

***Investigating Price to Value Indicators
In The
Capital Equity Markets***

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Working Paper 2008:1

January, 2008

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Executive Summary

The study evaluates the usefulness and validity of price to value and size related parameters in explaining capital asset pricing. Both qualitative and quantitative perspectives are provided. The Capital Asset Pricing Model (CAPM) serves as the theoretical basis for the statistical analysis. The traditional single-factor pricing model is expanded to encompass three independent variables, that of size, value, and market. The study finds that a three-factor model provides more explanatory power than just the single-factor market model of the CAPM. This central finding of the paper persists across numerous methods of portfolio composition. Two distinct time periods are studied: 1963-1993; and a more inclusive period of 1963-2006. The statistical validity of a three-factor model exists for both time periods.

The implication of a multi-factor investment universe is quite significant: there may indeed be “value” to the value style of investing. Considering that the CAPM has been used for more than forty years to theoretically support passive management styles, the apparent validity of value parameters through the use of an expanded market model takes on even more meaning.

The findings and implications of the study must be considered only a starting point in the determination of appropriate investment management policies, however. Many other influences may exist to obviate or expand upon the conclusions of this paper, the most important being that of operational efficiency: after the costs of research and tax impacts are accounted for, it becomes much more problematic whether active styles can outperform passive strategies. A post-tax, post-cost perspective to investing may largely

temper the statistical conclusion that size and value factors add to the explanatory power of the market model. A myriad number of additional factors should be considered, including the usage of momentum, mean-reversion, and macro-level variables. Any of these factors may dramatically affect quantitative results reach in this study.

1. Introduction

The appropriate selection of investments has been a much discussed and debated topic over the entire course of the modern business era. As far back as the Depression, Benjamin Graham (1934) pioneered the fundamental method of investment analysis. For many years thereafter, the focus was on the active selection of individual assets, carefully chosen for value and quality considerations. Accounting principles of return on investment (ROI) and times-interest coverage were paramount to the analysis. The discussion shifted by the 1960's towards statistical and mathematical efforts aimed at asset returns. A theoretical consensus developed that capital markets efficiently balanced risk and return parameters, and usually did so before anyone could readily profit from over or under-valued situations. This gave great impetus to the development of passively managed index funds in the 1970's. Numerous studies were still indicating the presence and validity of price to value indicators, however. By the 1980's and 1990's, notions of behavioral finance were advanced. These concepts suggested that investor-level irrationality generated continuing value situations in asset pricing. The stock market gyrations of October, 1987, the tech bubble of 2000, and most recently, the sub-prime real estate debacle of 2007, have all been cited as basic human and market-level irrational behavior in the pricing of assets.

This paper investigates whether price to value indicators convey valuable information regarding the pricing of assets. In a broader sense, the inquiry is one of active versus passive management of assets. Can active styles of investing out-perform passive investment vehicles?

This study is divided into two divisions of thought, one being qualitative in nature, while the other is more quantitative in tone. Both approaches have merit. In Part II of this study, numerous price to value indicators are reviewed and summarized in a qualitative review of the literature. Many insights are gleaned from the effort.

Part III then details the quantitative aspects of the study. The focus is on whether size, price to value, and other variables can explain variations in asset pricing. Time series multiple regression analysis is conducted on numerous variables. These variables include market excess return, size, value to price, earnings to price, dividend yield, and cash flow to price. The study tested various asset portfolio compositions in over 300 separate regressions.

Many of the groundbreaking papers in this area were done between 1992 and 1998. The present study extends the research to more current time frames. Indeed, the real benefit of this paper is in gathering together many price to value variables that have been scattered throughout the literature, and to do so using updated data.

Generally, aggregate market returns, size, and value variables are found to be relevant in individual asset pricing. Research costs and tax impacts may offset any active strategy, however. Part IV of the paper summarizes the statistical findings of this paper. Appendices for the statistical output are also provided. The paper concludes with an Addendum containing recommendations for investment portfolio composition.

2. Qualitative Findings – Literature Review

The literature contains two main and opposing themes on the topic of valuation indicators in equity asset pricing. The following is a very brief summary of the literature.

For a more extensive analysis on the topic of value indicators, see a working paper of the author, Kaufhold (2005:3).

The Value Studies. Numerous cross sectional studies have found that value parameters can identify valuation discrepancies in asset pricing. Low price to earnings ratios have been noted in the literature for some time. For example, Nicholson (1960) wrote on equities having low price to earnings just a few years after Markowitz penned his thoughts on the efficient frontier. Price to growth ratios (PEG) possess an inverse relationship with forward returns (Reilly and Brown, 2000, at 228). Tweedy & Brown (2003) showed that a Net Cash Asset Valuation (NCAV) strategy produced superior stock performance. Lakonishok, Vishny & Shleifer (1994) determined that low price to cash flow produced far greater returns than did equities having high price to cash flow. O'Shaughnessy (1998) demonstrated that a dividend yield approach had 1.7% higher annualized returns than an all-stock universe. Ken Fisher (1984) described the price to sales ratio (PSR) as an "almost a perfect measure of popularity". Distressed businesses can generate excess returns, as well. See, Siegel (1998). Equities also exhibit a size effect (Banz, 1981; Basu, 1983), although disputes exist as to whether size is really part of the value style. Simply concentrating on quality of earnings and dividend streams generates out-performance on both an absolute and risk-adjusted basis (S&P Report, 2003).

Combining several value indicators into an overall stock selection strategy may reinforce valuation characteristics. See, Keim (1988); and O'Shaughnessy (1998). Chan, Lakonishok, Sougiannis (2001) found that blending various approaches allows investors to have larger returns than just with value versus growth distinctions.

Additionally, information provided by value parameters is persistent and predictable in nature. Jegadeesh and Titman (1993) showed that returns were mean accelerating in very short time frames of 3 to 12 months. In longer periods, DeBondt and Thaler (1985, 1987) demonstrated that reversion to the mean existed at both the individual stock level and in the aggregate capital markets, and attributed the findings to an eventual correction of initial investor over-reaction. Reichenstein & Dorsett (1995) showed that bad periods of market behavior were *predictably* followed by good periods, and visa versa.

Notions of Efficiency. Over the years, numerous theoreticians have developed extensive mathematical models on portfolio analysis. Almost all of these models suggest capital markets are efficient in asset pricing, in contradiction to value-oriented findings. Markowitz (1952, 1959) originated complex models on efficient frontiers and diversification. Sharpe, Lintner, and Mossin, writing independently between 1964 and 1966, advanced the standard form of the Capital Asset Pricing Model (CAPM). This model is a linear, single factor function, with stock pricing volatility compared to market volatility being the sole explanatory variable for the asset risk premium. In 1970, Fama reviewed the developing literature, and categorized it into three components of the Efficient Market Hypothesis (EMH). With all versions of efficiency, the general belief is that new information quickly drives market pricing to an equilibrium point with little or no possibility for out-sized return.

Theorists advocating notions of efficiency have responded in a variety of ways to contrary conclusions reached in the value studies. The theoretical analysis has largely been based on regression and back-testing analysis. Survivorship and data selection

biases can creep into these statistical processes, invalidating the results. Kothari, Shanken, and Sloan (1995). There may also be dual effects occurring: positive findings of valuation studies are indicative of *either* market inefficiency *or* the market model not correctly estimating expected risks and returns. See, Reilly and Brown (2000, at 227); and Ball (2003). Banz (1981) felt that the size effect was the result of misspecification of the CAPM rather than evidence of market inefficiency. Additionally, a value-oriented researcher, O'Shaughnessy (1998, at 42) believes the size effect to be illusionary, the result of micro-caps that are difficult or impossible to trade. Fama and French (2007) have very recently made the same conclusion as to size.

Market theorists also note that efficiency does not compel a conclusion that market averages can never be beat. Indeed, the laws of probability and the central limit theorem suggest and even require that prices will deviate from true value from time to time, that roughly half of all investors will beat market averages at any one time, and that a fairly large number of people will consistently outperform over long periods (Damodaran, 1996, at 147).

Post-1992 Considerations. Until the early 1990's, believers in market efficiency generally sought to minimize or dismiss studies showing the existence of various pricing anomalies. That all changed in 1992, when leading advocates of efficiency, Fama and French, stunned the financial world by showing the statistical validity to size and price to book ratios. A paper by Lakonishok, Shleifer, and Vishny (1994) also had great impact, with its eloquent statement of the contrarian viewpoint using current statistical methods. These papers shifted the focus of discussion in a most fundamental way. No longer was

there a debate over the existence of value. Instead, the question has become: what accounts for the value?

