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Abstract

While the low P/E effect has been examined rather extensively in international markets particularly in the US, there is a notable absence of Australian market-based P/E studies. This research examines the relationship between the investment performance of Australian Industrial common stock and their P/E ratios in an attempt to uncover potential for a P/E based trading strategy. The excess and differential returns of P/E ranked portfolios containing 1310 Industrial firms over a 9 year period (January 1998 to December 2006) are examined. The results show the existence of a low P/E effect in the Australian capital market. Furthermore, the superior returns of low P/E stocks increase when a consensus of two business failure prediction models is applied to the portfolio of low P/E stocks. The statistically significant risk-adjusted returns afforded to hypothetical investors over the sample period (up to 12½% per annum), not only provide support for a P/E based trading strategy, but also suggest a violation of the semi-strong form of the Efficient Market Hypothesis.

Key words: efficient market hypothesis, price earnings ratio, P/E, trading strategy, equity valuations

JEL classification codes: G11 G14

1. Introduction

Studies examining the relationship between accounting information and share prices became most popular during the 1970s. This market-based accounting research arose from a group of studies that examined the predictive ability of accounting information (Beattie 2003). It was believed that accounting based ratios such as P/E ratios and dividend-price ratios may "be useful in forecasting future stock price changes, contrary to the simple efficient-markets models" (Campbell & Shiller 2001, abstract).

Basu's 1977 paper, *Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis* is the seminal paper in this area. Basu's empirical study finds that companies with low P/E ratios on average earn significantly higher absolute and risk-adjusted rates of return than higher P/E portfolios. Basu's findings challenge the EMH and he was the first to test the notion that value-related variables might explain violations of the Capital Asset Pricing Model (CAPM) (Keim 2006). After referring to this phenomenon as the low P/E effect, subsequent papers have offered a behavioural explanation summarised by the 'overreaction hypothesis'.

Adopting a methodology similar to Basu (1977), Johnson, Fiore and Zuber (1989) question the validity of Basu's (1977) conclusions. Johnson et al. (1989) acknowledge that some moderate excess rates of return may have been achieved by selecting stocks on the basis of their P/E ratios. They found, however, that these excess returns would have been achieved by investing in *high* P/E stocks. Basu's study spurred numerous studies both challenging and confirming his findings (See Johnson et al. 1989, Ball (1978), Dreman and Berry (1995) for example). Given the conflicting results, this thesis seeks to provide further evidence on this topic by adopting a very similar methodology to that of Basu.

The objective of this research is to investigate a potential low price-earnings (P/E) investment strategy as a means of making abnormal returns. Basu's research is extended, by testing a trading strategy based on this low P/E proposition, coupled with the use of a business failure prediction model (BFPM). Consistent with the findings of early studies that show PE ratios regress to the norm, ((Molodovsky, 1995, Block, 1995) we argue that this regression to the norm is a change in equilibrium positions where those firms that have the capacity to survive will eventually produce market expected returns. The prediction of those with the potential for success enables the investor to achieve an abnormal return over the holding period.

The excess and differential returns of portfolios containing 1310 Industrial firms in total were examined over 9 full calendar years from January 1998 to December 2006. Consistent with prior research (Basu 1977), the results documents the existence of the low P/E effect in the Australian capital market. A portfolio based on low P/E stocks was able to earn a return of 11.52% per annum more than what is implied by its risk. Furthermore it was found that the superior returns of low P/E stocks increase when a consensus of two Failure Prediction Models is applied to the portfolio of low P/E stocks, increasing the risk-adjusted return to approximately 12½% per annum. This thesis concludes that there is strong support for a trading strategy based on low P/E ratios.

The remainder of this paper proceeds as follows. The next section documents the theory behind the use of low PE ratio firms. This is followed by the research methods and sample selection. The penultimate section presents the analysis of the data. The final section presents the conclusions, limitations and suggestions for future research.

2. Theory Development

Several empirical studies have since surfaced with evidence suggesting otherwise, challenging the RWM and, more generally, the EMH. Considering the body of efficient markets literature in its entirety, much of the empirical evidence appears to support the semi-strong form of market efficiency. However, many academics have also offered opposing views. Grossman (1976) and Grossman and Stiglitz (1980) are two of the more notable theoretical contributions to the area. The growing 'evidence' of EMH inconsistencies identifies a number of abnormalities. These include

- seasonal anomalies (Keim 1983; Harris, 1986; French 1980; Ariel 1987; Rozeff and Kinney 1976;
- new issue anomalies (Ritter 1991; Loughran and Ritter 1995);
- winner-loser anomalies (DeBondt and Thaler's 1985, Brailsford 1992, Fama and French 1986, Vermaelen and Verstringe 1986, DeBondt and Thaler 1987, Chan

1988, Chopra, Lakonishok and Ritter 1992, Jegadeesh and Titman 1993, and Ball, Kothari and Shanken 1995, Brailsford 1992, Allen and Prince 1995, Gaunt 2000);and

- P/E anomalies and/or firm size anomalies. This research falls into the category of P/E and size anomalies. P/E anomalies have focused on negative P/Es and size anamolies. The remainder of this research deals specifically with the P/E anomaly.

An anomaly detected across many of the P/E studies became known as the *'low P/E effect'* or just the *'P/E effect'* (Nicholson 1969, 1968). Basu's 1977 paper, *Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis* is the seminal paper in this area. Basu's results (1977) generally support Nicholson's results (1960, 1968) that report that companies with low P/E ratios on average earn significantly higher absolute and risk-adjusted rates of return than higher P/E portfolios. Basu examines the common stock of approximately 1400 industrial firms with December 31st fiscal year ends, listed on the New York Stock Exchange (NYSE) for the period between 1957 and 1971. Stocks were ranked by E/P ratios (the reciprocal of the P/E ratio – also referred to as *earnings yield*) and divided into quintiles. By ranking the firms on earnings yield, this meant that firms with negative earnings formed a part of the highest P/E ratio quintile. These portfolios were rebalanced yearly, with a hypothetical investment date of April 1st. Basu finds that low P/E ratio portfolios have significantly higher absolute and risk-adjusted rates of return than high P/E portfolios. The average annual rate of return and beta were 9.34% and 1.11 respectively for the highest P/E ratio portfolio, and 16.3% and 0.99 respectively for the lowest P/E ratio portfolio.

Basu notes that the average annual rates of return for the interim portfolios decline almost monotonically as one moves from low P/E to high P/E portfolios. He also finds that, contrary to capital market theory, increased levels of systematic risk do not completely explain these differences in return. Basu explains that his results "are consistent with the view that P/E ratio information was not 'fully reflected' in security prices in as rapid a manner as postulated by the semi-strong form of the efficient market hypothesis" (1977, p.680). Therefore under the assumption that the asset pricing model is valid, Basu concludes that disequilibria persisted in capital markets during the period studied.

A direct reply to Basu's paper by Johnson et al. (1989) offered results which contradict those found by Basu. They found, however, that these excess returns would have been achieved by investing in *high* (not low) P/E stocks. While Johnson et al. (1989) do not offer an explanation for the dissimilarity in results, it is noted that the major difference between the two studies is the time period in which they studied.

Subsequent to these early low P/E studies, many publications surfaced attempting to explain the low P/E phenomena. Ball (1978) and Banz and Breen (1986) were among those who criticised Basu for some of his methodology choices. Cook and Rozeff (1984) also claim that Basu's results are sample-specific. Some studies on the other hand, attempted to explain the low P/E effect as the 'size effect' or 'small firm effect'.

