(519)	(1)
1993	19.8	15.6	0.84	12.4	6.83	7.43	39.0	42.8	7.93
	(491)	(526)	(525)	(521)	(526)	(525)	(491)	(519)	(1)
1994	16.1	2.15	0.92	12.3	6.39	7.42	35.8	42.8	8.62
	(510)	(526)	(525)	(517)	(526)	(526)	(510)	(522)	(1)
1995	17.6	27.9	1.07	12.37	6.02	7.65	34.3	43.1	8.2
	(496)	(526)	(526)	(519)	(526)	(524)	(496)	(525)	(1)
1996	18.3	18.3	1.19	12.6	6.64	7.77	32.1	43.7	8.05
	(508)	(526)	(525)	(514)	(526)	(525)	(508)	(525)	(1)
1997	20.4	27.3	1.31	12.68	7.54	7.94	30.7	44.6	7.86
	(494)	(526)	(526)	(521)	(526)	(525)	(494)	(525)	(1)
1998	21.04	12.11	1.37	12.86	9.90	7.98	33.0	46.9	7.22
	(486)	(526)	(526)	(520)	(526)	(525)	(486)	(526)	(1)
1999	18.7	2.15	1.42	12.68	10.3	7.89	32.6	47.2	7.87
	(501)	(526)	(525)	(517)	(526)	(519)	(501)	(519)	(1)
2000	18.1	20.4	1.58	12.98	12.4	7.98	28.5	49.0	8.36
	(468)	(517)	(516)	(503)	(516)	(502)	(468)	(506)	(1)
2001	22.97	11.2	1.48	12.48	9.65	7.99	33.4	48.5	7.95
	(426)	(502)	(500)	(482)	(501)	(492)	(426)	(495)	(1)
2002	18.0	−1.35	1.37	12.09	8.88	7.96	28.5	46.6	7.8
	(431)	(491)	(482)	(464)	(490)	(484)	(431)	(490)	(1)

Notes: All figures are percentages except P/E and Size. The number of observations is in parentheses. Return is the annual stock return.

3. Empirical Results

3.1 Results of the P/E Regression Model

We now turn to the presentation and interpretation of the empirical results. Although the DDM does not imply a linear regression as in Equation (3), we adopt a linear regression for two reasons. First, linear models have been used in many previous studies (e.g., Beaver and Morse, 1978; Cho, 1994; Park, 2000). Second, we also fit a log-linear model with results not materially different, yet it produces a significantly lower R-square value. The results of a pooled regression are shown in Table 2. We observe that P/E ratios are positively and strongly correlated with the analysts' long-term growth estimate (G5), consistent with the model prediction that P/E ratios are positively related to earnings growth rate expectations. The short-term growth forecast (G1), however, bears a negative sign although it is only weakly significant at the 10% level. It is evident that the dividend payout ratio (D/E), as expected, carries a positive sign and is statistically significant at the 0.1% level.

Table 2. Regression Model of P/E Ratios

Variable	Coefficient	Standard Errors	*t*-Statistic	p-Value
Intercept	5.05	8.51	0.59	0.5530
G1	−1.25	0.68	−1.83	0.0667
G5	1.62	0.17	9.27	<0.0001
D/E	20.28	0.21	98.43	<0.0001
Size	2.65	0.63	4.19	<0.0001
Debt	−34.42	6.05	−5.69	<0.0001
Std	49.08	26.22	1.87	0.0613
Baa	−1.99	0.43	−4.66	<0.0001

Notes: Adjusted $R^2 = 0.5122$.

To measure firm risk, we employ the debt ratio and the standard deviation of stock returns. The estimated coefficient for the debt ratio is negative and is statistically significant at the 0.1% level, in agreement with the argument that higher financial risk raises equity holders' required returns and thus lowers the P/E multiples. The second measure of firm risk, Std, is marginally significant at the 10% level. However, the positive sign contradicts the prediction of the discounted cash flow model. One possible interpretation is that the standard deviation of stock returns serves as a proxy for other unknown variables that positively impact P/E ratios. We know that high growth rate firms are usually more volatile and command higher P/E multiples. Since we control for the effect of the earnings growth rate in the estimation, Std doesn't reflect the impact of growth rate. Nevertheless, it could still capture the effect from unobservable variables, such as intangible assets. For instance, stock return volatility could be a proxy of a firm's information asymmetry, which often is associated with intangible assets.