The intellectual discourse still pits efficiency versus behavior. Fama and French believe that the markets are rationally conveying information on financial distress and other firm-level matters (1995, 1996). Others feel that a basic irrationality in investor behavior exists, instead. See, DeBondt and Thaler (1985, 1987); and Haugen (1995). Lakonishok, et al (1994), and Chan and Lakonishok (2004) even showed that value assets had lower downside risk. Some observers, including Fama and French, are of the opinion that size and value effects are acting as proxies for undetermined “state” variables. Many researchers believe that macro economic variables may be the root cause of multi-factor alignment with asset pricing. A multi-factor asset-pricing model that truly explains the varied risks being priced into assets is just now in its formative stages.

Operational Efficiency. While value does seem to theoretically out-perform, in practice any actively managed style (including value) has great difficulty keeping up with passively managed indexes. Bogle (1999) estimates that a 2% expense ratio of a fund will reduce accumulated capital by as much as 24% over 10 years, and 39% over 25 years. In any one year, up to 70 % of all actively managed funds under-perform the Wilshire 5000 index (Malkiel, 1974). There is also little or no long-term relationship between performance in a past period and investment returns in a future period. (*Id.*, at 443-444). The probability of future out-performance by an active mutual may be close to that of random chance (Tanous, 1997, at 171). Bogle (1998) demonstrated that passively managed funds generally produced the highest risk-adjusted returns in each of the nine categories of the Morningstar equity style box.

This line of reasoning implies that apparent value situations will persist so long as returns beyond the risk premium are less than the frictional costs of research and taxes necessary to obtain them.

3. Quantitative Findings

3.1 The Econometric Model

Starting off with classical notions of market return (Sharpe, Lintner, Mossin, 1964-1966; and, Black, 1972), the Capital Asset Pricing Model (CAPM) postulates a single-factor linear relationship between individual asset returns and market returns:

$$E(R_i) - R_f = \alpha_i + \beta_i [E(R_m) - R_f] + \varepsilon_i \quad (1)$$

Where, $E(R_i)$ is the expected return on asset i ; R_f is the risk-free rate of return; the difference of $E(R_i) - R_f$ is the asset risk premium that must be offered to induce investors to assume asset pricing volatility risk; alpha, α_i , is the y intercept; R_m is the return of the market; β is the beta coefficient of the market excess return ($R_m - R_f$), and is mathematically defined as the slope of the linear regression line; and ε_i is the residual error term. At market equilibrium, Beta should completely capture the cross-sectional variation in average returns, have a positive value, and be statistically significant. α_i should be zero in a mean-variance efficient market, as zero return of the entire equity markets should correspond with zero return of individual assets.

The econometric model used in this paper closely follows methods developed by Fama and French. To analyze whether size or value factors can affect asset pricing, Fama and French (1993, 1996) developed a three-factor asset-pricing model:

$$E(R_{it}) - R_{ft} = \alpha_i + b_i (E(R_{mt}) - R_{ft}) + s_i E(\text{SMB}_t) + h_i E(\text{HML}_t) + \varepsilon_{it} \quad (2)$$

Where, SMB is the size variable, being composed of a set of mimicking portfolios that measure the return on small cap equities minus the return on large cap equities; and HML is the value variable, being a set of mimicking portfolios measuring the return on high book-to-market equities minus the return of low book-to-market equities. Thus, $E(R_{mt}) - R_{ft}$, $E(\text{SMB}_t)$, and $E(\text{HML}_t)$ are expected premiums of the market, size, and value. b_i , s_i , and h_i are factor sensitivities of the premiums, being the slopes or beta coefficients for each factor of a regression equation. See, Fama and French (1996), at 56.

$E(R_i)$ is composed of portfolio returns broken in quintiles (or otherwise) and generally two-way sorted by size and value. Portfolios are preferred for the dependent variable rather than individual assets since betas of diversified portfolios are more precise. See, Black, Jensen, and Scholes (1972); and Fama and French (1993). Value-weighted size and book-to-market portfolios are initially used for the asset pricing dependent variable. Other price to value indicators are also modeled by forming equally-weighted asset portfolios for the dependent variable that are based on CF/P, D/P, E/P, BE/ME, and ME only, and then regressing on the three independent factors. This acts as a safeguard against spurious results being generated in regressions using size and book-to-market in both dependent and independent variables. See, Fama and French (1993).

Essentially, the multi-factor model regresses portfolios representing individual asset returns against common risk factors, including overall market return, market cap, and book-to-market considerations. In this vein, the multi-factor asset-pricing model uses the general format of the Arbitrage Pricing Model (APT) and the inter-temporal CAPM (ICAPM). See, Ross (1976); and Merton (1973). The beta coefficients of the model represent the APT's sensitivity of asset i 's return on factor k . The intercept effectively constitutes the null hypothesis of $H_0: \alpha_i = 0$, while the sum of the regression intercepts for a set of dependent portfolios can be jointly tested against zero via a F test for joint significance. If the three-factor model closely describes asset returns, then results will generate multi-factor minimum variance (MMV) and represent market equilibrium per the ICAPM. See, Fama and French (1996, at 69).

Jensen (1968) was the first to realize that estimation of the CAPM's beta coefficient implies a time series regression. Subsequently, many valuation studies, including those of Fama and French (1993), have used time series regression analysis. The three-factor model can be stated as a time series:

$$R_{it, t-1} - R_{ft, t-1} = \beta_{0i} + \beta_{1i} (R_{m, t-1} - R_{ft, t-1}) + \beta_{2i} \text{SMB}_{t-1} + \beta_{3i} \text{HML}_{t-1} + \epsilon_{it, t-1} \quad (3)$$

Interestingly, the professional literature typically has not included a time trend, t , in the time series equations, but sometimes adds a variant of the F test used to test the efficiency of portfolio composition. See, Gibbons, Ross, and Shanken (1989). Various methods of correction for serial correlations have been utilized over the years. Adding a time trend, and using various inferential statistics and methods of correcting for serial correlation would be appropriate to explore in future research.

3.2 Description of Data

Monthly asset pricing return data has been collected on the period between July, 1963 and December, 2006 (522 months). Equity return information is based upon CRSP (Center for Research of Security Prices) and COMPUSTAT data, and is collected on all NYSE, AMEX, and NASDAQ firms. The one-month Treasury bill rate is used for the risk-free asset. The market excess return independent variable, $R_m - R_f$, is the value weighted return of returns minus the Treasury bill rate.

Note that CRSP recently made changes to their collection methodology. There are therefore small changes in historical return data from earlier published data. This nullifies exact comparisons to older regression studies using the same historical periods. The differences between published results using older CRSP procedures and results using the CRSP changes are quite small however. See, Section 3.3, below.

Compilation of data would normally be very cumbersome. Up to 10,000 domestic equities are listed across the three major domestic exchanges, and sorting the equities for the various portfolio characteristics would be an arduous task. Fortunately, the data has already been collected and sorted into the relevant portfolios and factors by Professor Kenneth French. Researchers have access to a vast amount of information that is freely available at Professor French's web-site.¹ All data used in this study have been downloaded from Professor French's data library, including the dependent and independent variable portfolios, the market return factor, and the risk-free rate of return.

Appendixes contain summary statistics on all the major variables in this study as well as summaries of regression runs.

¹ Prof. French's data is at: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

3.3 Estimation Results

Replication of 1963-1993 Results. Since the methodologies of this paper are rather involved, it was decided that results of Fama and French (1996) should be initially replicated to ensure accuracy of statistical processes. With all regressions used in this paper, Prais-Winston auto-regressions were used with alternate Durbin-Watson to correct for any serial correlation problems. Using very similar (but not exact) historical data for the same time periods (366 months) and with the same equations and variables as Fama and French, results were very close to that of published literature. All beta coefficients and t values of both runs are extremely close. See Tables B1 and B2 of the Appendix; Fama and French (1996). The explanatory power of the runs are almost identical, as well, with the one factor model generating an adjusted R^2 of .78 through this study, and an adjusted R^2 of .77 with data used in the 1996 effort. As shown in the brief summary below, the three-factor model produced an adjusted R^2 of .93 in both studies, and the average absolute value and average squared value of the intercept on both models were very close, as well.