Reinganum (1981) found that firms characterised by small market capitalisation have higher risk adjusted returns relative to those firms with larger market capitalisation. Reinganum analyses a sample of 566 New York Stock Exchange and American Stock Exchange stocks finds that portfolios formed on the size of firms or earnings-price ratios exhibit average returns systematically different from those predicted by the CAPM (Reinganum 1983). However, this earnings-price effect is not evident when the size effect is controlled for, leading Reinganum to conclude that the firm size effect for the most part subsumes the P/E effect.

Banz (1981) produced results consistent with Reinganum's findings. Roll (1981) notes that previous empirical studies have found that small listed firms yield higher average returns than large firms even when risk levels are matched. Brown, Kleidon and Marsh (1983) also identified anomalous behaviour consistent with the findings of Basu (1977). They showed that small firms tend to yield greater returns than what is predicted by the CAPM. They identified that the size effect is not stable through time and is hence sensitive to the time period under analysis. Blume and Stambaugh (1983) also offered criticisms of the size effect, asserting that "previous estimates of a 'size effect' based on daily returns data are biased" (p.387).

While it may be thought that the size effect subsumes the low P/E effect, no underlying explanation has been forthcoming. Ryan et al. (2002) note that there has not been a comprehensive explanation for the size effect to date. It may be the case that both ‘effects’ are capturing the same phenomena and, as such, the size effect may simply serve as a proxy for the P/E effect. Similarly, Cook and Rozeff (1984) have suggested that the P/E and size effects may both be aspects of a single underlying effect.

Basu (1983) confirms that firms with high earnings-price ratios earn, on average, higher risk-adjusted returns than firms with low earnings-price ratios and “this effect is clearly significant even if experimental control is exercised over differences in firm size” (Basu 1983, p.26). Numerous papers have sought to confirm, extend, or challenge the P/E effect. More recent US studies are briefly outlined in Table 1.

INSERT TABLE 1 HERE

Table 2 gives a non-exhaustive list of international studies on the low P/E effect as documented by Anderson and Brooks (2006). This table highlights the extensive coverage of the low P/E effect worldwide. After considering the numerous studies discussed thus far and the international examples listed in Table 2 it is evident that the Australian market remains relatively untouched from a low P/E effect perspective.

A Theory of Price-earnings Ratios – Mean Reversion

A *generally* accepted notion among academics and practitioners alike is the negative relationship between P/E ratios and stock returns (Weigand and Irons 2004). The decreasing (increasing) stock price will decrease (increase) the firm’s P/E ratio, such that over time the P/E ratios will revert to a comparable firm (or market) average. The low P/E class supposedly outperforms the market, while their high P/E counterparts under-perform the market (Dreman and Berry 1995).

This mean reverting process was alluded to as early as Molodovsky (1953). He notes that while stocks fluctuate, they will do so around a computable value. The technical reasoning behind this process was discussed in a seminal paper by Campbell and Shiller (1987). In this paper they identify both prices and earnings as nonstationary time series. However, when considered together in a linear form, the two variables exhibit a cointegrating relationship, and as such the P/E ratio is a stationary process[1]. An

[1] In a recent study, Weigand and Irons (2004) found that the market P/E becomes nonstationary about the same time investors begin using the Fed Model (at a high level of P/E ratio), implying that the P/E ratio can stay above trend, no longer displaying a mean-reverting behaviour.

important property of stationary time series is that the data (in this case the P/E ratios), will "revert to its mean with some regularity via a reverse repricing effect" (Weigand and Irons 2004, p.3). Figure 1 below demonstrates graphically a simplistic mean reversion process over time.

INSERT FIGURE 1 HERE

In a later paper, Campbell and Shiller (1998) posit that the shift of P/E ratios back toward their long-term averages is driven mostly by changes in stock price growth rather than changes in earnings growth. From this observation, it can be inferred that the forces of supply and demand in financial markets are responsible for P/E mean reversion.

While Campbell and Shriller (1987, 1998, 2001) were able to explain the technical process behind P/E ratio mean reversion, the properties of stationary time series do little to explain *why* prices and earnings have a cointegrating relationship. The various hypotheses will be addressed firstly in chronological order, and then in a categorical diagram format to avoid any confusion.

A Theory of Price-earnings Ratios Investor Exaggeration

Smidt (1968) posits that exaggeration from markets is an inappropriate response to information and is a potential source of market inefficiency. Smidt suggests that this exaggeration affects P/E ratios: exaggerated pessimism is, on average, reflected in low P/E ratios, and exaggerated optimism is, on average, reflected in high P/E ratios.

The price-ratio hypothesis popularised by Basu (1975, 1977) is the theory that "P/E ratios are indicators of the future investment performance of securities" (Basu 1975, p.53). This hypothesis surfaced as attempts were made to determine the usefulness of the P/E ratio as an analytical tool for stock selection (Basu 1975). The low P/E effect as discussed previously, is a special case of the price-ratio hypothesis whereby securities with low P/E ratios, on average, outperform their high P/E counterparts. It is hypothesised that this phenomena is due to investor exaggeration as described by Smidt (1968). Basu (1977) suggests that this behavioural explanation is an appropriate rationalisation for those studies gone before him, which also identify the superior investment performance of low P/E stocks[2].

The IOH or simply 'investor overreaction' is discussed widely in financial literature, most notably by DeBondt and Thaler (1985, 1987), Dreman and Berry (1995) and Dreman and Lufkin (2000). Investor overreaction, as described by Dreman and Berry (1985) is the process whereby investors tend to overreact to unexpected news. This hypothesis asserts that the market places extra weight on the most current information, while diverting emphasis from earlier information. The IOH is simply a broader version of the price-ratio hypothesis that is able to explain both the exaggeration captured by the price-ratio hypothesis *and* the success of other contrarian strategies[3,4].

The winner-loser anomaly[5] and its subsequent hypothesis were largely uncovered by DeBondt and Thaler (1985, 1987). This hypothesis is based on the finding that the *worst* performing stocks in one period (low P/E stocks) *outperformed* the market in the subsequent periods, and the *best* performing stocks in one period (high P.E stocks) *underperformed* the market in the subsequent periods. DeBondt and Thaler (1985) found this result to be consistent with the overreaction hypothesis.

A Theory of Price-earnings Ratios - Mispricing-Correction Hypothesis (MCH)

The MCH emerged in response to the inadequacy of the IOH to explain similar behavioural phenomena, such as investor underreaction[6]. Dreman and Berry (1995) suggested calling the idea (that the original mispricing is followed by corrective price action) the MCH. Under this hypothesis, underreaction and overreaction need not be mutually exclusive. In fact, Dreman and Berry (1995) suggests they could "play complementary and interactive roles" (p.22). They found that overreaction (mispricing) occurs prior to the news event and underreaction (correction) occurs after the news event.

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[2] See McWilliams (1966), Miller and Widmann (1966), Breen (1968), Breen and Savage (1968), and Nicholson (1968).
[3] A contrarian stock selection strategy as defined by Chan (1988) "consists of buying stocks that have been losers and selling short stocks that have been winners" (p.147).
[4] See section 2.2.4.4 and 2.3.1.4.
[5] See section 2.2.4.4.
[6] See Bernard and Thomas (1990).

The earnings surprise hypothesis, with elements of both over and underreaction, is one source of the demand for the MCH. This hypothesis suggests that "investors often overvalue the prospects of best [high P/E] and undervalue the prospects of worst [low P/E] investments" (Dreman and Berry 1995, p.22). Dreman and Berry (1995) propose two distinct types of price response: event triggers and reinforcing events. They predict that as a net effect, the worst stocks outperform the market (low P/E stocks) and the best stocks underperform the market (high P/E stocks).