The company size variable (Size), measured by the natural logarithm of a

firm's market value of equity, exerts a positive and statistically significant impact on P/E ratios at the 0.1% level. Finally, the yield of Baa-rated corporate bond is negatively and significantly associated with P/E ratios, reflecting the contention that bad economic fundamentals, i.e., high default risk and/or inflation risk, reduces the earnings multiple. Since the Baa-yield is a time series variable, it can capture structural shifts in cross-sectional P/E models over time.

With an adjusted R-square value of 51.22%, this P/E regression model seems to fit reasonably well, thus we can extract residual P/Es from observed P/E ratios:

$$\xi_{it} = (\text{P/E})_{it} - E\left[(\text{P/E})_{it}\right], \tag{4}$$

for each firm in each year, and we call ξ_{it} the residual P/E.

3.2 Performance of Extreme P/E Portfolios

It is noted that only very high and very low P/E ratios reflect investor "greed or fears." To investigate whether the P/E anomaly is attributed to investor over-optimism (pessimism) or to time-varying fundamentals, we study the performance of extreme P/E portfolios for up to three years after the portfolio formation year. For each year beginning in 1982, we establish portfolios based on individual stocks' residual P/E ratios. Stocks with residual P/Es in the top decile are grouped into an equally weighted portfolio called the top residual P/E portfolio, while those with residual P/E ratios in the bottom decile are combined into an equally weighted bottom residual P/E portfolio. For comparison, we also form the top P/E and bottom P/E portfolios based on observed P/E ratios in the same fashion.

We calculate portfolio returns for three years and then classify these returns into 10 different levels, with level 10 the best performer and level 1 the worst. In other words, the 10 levels of performance are determined each year separately when stock returns of the whole sample are partitioned into 10 categories. For example, in a given year, if stock returns of the top decile range from 28% to 25%, then any return falling into this range will be assigned level 10. We repeat this ranking procedure for the extreme portfolios corresponding to various degrees of observed and residual P/E ratios. One advantage of this ranking procedure is that it allows us to bypass the complication of introducing the effect of yearly market performance.

3.3 Extreme Portfolios Formed Based on Observed P/E Ratios

For comparison with previous studies, the results for the top P/E portfolios based on observed P/E ratios are given in Table 3. Year t is the portfolio formation year and $t+1$, $t+2$, and $t+3$ represent the first, second, and third year after the formation year. For example, in 1983 (the first post-formation year), the top P/E portfolio was placed in the level 8 category in 1982 (the formation year). The portfolio, however, declined to a level 6 performer in 1983 ($t+1$), a level 2 performer in 1984 ($t+2$), and ratcheted up to level 6 in 1985 ($t+3$).

Table 3. Post-Formation Performances of the Top P/E Portfolio

Top P/E Portfolio				
$t+1$	t	$t+1$	$t+2$	$t+3$
1983	8	6	2	6
1984	8	2	3	3
1985	3	5	4	7
1986	5	4	7	4
1987	4	7	5	4
1988	7	6	4	5
1989	7	6	6	5
1990	6	3	5	6
1991	7	7	7	5
1992	8	7	7	7
1993	8	7	7	4
1994	8	6	5	7
1995	7	6	7	5
1996	8	7	4	5
1997	7	3	7	6
1998	5	6	6	6
1999	7	6	5	4
2000	9	4	3	2
Average	6.78	5.44	5.22	5.06
Change		−19.67%	−4.08%	−3.19%

Notes: Portfolio performance is rated from 1 (worst) to 10 (best) based on the performance of all stocks in that year. Average performance is the arithmetic mean of yearly performance from 1983 to 2000.