Table 1 – Regressions of 1963-1993 (366 Months), One and Three Factor Models

Dependent	Sort	Weighting	Explan.	KCK63-93			FF63-93				
				aveabsa	avea2	AveR2	aveabsa	avea2	AveR2		
Size/BKP	5x5	Value	Mktprem	0.299	0.1255	0.78	0.286	0.1140	0.77		
Size/BKP	5x5	Value	Mktprem	SML	HML	0.127	0.0312	0.93	0.093	0.0164	0.93

1963-2006 Results. With prior efforts effectively being replicated, more current data using somewhat different variables could be evaluated. For the period between July, 1963 and December, 2006 (522 months), regressions on the one-factor CAPM model

(equation 1) demonstrate a good amount of explanatory power. Initially using the 5 x 5 size and book to market asset portfolios for the dependent variable, the market excess return independent variable has an average adjusted R^2 of 72% among all 25 portfolios. This is a slight drop from the findings for 366 months of data, with Fama and French having found 77% explanatory power. See Table 2, below.

Table 2 – Regressions of 1963-2006 (522 Months), One and Three Factor Models

Depend.	Sort	Weighting	Explan.			KCK 63-06			FF 63-93		
						ave abs a	ave a2	Ave R2	ave abs a	ave a2	Ave R2
Size/ BKP	5x5	Value	Mktprem			0.320	0.1387	0.72	0.286	0.1140	0.77
Size/ BKP	5x5	Value	Mktprem	SML	HML	0.096	0.0194	0.86	0.093	0.0164	0.93

Of added significance, the intercept coefficients are relatively small, and are mostly positive. This is very important, as the alpha intercept should be zero at market equilibrium, with no returns achievable beyond the risk premium. The fact that the CAPM equation does not explain all of the variation in asset pricing is expected, as prior research has repeatedly shown that the market model is less than perfect. The intercept has been higher in some studies than predicted, and the beta coefficient is less than predicted for the excess market return (Blume and Friend, 1973). Beta is too flat in other time series regressions (Fama and French, 1992), and has even been negative in some sub-periods (Black, Jensen and Scholes, 1972).

Results are vastly improved with the three-factor model (equations 2 and 3) applied to the same asset portfolios used in the single-factor model. All three proposed independent variables of market excess return, size, and value are individually and jointly

significant for most of the 25 regressions. The coefficients on all three variables are generally positive, which is also expected. See Tables B4.

The intercept has far lower values than with the one-factor model, as evidenced by the lower average absolute intercept value and the average square of the intercept value. In fact, these intercept values are very close to the original Fama and French values. See, Table 2. The explanatory power of the model improves, as well. Between 71% to 93% of the variation in the 25 asset portfolios can be explained by the combined variation in the three independent factors, with an average adjusted R^2 of 86% among all 25 portfolios. The updated findings are consistent with Fama and French's conclusion (1992, 1993, 1996) that market beta alone cannot fully explain the expected returns on all asset portfolios.

Testing Other Dependent Variables, 1963-2006 Periods. Using size and book to price asset portfolios for the dependent variable has been criticized when the independent variables are also based upon size and book to price. The procedure is defended in the literature, however (Fama and French, 1996). To overcome objections to the process, past research has tested the three-factor model using other well-known pricing anomalies for the dependent variable (Fama and French, 1996; Lakonishok, Shleifer, and Vishny, 1994).

This study also moves past size / book to price intersecting portfolios by developing alternative dependent variable measures. Asset portfolios based on cash flow to price, dividend yield, earnings to price, and book to price (only) were run on both the single-factor CAPM model and the multi-factor model. The regressions using these variables use asset portfolios formed solely on the basis of various accounting ratios,

without size being a consideration. This should give a better test of the explanatory powers of the independent variables, as the possibility for spurious results as to size is eliminated, while different determinants of value are used for each side of the regression equation.

The results confirm the statistical validity of value independent parameters in explaining asset-pricing variation. Even without size being included in the formation of the dependent variable asset portfolios, the size independent variable was statistically significant, as were the market premium and value independent variables. This was the case regardless of how the dependent variable asset portfolios were formed. The three-factor model provided greater explanatory power for asset pricing than did the one-factor CAPM in all test runs using a variety of dependent variables and portfolio compositions. The following summary table displays intercept and adjusted R^2 estimates for the various asset portfolios that were tested.

Table 3 – Regressions of 1963-2006 (522 Months), Other Dependent Portfolios

Dependent	Sort	Weighting	Explan.			KCK 63-06			FF 63-93		
						ave abs a	ave a2	Ave R2	ave abs a	ave a2	Ave R2
CFP	Decile	Equal	Mktprem			0.4664	0.2764	0.71	0.268	0.1007	0.80
CFP	Decile	Equal	Mktprem	SMB	HML	0.1902	0.0473	0.91	0.062	0.0068	0.93
DP	Decile	Equal	Mktprem			0.4552	0.2194	0.70			
DP	Decile	Equal	Mktprem	SMB	HML	0.1443	0.0248	0.89			
EP	Decile	Equal	Mktprem			0.4211	0.2367	0.72	0.260	0.1059	0.83
EP	Decile	Equal	Mktprem	SMB	HML	0.1577	0.0358	0.91	0.051	0.0039	0.93
BE/ME	Decile	Equal	Mktprem			0.4876	0.3166	0.68			
BE/ME	Decile	Equal	Mktprem	SMB	HML	0.2471	0.0832	0.88			
Size (ME)	Decile	Value	Mktprem			0.1511	0.0281	0.82			
Size (ME)	Decile	Value	Mktprem	SMB	HML	0.0349	0.0017	0.92			

While the above regressions consider size in only the right side of the equations, an argument can still be made, however, that both sides of the equation are using closely related accounting variables. Indeed, all accounting ratios measure different aspects of the same basic operating environment at the micro-level. To alleviate this concern, regressions were then run with only size (ME) for the dependent variable. This provides a good test of the book to price HML independent variable, since the dependent variable is now formed without any accounting ratios being involved. The results once again show the significance of all three independent variables, with the three-factor model having higher adjusted R^2 values, and with the intercept being very close to zero return. See the last two lines of the above summary table for average intercept values and average adjusted R^2 values for dependent portfolios sorted by size only.

Loss of Explanatory Power? While this study generally has shown the statistical significance of a multi-factor approach to asset pricing, the explanatory power of the one-factor equations are somewhat lower than in studies run in the 1990's (Fama and French,

1992, 1993, 1996). As the above summary table shows, the explanatory power of the three-factor model during the 1963-2006 time period (522 months) is somewhat below the earlier results using 1963-1993 data (366 months). The drop in explanatory power for both the one and three factor models can be from any of the following:

- 1) Correlations between the independent variables have changed between periods. The market premium now has less correlation to either size or value, while the correlation between size and value has increased. See, the correlation matrices of Table A-1 and A-2 contained in the Appendix. The net effect on the model is therefore problematic, but could still conceivably be affecting results.
- 2) As noted by Chan and Lakonishok (2004), the 1990-era papers pre-date the market bubble of the year 2000. The extreme market peak and subsequent collapse may be affecting the statistical relationship between all independent variables and the variation in asset-pricing.
- 3) Macro variables could be impacting R^2 values. The data collected for this study spanned 522 months. This period comprised the economic expansion of the 1960's "guns and butter" era; the high-inflation and low productivity environment of the 1970's; a technology-driven expansion of the 1990's; and then a "dot.com" market-level asset pricing implosion commencing in 2000. With such vastly different macro environments, it would be rather amazing if macro variables do not affect the ability of the independent variables to explain asset pricing.

4. Conclusions

Findings. Both the qualitative and quantitative findings of this study show that size and value indicators provide explanatory power in asset pricing variation. Market

premium, size, and book to price variables were shown to be statistically significant in explaining the variation in asset pricing. Several different asset portfolios were developed and tested, including size, book to price, earnings to price, dividend yield, and cash flow to price.

While the single-factor market model continues to serve as the baseline for asset pricing, a multi-factor process incorporating several additional independent factors is becoming more established in the literature. The reasons for the statistical significance of these factors are less clear however, and go back to the debate between efficiency and behavior. Research will most undoubtedly continue in this contentious area.

Caveats. There are several important caveats to the results of this study. Much of the “success” of the independent variables may be due to macro-economic fluctuations. The statistical tests that have been run in this study, as well as in the literature, impliedly assume a fixed macro environment. In reality, macro events are constantly changing. Many studies suggest that macro conditions may be impacting the multiple factors. This is a fertile area in which research is well underway. See, Chen, Roll, Ross (1986); and Liew and Vassalou (2000). It may very well turn out that both micro and macro level factors are responsible for variations in asset pricing. If this is the case, then the single-factor CAPM should eventually be supplemented with a multi-factor model incorporating both firm-level and macro-level factors.

