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Investment Performance of Common Stock in Relation to their Price-Earnings Ratios: BASU 1977 Extended Analysis

Jordan R. Tilley
Utah State University

INVESTMENT PERFORMANCE OF COMMON STOCK IN RELATION TO THEIR PRICE-EARNINGS RATIOS: BASU 1977 EXTENDED ANALYSIS

By

Jordan R. Tilley

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Approved:

Tyler Brough Major Professor	Jason Smith Committee Member

Jared Delisle
Committee Member

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ABSTRACT

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Jordan R. Tilley, Masters of Science

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Major Professor: Tyler Brough
Department: Finance

In this study, the work of Basu 1977 is partly replicated using subsequent market data. A trading strategy of investing in assets based on their price-earnings ratio is back-tested, thus also testing the efficient market hypothesis. Market data over the past twenty-five years (1989-2014) was gathered, cleaned, and modeled to test for unexplained return to five portfolios ranked by PE ratio. The data was tested using the single-factor Capital Asset Pricing Model and the Fama-French three-factor model. The dataset was then decomposed by price and similarly modeled to test whether the effectiveness of using PE as a leading indicator is limited by the price level of an asset. I conclude that investing in a portfolio comprised of the lowest PE ratio assets yields the highest unexplained returns over the period examined. I also find that this strategy is primarily driven by low and mid-priced stocks, and does not hold at high price levels. In this analysis, the efficient market hypothesis does not hold.

(14 pages)

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I. INTRODUCTION

The "Oracle of Omaha", Warren Buffet, is quoted as saying, *"I made my first investment at age 11. I was wasting my life up until then"* (Buffet 2006). Schooled by the philosophy of Benjamin Graham, Buffet has long been hailed as a value-investor. Value investing is simply a strategy of selecting stocks that trade below their intrinsic value—these stocks are typically identified by their lower-than-average price-to-book or price-earnings ratios. In 1977 Basu published a work back-testing a value investment strategy entitled "Investment Performance Of Common Stock In Relation To Their Price-Earnings Ratios: A Test Of The Efficient Market Hypothesis." He tests whether the PE ratio could be used as a leading indicator of performance. He concludes that over the fourteen-year time period of April 1957 – March 1971, "the low PE portfolios seem to have on average, earned a higher absolute and risk-adjusted rates of return than the high PE securities" (Basu 1977). According to the efficient market hypothesis, if this strategy truly existed, it would be exploited by investors until the extra return vanished. With frictions and lags, information did not disseminate as quickly into market prices in the 1960's as it does today, thus investors might be able to use PE information as an indicator of future performance. Since 1977, could have investors used this strategy in selecting investments to obtain excess risk-adjusted return? The past twenty-five-year period is examined to see if this strategy holds.

II. DATA

All financial data was sourced from Wharton Research Data Services (WRDS). The data set was gathered and merged from three databases. Monthly closing stock prices and holding period returns were gathered from the Center of Research on Security Prices (CRSP) from June 1989 through May 2014. If a monthly closing price was not available the negative bid/ask spread was reported. The absolute value of those prices was taken and treated as closing prices. Stocks with prices less than $5 were not considered. The rationale was that low priced stock, including penny stocks, can demonstrate extreme values when dealing with ratios. As well, it was assumed that most rational investors don't trade penny stocks. This removed about 85,000 observations of about 791,000.

Quarterly earnings per share data (including extraordinary items) was pulled from Compustat. Some companies either did not report earnings or reported them as 0. This made for undefined PE ratios, and were therefore not considered. Also when observations reported negative EPS they were not considered in this analysis. Basu separately considers and does not consider negative earnings in his study, most likely to be thorough and comprehensive. Negative earnings were not considered here because it made for negative ratios and it was assumed rational investors wouldn't buy companies who demonstrated negative earnings. The merit of value investing in low PE ratio stocks is the purchase of earnings at a low price. A high ratio, also else equal, would infer purchasing the same amount of earnings at a higher price. A negative ratio from negative earnings infers you are purchasing an asset that loses money.

Lastly, I pulled the risk-free rate (30 day Treasury bill rate), excess return on the market, Small Minus Big, and High Minus Low factors from the Fama-French Portfolios and Factors database. Excess return on the market is calculated at the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate (from

Ibbotson Associates). Small Minus Big (SMB) is the average return on the three small market-value portfolios minus the return on the three large market-value portfolios, and accounts for the difference in returns between large and small firms. High Minus Low (HML) is the average return on the two value portfolios minus the average return on the two growth portfolios, and accounts for high book-to-market (value stocks) outperforming low ones (growth stocks). After cleaning, the dataset contained 698,538 observations. Summary statistics, including average ratio and return values, are reported with the performance measures after modeling in Table 1.

