

MULTI FACTOR PRICING MODEL: AN ALTERNATIVE APPROACH TO CAPM

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ABSTRACT: *This study analyzes the effect of significant variables among the alternative measures of risk other than beta and establishes a framework in search of an efficient alternative to the Capital Asset Pricing Model (CAPM). Several other recent studies on this issue explore additional variables as proxies for risk in stock return and have fueled considerable debate among investors and policy-makers. Finance scholars have brainstormed and debated over the appropriate and significant proxy for risk in pricing the return of stock. Through combined univariate and multivariate regression techniques, the study analyzes data collected from <http://multexinvestor.com> for 1,723 firms as of the Monday, August 07, 2006. By simultaneously testing the FF (Fama-French) model on recent return data this study extends previous developments on the improvement of CAPM and broadens the scope by testing additional financial factors as proxies for risk. The statistical model developed as part of the study explains return as a function of financial variables including the price to earnings per share ratio, price to book ratio, financial leverage, dividend yield, firm size, and beta. Results were mixed with beta and price to EPS performing in line with the FF model while results for price to book, firm size, leverage, and dividend yield were contrary to FF findings. This model divulges the relevance and significance of beta, firm size, and dividend yield as independent variables determining return on stocks, which neither support nor disagree with CAPM, FF or other research supporting significance of financial ratios and keeps the scope open for further research and debate on this matter.*

BACKGROUND

Recent empirical analysis of the Capital Asset Pricing Model (CAPM) tests the conditional relationship between beta and stock return. Is beta a useful measure of the risk of stock or portfolio returns? If so, how accurate is beta at predicting expected returns? Several other recent studies (Howton and Peterson, 1999) have analyzed the effects of betas, size, book-to-market equity, and earnings-price ratios on stock returns. Lewllen (2004) studied whether financial ratios like dividend yield can predict aggregate stock returns. In a weak form of efficient market, the stock return would already reflect the publicly available information on the past trading of firm's stock. Fama-French's (FF) 1992 paper evidences no relation between stock returns and beta coefficients. Other evidence suggest that these relationships are not lost even after other independent variables, including size, book-to-market equity, and an earnings-price ratio, are added to the cross-sectional regressions.

RESEARCH PROBLEM

CAPM assumes that stockholders have a well diversified portfolio and the only risk that is priced in the return of a stock is systematic risk. In general investors are risk-averse wealth maximizers. A clearer understanding of the major factors that constitute stock return would be of interest to investment

professionals and significantly add to the body of finance literature. The literature advances the following set of important factors that purport to explain stock price and return: book to market, price to earnings, firm size, financial leverage and dividend yield. Are there other variables could be a better proxy for risk and return?

PURPOSE OF STUDY

Finance scholars continue the debate over the appropriate proxy for risk in pricing the return of stock (see literature review section). The purposes of this research are to: identify the list of significant variables among the alternative measures of risk other than beta and provide theoretical significance thereof; and develop a model for return on stocks. Specifically, with the data available from MultexInvestor.com, the study will perform statistical analysis to develop a multifactor pricing model that is an alternative CAPM. Finally, the work here will analyze the significance and interpret the performance of the model compared to previous empirical research and present a multifactor model, that includes beta and other financial ratios, as a potential alternative to CAPM.

LITERATURE REVIEW

To enhance the statistical power of the Fama-MacBeth technique, various improvements have been suggested. Some significant research in this area includes those studies focused on more precise estimation of betas (i.e, Shanken, 1992), those exploring additional proxies for risk (i.e, Fama and French, 1996) and those focusing on the time-varying characteristic of beta and the risk premium. Freeman and Guermat (2006) explore the idea that the ex-ante risk premium is always positive and the ex-post excess return to the market is not. Likewise, they evaluated a series of tests that analyzed the conditional relationship between betas and market returns from the CAPM perspective. They present an Adjusted Conditional Beta Test (ACBT) to provide an adjusted version of the empirical test. The test results reveal that the null hypothesis is consistent with Fama-MacBeth (i.e., beta is not priced), meaning that financial market noise does not work in favor of the CAPM.