There is also some question as to the validity of the size variable. Several studies, such as O’Shaughnessy (1998) and Fama and French (2007), show that out-performance by size is really due to a micro-cap effect. The usefulness of a small-cap strategy may

therefore be in serious jeopardy, since micro-caps are generally too illiquid for investment by many active managers.

Further, stress analysis conducted on the variables contained in many value and macro studies has generally shown a lack of robustness in the findings. For instance, Durham (2001) used extreme boundary analysis (EBA) to evaluate model uncertainty. Analyzing 23 proposed explanatory variables of stock returns, only a few variables withstood statistical testing in extreme situations.

The last caveat involves operational efficiency. As suggested in the qualitative findings of this paper, value indicators may persist precisely because of the frictional costs of expense ratios and tax impacts necessary to extract the value. Indicators of value will be utilized only when returns are higher than the costs of research and taxes. This also suggests why momentum as well reversion to the mean has been found in many studies: when value does exceed the frictional costs, buying will commence on the equity with an initial mean acceleration in pricing from historic lows, followed by eventual mean reversion to the long-run averages.

Future Research. Expansion of the model could possibly address some of these items. The Gibbons, Ross, and Shanken (1999) F test for portfolio efficiency could be used in conjunction with regression runs to determine how close the multiple independent factors are to means-variance efficiency (MVE). A time trend should also be used to determine whether variables are merely trending together. Macro variables, as well as country and industry specific pricing ala French and Fama (1994, 1996), could be added into a multi-factor model. Returns stated on a post-cost, post-tax basis should also be developed for a better direct comparison with benchmark indices. Momentum and

reversion to the mean variables could be studied. Independent variables could be developed based on breakpoints of accounting ratios. This would generate more of a fundamental perspective regarding the value factor. The multi-factor model could be analyzed over successively longer holding periods, as well.

These additional efforts would extend the selection of assets into a very complex matrix sorted by macro-events, country, industry, size, value, and mean changing / accelerating occurrences. Such an involved approach would be consistent with a top-down methodology to asset selection, although conceivably, asset-level considerations could still be emphasized through the use of fundamental factors. Adding such variables on a post-cost, post-tax basis would take the quantitative analysis up to current professional levels of asset allocation and portfolio composition.

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Appendixes

Table A1 – Summary Statistics, 1963-1993 Data, 366 Months

Explanatory Variables

Name	Mean	Std	t Value	p > t
RF	0.5340	0.2236	45.69	<.0001
MktPrem	0.4097	4.4396	1.77	0.0783
SMB	0.2832	2.8690	1.89	0.0598
HML	0.4683	2.5831	3.47	0.0006

Correlation

	MtkPrem	SMB	HML
MktPrem	1.0000	0.3661	-0.3542
SMB	0.3661	1.0000	-0.1044
HML	-0.3542	-0.1044	1.0000

Dependent Variable, Value-weighted Excess Returns, Size vs BE/ME

Size	BE/ME				
	Low	2	3	4	High
	Mean				
Small	0.2599	0.7098	0.7301	0.9370	1.0986
2	0.3882	0.6764	0.9156	0.9452	1.0848
3	0.4298	0.7472	0.6999	0.8995	1.0052
4	0.4550	0.4013	0.6761	0.8057	0.9192
Big	0.3248	0.3664	0.3800	0.5330	0.6349

Size	Std Dev				
	Low	2	3	4	High
Small	7.6563	6.7290	6.1471	5.8308	6.2009
2	7.1873	6.1522	5.6001	5.2753	5.9035
3	6.5736	5.6051	5.0723	4.8056	5.5876
4	5.7913	5.3204	4.9707	4.7741	5.5319
Big	4.8029	4.6090	4.2628	4.2583	4.7773

Size	t stat for Mean				
	Low	2	3	4	High
Small	0.65	2.02	2.27	3.07	3.39
2	1.03	2.10	3.13	3.43	3.52
3	1.25	2.55	2.64	3.58	3.44
4	1.50	1.44	2.60	3.23	3.18
Big	1.29	1.52	1.71	2.39	2.54

Table A2 – Summary Statistics, 1963-2006 Data, 522 Months

Explanatory Variables

Name	Mean	Std	t Value	p > t
RF	0.4699	0.2247	47.78	0.0001
MktPrem	0.4768	4.3799	2.49	0.0132
SMB	0.1170	3.2473	0.82	0.4107
HML	0.5455	2.9001	4.30	0.0001

	Correlation		
	MtkPrem	SMB	HML
MktPrem	1.0000	0.2747	-0.3914
SMB	0.2747	1.0000	-0.2790
HML	-0.3914	-0.2790	1.0000

Dependent Variable, Value-weighted Excess Returns, Size vs BE/ME

Size	BE/ME				
	Low	2	3	4	High
	Mean				
Small	0.2431	0.8342	0.8717	1.0861	1.1973
2	0.4083	0.6897	0.9476	0.9906	1.0662
3	0.4239	0.7428	0.7471	0.8724	1.0492
4	0.5293	0.5351	0.7654	0.8632	0.9065
Big	0.4108	0.4960	0.5025	0.6019	0.6234

Size	BE/ME				
	Low	2	3	4	High
	Std Dev				
Small	8.1672	6.9888	5.9769	5.5950	5.8930
2	7.4048	5.9978	5.3383	5.1358	5.6949
3	6.7722	5.4277	4.8776	4.6980	5.3408
4	6.0017	5.1048	4.8089	4.6449	5.2628
Big	4.7287	4.4954	4.2439	4.1991	4.7654

Size	BE/ME				
	Low	2	3	4	High
	t stat for Mean				
Small	0.68	2.73	3.33	4.44	4.64
2	1.26	2.63	4.06	4.41	4.28
3	1.43	3.13	3.50	4.24	4.49
4	2.01	2.39	3.64	4.25	3.94
Big	1.98	2.52	2.70	3.28	2.99

**Table A3 – Summary Statistics, 1963-2006 Data
Other Price to Value Dependent Portfolios**

Dependent Variable, Equal-Weighted Excess Returns, CFP

Port	Obs	Mean	Std Dev	t Value	p > t
CFP1	522	0.4573	6.7582	1.55	0.1227
CFP2	522	0.6224	5.8294	2.44	0.0150
CFP3	522	0.7722	5.3175	3.32	0.0010
CFP4	522	0.8123	5.0638	3.67	0.0003
CFP5	522	0.8910	4.9862	4.08	<.0001
CFP6	522	0.9789	4.9209	4.55	<.0001
CFP7	522	1.0589	4.8716	4.97	<.0001
CFP8	522	1.0244	4.9271	4.75	<.0001
CFP9	522	1.2273	5.1084	5.49	<.0001
CFP10	522	1.3120	5.6376	5.32	<.0001

Dependent Variable, Equal-Weighted Excess Returns, DP

Port	Obs	Mean	Std Dev	t Value	p > t
DP1	522	0.7724	5.7449	3.07	0.0022
DP2	522	0.8536	5.2761	3.70	0.0002
DP3	522	0.8333	5.0384	3.78	0.0002
DP4	522	0.8787	4.8784	4.12	<.0001
DP5	522	0.8700	4.6485	4.28	<.0001
DP6	522	0.9474	4.4969	4.81	<.0001
DP7	522	0.9319	4.2650	4.99	<.0001
DP8	522	0.9733	4.1439	5.37	<.0001
DP9	522	0.8627	3.7918	5.20	<.0001
DP1	522	0.7637	4.0159	4.35	<.0001

Dependent Variable, Equal-Weighted Excess Returns, EP

Port	Obs	Mean	Std Dev	t Value	p > t
EP1	522	0.5383	6.7712	1.82	0.0699
EP2	522	0.6680	5.8388	2.61	0.0092
EP3	522	0.7184	5.5453	2.96	0.0032
EP4	522	0.7820	5.1802	3.45	0.0006
EP5	522	0.8518	5.0527	3.85	0.0001
EP6	522	0.8990	4.8792	4.21	<.0001
EP7	522	0.9675	4.7863	4.62	<.0001
EP8	522	1.0070	4.6917	4.90	<.0001
EP9	522	1.1455	4.8909	5.35	<.0001
EP1	522	1.3061	5.6249	5.30	<.0001