We form new extreme portfolios in 1983 and repeat this procedure for each year thereafter, and the average performance is also provided. During the 18 post-formation years, it is evident that 14 witness a performance reversal (performance decline) a year after the formation year (in year $t+1$), one experiences the same performance, and two achieve better performance. These results imply a reversal in performance for the top P/E portfolio (glamour stocks), consistent with previous findings. As shown in the bottom line of the table, the average performance (at 6.78 in year t) drops by 19.67% to 5.44 in year $t+1$, followed by a further decline of 4.08% to 5.22 in year $t+2$, then again decreases by 3.19% to 5.06 in year $t+3$. Panel A of Figure 1 plots the changes in the average performance over the four-year period for the top P/E portfolio.

Table 4 reports the results for the bottom P/E portfolio formed upon observed P/E ratios. We find that during the 18-year period, 12 exhibit increases in performance in year $t+1$, one maintains a similar level of performance, and three deteriorate in performance. This performance reversal is also confirmed by the average performance reported. The bottom P/E portfolio has an average performance level of 4.39 in the portfolio formation year but increases by 39.24% to 6.11 in year $t+1$. Comparing Tables 3 and 4, it can be concluded that one-year

performance reversal for the bottom P/E portfolio appears to be stronger than the top P/E portfolio, signifying that contrarian strategies may work better for low P/E portfolios (value stocks) than for high P/E portfolios (glamour stocks). Panel B of Figure 1 illustrates the average performance for the bottom PE portfolio over a four-year period. This finding again is consistent with previous studies that value stocks perform better in subsequent years.

To summarize, our analysis indicates that Hypothesis 1 cannot be rejected. There exist performance reversals when extreme portfolios are formed using observed P/E ratios. In other words, the high P/E portfolio (glamour stocks) performs comparatively worse, while the low P/E portfolio (value stocks) achieves better performance in subsequent years.

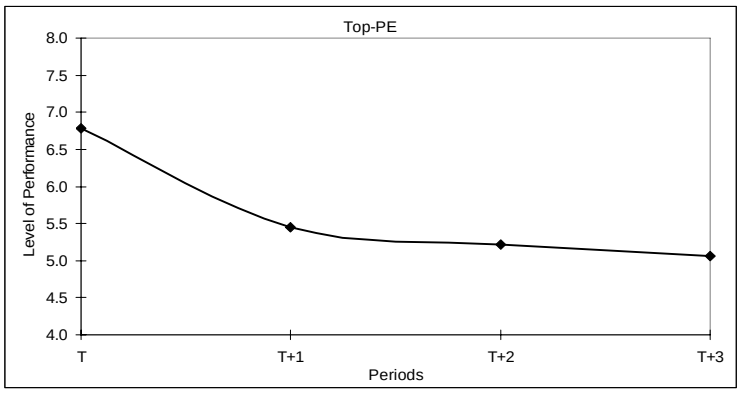
Table 4. Post-Formation Performances of the Bottom P/E Portfolio

Bottom P/E Portfolio				
$t+1$	t	$t+1$	$t+2$	$t+3$
1983	3	6	7	5
1984	4	9	6	7
1985	8	6	7	4
1986	5	6	4	7
1987	6	4	6	6
1988	5	8	6	4
1989	7	5	4	6
1990	4	5	7	8
1991	3	8	8	7
1992	5	7	5	5
1993	5	6	4	6
1994	5	6	7	6
1995	3	6	4	6
1996	4	5	5	5
1997	3	7	5	6
1998	4	4	6	6
1999	2	6	5	7
2000	3	6	7	6
Average	4.39	6.11	5.72	5.94
Change		39.24%	−6.36%	3.88%