All of the above forms of investor irrationality allude to investor overreaction (or underreaction) in some form or another. Investor overreaction is caused when sample information is overweighted relative to priors (Ryan et al. 2002). But why do investors weight information incorrectly?

DeBondt and Thaler (1985, 1987) suggest that this is because many investors are poor Bayesian decision makers. DeBondt and Thaler (1987) posit that overreaction is a tendency in the probability revision process of Bayesian decision making. Renshaw (1995) hypothesises that this may be because many investors are inexperienced. As experienced investors leave the market and new naive investors join, the proportion of investors with little market experience grows. An alternative explanation for decisions leading to overreaction is *herd mentality*. Instead of analysing and incorporating all new information into their existing beliefs, many investors buy and sell only because they see others doing the same. These investors, in an attempt to beat the crowd, little realise that in fact, they *are* the crowd.

Efficient market theory predicts that there will be no significant relationship between P/E ratios and average excess returns. All behavioural theories are at variance with the efficient market theory. Hypotheses 1a, 1b and 1c have been developed to formally test the above prediction. This section presents the results of these tests.

HYPOTHESIS 1a:	*The mean excess return of low P/E stocks is equal to the mean excess return of high P/E stocks.*
Testable hypothesis:	$H_0 : \mu_L = \mu_H$ *Against:* $H_1 : \mu_L > \mu_H$
HYPOTHESIS 1b:	*The mean excess return of low P/E stocks is equal to the mean excess return of the market*
Testable hypothesis:	$H_0 : \mu_L = \mu_M$ *Against:* $H_1 : \mu_L > \mu_M$

Where μ_M is the mean return of the market portfolio, in excess of the risk free rate.

HYPOTHESIS 1c: The mean excess return of high P/E stocks is equal to the mean excess return of the market.

Testable hypothesis: $H_0 : \mu_H = \mu_M$ *Against:* $H_1 : \mu_H < \mu_M$

Similar to Hypothesis 1, efficient market theory predicts that there will be no significant relationship between P/E ratios and average differential returns. Specifically (contrary to Basu (1977)) it is predicted that, on average, stocks with low P/Es will not have a positive risk-adjusted return; stocks with high P/Es will not have a negative risk-adjusted rate of return; and low P/E stocks will not outperform high P/E stocks in terms of risk-adjusted average rates of return. The following hypotheses are formulated to test these propositions.

HYPOTHESIS 2a: The average risk-adjusted rate of return of low P/E stocks is not significantly different from zero.

Testable hypothesis: $H_0 : \hat{\delta}_L = 0$ *Against:* $H_1 : \hat{\delta}_L > 0$

Where $\hat{\delta}_L$ *is Jensen's differential return of the low P/E portfolio.*

HYPOTHESIS 2b: The average risk-adjusted rate of return of high P/E stocks is not significantly different from zero.

Testable hypothesis: $H_0 : \hat{\delta}_H = 0$ *Against:* $H_1 : \hat{\delta}_H < 0$

Where $\hat{\delta}_H$ *is Jensen's differential return of the high P/E portfolio.*

HYPOTHESIS 2c: The average risk-adjusted rate of return of low P/E stocks is equal to the average risk-adjusted rate of return of high P/E stocks.

Testable hypothesis: $H_0 : \hat{\delta}_L = \hat{\delta}_H$ *Against:* $H_1 : \hat{\delta}_L > \hat{\delta}_H$

Note: If hypothesis 2a and hypothesis 2b are not rejected, then by definition, hypothesis 2c must also not be rejected. Similarly, if hypothesis 2a and hypothesis 2b are rejected, then by definition, hypothesis 2c must be rejected.

Low P/E stocks not conforming to P/E mean reversion theory (particularly failing firms) will noticeably weaken the effect of a low P/E based trading strategy. If these failing firms are removed from a portfolio of low P/E stocks, then in theory this portfolio *should* perform better than it otherwise would. Identifying failed firms post-fact is simple; the difficulty comes in predicting the stocks that will fail prior to investment. If filtering failing firms appears to increase the effectiveness of a low P/E based trading strategy, then the potential for such a strategy in practice is greatly enhanced.

Extending the work of Basu (1977), this thesis will test the effectiveness of such a strategy through the use of a BFPM. As BFPMs use financial information that is publicly available, according to efficient market theory any prediction of failure should already be reflected in the price of the financial asset, hence driving the price towards zero. Assuming low P/E portfolios do not include firms with zero prices, efficient market theory predicts that the use of a market-supported BFPM will not have a significant impact on the differential returns of low P/E portfolios. The following hypothesis is formulated to test this proposition.

HYPOTHESIS 3: *The average risk-adjusted rate of return of a portfolio of low P/E stocks is equal to the average risk-adjusted rate of return of a portfolio of low P/E stocks constructed after the use of a BFPM.*

Testable hypothesis: $H_0 : \hat{\delta}_L = \hat{\delta}_{LF}$ *Against:* $H_1 : \hat{\delta}_L < \hat{\delta}_{LF}$

Where $\hat{\delta}_{LF}$ *is Jensen's Differential Return of the low P/E portfolio(s) constructed after the use of a BFPM.*

3. Research Methods

To date, little evidence pertaining to the Australian equity market exists. Australian studies examining market overreaction include Brailsford (1992), Allen and Prince (1995), Gaunt (2000) and Gray and McAllister (2000). Their analyses focus specifically on the winner / loser anomaly[7], highlighting the absence of research surrounding the P/E ratios of listed Australian companies. Brailsford (1992) suggests that the deficiency of Australian research examining market overreaction is due to the lack of a sufficient return database. Hence, the opportunity exists for the compilation and testing of such a database to investigate a relatively unexamined marketplace.

While this research replicates much of Basu's (1977) methodology, it seeks to update and improve the econometric techniques employed in order to heighten statistical validity. Firstly, it is not clear that Basu has adequately tested all regression assumptions. Second,

[7] The winner / loser anomaly refers to the phenomena whereby those stocks experiencing over and under performance (winners and losers) tend to experience extended performance reversal in the subsequent test period.

this paper improves upon Basu's methodology by using more refined measures of testing for regressor stationarity. Unit root tests such as the Augmented Dickey-Fuller test, the Phillips-Perron test and the Kwiatkowski, Phillips, Schmidt and Shin test are the most appropriate to examine stationarity.

Thirdly, Basu (1977, p.666) observes without testing that "average annual rates of return decline (to some extent monotonically) as one moves from the low P/E to high P/E portfolios. The absence of such a statistical test casts doubt over the interpretation of Basu's results

Method

1. All industrial, non ex-resource companies and non resource holding companies trading on the ASX from 1998-2006 are selected.
2. The P/E ratios of all sample companies are calculated as at December 31 each year from 1997-2005.
3. Each year the firms are ranked according to the reciprocal of their P/E ratios and grouped into portfolios based on this ranking.
4. Continuously compounded monthly returns are calculated for each portfolio over the 9 year sample period.
5. Ordinary Least Squares (OLS) regressions are performed, estimating the relationship between the excess returns of each portfolio and the excess returns of the market (All Ordinaries Index).
6. Each year, those firms in the lowest P/E portfolio are subjected to (a) business failure prediction test(s) using Altman (1968) and Castanga and Matolcsy's (1981) models.
7. Those firms predicted to fail are excluded from the sample and steps 4 and 5 are repeated for the testing of Hypothesis 3.