Dependent Variable, Equal-Weighted Excess Returns, BKP

Port	Obs	Mean	Std Dev	t Value	p > t
BKP1	522	0.2282	7.4965	0.70	0.4870
BKP2	522	0.5623	6.3897	2.01	0.0449
BKP3	522	0.6751	5.9977	2.57	0.0104
BKP4	522	0.8164	5.7123	3.27	0.0012
BKP5	522	0.8711	5.3935	3.69	0.0002
BKP6	522	0.9927	5.2117	4.35	<.0001
BKP7	522	1.0825	5.0757	4.87	<.0001
BKP8	522	1.1120	5.1313	4.95	<.0001
BKP9	522	1.2722	5.4396	5.34	<.0001
BKP10	522	1.4917	6.2435	5.46	<.0001

Dependent Variable, Equal-Weighted Excess Returns, ME (Size)

Port	Obs	Mean	Std Dev	t Value	p > t
ME1	522	0.8120	6.4060	2.90	0.0039
ME2	522	0.7393	6.3083	2.68	0.0076
ME3	522	0.7777	5.9935	2.96	0.0032
ME4	522	0.7227	5.7892	2.85	0.0045
ME5	522	0.7472	5.5345	3.08	0.0021
ME6	522	0.6339	5.2132	2.78	0.0057
ME7	522	0.6865	5.1045	3.07	0.0022
ME8	522	0.6283	4.9692	2.89	0.0040
ME9	522	0.5587	4.5209	2.82	0.0049
ME10	522	0.4174	4.2148	2.26	0.0241

Note on all Table B Series – Regressions

All numbers in the following regressions are corrected for serial correlation using Prais-Winston, with the alternative Durbin Watson statistic also being reported after transformation. The F test is for joint significance of all dependent variables. All R^2 values in this paper and the following tables report adjusted R^2 .

Table B1 – 1963-1993 Data, Size and Book to Price Dependent Portfolios

CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

Size	Low	2	3	4	High	Size	Low	2	3	4	High
a						t(a)					
Small	-0.3053	0.2055	0.2619	0.4997	0.6583	Small	-1.14	0.94	1.38	2.71	2.92
2	-0.1909	0.1739	0.4532	0.5190	0.6257	2	-0.95	1.13	3.46	3.77	3.53
3	-0.1243	0.2692	0.2772	0.5006	0.5679	3	-0.85	2.39	2.37	4.49	3.27
4	-0.0460	-0.0641	0.2480	0.4079	0.4723	4	-0.41	-0.72	2.62	3.51	3.14
Big	-0.0874	-0.0390	0.0194	0.1859	0.2802	Big	-0.89	-0.47	0.18	1.94	1.86
b						t(b)					
Small	1.3798	1.2298	1.1430	1.0666	1.0718	Small	27.94	27.93	28.93	272.80	24.20
2	1.4116	1.2277	1.1258	1.0395	1.1205	2	37.23	37.68	37.01	35.20	30.68
3	1.3525	1.1670	1.0327	0.9736	1.0653	3	45.16	46.54	41.46	39.78	31.54
4	1.2243	1.1364	1.0451	0.9699	1.0904	4	54.69	58.09	49.71	40.14	34.38
Big	1.0056	0.9903	0.8803	0.8476	0.8659	Big	48.14	59.26	40.98	37.32	25.84
Adj R2						s(e)					
Small	0.68	0.68	0.70	0.67	0.62	Small	4.2125	3.7326	3.3407	3.3113	3.7588
2	0.79	0.80	0.79	0.77	0.72	2	3.2284	2.7590	2.5864	2.5008	3.0934
3	0.85	0.86	0.82	0.81	0.73	3	2.5374	2.1661	2.1094	2.0739	2.8684
4	0.89	0.90	0.87	0.82	0.76	4	1.8987	1.6571	1.7823	2.0465	2.6857
Big	0.86	0.91	0.82	0.79	0.65	Big	1.7688	1.1463	1.8219	1.9362	2.8410
DW						F test					
Small	2.0191	2.0097	2.0080	2.0067	2.0088	Small	780.86	780.19	839.67	744.00	585.72
2	2.0092	2.0055	1.9957	2.0059	2.0031	2	1385.98	1419.00	1369.84	1238.86	941.43
3	2.0053	2.0018	1.9988	2.0035	1.9975	3	2039.70	2166.09	1718.76	1582.04	994.63
4	2.0160	2.0055	2.0014	2.0029	1.9983	4	2990.61	3374.86	2471.06	1610.88	1181.92
Big	2.0046	1.9948	1.9877	1.9953	2.0001	Big	2317.58	3512.32	1679.26	1393.14	667.52

Table B2 – 1963-1993 Data, Size and Book to Price Dependent Portfolios
Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

Size	Low	2	3	4	High	Size	Low	2	3	4	High
a						t(a)					
Small	-0.4342	-0.0973	-0.0954	0.0777	0.0772	Small	-4.06	-1.35	-1.45	1.24	1.09
2	-0.1212	-0.0107	0.1747	0.1273	0.0824	2	-1.50	-0.16	2.69	1.97	1.19
3	-0.1105	0.1293	0.0010	0.1502	0.5652	3	-0.15	1.71	0.01	2.18	0.66
4	0.1470	-0.1344	0.0340	0.0728	0.0177	4	1.95	-1.60	0.42	0.88	0.19
Big	0.2069	0.0478	-0.0423	-0.0781	-0.1479	Big	2.88	0.06	-0.44	-1.18	-1.39
b						t(b)					
Small	1.0415	0.9692	0.9412	0.8974	0.9513	Small	40.85	50.11	60.65	59.64	58.87
2	1.1035	1.0246	0.9659	0.9744	1.0748	2	54.16	59.76	61.48	63.56	64.93
3	1.1067	1.0326	0.9765	0.9696	1.0716	3	59.33	56.75	54.58	59.28	51.59
4	1.0679	1.0846	1.0544	1.0367	1.1479	4	58.24	53.58	52.48	51.87	46.45
Big	0.9557	1.0322	0.9808	1.0038	1.0363	Big	56.74	58.52	46.01	55.58	36.43
s						t(s)					
Small	1.4100	1.2992	1.1466	1.1056	1.1926	Small	37.82	46.55	50.47	50.26	50.25
2	1.0062	0.9178	0.8343	0.7087	0.8463	2	33.98	36.80	36.28	31.59	34.97
3	0.7012	0.6128	0.5371	0.4415	0.6388	3	25.82	23.05	20.59	18.45	21.06
4	0.2973	0.2595	0.2310	0.1943	0.3516	4	11.11	8.78	7.91	6.66	9.84
Big	-0.2004	-0.2012	-0.2765	-0.1827	-0.0318	Big	-8.12	-7.79	-8.81	-7.02	-0.77
h						t(h)					
Small	-0.2817	0.0905	0.2462	0.3809	0.6265	Small	-6.80	2.96	9.73	15.58	23.62
2	-0.4860	0.0158	0.2306	0.4649	0.6886	2	-14.87	0.57	9.04	18.62	25.59
3	-0.4508	0.0461	0.3139	0.4846	0.7018	3	-15.01	10.86	10.86	18.21	20.83
4	-0.4561	0.0387	0.3092	0.5403	0.7082	4	-15.36	1.18	9.57	16.69	18.07
Big	-0.4640	-0.0088	0.2113	0.5375	0.7842	Big	-16.88	-0.31	6.00	18.93	17.45
Adjusted R2						s(e)					
Small	0.94	0.96	0.96	0.96	0.96	Small	1.8980	1.4332	1.1567	1.1200	1.2085
2	0.96	0.96	0.96	0.95	0.96	2	1.5107	1.2717	1.1711	1.1421	1.2323
3	0.96	0.94	0.93	0.93	0.92	3	1.3841	1.3538	1.3290	1.2182	1.5450
4	0.94	0.92	0.91	0.90	0.89	4	1.3630	1.5052	1.4902	1.4860	1.8299
Big	0.93	0.92	0.86	0.90	0.81	Big	1.2560	1.3153	1.6000	1.3376	2.1065
DW						F test					
Small	1.9982	2.0108	2.0004	1.9969	1.9971	Small	1822.97	2670.85	3247.43	3123.99	2979.28
2	1.9998	2.0000	2.0025	1.9899	2.0039	2	2643.84	2729.30	2636.03	2440.03	2640.98
3	1.9997	1.9977	1.9968	1.9930	2.0023	3	2619.97	1943.01	1642.41	1748.13	1458.04
4	2.0037	2.0047	2.0004	2.0001	2.0014	4	2064.41	1388.80	1233.33	1130.77	1000.14
Big	2.0072	1.9975	1.9863	1.9985	2.0017	Big	1651.86	131.97	760.62	1106.96	511.01