Other previous researchers, Campbell and Hentschel (1992) and Glosten, Jagannathan, and Runkle (1993) had analyzed the relationship between the volatility of the market and the expected return on the market. The relationship between the aggregate volatility and the cross section of expected stock returns have received less attention. Ang, Hodrick, Xing, And Zhang (2006) reveal that innovations in aggregate volatility carry a statistically significant negative value of 1% per annum. Stocks that perform well when volatility rises, tend to have a positively skewed return and stocks that do badly when volatility increases, tend to have negatively skewed returns. Forming portfolios by sorting on idiosyncratic volatility would not present any difference in average returns, if the Fama–French model is correct. However, if the Fama–French model is false, sorting on idiosyncratic volatility would potentially provide a set of assets that may have different exposures to aggregate volatility and hence different average returns.

Lewellen (2004) finds strong evidence that dividend yield (DY) predicts both equal and value-weighted NYSE returns from 1946–2000. In the full sample and various sub-samples, DY is typically significant at the 0.01 level, with many t-statistics greater than 3.0 or 4.0. The evidence for Book to Market and PE ratios is somewhat weaker and, overall, they seem to have limited forecasting power. Even when the statistics cannot reject the null, the conditional biased adjusted slopes look much different than the unconditional estimates.

Howton and Peterson (1999) examine relationships between returns and conditional market and economic-factor betas, size, book-to-market equity, and earnings-price ratios. They find that relationships shift across regimes, and seasons (January effect) suggesting the importance of a conditional, as opposed

to unconditional, model. When bull and bear markets are separated in January, results are different than when all January months are examined. In particular, the significant negative relationship found between returns and size in all January months is now found to exist only in bull markets, while in bear markets there is no relationship. Further, there is a strong and significant, at the 0.01 level, positive relationship between returns and book-to-market equity in bear markets, but no significant relationship in bull markets. The study finds that coefficients on the market betas are no longer significant in either the bull or bear market models.

Howton and Peterson's (1998) study examines the cross-section of realized stock returns. Bull-market betas are significantly positively related to returns and, except for some models in January, bear-market betas are significantly negatively related to returns. These relationships are not lost even after other independent variables, including size, book-to-market equity, and an earnings-price ratio, are added to the cross-sectional regressions. Book-to-market equity is an important factor in bear, but not bull, markets. Size is important in January and in bear markets during February through December.

Ang and Chen (2006) show that under a conditional CAPM with time-varying betas, predictable market risk premia, and stochastic systematic volatility, there is little evidence that the conditional alpha for a book-to-market trading strategy is different from zero.

Bloomfield (2004) performed two experiments to assess whether security characteristics are associated with returns because investors believe they affect risk, or because investors believe they reflect mispricing. He examines how beta, market-to-book ratios, and firm size affect the returns Wall Street professionals expect, and how those factors affect perceived risk and mispricing. Consistent with traditional asset pricing models, professionals expect firms with higher betas to be riskier investments and to generate higher returns. Consistent with behavioral models, professionals expect firms with higher market-to-book ratios to be overpriced (and riskier). Professionals expect large firms to be less risky, but most do not view firm size to be a sign of mispricing. Empirical tests of asset pricing models that use realized return as a proxy for expected return cannot easily distinguish risk from mispricing.

METHODOLOGY

Through univariate and multivariate regressions, the study analyzes data collected from <http://multinvestor.com> for 1,723 firms as of the Monday, August 07, 2006 (see Table 1). This analysis extends previous work on improvement of CAPM by simultaneously testing the FF model on recent return data. This model explains return as a function of financial ratios (price to earnings per share ratio, price to book ratio, financial leverage, Dividend Yield), firm size and beta. Return = f (Beta, PE, PB, DY, Fin leverage, size).

$$r = \alpha + \beta_0 \text{Beta} + \beta_1 \text{PE} + \beta_2 \text{PB} + \beta_3 \text{DY} + \beta_4 \text{Leverage} + \beta_5 \text{Size} + \varepsilon$$

The study sample and variables used are described in Table 1. A common problem with multiple regression analysis arises when the potential for collinearity among the selected independent variables or multicollinearity exists. The presence of multicollinearity is tested as per the process offered by Canavos (1984). Table 2 provides the collinearity matrix among independent variables. According to Mason and Lind (1996, p. 541), "A common rule of thumb is that correlations among independent variables from negative .70 to positive .70 do not cause problems." The highest absolute value of the collinearity from table is .25, which suggests that the independent variables are not highly correlated with each other. This study adds to previous research by combining return from capital gain (52 week price change) with DY.