Sample

The research examines industrial companies listed on the ASX over the period from January 1, 1998 to December 31, 2006 (9 full calendar years). The test period covers periods of poor market performance, such as the aftermath of the Asian Financial Crisis

(1998), the Dot Com Crash and the subsequent bear market that prevailed from 2001-2002. In addition, the period also covers quite buoyant years, such as the bull market which reigned from 2003-2006.

Four data sources have been employed for this analysis, namely Aspect Huntley's DatAnalysis, Aspect Huntley's FinAnalysis[8], IRESS Market Technology[9] and the Reserve Bank of Australia (RBA) statistics database[10].

The firms to be included in the analysis are identified using Aspect DatAnalysis. Specifically, the generated list of companies reflects all firms listed as at December 31, 2006 plus all firms that have traded sometime between January 1, 1998 and December 31, 2006 that have since delisted. Basu (1977) highlights that the inclusion of delisted firms in the sample is essential to the study, avoiding a survivorship bias[11] which some of his predecessors failed to recognise.

Closing prices, volumes, dilution factors and dividend details are collected from January 1, 1998 to December 31, 2006. The closing prices provided by IRESS have been adjusted for dividends and capitalisation changes over 5%; deeming changes less than 5% to have negligible impact on per-share statistics[12]. Closing levels of the All Ordinaries Index are also obtained over the same time period.

Balance sheet, income statement and other accounting information of the sample firms are collected from Aspect's FinAnalysis. Three criteria are used in selecting sample firms for any given test year period:

The Firm is non-Resource, non-ex Resource or a non-Resource holding company

Table 3 summarises the sample selection procedures.

INSERT TABLE 3 HERE

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[8] DatAnalysis and FinAnalysis are two query-driven databases constructed by Aspect Huntly, with various accounting and market information on stocks that are trading or have previously traded on the ASX.

[9] IRESS is a real-time market database used primarily by institutions active in the Australian market place. IRESS delivers comprehensive static and historical data on all aspects of the equity and derivative markets.

[10] The RBA statistics database offers time series information on various national statistics both macroeconomic and microeconomic.

[11] Survivorship bias refers to the bias created when failed companies tend to be excluded from performance studies due to the fact that they no longer exist.

[12] Details of IRESS adjustments were offered by John Lawlor, Senior Research Analyst at Ord Minnett Ltd., Brisbane.

P/E Ratio Calculation

From 1997 through to 2005, the P/E ratio of every sample security is computed as at December 31, for the purpose of portfolio allocation and immediate investment in the subsequent year (beginning January 1, 1998). The P/E ratios are calculated as follows:

$$\text{P/E ratio} = \frac{\text{weighted average number of shares * price}}{\text{Net profit after tax before abnormals – preference shares}} \qquad (1)$$

Portfolio Allocation

Each year from 1997-2005, firms are grouped into five portfolios. This grouping is performed on the basis of ranked reciprocal P/E ratios, referred to as earnings yields (E/P ratios). Basu (1977, 1983), Johnson et al. (1989) and many subsequent papers have similarly adopted this technique. As Basu (1977) explains, the choice of five portfolios is arbitrary though our five is consistent with Basu (1977), Johnson et al. (1989) and subsequent papers. It ensures that the minimum number of stocks in a given portfolio for each sample year is approximately 100.

In the analysis where firms with negative earnings are grouped with high P/E ratios (called Analysis One hereafter), portfolios contain roughly the same amount of stocks in a given year. In the analysis where firms with negative earnings are confined to their own portfolio (called Analysis Two hereafter), portfolios, other than the one restricted to negative earnings firms, contain roughly the same amount of stocks in a given year. The portfolio restricted to firms with negative earnings, holds a far larger sample of firms than the four other non-negative P/E ratio portfolios. This is because the number of firms that made losses in a given year often exceeded 20% of all firms. As mentioned above, portfolios were reallocated yearly. The number of stocks contained in each portfolio year by year, is detailed in Table 3 and Table 4 :

Portfolio Allocation with a Filter for Failure

Hypothesis 3, seeks to test whether the application of a BFPM to the lowest P/E portfolio would significantly alter the returns. In order to test this hypothesis two BFPMs are selected, partially due to their comprehensive documentation in business failure prediction literature: Castanga and Matolcsy (1981) and Altman (1968).

In summary, both BFPMs are applied to each firm in the lowest P/E portfolios (the lowest in Analysis One and the lowest in Analysis Two. If the BFPM forecasts that a particular firm will fail, that firm is deleted from the portfolio. Both BFPMs will suggest separate exclusions to be made to each of the low P/E portfolios. In an attempt to increase the accuracy of failing firm prediction, a consensus between the two models is also obtained, offering another possible version of the low P/E portfolios. After the application of the BFPMs, there will be 8 different versions of the low P/E portfolio to compare: 4 under Analysis One and 4 under Analysis Two.Analysis

Analysis 1	Analysis 2
Original Protfolio	Original Protfolio
Filtered using Castanga and Matolcsy (1981)\	Filtered using Castanga and Matolcsy (1981)
Filtered using Altman (1968)	Filtered using Altman (1968)
Filtered using a consensus of the two models	Filtered using a consensus of the two models

In addition to applying the two BFPMs independently, a consensus of the two models is also obtained to gain another version of the low P/E portfolio for each analysis. As both models were developed in different periods to this study's test period, and one was developed using non-Australian firms, it is considered that a consensus between the two models may enhance the accuracy of firm classification. Only those firms classified by *both* models as being potential failure cases were deleted from the portfolio.

Portfolio Returns

After applying the BFPMs to the lowest P/E portfolio of Analysis One and Analysis Two, 16 separate portfolios are available for analysis: the five original portfolios plus the three additional versions of the lowest P/E portfolio created by the BFPMs for each analysis. The monthly returns on each of the 16 portfolios are then computed for the next twelve months. The returns are calculated using portfolio values which assume equal investment in each security of the respective portfolios, and like Basu (1977), the portfolios mimic a buy and hold policy. As Basu (1977) stipulates, each of the 16 portfolios may be viewed as a mutual fund whereby securities in a given P/E class are acquired on January 1, held for a year, and then the proceeds from disposition are reinvested in the same P/E class on the following January 1[13].

Table 4 Summarises the hypotheses and the tests of those hypotheses.

4. Results

Hypothesis 1

Hypothesis 1a, 1b and 1care tested using simple one-tailed Student t-tests. The results of the tests are shown in Table 5 and Table 6 .

INSERT TABLED 5 AND 6 HERE

Under Analysis One, all three null hypotheses are not rejected at the 5% significance level. That is, at the 95% level of confidence, there is evidence to suggest that the mean excess return of low P/E stocks is not significantly different from the mean excess return of high P/E stocks; the mean excess return of low P/E stocks is not significantly different from the mean excess return of the market; and the mean excess return of high P/E stocks is not significantly different from the mean excess return of the market.

The results of these hypothesis tests under Analysis One indicate that no significant relationship exists between the mean excess returns and the P/E class of a given portfolio. Basu (1977) noted however, that ranking firms on the basis of E/P ratios (i.e. grouping negative P/E firms with high P/E portfolios) is somewhat debatable. Hence, the results of Analysis Two (where negative P/E firms are separated) are also tested.

Under Analysis Two, hypotheses 1a and 1b are rejected at the 5% level of significance. Hypothesis 1c is not rejected at the significance level. That is, at the 95% level of confidence, there is evidence to suggest that the mean excess return of low P/E stocks is higher than the mean excess return of high P/E stocks; the mean excess return of low P/E stocks is higher than the mean excess return of the market; and (as suggested by Analysis One) the mean excess return of high P/E stocks is not significantly different from the mean excess return of the market.