Table B3 – 1963-2006 Data, Size and Book to Price Dependent Portfolios

CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

Size	Low	2	3	4	High	Size	Low	2	3	4	High
a						t(a)					
Small	-0.4451	0.2462	0.3583	0.6161	0.7234	Small	-1.84	1.22	2.13	3.71	3.74
2	-0.2849	0.1262	0.4496	0.5235	0.5660	2	-1.69	0.94	3.73	4.06	3.56
3	-0.2341	0.2093	0.2838	0.4400	0.5768	3	-1.81	2.02	2.56	3.78	3.70
4	-0.0720	0.0239	0.2975	0.4247	0.4313	4	-0.69	0.24	2.78	3.90	3.08
Big	-0.0701	0.0419	0.0949	0.2252	0.2286	Big	-0.87	0.57	1.00	2.23	1.69
b						t(b)					
Small	1.4439	1.2332	1.0768	0.9860	0.9940	Small	28.85	28.26	29.96	28.86	26.78
2	1.4535	1.1818	1.0447	0.9790	1.0481	2	38.62	39.03	37.75	35.19	31.89
3	1.3808	1.1185	0.9710	0.9061	0.9883	3	44.49	48.21	41.87	36.90	32.78
4	1.2608	1.0705	0.9793	0.9190	0.9959	4	53.81	56.35	45.98	39.79	33.78
Big	1.0084	0.9525	0.8553	0.7900	0.8280	Big	59.19	56.79	42.07	33.48	26.76
adj R2						s(e)					
Small	0.62	0.60	0.63	0.61	0.58	Small	5.0001	4.3567	3.5877	3.4365	3.7246
2	0.74	0.75	0.73	0.70	0.66	2	3.7591	3.0268	2.7684	2.7777	3.283
3	0.79	0.82	0.77	0.72	0.67	3	3.1195	2.3177	2.3161	2.4514	3.0228
4	0.85	0.86	0.80	0.75	0.69	4	2.3407	1.9046	2.1317	2.3062	2.9437
Big	0.87	0.86	0.77	0.68	0.58	Big	1.7008	1.6767	2.0299	2.3642	3.0943
DW						F test					
Small	2.0063	2.0004	2.0051	2.0111	2.0166	Small	832.21	798.45	897.87	821.57	716.87
2	2.0007	2.0007	1.9967	2.0104	2.0105	2	1491.77	1522.95	1425.35	1237.98	1017.17
3	1.9998	2.0051	2.0155	2.0149	2.0190	3	1979.22	2324.43	1753.07	1361.89	1074.74
4	2.0058	2.0484	2.0136	2.0092	1.9976	4	2895.43	3174.86	2114.06	1582.94	1141.26
Big	2.0060	2.0002	1.9985	1.9969	2.0008	Big	3503.69	3224.83	1769.54	1120.80	716.35

Table B4 – 1963-2006 Data, Size and Book to Price Dependent Portfolios
Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

Size	Low	2	3	4	High	Size	Low	2	3	4	High
a						t (a)					
Small	-0.4569	-0.0009	0.0212	0.1938	0.1909	Small	-2.31	-0.01	0.19	1.85	2.15
2	-0.1542	-0.0655	0.1430	0.0973	-0.0039	2	-1.19	-0.71	1.99	1.38	-0.06
3	-0.0367	0.0515	-0.0428	0.0213	0.0305	3	-0.36	0.58	-0.57	0.30	0.38
4	0.1310	-0.1280	0.0063	0.0194	-0.0590	4	1.41	-1.45	0.07	0.27	-0.63
Big	0.2071	0.0103	-0.0277	-0.0960	-0.2161	Big	3.49	0.14	-0.31	-1.19	-1.94
b						t (b)					
Small	1.2654	1.1467	1.0402	0.9872	1.0239	Small	28.39	31.23	39.24	43.14	51.57
2	1.2555	1.1032	1.0090	1.0109	1.1158	2	39.28	48.93	59.75	63.11	66.77
3	1.1963	1.0724	1.0076	0.9766	1.0880	3	43.97	56.65	57.68	58.84	56.31
4	1.1505	1.0847	1.0423	1.0270	1.1039	4	49.53	57.67	54.24	56.46	47.11
Big	0.9503	0.9870	0.9188	0.9165	0.9850	Big	70.54	54.53	42.84	42.62	34.89
s						t (s)					
Small	0.9507	0.9196	0.8407	0.8255	0.9724	Small	16.38	19.39	24.47	27.61	37.57
2	0.7121	0.7261	0.7180	0.6620	0.7733	2	17.27	24.90	32.78	31.84	35.85
3	0.4851	0.5082	0.4561	0.4619	0.5808	3	13.94	20.52	20.12	21.45	23.21
4	0.1567	0.2394	0.2538	0.2349	0.3755	4	5.24	9.72	10.15	10.02	12.44
Big	-0.2446	-0.1057	-0.0909	-0.0227	0.0743	Big	-13.95	-4.53	-3.27	-0.82	2.04
h						t (h)					
Small	-0.0259	0.3314	0.4697	0.5964	0.7418	Small	-0.38	5.98	11.65	16.87	24.30
2	-0.2188	0.2644	0.4389	0.6164	0.8205	2	-4.54	7.75	17.07	25.23	32.56
3	-0.3042	0.2199	0.4693	0.6071	0.7917	3	-7.58	7.50	17.62	24.00	26.98
4	-0.3088	0.2150	0.4252	0.5990	0.7247	4	-8.85	7.37	14.44	21.90	20.61
Big	-0.4050	0.0502	0.1883	0.4832	0.6621	Big	-19.60	1.84	5.79	15.17	15.65
adj R2						s (e)					
Small	0.75	0.78	0.84	0.86	0.90	Small	4.0356	3.3188	2.3960	2.0769	1.7987
2	0.85	0.88	0.92	0.92	0.93	2	2.8892	2.0379	1.5264	1.4482	1.5106
3	0.87	0.90	0.89	0.90	0.89	3	2.4801	1.7199	1.5794	0.0002	1.7460
4	0.88	0.89	0.87	0.88	0.84	4	2.1010	1.7105	1.7390	1.6451	2.1196
Big	0.93	0.87	0.79	0.78	0.71	Big	1.2195	1.6363	1.9380	1.9556	2.5544
DW						F test					
Small	1.9980	1.9998	1.9970	1.9974	1.9836	Small	521.55	600.06	898.14	1047.26	1628.33
2	1.9996	2.0003	2.0072	1.9988	1.9990	2	974.01	1330.51	1930.04	1986.71	2306.83
3	1.9981	2.0252	2.0042	1.9962	2.0031	3	1179.06	1523.93	1467.94	1512.76	1443.22
4	1.9855	2.0309	1.9936	2.0013	2.0072	4	1254.41	2353.24	1145.47	1218.68	903.72
Big	2.0079	1.9988	1.0006	2.0119	2.0071	Big	2436.78	1139.58	660.73	629.95	434.62

Table B5 – 1963-2006 Data, CFP Dependent Portfolios**CAPM Model --- $R_i - R_f = a + b(R_m - R_f) + u_i$**

	CFP1	CFP2	CFP3	CFP4	CFP5	CFP6	CFP7	CFP8	CFP9	CFP10
a	-0.1683	0.0712	0.2763	0.3425	0.4308	0.5309	0.6254	0.5861	0.7875	0.8455
t(a)	-1.03	0.54	2.14	2.73	3.45	4.16	4.63	4.31	5.21	4.78
b	1.3119	1.1557	1.0404	0.9850	0.9642	0.9396	0.9073	0.9177	0.9223	0.9773
t(b)	38.30	42.12	41.09	40.58	38.86	37.19	34.42	34.34	31.40	28.08
adj R2	0.74	0.77	0.76	0.76	0.74	0.73	0.69	0.69	0.65	0.60
s(e)	3.4206	2.7410	2.5367	2.4334	2.4837	2.5294	2.6419	2.6774	2.9440	3.4862
DW	2.0025	2.0193	2.0295	2.0212	2.0304	2.0299	2.0326	2.0266	2.0307	2.0234
F test	1466.82	1774.39	1688.17	1646.79	1510.02	1382.76	1184.58	1179.17	985.88	788.30