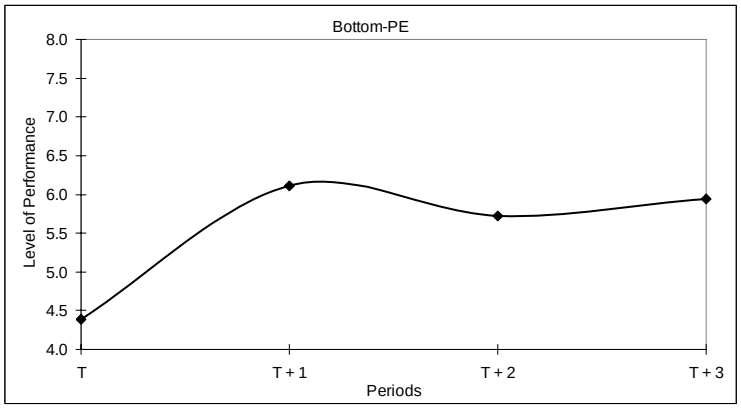
Notes: Portfolio performance is rated from 1 (worst) to 10 (best) based on the performance of all stocks in that year. Average performance is the arithmetic mean of yearly performance from 1983 to 2000.

Figure 1. Average Performance Levels of Extreme Portfolios Based on Observed P/E Ratios

Panel A: Top P/E Portfolio



Panel B: Bottom P/E Portfolio



3.4 Extreme Portfolios Formed Based on Residual P/E Ratios

Since we argue that observed P/E ratios contain both fundamental and overreaction components, we proceed with the investigation of the performance of top residual P/E and bottom residual P/E portfolios corresponding to the top and bottom deciles of the residual P/E ratios in the P/E regression model. This exercise provides us with further insight into the extreme portfolio issue. We argue that if the P/E anomaly is caused by investor over-optimism (pessimism), extreme portfolios formed on the basis of residual P/E ratios provide cleaner measure of investor behavior. Therefore, if residual P/E portfolios exhibit no mean reversion, the reported P/E anomaly is due to time-varying fundamentals and is consistent with market efficiency.

The results of the top residual P/E portfolios are presented in Table 5. During

the same 18-year formation period, eleven evidence performance reversals a year after the portfolio formation year, two show no change, and five exhibit increases in performance. Albeit a little weaker than the results reported in Table 3, performance reversals are also found in the top residual P/E portfolio. The average performance level of 6.5 in the formation year decreases to 5.28 in year $t+1$, which translates into a decline of 18.8%. These results are thus consistent with Hypothesis 2: investors tend to be over-optimistic and overbid growth stocks. In general, the observed performance reversals based on P/E sorted portfolios cannot be explained solely by the time-varying fundamentals. In Panel A of Figure 2 the average performance level of the top residual P/E portfolio over the four-year period is plotted, where a performance reversal in year $t+1$ is visibly seen.

Table 5. Post-Formation Performances of the Top Residual P/E Portfolio

Top Residual P/E Portfolio				
$t+1$	t	$t+1$	$t+2$	$t+3$
1983	4	6	5	4
1984	8	3	6	5
1985	4	5	5	7
1986	5	4	7	6
1987	5	6	8	6
1988	6	6	6	4
1989	7	6	5	6
1990	7	5	7	6
1991	5	6	8	7
1992	8	7	7	8
1993	9	7	7	5
1994	8	6	6	8
1995	8	6	7	6
1996	6	6	5	6
1997	7	3	6	8
1998	3	4	7	4
1999	8	5	5	5
2000	9	4	4	2
Average	6.50	5.28	6.17	5.72
Change		−18.80%	16.84%	−7.21%