The results of the Analysis Two hypothesis tests are presented in Table 8. The results clearly show that low P/E stocks outperform their high P/E counterparts and the market.

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[13] Basu (1977) repeated the entire analysis using monthly reallocations, with a substantially identical result.

INSERT TABLE 8 HERE

Yet the results also suggest that high P/E stocks do not necessarily underperform the market. This latter result is confirmed by Analysis One. Rejection of the 1a and 1b null hypotheses therefore provides support for the *main* proposition of a low P/E based trading strategy.

Hypothesis 2

Jensen's differential return (1968) is a construct based on the CAPM which measures risk-adjusted rates of return. Estimation of Jensen's differential return represents the core part of the analyses emphasised in Basu's 1977 study. Similar to hypotheses 1a, 1b and 1c, efficient market theory predicts that there will be no significant relationship between P/E ratios and differential returns. This section presents the results of hypotheses 2a, 2b and 2c which apply to the 10 original portfolios.

Before the results of these hypotheses are presented, the dependent and independent variables are inspected for stationarity and all linear regression assumptions are tested. All excess return series in the analysis have been inspected for stationarity using formal unit-root tests, namely the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. that all excess return series are stationary, meaning that any significant relationships found will be genuine and not spurious.

For inferences to be confidently made from the regression results there are a number of assumptions that must hold. These assumptions are:

1. *The expectation of the error terms is zero* – $E(\varepsilon_i) = 0$
2. *The model is linear in parameters* - $\hat{\beta}_p \neq 0$
3. *The residuals have constant variance* – $Var(\varepsilon_i) = \sigma^2$
4. *There is no serial correlation in the residuals* – $Cov(\varepsilon_i, \varepsilon_j) = 0$ for $i \neq j$
5. *Regressors are non-stochastic* – $Cov(X_i, \varepsilon_i) = 0$

Table 9 presents the statistical tests for these assumptions.

INSERT TABLE 9 HERE

The results of the Student's T hypotheses tests[14] are considered and the results are reported in Table 10 and Table 11. Under Analysis One and Two, the null hypothesis is rejected for Hypothesis 2a and the null hypothesis is not rejected for Hypothesis 2b. This finding suggests that in both analyses, the low P/E portfolios (E and J) earn rates of returns that are significantly higher than what is warranted by their level of risk. This is consistent with Basu's finding (1977) of the superior performance of low P/E stocks. High P/E portfolios on the other hand (A and F) earn differential returns not significantly different from zero. While the low P/E portfolios show superior performance, the high P/E portfolios do not necessarily show inferior performance. Under both analyses, since Hypothesis 2a is rejected and Hypothesis 2b is not rejected at the 10% significance level, then by definition Hypothesis 2c must be rejected. That is, since low P/E stocks earn differential returns significantly higher than zero, and high P/E stocks earn differential returns not significantly different from zero, then the differential returns of low P/E stocks must be higher than the differential returns of high P/E stocks.

INSERT TABLES 10 AND 11 HERE

Recalling the results from Hypothesis 1, the highest excess returns were achieved by portfolio A, earning on average 15.41% per annum above the risk-free rate of return. However, when considering the results of the regressions, differential return of portfolio A is not significantly different from zero (highlighted in Table 10). Assuming that the CAPM is specified correctly, the superior excess returns achieved by this portfolio can be justified by the portfolio's level of systematic risk. Hence, the excess returns of portfolio A would not necessarily be more attractive to the risk-averse investor.

Consistent with Basu (1977), Table 12 shows that the best risk-adjusted performances can be identified from the two lowest portfolios – E and J, earning 0.73% and 0.96% per month respectively *more* than the returns implied by their levels of risk. These returns are significant at the 10% and 5% levels of significance respectively. Portfolio J is the better performer of the top two portfolios. Given that portfolio J belongs in Analysis Two where there are fewer stocks to be distributed between the four non-negative

[14] These tests are one-tailed, one sample tests for means, with standard deviation unknown.

portfolios, it is evident that portfolio J's superior performance is delivered by stocks concentrated at the lowest end of the P/E range.

At the other end of the P/E spectrum, portfolios B, C, D, G and H have earned returns -0.47%, -0.71%, -0.09%, -0.40% and -0.27% respectively *lower* than what is warranted by their levels of risk. While the significance of portfolios B and G cannot be confidently determined to their violation of residual normality, it can be inferred that the differential returns of portfolios C, D and H are not significantly different from zero at the 95% level of confidence.

The betas estimated by the regression equation are significant at the 1% level of significance. Caution must be taken in interpreting the betas, as some regressions violated the residual normality assumption and Roll (1981) suggests that infrequent trading may cause risk to be incorrectly measured. Like Basu (1977), this thesis also finds that, contrary to capital market theory, the higher excess returns earned by the low P/E portfolios are not associated with higher levels of systematic risk. In fact, the systematic risk of the portfolios increases monotonically as one moves from low to high P/E portfolios. It is also noteworthy that the portfolios containing only negative P/E firms are also the portfolios with the greatest amount of systematic risk.

Hypothesis 3

If the low P/E effect is found to hold, it is proposed that through the application of a failure filter, the superior returns of low P/E portfolios will become more robust. Efficient market theory predicts that the use of a market-supported BFPM will not have a significant impact on the differential returns of low P/E portfolios. Hypothesis 3 tests this proposition.

Before the results of the hypothesis tests are presented, the dependent and independent variables are inspected for stationarity and all linear regression assumptions are tested.

The coefficients estimated in the regressions – beta and Jensen's differential return (1968) – are recorded in Table 15. First, the results of the Student t-hypotheses tests[15] are considered and the results are reported in Table 13 and Table 14.

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[15] These tests are one-tailed, one sample tests for means, with standard deviation unknown.

INSERT TABLE 13, 14, and 15 HERE

Each of the null hypotheses tested in Table 13 and Table 14 are rejected at the 10% level of significance (at least). This result provides support for the alternate hypotheses that the differential returns of the portfolios tested are significantly greater than zero. The low P/E portfolio in each analysis produces the largest differential return. Whether the differential returns of those portfolios subjected to a failure filter(s) outperform those low P/E portfolios is tested. Figure 4.3 presents the performance (differential returns) of all eight low P/E portfolios in a graphical manner.

Evident in Figure 4.3 is the poor performance of portfolio E_{ALT} relative to its other low P/E counterparts. The application of Altman's 1968 BFPM to the low P/E portfolio in Analysis One (portfolio E), has *decreased* the differential return of portfolio E by 0.06% per month. However, this is the only instance where a failure filter has decreased the differential returns of the low P/E portfolios. The five other portfolios subjected to failure filters have actually *increased* the differential returns of portfolios E and J. These differential returns are significant[16] at the 90% confidence level. Across the two analyses, the greatest differential returns are earned by the low P/E portfolio subjected to the consensus failure filter, followed by the low P/E portfolio subjected to Castanga and Matolcsy's (1981) BFPM. This relationship also holds at the absolute (non risk-adjusted) excess return level.

The best risk-adjusted performance observed in this analysis, comes from the application of a consensus filter on the lowest P/E portfolio in Analysis Two. This portfolio earned 1.02% per month more than what is implied by its level of risk. This is equivalent to an annual rate of approximately 12½%[17]. The largest differential return found by Basu was from the lowest P/E portfolio (no failure filters employed) with a significantly smaller differential return of approximately 4.7% per annum.

[16] It cannot be said with confidence that the differential return for portfolio J_{ALT} is significant as the assumption of residual normality has been violated.