Table B6 – 1963-2006 Data, CFP Dependent Portfolios**Three-Factor Model --- $R_i - R_f = a + b(R_m - R_f) + s(SMB) + h(HML) + u_i$**

	CFP1	CFP2	CFP3	CFP4	CFP5	CFP6	CFP7	CFP8	CFP9	CFP10
a	-0.1365	-0.0292	0.0859	0.1161	0.1468	0.2129	0.2500	0.1958	0.3567	0.3718
t(a)	-1.04	-0.30	0.92	1.38	1.99	2.85	3.47	2.96	4.74	4.26
b	1.1484	1.0516	0.9881	0.9507	0.9484	0.6620	0.9232	0.9408	0.9450	0.9918
t(b)	42.72	58.51	60.37	63.48	66.22	35.29	66.60	64.77	63.13	50.87
s	0.7609	0.7224	0.6604	0.6382	0.6573	0.4453	0.6848	0.6839	0.7665	0.9035
t(s)	21.56	30.37	30.38	32.11	34.79	19.88	37.42	36.06	38.89	35.54
h	-0.7813	0.1206	0.2544	0.3087	0.3937	0.4453	0.5289	0.5493	0.6063	0.6628
t(h)	-1.86	4.24	9.76	12.96	17.47	19.88	24.22	24.51	25.84	22.10
adj R2	0.86	0.92	0.91	0.92	0.93	0.93	0.93	0.93	0.92	0.90
s(e)	2.4544	1.6613	1.5247	1.3928	1.3161	1.3081	1.2752	1.3175	1.3710	1.7665
DW	1.9813	2.0460	2.0103	1.9895	2.0223	2.0224	2.0378	2.0029	1.9930	2.0058
F test	1100.81	1894.07	1867.89	2029.63	2226.09	2186.53	2256.43	2179.80	2134.04	1543.93

Table B7 – 1963-2006 Data, DP Dependent Portfolios
CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10
a	0.2216	0.3557	0.3704	0.4302	0.4546	0.5403	0.5523	0.6125	0.5433	0.4710
t(a)	1.68	42.41	2.82	3.35	3.46	4.35	4.41	4.75	4.34	3.28
b	1.1518	1.0438	0.9695	0.9392	0.8695	0.8534	0.7947	0.7556	0.6887	0.6136
t(b)	46.99	42.41	39.80	39.03	35.98	37.47	35.43	33.07	30.08	20.96
adj R2	0.81	0.78	0.75	0.75	0.71	0.73	0.71	0.68	0.63	0.46
s(e)	2.4695	2.4620	2.4513	2.4187	2.4343	2.2945	2.2648	2.3103	2.2463	2.9256
DW	2.0466	2.0305	2.0395	2.0209	2.0451	2.0505	2.0424	2.0415	2.0432	2.0087
F test	2207.66	1798.42	1584.09	1523.53	1294.16	1403.56	1255.44	1093.55	904.93	439.47

Table B8 – 1963-2006 Data, DP Dependent Portfolios
Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10
a	0.1332	0.1558	0.0974	0.1239	0.1133	0.2119	0.2108	0.2432	0.1389	-0.0146
t(a)	1.18	1.53	1.04	1.50	1.43	2.83	2.62	3.14	2.04	-0.14
b	1.0773	0.9914	0.9606	0.9512	0.8952	0.8833	0.8336	0.8071	0.7434	0.7052
t(b)	60.44	65.46	62.73	60.77	29.76	61.35	0.70	57.88	55.12	32.49
s	0.5921	0.6537	0.6124	0.5807	0.5844	0.5371	0.5192	0.5155	0.4578	0.4891
t(s)	24.86	32.21	29.99	28.08	29.76	28.26	28.49	27.88	25.77	17.19
h	0.9782	0.2722	0.3767	0.4269	0.4784	0.4612	0.4811	0.5219	0.5783	0.7053
t(h)	3.41	11.11	15.34	17.28	20.39	20.33	21.98	23.57	27.33	20.90
adj R2	0.91	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.75
s(e)	1.6873	1.4488	1.4416	1.4424	1.3703	1.3245	1.2817	1.2940	1.2363	1.9765
DW	2.0490	2.0461	1.9801	2.0053	2.0154	2.0395	2.0085	2.0249	2.0217	1.9879
F Test	1813.96	2118.21	1874.61	1743.47	1734.59	1751.69	1690.93	1547.01	1395.46	526.06

Table B9 – 1963-2006 Data, EP Dependent Portfolios
CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9	EP10
a	-0.0798	0.1136	0.1911	0.2960	0.3844	0.4513	0.5353	0.5941	0.7236	0.8418
t(a)	-0.47	0.86	1.53	2.38	3.09	3.71	4.21	4.41	4.99	4.74
b	1.2962	1.1624	1.1054	1.0190	0.9798	0.9386	0.9059	0.8652	0.8834	0.9728
t(b)	36.42	42.95	43.25	41.57	38.78	37.44	36.23	34.01	31.60	28.17
R ²	0.72	0.78	0.78	0.77	0.74	0.73	0.72	0.69	0.66	0.60
s(e)	3.5539	2.7049	2.5547	2.4545	2.5261	2.5047	2.5010	2.5558	2.8039	3.4613
DW	2.0061	2.0143	2.0240	2.0251	2.0261	2.0195	2.0271	2.0390	2.0371	2.0285
F Test	1326.63	1844.62	1870.44	1728.42	1503.48	1401.94	1316.31	1156.56	998.48	793.55

Table B10 – 1963-2006 Data, EP Dependent Portfolios
Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9	EP10
a	-0.0993	0.0366	0.0428	0.0786	0.0972	0.1413	0.2040	0.2139	0.2982	0.3647
t(a)	-0.75	0.36	0.48	0.90	1.30	2.02	2.86	3.15	4.24	4.17
b	1.1439	1.0560	1.0348	0.9833	0.9605	0.9301	0.9112	0.8928	0.9180	0.9923
t(b)	41.00	57.94	59.61	61.86	65.50	64.17	64.91	65.74	60.33	51.46
s	0.8062	0.6988	0.6572	0.6315	0.6684	0.6524	0.6461	0.6496	0.7044	0.8947
t(s)	22.04	28.89	28.68	29.98	34.58	34.30	34.93	36.35	35.40	35.55
h	-0.0033	0.0850	0.1928	0.2949	0.4001	0.4361	0.4646	0.5341	0.5993	0.6665
t(h)	-0.08	2.93	7.05	11.70	17.37	19.31	21.09	25.11	25.45	22.41
adj R ²	0.85	0.91	0.91	0.92	0.93	0.92	0.92	0.93	0.92	0.90
s(e)	2.5407	1.6951	1.5962	1.4732	1.3456	1.3218	1.2872	1.2430	1.3821	1.7486
DW	1.9931	2.0188	2.0323	2.0216	2.0080	2.0051	2.0057	2.0197	2.0081	2.0047
F Test	1020.18	1835.38	1857.32	1910.42	2187.48	2109.19	2126.94	2187.50	1923.98	1561.09

Table B11 – 1963-2006 Data, BKP Dependent Portfolios

CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

	BKP1	BKP2	BKP3	BKP4	BKP5	BKP6	BKP7	BKP8	BKP9	BKP10
a	-0.4536	-0.0358	0.1155	0.2898	0.3754	0.5175	0.6332	0.6714	0.8205	0.9631
t(a)	2.50	-0.24	0.82	2.07	2.85	3.93	4.60	4.53	4.89	4.58
b	1.4300	1.2538	1.1735	1.1035	1.0393	0.9963	0.9415	0.9236	0.9464	0.9631
t(b)	34.67	39.63	39.61	38.29	37.05	36.69	33.42	30.60	28.31	22.16
adj R2	0.70	0.75	0.75	0.74	0.72	0.72	0.68	0.64	0.61	0.48
s(e)	4.1235	3.1589	2.9590	2.8796	2.8007	2.7130	2.8154	3.0177	3.3452	4.3596
DW	1.8956	2.0136	2.0126	2.0157	2.0178	2.0213	2.02316	2.0153	2.0135	2.0117
F Test	1177.89	1570.31	1568.56	1466.24	1372.50	1346.08	1117.03	936.01	801.50	490.87