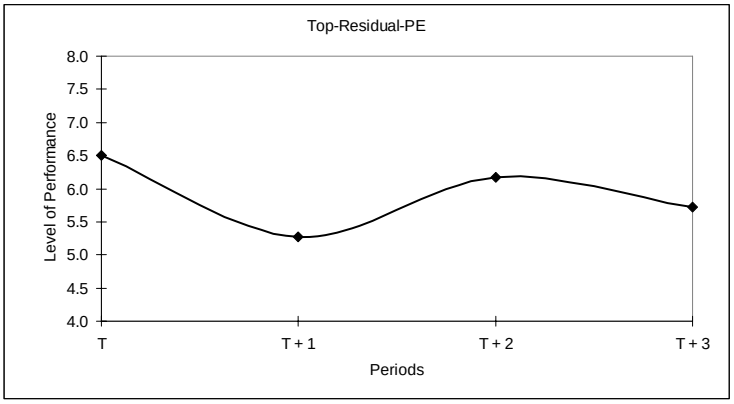
Notes: Portfolio performance is rated from 1 (worst) to 10 (best) based on the performance of all stocks in that year. Average performance is the arithmetic mean of yearly performance from 1983 to 2000.

Table 6 contains information about the bottom residual P/E portfolios formed based on the bottom decile of residual P/E ratios. Here little evidence of a performance reversal is detected. We find that nine out of eighteen years experience performance reversals in year $t+1$, six show decreases in performance, and three stay at the same level as in the formation year. The average performance level increases minimally from its initial value of 5.78 (in year t) to 6.00 a year later, or a 3.85% increase in performance. Performance reversals in years $t+2$ and $t+3$ are

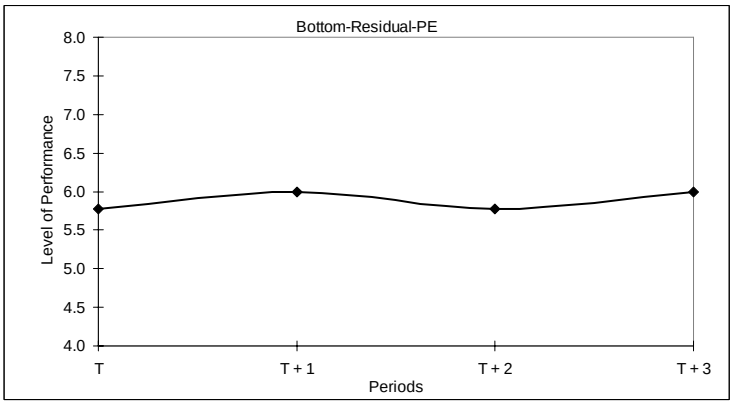
both small in magnitude. Hence, after time-varying fundamentals are removed from the observed P/E multiples, investor over-pessimism is absent in our analysis. This reveals that previous findings of investor over-pessimism in low P/E stocks can be attributed to firm and economic fundamentals (i.e., firm and economic risk factors). Panel B of Figure 2 plots the average performance level of the bottom residual P/E portfolio over the four-year period. Results from Tables 5 and 6 generally do not support the third hypothesis that investor overreaction is symmetrical.

Figure 2. Average Performance Levels of Extreme Portfolios Based on Residual P/E Ratios

Panel A: Top Residual P/E Portfolio



Panel B: Bottom Residual P/E Portfolio



Overall, we conclude that our findings only partially support past findings of investor overreaction. Specifically, after removing firm and economic fundamentals from the observed P/E ratios, results of the top residual P/E portfolio confirm the existence of investor over-optimism and tendency to overbid glamour stocks. In contrast, results of the bottom residual P/E portfolio reveal the absence of investor

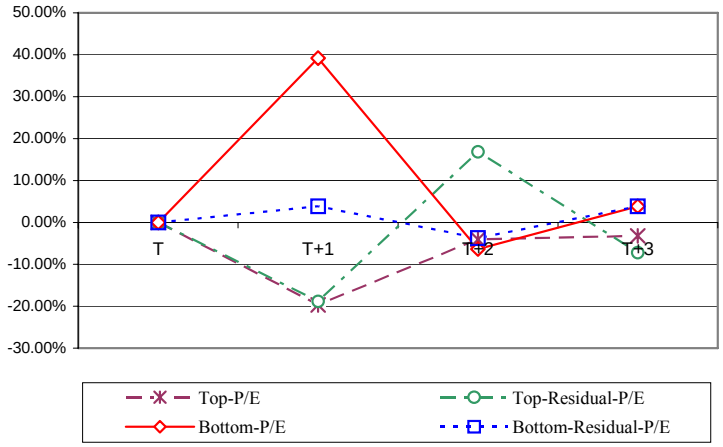
over-pessimism. Although bottom P/E portfolios exhibit strong increases in stock returns, they can be explained by the changes in firm and economic fundamentals. After these fundamentals are subtracted from the observed P/E ratios, stock return reversals vanish. In Figure 3, we plot the percentage changes in portfolio performances for all extreme portfolios. The difference between the performance patterns of the bottom P/E and the bottom residual P/E portfolios is evident.