[17] The monthly rate has been annualised by multiplying the rate 12. This is possible because of the additive property of logarithms.

Initially, it may seem peculiar that the application of BFPMs to the low P/E portfolios has with one exception, significantly increased their differential returns. Perhaps then, these exclusions are not as random as they seem. As portfolio performance has improved when non-failing firms are removed from the sample, it may be the case that the market uses those indicators contained within the BFPMs, as signals of not only failure, but poor investment performance.

From inspection of the differential returns produced by 5[18] of the 6 failure filtered regression equations, it is evident that the average risk-adjusted rate of return of a portfolio of low P/E stocks is less than the average risk-adjusted rate of return of a portfolio of low P/E stocks constructed after the use of a BFPM. This finding is not consistent with efficient market theory.

The results of the test of hypotheses are summarized in Table 16

INSERT TABLE 16 HERE

5. Conclusions

This research examines whether the investment performance of low P/E stocks is greater than the investment performance of other classes of P/E stock, as proposed by investor overreaction theory and the low P/E effect. This thesis also examines whether greater returns can be achieved if failure filters are applied to a portfolio of low P/E stocks.

Consistent with the findings of Basu (1977), it was found that on average, the low P/E portfolios earned higher absolute and risk-adjusted rates of return than their higher P/E counterparts. It was found that stocks with negative earnings also performed quite well, consistent with Jaffe et al. (1989). In an extension of Basu's (1977) work, this thesis also found that through the application of a failure filter, the superior returns of low P/E portfolios will become more robust. These results appear to be inconsistent with efficient market theory, suggesting that either the asset pricing model has been misspecified, or the EMH has been violated.

Given the large risk-adjusted returns achievable through the use of a calculated trading strategy, the obvious question asked by DeBondt and Thaler (1985, p.794) is "How does

[18] The differential return of portfolio E_{ALT} was less than the differential return of portfolio E.

the anomaly survive the process of arbitrage?" If it is assumed that the CAPM has been correctly specified and differential returns are still significantly positive after tax and transaction costs[19], then the results obtained in this thesis suggest a violation of the semi-strong form of the EMH. It appears that the information content of P/E ratios was not rapidly impounded into prices as the theory suggests. The prices at their 'inefficient' levels therefore caused disequilibrium in the capital market and opportunities for earning "abnormal" returns were afforded to investors (Basu 1977). The fact that the largest differential return in this analysis (pre BFPM application) exceeded Basu's (1977) largest differential return by over 6 ½%, suggests that the US equity market may be more efficient than the Australian market, arbitraging away abnormal returns more quickly than is done in Australia.

[19] Jensen (1968) assets that a market is only inefficienct when consistent abnormal returms are made above and beyond transaction costs and taxes. Given that Basu (1977) still found evidence of market inefficiency after these costs, and this thesis has recorded much higher returns than Basu (1977), it is fairly safe to say that significant diferential returns will still exist post fees and taxes.

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Table Error! No text of specified style in document.**1 - Influential US P/E Effect Studies**

Author	Sample	Conclusion
Jaffe, Keim & Westerfield (1989)	US stocks listed 1951-1986. Number of stocks ranged from 352 in 1950 to 1,309 in 1974.	Found evidence of January effect, size effect and P/E effect.
Goodman and Peavey (1986)	A random sample of 125 industrial US stocks listed 1970-1980.	Found evidence of P/E effect and size effect. Mostly only P/E effect was significant. Concluded size effect was a proxy for P/E effect.
Fama & French (1992)	US stocks (NYSE, AMEX & NASDAQ) listed 1962-1989. Financial firms excluded.	Found evidence of P/E effect, but found a stronger relationship between book value to price ratios and abnormal returns.
Fuller, Huberts & Levison (1993)	US stocks listed 1973-1990. Number of stocks ranged from 887 stocks in 1973 to 1,179 stocks in 1990. Oct, Nov, Dec, Jan yr ends.	Found evidence of P/E effect, however, factors in multi-factor model did not explain this effect.
Lakonishok, Schleifer & Vishny (1994)	US stocks (AMEX and NYSE) listed 1963-1990, with at least 5 years of past accounting data.	Value stocks (low P/E stocks) outperform glamour stocks (high P/E stocks).
Dreman & Berry (1995)	US stocks listed Jan 1973-1993. Mar, Jun, Sept, Dec yr ends. Sample size = 995 firms.	Earnings surprises favour worst (low P/E) stocks. Long-term reversion to mean continues for at least 19 quarters.
Dreman & Lufkin (1998)	US stocks listed 1973-1998. Number of stocks in sample was 4,721 for full 25 years.	Found evidence of both size and P/E effects. P/E effect was more pronounced.

Table Error! No text of specified style in document. **- P/E Effect Studies From Around the World**

Author	**Year**	**Country**
Levis	1989	UK
Aggarwal, Rao & Hiraki	1990	Japan
Chou & Johnson	1990	Taiwan
Chan, Hamao & Lakonishok	1991	Japan
Booth, Martikainen, Perttunen & Yli-Olli	1994	Finland
Cai	1997	Japan
Brouwer, van der Put & Veld	1997	European countries
Doeswijk	1997	Holland
Gregory, Harris & Michou	2001	UK
Levis & Liodakis	2001	UK
Chin, Prevost & Gottesman	2002	New Zealand
Park & Lee	2003	Japan
Bird & Whitaker	2003	European countries
Anderson & Brooks	2005	UK

Table Error! No text of specified style in document. **- Sample Selection**

Total number of firms listed as at Dec 31, 2006	**1747**
Plus: Firms delisting over period Jan 1, 1998 – Dec 31, 2006	**565**
Total number of firms trading on ASX from Jan 1, 1998 – Dec 31, 2006	**2312**
Less: Firms with Resource sector involvement	**(800)**
Less: Firms with unavailable time series data	**(11)**
Less: Firms with insufficient price and financial statement data	**(191)**
Total number of firms in final sample	**1310**

Table 4 - Summary of Hypotheses

Hypothesis	What the Hypothesis Examines	Measurement and statistical Test	
1a	The performance of low P/E stocks relative to high P/E stocks	One tailed Student t-test[20]: $H_0 : \mu_L = \mu_H$ $H_1 : \mu_L > \mu_H$	
1b	The performance of low P/E stocks relative to the market	One tailed Student t-test: $H_0 : \mu_L = \mu_M$ $H_1 : \mu_L > \mu_M$	
1c	The performance of high P/E stocks relative to the market	One tailed Student t-test: $H_0 : \mu_H = \mu_M$ $H_1 : \mu_H < \mu_M$	
2a	The risk-adjusted performance of low P/E stocks	$r_{pt} - r_{ft} = \hat{\delta}_{pf} + \hat{\beta}_{pf}\left[r_{mt} - r_{ft}\right]$ (OLS)	$H_0 : \hat{\delta}_L = 0$ $H_1 : \hat{\delta}_L > 0$
2b	The risk-adjusted performance of high P/E stocks		$H_0 : \hat{\delta}_H = 0$ $H_1 : \hat{\delta}_H < 0$
2c	The risk-adjusted performance of low P/E stocks relative to high P/E stocks		$H_0 : \hat{\delta}_L = \hat{\delta}_H$ $H_1 : \hat{\delta}_L > \hat{\delta}_H$
3	The risk-adjusted performance of a failure-filtered P/E portfolio relative to a		$H_0 : \hat{\delta}_L = \hat{\delta}_{LF}$ $H_1 : \hat{\delta}_L < \hat{\delta}_{LF}$

Table 5 – Hypothesis 1 Test Results: Analysis One

	Hypotheses Tested		
Test details	**1a**	**1b**	**1c**
***H_0*:**	$\mu_E = \mu_A$	$\mu_E = \mu_M$	$\mu_A = \mu_M$
***H_1*:**	$\mu_E > \mu_A$	$\mu_E > \mu_M$	$\mu_A < \mu_M$
α[21]	0.05	0.05	0.05
df	135.62	211.95	130.63
Critical Value (df)	1.656	1.652	1.657
t-statistic	-0.755	1.295	1.120
Conclusion	Do Not Reject H_0	Do Not Reject H_0	Do Not Reject H_0

[20] All Student t-tests for Hypotheses 1a, 1b and 1c use two sample test for means; sigma unknown and unequal.
[21] Alpha (α) refers to the level of significance used when conducting the tests.