III. METHODOLOGY

Basu chose to rebalance his PE portfolios annually in his study, however notes that repeating the analysis monthly he finds substantially identical results (Basu 1977). If trading low PE assets does exhibit excess return, a rational investor might choose to update his portfolio more frequently—therefore monthly portfolio rebalancing was chosen in this study. PE ratios were calculated by dividing monthly prices by four times the reported quarterly EPS. The PE values were lagged one month to be used as leading indicators of performance. Every month, total observations were ranked into quintiles by PE ratios. Note that the number of portfolios chosen is arbitrary. I chose five groups to more closely follow the methodology of Basu. The five portfolio's returns each month were then modeled over the twenty-five-year period using the Capital Asset Pricing Model (CAPM) and the Fama-French 3-Factor (FF3F) models. The asset pricing equations are estimated:

CAPM $$R_p - R_f = \alpha_p + \beta_p[R_M - R_f] + \varepsilon_p$$

FF3F $$R_p - R_f = \alpha_p + \beta_p[R_M - R_f] + s_pSMB + h_pHML + \varepsilon_p$$

where: R*p* = the continuously compounded return on PE portfolio *p* each month

R*f* = the continuously compounded "risk-free" rate each month

α*p* = the estimated intercept (Jensen's alpha in CAPM, or FF3F alpha)

ß*p* = the estimated slope of excess return (Market return minus "risk-free" rate) and measures "systematic risk" in the CAPM model

S*p* = the estimated slope of Small [market capitalization] minus Big

h*p* = the estimated slope of High [book-to-market] minus Low

ε*p* = the error term

Basu only used the single-factor CAPM model perhaps because it was the best model available at his time. The FF3F model was later developed in 1993 by Eugene Fama and Kenneth French attempting to further describe stock returns beyond the single-factor Beta CAPM. The inclusion of the FF3F model in this study should explain stock returns beyond what the CAPM provided Basu and offer us a slightly different perspective (Fama 1993).

IV. EMPIRICAL RESULTS

The equations were estimated with ordinary least squares (OLS) using the 300 months of average return data on five portfolios each month—hence a total of 1500 observations in the regression analysis. Table 1 reports the results from the analysis and summary statistics.

These results were similar to the results of Basu, yet also appear more drastic. The first thing to notice is the difference between the portfolios average PE ratio values; the differences all seem significant. There is a large disparity between even the fourth and fifth quintile, portfolio D and E, with averages of 23.66 and 88.53 respectively. We can assume there are some extremely high PE ratios in portfolio E pulling up the mean. The maximum PE ration in the sample was 8856.25.

Second, consider the average returns of the portfolios. The low PE portfolio earned 3.46% monthly compared to the high PE portfolio of 0.88% monthly. These are substantial amounts when compounded annually to 50% and 11%. Between portfolios the average returns seem to decrease almost monotonically as you increase towards higher PE portfolios. However, despite higher returns in the lower PE portfolios, the levels of systematic risk measured by Beta are not necessarily higher. The relationship between returns and beta appears to be contrary to capital market theory, which states higher returns are realized through higher levels of risk. Also note that Beta values are the highest on the end portfolios, and decrease toward the middle portfolio. This could demonstrate that these somewhat extreme portfolios are associated with higher levels of risk as measured by beta.

The difference between the high PE portfolio E and low PE portfolio A had a Jensen's alpha of 0.0269 with a test-statistics of 11.58 and a 3-Factor alpha difference of 0.0249 with a 16.18 test-statistic. Keep in mind this is excess unexplained *monthly* return. Once again, annualized these returns would be 0.3751 and 0.3433 respectively. When compared to Basu's resulted difference of almost .08 *annual* return, my alpha estimates seemed too extreme. The alpha between portfolios, like returns, also appears to be monotonic. This was less concerning to me as Basu had a similar outcome. In his work, he found an inverse relationship between beta and alpha (Basu 1977). My estimates were somewhat disturbing as I was sure I had done something incorrect.

An explanation considered was the analysis was performed on an equally weighted basis with no consideration of value weight or market capitalization. A $5 low price stock, its returns and PE ratio, is treated equally with a $1000 stock with its returns and ratio. Instead of repeating the analysis using a value-weighted adjustment, I decided to isolate price to see if the PE ratio strategy would hold independent of the price of a stock. Perhaps only low price stocks exhibit extreme alpha using this PE strategy, and because they were equally weighted with high price stocks they biased our analysis when treated together. Testing this, I decomposed the stock observations into four groups by price: less than or equal to $10, between $10-20, between $20-35, and greater than $35. The observations were almost divided into equal groups. The modeling was then repeated on these four new price categories. Table 2 reports the outcomes of this analysis.