Table B12 – 1963-2006 Data, BKP Dependent Portfolios

Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

	BKP1	BKP2	BKP3	BKP4	BKP5	BKP6	BKP7	BKP8	BKP9	BKP10
a	-0.2715	-0.4846	-0.0227	0.0732	0.1017	0.1896	0.2664	0.2442	0.3503	0.4673
t(a)	1.83	-0.41	-0.21	0.81	1.24	2.44	3.48	3.13	4.04	3.50
b	1.2068	1.1157	1.0789	1.0400	0.9939	0.9844	0.9390	0.9397	0.9721	0.9962
t(b)	33.43	44.33	50.43	54.83	58.39	60.90	59.47	56.11	49.50	33.77
s	0.7224	0.7058	0.7338	0.7499	0.7455	0.7006	0.7333	0.7691	0.8357	1.0244
t(s)	15.48	21.42	26.05	30.17	33.39	33.04	35.38	35.10	32.68	26.60
h	-0.2936	-0.0075	0.1791	0.2920	0.3817	0.4617	0.5177	0.6046	0.6610	0.7878
t(h)	5.38	-0.19	5.34	9.91	14.40	18.35	21.03	23.31	21.94	17.32
adj R2	0.81	0.87	0.89	0.91	0.91	0.92	0.92	0.91	0.89	0.81
s(e)	3.2627	2.2892	1.9594	1.7264	1.5514	1.4731	1.4403	1.5219	1.7778	2.6750
DW	1.8322	2.0165	2.0010	1.9925	2.0201	2.0035	2.0182	1.9962	1.9922	1.9916
F test	729.31	1138.91	1393.83	1654.84	1853.52	1917.70	1892.69	1730.05	1408.65	735.87

Table B13 – 1963-2006 Data, ME Dependent Portfolios

CAPM Model --- $R_i - R_f = a + b (R_m - R_f) + u_i$

	ME1	ME2	ME3	ME4	ME5	ME6	ME7	ME8	ME9	ME10
a	0.3059	0.1667	0.2054	0.1618	0.1921	0.1044	0.1575	0.1085	0.0800	-0.0282
t(a)	1.43	1.07	1.63	1.40	2.10	1.26	2.29	1.68	1.70	-0.60
b	1.0618	1.2010	1.2005	1.1765	1.1649	1.1105	1.1094	1.0894	1.0038	0.9347
t(b)	25.69	34.86	41.42	44.25	52.03	59.11	70.69	79.79	95.72	90.34
adj R2	0.56	0.70	0.77	0.79	0.84	0.87	0.91	0.92	0.95	0.94
s(e)	4.1449	3.4405	2.9007	2.6602	2.2570	1.8784	1.5692	1.3633	1.0476	1.0333
DW	2.0048	2.0035	1.9987	1.9978	1.9866	2.0000	1.9992	2.0210	2.0009	2.0035
F test	659.92	1215.05	1715.34	1957.90	2707.53	3493.78	4997.27	6365.56	9161.90	8160.87

Table B14 – 1963-2006 Data, ME Dependent Portfolios

Three-Factor Model --- $R_i - R_f = a + b (R_m - R_f) + s (SMB) + h (HML) + u_i$

	ME1	ME2	ME3	ME4	ME5	ME6	ME7	ME8	ME9	ME10
a	-0.0287	-0.0885	-0.0112	-0.0197	0.0386	-0.0402	0.0332	-0.0250	-0.0090	0.0552
t(a)	-0.20	-0.82	-0.14	-0.29	0.67	-0.66	0.59	-0.45	-0.20	1.77
b	1.0184	1.1350	1.1252	0.6721	1.1025	1.0751	1.0975	1.1062	1.0302	0.9509
t(b)	31.90	43.45	57.71	29.04	69.14	74.05	78.18	83.97	94.10	120.68
s	0.9548	0.8048	0.7429	0.6721	0.5423	0.4306	0.2848	0.1731	0.0402	-0.2381
t(s)	22.90	23.83	29.49	29.04	26.71	22.89	15.74	10.13	2.85	-23.47
h	0.4469	0.3528	0.3034	0.2518	0.2197	0.2035	0.1773	0.1933	0.1316	-0.1163
t(h)	9.06	8.93	10.30	9.39	9.41	9.23	8.39	9.63	7.79	-9.84
adj R2	0.79	0.86	0.91	0.92	0.93	0.94	0.94	0.94	0.95	0.97
s(e)	2.8968	2.3607	1.7621	1.6416	1.4615	1.3121	1.2694	1.1910	0.9896	0.7129
DW	1.9774	2.0001	2.0009	1.9866	1.9870	1.9982	1.9950	2.0097	1.9999	1.9998
F test	641.72	1067.31	1838.72	2070.17	2492.44	2553.44	2653.41	2837.95	3458.26	5901.97

Addendum

Recommendations for Investment Portfolio Composition

The following general recommendations should be seriously considered in the development of any asset portfolio:

A passive investment strategy should arguably exist for the large bulk of the portfolio. Bogle (1999) feels that only three funds are necessary for core holdings: broadly diversified holdings in an all-domestic equity index fund; an international equity fund; and a domestic bond fund. This can be developed through index funds that track the Wilshire 5000, the MSCI world ex-US equity index, and the Lehman Bond Aggregate. A three-fund recommendation is quite consistent with the two-fund separation theory of Tobin (1958), in which broadly diversified domestic bond and equity funds could be used to maximize investor marginal utility along the efficient frontier. The third fund is added to include international assets, thereby increasing diversification and improving the overall return-to-risk ratios of the portfolio.

A recommendation of passive portfolio composition is also based on the recognition that 90% or more of asset returns are due to the basic asset allocation decision (Brinson, Hood, and Beebower, 1986). The allocation of assets will establish the primary risk-return structure of the portfolio, not the selection of individual assets in the portfolio.

The exact percentage of assets allocated to each of these positions depends upon the time frame of investment, the risk-return objectives of the portfolio, and the investor's risk tolerances. In longer time frames, the investor should be able to tolerate more short-term pricing volatility, and therefore concentrate more in equities. With greater risk

tolerance, the investor can also prefer equities over bonds. Risk-return parameters will also affect the desired or needed allocation.

Once the core of a portfolio is invested in passive vehicles, portfolio managers can move onto sector and specialty index funds. In this fashion, style, size, country, and industry allocations of a Fama and French styled, multi-factor modeling process can be achieved. The chief advantage of active styles - that of higher returns - can thereby potentially be obtained without having to incur the higher costs of active management.

Then, as the portfolio matures, one can entertain active styles. At all times however, it is imperative to keep expense ratios and tax impacts extremely low. Otherwise, the portfolio is doomed to under-perform.

The overall goal should be to generate risk-adjusted alpha on a post-tax, post-cost basis, and to do so on a long-term, compound annualized basis. This is very difficult to do in practice. As Warren Buffett and others have shown however, it is at least possible for some extraordinarily skilled investors to do. The literature indicates that it will also be difficult to find skilled managers who will continue to outperform in the future. Indeed, reversion to the mean tendencies exist on the performance statistics of out-performing fund managers as much as they do on individual assets (Carhart, 1997).

Some analysts feel that the least efficient capital markets (emerging; international; domestic small-cap; alternatives) should be emphasized for active styles, since domestic large caps and domestic fixed income assets are considered generally efficient, and thus, very difficult to out-perform.

As time frames lengthen, the entire debate between active vs passive and behavior vs efficiency becomes rather pointless. The quest for out-performance is replaced with a

need (and often times in an institutional setting, an absolute fiduciary mandate) to match assets with liabilities across all time frames. For more information on liability modeling in portfolio issues, see Kaufhold (2006:4).

As time frames become inter-generational in nature, the investment focus again shifts, now towards the maximization of lifetime consumption. The basic allocation decision can be even more important here, as an investor can deliberately change short-term asset-class allocations in order to maximize long-term utility (Eeckhoudt, Gollier, and Schlesinger, 2005). The ability to adjust short-term allocations is a distinct economic advantage for anyone emphasizing long-term consumption choices.

As a final thought on the matter, the deep desire of the financial community to dissect asset pricing into component parts in a quest to out-perform may be a peculiar endeavor of short-term thinking patterns. Indeed, the entire concept of pricing volatility is largely applicable to short-time frames, since pricing risk is virtually non-existent in very long holding periods. With long-term risks shifting away from pricing volatility and towards the probability of shortfall and the variation in lifetime consumption, more attention should be given to overall portfolio management and less to the daily gyrations of asset and market-level pricing. Individuals and managers alike might be better served by adopting long-term investment beliefs and philosophies that optimizes consumption over a lifetime of decisions involving economic choices under conditions of uncertainty.