Table 6 – Hypothesis 1 Test Results: Analysis Two

Test details	Hypotheses Tested 1a	1b	1c
***H_0*:**	$\mu_J = \mu_G$	$\mu_J = \mu_M$	$\mu_G = \mu_M$
***H_1*:**	$\mu_J > \mu_G$	$\mu_J > \mu_M$	$\mu_G < \mu_M$
α	0.05	0.05	0.05
df	201.94	206.89	183.06
Critical Value (df)	1.652	1.652	1.653
t-statistic	2.158	1.726	-0.830
Conclusion	Reject H_0	Reject H_0	Do Not Reject H_0

Table 7 - Portfolio P/E Profiles: Analysis One

	P/E Portfolios[22] A	B	C	D	E	E_{ALT}	$E_{C\&M}$	E_{CONS}
Mean	-5.11	-33.17	-28.81	14.45	6.64	6.82	6.65	6.69
Median	-3.11	-19.29	25.22	14.06	6.71	7.02	6.72	6.77
S.D.[23]	5.97	3460.5	1096.72	3.02	3.14	3.12	3.14	3.13
I.Q.R.[24]	4.62	45.46	19.95	3.9	4.77	4.66	4.77	4.73
Skewness	-2.4	0.3	-21.37	0.56	-0.12	-0.19	-0.12	-0.13

Table 8 - Portfolio P/E Profiles: Analysis Two

	P/E Portfolios[25] F	G	H	I	J	J_{ALT}	$J_{C\&M}$	J_{CONS}
Mean	-215.97	262.25	17.98	11.8	5.55	5.67	5.54	5.58
Median	-9.42	40.6	17.67	11.85	5.61	5.8	5.62	5.67
S.D.	2719.72	2825.85	2.94	1.94	2.66	2.66	2.66	2.66
IQR	37.13	50.52	4.22	2.6	4.18	4.13	4.19	4.18
Skewness	-30.93	28.21	0.4	-0.05	-0.07	-0.13	-0.07	-0.09

[22] A = Highest P/E Quintile, E = Lowest P/E Quintile, E_{ALT} = Lowest P/E Quintile after applying Altman's BFPM, $E_{C\&M}$ = Lowest P/E Quintile after applying Castanga & Matolcsy's BFPM, E_{CONS} = Lowest P/E Quintile after filtering firms based on a consensus of Altman's and Castanga & Matolcsy's BFPMs.

[23] Standard Deviation of the Mean.

[24] Inter-Quartile Range.

[25] F = P/E Quintile containing only negative P/E firms, G = Highest P/E quintile excluding negative P/E firms, J = Lowest P/E Quintile.

Table 9 - Testing Linear Regression Assumptions: Hypothesis Set 2

REGRESSION ASSUMPTION TEST STATISTICS		PORTFOLIO EXCESS RETURNS									
		ANALYSIS ONE					ANALYSIS TWO				
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
White's Heteroskedasticity F-Statistic (2,105) and p-value in parenthesis		1.399 (0.2514)	0.889 (0.4139)	0.536 (0.5866)	1.462 (0.2364)	0.865 (0.4239)	1.119 (0.3303)	0.399 (0.6722)	1.186 (0.3094)	0.529 (0.5905)	0.592 (0.5549)
Ljung-Box Q-Statistic[26]:	Lag 1		4.30**	5.78**	No serial-correlation detected	7.38***	4.94**	9.18***	No serial-correlation detected	5.64**	7.21***
	Lag 4	10.73**					14.81***				
	Lag 12			23.82**						22.95**	
Coefficient(s) of Serial-Correlation[27]:	ϵ_{t-1}		0.221***	0.260***	No correction needed	0.303***	0.220**		No correction needed	0.283***	0.303***
	ϵ_{t-4}	0.262***					0.241**	0.310***			
	ϵ_{t-12}			0.257***						0.271***	
Jarque-Bera Statistic (after serial-correlation correction) and p-value in parenthesis		13.73 (0.0010)	417.97 (0.0000)	0.91 (0.6333)	1.49 (0.4737)	7.73 (0.0209)	238.34 (0.0000)	93.17 (0.0000)	2.16 (0.3391)	0.48 (0.7877)	11.10 (0.0039)
Conclusion[28]		Approx. normal	Not normal	Normal	Normal	Normal	Not normal	Not normal	Normal	Normal	Approx. normal

[26] Only the lags showing serial-correlation are reported. I.e. serial-correlation only detected up to lags 1, 4 and 12.
[27] Only the lags needing correction are reported. I.e. serial-correlation correction only required for lags 1, 4 and 12.
[28] Classified as *not normal* if the null hypothesis of normality is rejected at any level above the 0.1% level of significance; classified as *approximately normal* if the null hypothesis of normality is not rejected at the 0.1% levels of significance; classified as *normal* if the null hypothesis of normality is not rejected at the 1% level of significance or higher.

Table 10 - Hypothesis 2 Test Results: Analysis One

	Hypotheses Tested	
Test details	**2a**	**2b**
H_0:	$\hat{\delta}_E = 0$	$\hat{\delta}_A = 0$
H_1:	$\hat{\delta}_E > 0$	$\hat{\delta}_A < 0$
α	0.1	0.1
df	107	107
Critical Value (df)	1.2895	1.2895
t-statistic	1.9107	0.7201
Conclusion	Reject H_0	Do Not Reject H_0

Table 11 - Hypothesis 2 Test Results: Analysis Two

	Hypotheses Tested	
Test details	**2a**	**2b**
H_0:	$\hat{\delta}_J = 0$	$\hat{\delta}_F = 0$
H_1:	$\hat{\delta}_J > 0$	$\hat{\delta}_F < 0$
α	0.1	0.1
df	107	107
Critical Value (df)	1.2895	1.2895
t-statistic	2.2405	0.1340
Conclusion	Reject H_0	Do Not Reject H_0

Table 12 - Performance Measures: Hypothesis Set 2

PERFORMANCE MEASURE	PORTFOLIO EXCESS RETURNS									
	ANALYSIS ONE					ANALYSIS TWO				
	A	B	C	D	E	F	G	H	I	J
Systematic Risk ($\hat{\beta}_p$) with standard errors in parentheses	1.643*** (0.2338)	1.084*** (0.2220)	0.727*** (0.0735)	0.527*** (0.0643)	0.462*** (0.0843)	1.362*** (0.2131)	0.909*** (0.1047)	0.584*** (0.0632)	0.520*** (0.0635)	0.448*** (0.0947)
Jensen's Differential Return ($\hat{\delta}_p$) with standard errors in parentheses[29]	0.0073 (0.0102)	-0.0047 (0.0088)	-0.0071 (0.0047)	-0.0009 (0.0019)	0.0073* (0.0038)	0.0017 (0.0130)	-0.0040 (0.0048)	-0.0027 (0.0019)	0.0014 (0.0045)	0.0096** (0.0043)
R-squared	0.305	0.253	0.557	0.388	0.329	0.329	0.473	0.446	0.482	0.291
S.E. of Regression	0.077	0.071	0.022	0.020	0.027	0.071	0.034	0.020	0.020	0.031
Treynor's Reward-to-Volatility Measure[30]: $\bar{r}'_p \big/ \hat{\beta}_p$	0.0938	-0.0249	-0.084	0.0115	0.2135	0.0536	-0.0233	-0.0243	0.0462	0.2803
Sharpe's Reward-to-Variability Measure[31]: $\bar{r}'_p \big/ \sigma(\bar{r}'_p)$	1.7183	-0.3348	-1.8658	0.2394	2.9794	0.8671	-0.4555	-0.5404	0.9002	3.4692

[29] NB: significance is inferred from critical values which assume two tails as directional testing cannot be employed for all portfolios. Hence differences in significance may be identified between these figures and those reported in the above hypothesis tests.