TABLE 1: CHARACTERISTICS OF THE STUDY SAMPLE

Variable Description	Factor	Mean
52 Week Return % + Dividend Yield % (In %)	Return	12.01
Market Capitalization (in \$ millions)	Size as a measure of Risk	9970.82
Price to Earnings per share (Ratio)	PE as a measure of Risk	34.59
Price per share to Book Value per share (Ratio)	PB as a measure of Risk	3.34
Beta	Systematic Risk	0.78
Total Debt To Total Equity (%)	Financial Leverage as measure of risk	105.62
Dividend Yield (%)	Dividend Yield as measure of risk	2.65

TABLE 2: CORRELATION MATRIX

	<i>Beta</i>	<i>PE</i>	<i>PB</i>	<i>MKT Cap</i>	<i>Lev</i>	<i>DY</i>
Beta	1.00000					
PE	0.01990	1.00000				
PB	-0.01852	-0.00198	1.00000			
Size	0.11438	-0.01801	0.01762	1.00000		
Leverage	-0.06923	0.00890	0.25143	0.06110	1.00000	
DY	-0.09985	0.04174	-0.02418	-0.02394	0.14524	1.00000

QUANTITATIVE TESTS AND RESULTS

The quantitative results are not in line with the previous studies. In the univariate regressions, coefficients for market capitalization, price to book, DY and leverage all have unanticipated signs. Considering the P value, the relevance of all of these six variables is high in determining return. P-Value determines the probability of getting something more extreme than the result, when there is no effect in the population. This model focuses on the P values (close to 0.000) to determine the significance of the independent variables in the model. In terms of significance of F-stat, DY, market capital and beta are very high. The coefficient of beta and the P/E ratio produced the appropriate sign. Beta produces the highest t-stat, representing higher significance, followed by DY and market capital. However, the coefficients of determination for all variables were weak. In each of the univariate regressions, the R²-value (all of the 6 variables have R² below .01) shows that variability in the independent variable explains little of the variability in rate of return.

Table 3 and 4 summarize the regression analysis results. The multivariate regression using market capitalization, price to EPS, price to book, beta, financial leverage and dividend yield as the independent

variables does not change the sign of the coefficient. But the model produces high significance in terms of F-Stat. P/E has the lowest t-stat of all the independent variables (smallest relevance) but reflects same sign as tested in the Fama-French model, which challenges CAPM. However, beta tested positive as CAPM suggests and has significantly low P-Value; contradicting Fama-French. High t-stat and low P-value for dividend yield supports Lewellen (2004), but it holds an inverse relationship with return. Similar results are displayed by leverage, market capital and the price to book ratio. Again, though much improved over the univariate regressions, the R^2 -value of 0.023 is still low.

These results only partially support the model suggested by FF. Certainly, the FF study is extremely powerful and must be respected unless and until a weight of evidence dictates the contrary.

TABLE 3: UNIVARIATE REGRESSION RESULTS

N = 1723	Fama-French Hypothesized Sign.	Coefficient	R-Square	Model F Statistic	T-Stat	P-Value	Theory Support
Market Cap	(-)	8.715E-05	0.00542	9.378571	3.062445	0.002229	NO
Price to Earnings Per Share	(-)	-0.001976	0.000365	0.627769	-0.79232	0.428284	YES
Price to Book Ratio	(-)	0.0550949	0.001225	2.110183	1.452647	0.146504	NO
Beta	(+)	6.2830801	0.0005	1.78	5.120929	3.38E-07	YES
Leverage	(+)	-0.004342	0.000694	1.196028	-1.09363	0.27427	NO
DY	(+)	-1.418986	0.011437	19.91022	-4.46209	8.64E-06	NO