This analysis added more insight and explanation. First, the average PE ratios reported between prices were interesting. As you increase price, it appears the average PE ratio increases as well – less than $10 stocks had an average PE ratio of 24.83 while the greater than $35 stocks had an average of 33.20. This seemed contrary to my first thought as I assumed that low price stocks generally leaned as growth (high PE ratio) compared to high priced stocks. It does make sense however, that holding all else constant, increasing price— the numerator of our fraction— increases the PE ratio.

The beta values for all the price portfolios all exhibited similar estimates and relationships as our previous analysis — the highest values appear on the low and high portfolios and decrease toward the middle portfolio. For sample beta estimates by price group, the <$10 category had the highest value (highest systematic risk), and appears to decrease at a decreasing rate as you move to higher price levels. This would support thinking that low price stocks, including penny stock, have greater levels of risk, while higher prices lead to less risk, all else equal.

Within the <$10 group, the hedge (A-E) returns were even more extreme than the previous analysis with Jensen's alpha of 0.0506 and FF3F alpha of 0.0408 compared to 0.0269 and 0.0249 respectively. As you move toward higher prices, however, the hedge return continually decreases, again almost monotonically, until at the >$35 group, Jensen's alpha is 0.0069 and FF3F alpha is 0.0043. It appears from these results that the previous analysis's estimates were heavily driven by low price stock. At the highest price level of <$35, PE ratio investing seems hardly effective. It does appear that even the mid-range price levels exhibited significant amounts of hedge alpha return from the strategy. Also notable was the summary alpha estimates between price groups. Despite the <$10 group exhibiting the largest hedge (A-E) return, it has insignificant and low estimates for its group as a whole. It seems this group has returns that are not easily explainable or linear. Beyond this group, as you increase price levels, the summary alpha estimates increase and become significant.

As before in our first analysis, most of these alpha relationships seem apparent, even before we model our data, given by the average reported returns between the price and PE groups. After modeling it does explain away some of the returns, and some values become insignificant, but almost all relationships between groups remain.

IV. SUMMARY AND CONCLUSIONS

The purpose of this paper was to test the relationship of stock performance in relation to its PE ratio, and thus test the efficient market hypothesis. Despite theory stating excess returns cannot be earned, it appears over the time period examined that investing using the PE ratio as a leading indicator produces excess unexplained returns for low and mid-priced stock. With low hedge alpha values, stock with prices above $35 show the PE strategy would be ineffective. Before isolating prices it appeared that this PE ratio strategy would work for all stock. Decomposing into price groups showed this strategy is driven by low/mid-priced stock. When back testing market data for strategies like this, it is important to realize factors that may be driving estimates. After being isolated or removed, the success of the strategy and relationship may altogether disappear.

All these conclusions either mean the models used here are not appropriate at explaining asset returns, or the behavior of the securities during this period are inconsistent with the efficient market hypothesis. The focus of this study hasn't been to critique asset pricing models or question their validity. The CAPM and FF3F model have served as practical tools to guide the testing of a trading strategy. The intent has been to merely discover from a practical standpoint whether an investor might capture alpha by implementing this PE value-investment strategy. If the efficient market theory doesn't hold, then the trading of these low-price stock with low PE ratios have exhibited excess unexplained returns over this period, and may do so in the future. Perhaps this inefficiency only exists at low price-levels. On the other hand, efficient market proponents may argue that there are increased levels of risk by investing in this strategy that have failed to be recognized in this study.

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APPENDIX

TABLE 1

PERFORMANCE MEASURES AND SUMMARY STATISTICS

(June 1989 - May 2014)