[30] Mean excess return on portfolio *p*, divided by its systematic risk.

[31] Mean excess return on portfolio *p*, divided by its standard deviation.

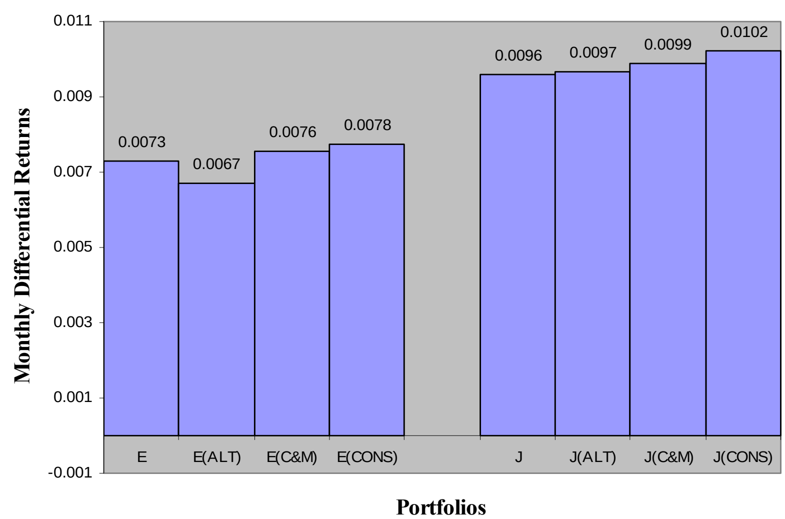
Table 13 – Hypothesis 3 Test Results: Analysis One

	BFPM Tested		
Test details	**ALT**	**C&M**	**CONS**
***H₀*:**	$\hat{\delta}_{E(ALT)} = 0$	$\hat{\delta}_{E(C\&M)} = 0$	$\hat{\delta}_{E(CONS)} = 0$
***H₁*:**	$\hat{\delta}_{E(ALT)} > 0$	$\hat{\delta}_{E(C\&M)} > 0$	$\hat{\delta}_{E(CONS)} > 0$
α	0.1	0.1	0.1
df	107	107	107
Critical Value (df)	1.2895	1.2895	1.2895
t-statistic	1.6427	1.9350	2.0637
Conclusion	Reject H_0	Reject H_0	Reject H_0

Table 14 – Hypothesis 3 Test Results: Analysis Two

	BFPM Tested		
Test details	**ALT**	**C&M**	**CONS**
H_0:	$\hat{\delta}_{J(ALT)} = 0$	$\hat{\delta}_{J(C\&M)} = 0$	$\hat{\delta}_{J(CONS)} = 0$
H_1:	$\hat{\delta}_{J(ALT)} > 0$	$\hat{\delta}_{J(C\&M)} > 0$	$\hat{\delta}_{J(CONS)} > 0$
α	0.1	0.1	0.1
df	107	107	107
Critical Value (df)	1.2895	1.2895	1.2895
t-statistic	2.0455	2.2412	2.4021
Conclusion	Reject H_0	Reject H_0	Reject H_0

Figure Error! No text of specified style in document.**.1 - Differential Returns for**



Low P/E

Table 15 - Performance Measures: Hypothesis 3

	PORTFOLIO EXCESS RETURNS					
	ANALYSIS ONE			ANALYSIS TWO		
	E_{ALT}	$E_{C\&M}$	E_{CONS}	J_{ALT}	$J_{C\&M}$	J_{CONS}
Systematic Risk ($\hat{\beta}_p$) with standard errors in parentheses	0.435*** (0.0842)	0.443*** (0.0835)	0.472*** (0.0847)	0.455*** (0.0958)	0.424*** (0.0933)	0.457*** (0.0948)
Jensen's Differential Return ($\hat{\delta}_p$) with standard errors in parentheses[32]	0.0067* (0.0041)	0.0076** (0.0039)	0.0078** (0.0038)	0.0097** (0.0047)	0.0099** (0.0044)	0.0102** (0.0043)
R-squared	0.330	0.328	0.328	0.311	0.294	0.293
S.E. of Regression	0.028	0.027	0.027	0.032	0.031	0.031
Treynor's Reward-to-Volatility Measure: $\bar{r}'_p / \hat{\beta}_p$	0.2107	0.2285	0.2207	0.2788	0.3022	0.291
Sharpe's Reward-to-Variability Measure: $\bar{r}'_p / \sigma(\bar{r}'_p)$	2.7354	3.0712	3.1455	3.3633	3.5598	3.6699

[32] Significance of differential returns are inferred from critical values which assume one tail, as directional testing may be employed for the low P/E portfolios.

Table 16 - Summary of the Results of the Hypotheses Tests

No.	Null Hypotheses	Alternate Hypotheses	Results of Testing	
			Analysis One	**Analysis Two**
1a	The mean excess return of low P/E stocks is equal to the mean excess return of high P/E stocks.	The mean excess return of low P/E stocks is **greater than** the mean excess return of high P/E stocks.	Null Not Rejected	Null Rejected
1b	The mean excess return of low P/E stocks is equal to the mean excess return of the market	The mean excess return of low P/E stocks is **greater than** the mean excess return of the market	Null Not Rejected	Null Rejected
1c	The mean excess return of high P/E stocks is equal to the mean excess return of the market.	The mean excess return of high P/E stocks is **less than** the mean excess return of the market.	Null Not Rejected	Null Not Rejected
2a	The average risk-adjusted rate of return of low P/E stocks is not significantly different from zero.	The average risk-adjusted rate of return of low P/E stocks is **greater than** zero**.**	Null Rejected	Null Rejected
2b	The average risk-adjusted rate of return of high P/E stocks is not significantly different from zero.	The average risk-adjusted rate of return of high P/E stocks is **less than** zero.	Null Not Rejected	Null Not Rejected
2c	The average risk-adjusted rate of return of low P/E stocks is equal to the average risk-adjusted rate of return of high P/E stocks.	The average risk-adjusted rate of return of low P/E stocks is **greater than** the average risk-adjusted rate of return of high P/E stocks.	Null Rejected	Null Rejected
3	The average risk-adjusted rate of return of a portfolio of low P/E stocks is equal to the average risk-adjusted rate of return of a portfolio of low P/E stocks constructed after the use of a BFPM.	The average risk-adjusted rate of return of a portfolio of low P/E stocks is **greater than** the average risk-adjusted rate of return of a portfolio of low P/E stocks constructed after the use of a BFPM.	Null Rejected[33]	Null Rejected

[33] The one exception was portfolio E_{ALT}.