TABLE 4: MULTIVARIATE REGRESSION RESULTS

N = 1723	Fama-French Hypothesized Sign.	Coefficient	T-Stat	P-Value	Theory Support
Beta	(+)	5.4561023	4.411658	1.09E-05	YES
Price to Earnings Per Share	(-)	-0.001668	-0.67669	0.498693	YES
Price to Book Ratio	(-)	0.060573	1.562466	0.118363	NO
Market Cap	(-)	7.041E-05	2.477077	0.013342	NO
Leverage	(+)	-0.003131	-0.76088	0.446834	NO
DY	(+)	-1.201262	-3.73849	0.000191	NO
R-Square	0.029248975				
F-Stat	8.617252764				

CONCLUSION

Several models developed by previous scholars challenges CAPM and suggest a multifactor pricing model that explains the risk and return relationship in a more practical way. The model developed in this research explains the relevance and significance of beta and dividend yield as independent variables determining return on stocks, which neither supports nor disagrees with CAPM, FF or other research supporting significance of financial ratios. This keeps the scope open for more intensive study and debate on developing the appropriate model to explain risk and reflected in stock return.

REFERENCES

- Ang, Andrew and Robert J. Hodrick, Yuhang Xing, and Xiaoyan Zhang (2006). "The Cross-Section of Volatility and Expected Returns." *The Journal Of Finance*, Vol. Lxi, No.1 (February), 259-298.
- Ang, Andrew and Joseph Chen (2006). "CAPM Over the Long Run: 1926–2001." *Journal of Empirical Finance*, Volume 8, 573-638.
- Bloomfield, Robert (2004). "Risk or Mispricing? From the Mouths of Professionals." *Financial Management*, Volume 33, Number 3 (Autumn), 61-81.
- Campbell, John and Lidger Hentschel (1992). "No News is good news: An Asymmetric Model of Changing Volatility in Stock Returns." *Journal of Financial Economics*, Volume 31, 281-318.
- Canavos, George (1984). *Applied Probability and Statistical Methods*, Boston: Little, Brown and Company, 1984, pp. 485-486.
- Fama, Eugene F. and Kenneth R. French (1996). "Multifactor Explanations of Asset Pricing Anomalies." *Journal of Finance*, Volume 51 (1), 55-84.
- Fama, E., and K. French (1992). "The Cross-Section of Expected Stock Returns." *Journal of Finance*, 47, 427-465.
- Fama, E., and J. MacBeth (1973). "Risk Return and Equilibrium: Empirical Tests." *Journal of Political Economy*, 81, 607-636.
- Freeman, Mark C. and Cherif Guermat (2006). "The Conditional Relationship Between Beta and Returns: A Reassessment." *Journal of Business Finance & Accounting*, Vol. 33, Issue 7-8, (September/October), 1213-1239.
- Glosten, Lawrence R., Ravi Jagannathan and David E Runkle (1993). "On the Relation Between the Expected Value and the Volatility of the Nominal Excess Return on Stocks." *Journal of Finance*, Volume 48, Number 5 (December), 1779-1801.
- Howton, Shelly W. and David R. Peterson (1998). "An Examination of Cross-Sectional Realized Stock Returns using a Varying- Risk Beta Model." *The Financial Review*, Volume 33, 199-212.
- Howton, Shelly W. and David R. Peterson (1999). "A Cross-Sectional Empirical Test of a Dual-State Multi-Factor Pricing Model." *The Financial Review*, Volume 34, 47-64.

- Lewellen, Jonathan (2004). "Predicting Returns with Financial Ratios." *Journal of Financial Economics*, Volume 74, 209–235.
- Mason, Robert D. and Douglas A. Lind (1996), *Statistical Techniques in Business & Economics*, Chicago: Irwin, p, 541.
- Multex Investor. <http://multexinvestor.com>.
- Shanken, J. (1992). "On the Estimation of Beta-Pricing Models." *Review of Financial Studies*, Volume 5, 1-33.