Table 6. Post-Formation Performances of the Bottom Residual P/E Portfolio

Bottom Residual P/E Portfolio				
$t+1$	t	$t+1$	$t+2$	$t+3$
1983	6	7	3	6
1984	6	4	2	4
1985	3	4	4	6
1986	4	2	5	6
1987	4	7	6	5
1988	6	6	5	5
1989	5	4	4	6
1990	4	5	7	7
1991	5	8	7	6
1992	6	7	7	8
1993	7	7	7	7
1994	7	8	7	8
1995	7	5	8	4
1996	6	7	4	7
1997	8	6	8	7
1998	7	7	8	5
1999	6	8	5	5
2000	7	6	7	6
Average	5.78	6.00	5.78	6.00
Change		3.85%	−3.70%	3.85%

Notes: Portfolio performance is rated from 1 (worst) to 10 (best) based on the performance of all stocks in that year. Average performance is the arithmetic mean of yearly performance from 1983 to 2000.

Figure 3. Comparison of Performance Reversals of Observed and Residual P/E Ratio Portfolios



4. Concluding Remarks

In this paper, we re-examine the P/E anomaly by decomposing P/E ratios into a fundamental component and a residual component, which enables us to capture factors that potentially provide better measures of investor overreaction. Although several earlier studies in the literature have found the high (low) P/E stocks earn lower (higher) returns in subsequent years, others have argued that P/E sorted portfolios are not very effective in timing the market (Shen, 2003). Furthermore, the causes of performance reversals have sparked a debate on whether stock returns are predictable or whether the reversal is simply the result of changing risk factors. We attempt to analyze whether this performance reversal is due to predictable time-varying firm and economic fundamentals or to investor over-optimism (pessimism).

If investor overreaction prevails, one would anticipate that performance reversals continue to exist when extreme P/E portfolios are formed based on residual P/E ratios. On the other hand, if prior findings of the P/E anomaly are attributable to the time-varying firm and economic fundamentals, extreme P/E portfolios constructed on the basis of residual P/E ratios should exhibit no performance reversals. Accordingly, the P/E regression model that combines firm-specific factors with macroeconomic fundamentals is examined and residuals extracted from this model for each firm are used to form extreme P/E portfolios. Within the above framework, we arrive at the following conclusions.

First, we find both firm-specific and macroeconomic factors determine P/E multiples. Analysts' long-term growth rate forecast, dividend payout ratio, and firm size are all positively associated with P/E ratios, while financial risk and aggregate bond yields are negatively associated with P/E ratios.

Second, we discover strong evidence of performance reversals for the top P/E and bottom P/E portfolios in the years subsequent to the portfolio formation year, with the strongest reversal occurring in the first post-formation year. The results also show stronger return reversals for the bottom P/E portfolio than for the top P/E portfolio. These findings are basically consistent with prior findings regarding stock return predictability using P/E ratios.

Third, extreme portfolios constructed based upon residual P/E ratios, however, exhibit performance reversals only for portfolios constructed using top residual P/E ratios. This result, therefore, supports the over-optimism hypothesis of the P/E anomaly: investors tend to overbid glamour stocks. Conversely, the bottom residual P/E portfolio shows no sign of performance reversals, indicating the lack of over-pessimism. The performance reversal of the low P/E stocks can thus be explained by changing firm and economic fundamentals, not investor overreaction.

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