	PE Portfolios						
Performance Measure/ Summary Statistic	A (Low)	B	C	D	E (High)	A - E	Summary
Avg P/E ratio	7.04	12.10	16.35	23.66	88.53	-81.49	29.54
						(-85.34)	
Avg Return	0.0346	0.0213	0.0148	0.0115	0.0088	0.0259	0.0182
						(5.97)	
Avg Excess Return Ret-RF	0.0319	0.0187	0.0121	0.0088	0.0061	0.0259	0.0155
						(5.95)	
Avg Abnormal Return Ret-Mkt	0.0258	0.0125	0.0060	0.0026	-0.0001	0.0259	0.0094
						(11.17)	
Systematic Risk (Beta)	0.9454	0.8443	0.8321	0.9448	1.1168	-0.1714	0.9328
	(23.15)	(28.03)	(30.85)	(34.06)	(33.57)	(-3.25)	(286.54)
Jensen's alpha	0.0261	0.0135	0.0070	0.0030	-0.0008	0.0269	0.0098
	(14.53)	(10.14)	(5.90)	(2.42)	(-0.54)	(11.58)	(14.21)
FF3F alpha	0.0241	0.0117	0.0055	0.0022	-0.0009	0.0249	0.0085
	(17.49)	(12.40)	(6.67)	(2.42)	(-1.26)	(16.18)	(15.53)

TABLE 2
PERFORMANCE AND SUMMARY STATISTICS BY PRICE

Performance Measure/ Summary Statistic	Stock Price	PE Portfolios						
		A (Low)	B	C	D	E (High)	A - E	Sample
Avg PE ratio	<10	3.68	8.94	14.16	23.58	73.83	-70.15	24.83
							(-90.64)	
	10-20	6.82	11.64	15.91	23.43	86.14	-79.32	28.76
							(-87.72)	
	20-35	7.83	12.55	16.46	23.02	84.05	-76.22	28.77
							(-70.99)	
	>35	8.53	13.65	18.08	25.38	100.35	-91.82	33.20
							(-31.60)	
Avg Return	<10	0.0384	0.0216	0.0071	-0.0034	-0.0126	0.0510	0.0102
							(9.05)	
	10-20	0.0345	0.0191	0.0109	0.0042	-0.0003	0.0347	0.0137
							(7.72)	
	20-35	0.0342	0.0229	0.0174	0.0146	0.0115	0.0226	0.0201
							(5.48)	
	>35	0.0340	0.0268	0.0248	0.0244	0.0285	0.0055	0.0277
							(1.26)	
Systematic Risk (Beta)	<10	1.1306	0.9795	0.9781	1.0003	1.0708	0.0598	1.0319
		(14.50)	(16.95)	(19.85)	(19.28)	(20.91)	(0.64)	(36.48)
	10-20	0.9699	0.8560	0.8418	0.9144	1.1093	-0.1394	0.9383
		(22.27)	(22.35)	(23.81)	(25.50)	(28.72)	(-2.40)	(49.93)
	20-35	0.8942	0.7787	0.8045	0.9154	1.0933	-0.1991	0.8972
		(25.64)	(24.63)	(27.98)	(34.46)	(33.24)	(-4.15)	(60.14)
	>35	0.8411	0.7997	0.8523	0.9046	1.0719	-0.2308	0.8939
		(26.66)	(31.64)	(32.43)	(32.08)	(21.27)	(-3.88)	(58.25)
Jensen's alpha	<10	0.0287	0.0128	-0.0016	-0.0122	-0.0219	0.0506	0.0012
		(8.36)	(5.02)	(-0.74)	(-5.35)	(-9.70)	(12.31)	(0.93)
	10-20	0.0258	0.0112	0.0031	-0.0041	-0.0098	0.0356	0.0052
		(13.41)	(6.63)	(1.98)	(-2.60)	(-5.77)	(13.86)	(6.30)
	20-35	0.0259	0.0154	0.0097	0.0062	0.0021	0.0239	0.0119
		(16.86)	(11.02)	(7.69)	(5.33)	(1.41)	(11.28)	(18.04)
	>35	0.0261	0.0192	0.0169	0.0161	0.0192	0.0069	0.0195
		(18.74)	(17.21)	(14.55)	(12.93)	(8.63)	(2.63)	(28.78)
FF3F alpha	<10	0.0258	0.0106	-0.0034	-0.0138	-0.0230	0.0488	-0.0008
		(9.15)	(5.21)	(-2.09)	(-7.93)	(-13.47)	(14.81)	(-0.75)
	10-20	0.0236	0.0094	0.0013	-0.0054	-0.0104	0.0340	0.0037
		(16.28)	(7.21)	(1.14)	(-4.50)	(-9.13)	(18.45)	(5.50)
	20-35	0.0242	0.0135	0.0083	0.0054	0.0010	0.0232	0.0107
		(19.10)	(13.10)	(8.47)	(5.60)	(2.02)	(17.09)	(19.00)
	>35	0.0246	0.0182	0.0165	0.0163	0.0204	0.0043	0.0192
		(20.29)	(18.17)	(15.11)	(15.37)	(11.95)	(2.03)	(30.11)