

A Test of Asset-Pricing Models at the Nairobi Securities Exchange

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Abstract

The Capital Asset Pricing Model (CAPM) has for a long time been used to explain the variations in expected return on stocks. However, the discoveries of market anomalies such as the Size, Book-to-Market and the Momentum effects, have greatly undermined CAPM's ability to explain the expected returns on stocks. These anomalies prompted Fama and French (1993) and Carhart (1997) to propound asset pricing models that captured the effects of these anomalies. This study sought to test whether the CAPM, Fama and French (1993) Three-factor model and the Carhart's (1997) Four-factor model can explain the returns of stocks traded in the NSE, from a portfolio perspective. The stock returns used in this study were those for the forty eight companies that trade under the MIMS in the NSE, during the period January 2009 to December 2013. Six portfolios that were sorted for size and Book-to-Market were created and used to test the CAPM as well as the Fama and French (1993) Three-factor model. Also, an additional six portfolios that were sorted for size and past performance were constructed to test the Carhart's (1997) Four-factor model. The data was then analyzed using time series regression analysis and the estimated parameters were tested for significance. This study finds that even though the CAPM has been highly regarded for many years, when tested at the NSE from a portfolios perspective, the evidence in support of it is weak. This study finds that other significant factors exists that were not captured by CAPM, implying therefore that beta is not an adequate measure of risk. Also, as for the Fama and French (1993) Three-factor model, this study finds that it doesn't quite capture all the factors influencing the returns of stocks traded at the NSE. However, this study finds that the Carhart's (1997) Four-factor model performs better relative to the CAPM and the Fama and French (1993) Three-factor model, as it was observed to have a better explanatory power of the variation of expected returns of most of the sets of portfolios that it was tested on. The findings of this study will be of great significance to the finance academia and policy makers as it will assist in boosting their understanding of an asset-pricing model that can explain better, the variations in returns of stocks traded at the security exchange.

Keywords: Asset pricing Models, NSE, Kenya

1. Background and Motivation

A perfectly legitimate question that one can ask is; "why does a return on a stock differ from that of another?" Any person with a background in the finance discipline, when presented with this question, has one thought that instantaneously goes through his or her mind –CAPM.

CAPM which was propounded by Sharpe (1964), Lintner (1965) and Black (1972) has always been considered to be the magnum opus, almost a magical formula for asset pricing. It attempts to explain why, the cross-sectional expected stock returns, differ, using only a single factor- beta, which is the covariance between the market return and the individual stock return (Rustam & Nicklas, 2010). Decades later, CAPM is still the centre piece of most finance courses and indeed, it is often the only asset pricing model that is taught in these courses. It is also widely used in applications such as evaluating the performance of an asset or portfolio and the estimation of the cost of capital for a firm. CAPM is an equilibrium model and provided it is correct and that the market is efficient, any stock behavior that cannot be explained by CAPM is considered to be a market anomaly (Rustam & Nicklas, 2010). The fascinating thing about CAPM is that it offers a powerful prediction about how to measure risk and it describes the relationships between expected return and risk as measured by beta (Fama & French, 2004). Unfortunately, the empirical studies that have been conducted to test CAPM conclude that the model is poor enough to invalidate the way it is used in application (Fama & French, 2004).

Throughout the history of stock markets, there have been many markets anomalies that have been spotted and rigorously researched on by the world's academia. Since the advent of CAPM, many studies on the variations of cross-sectional expected returns of portfolios have been conducted, using different methods, to test its empirical validity. After testing CAPM, Fama and French (1992), have in their findings, proof that beta alone cannot explain the differences between the cross-sectional expected stock returns in the United States Stock Markets as well as other international stock markets. Fama and French (1993) propose an addition of two more variables to the CAPM, to form a three-factor model. When tested, they find that it offered a better explanation of the cross-sectional variations of expected stock returns relative to the CAPM.

The three factors include; the market factor, the ratio of Book-to-market equity factor and the Size factor. The resulting asset-pricing model came to be known as the Fama and French (1993) three-factor model.

Fama and French (1993) find that simple variables such as firm size and Book-to-Market equity, can strongly explain the variations in the expected returns of stocks better than beta. A controversy arises in an attempt to explain why the two variables predict stock expected returns. Fama and French (1995) argue that the two factors function as a proxy to risk exposure. Kothari, Shanken and Sloan (1995) noted that the Book-to-Market equity and the Size factor are able to explain the variation in cross sectional returns of stocks because of survivorship bias. However, Fama and French (1996) have in their findings that the Fama and French (1993) Three-factor model cannot explain the continuation of short term past returns which suggested the existence of the momentum factor.

Carhart (1997) finds that the addition of a new variable, the momentum factor, into the Fama and French (1993) three-factor model significantly boosted its explanatory power. The resulting model came to be known as the Carhart's (1997) Four-factor model. Momentum effect, just like the Size and the Book-to-Market equity ratio, is a market anomaly. Jegadeesh (1990) and Jegadeesh and Titman (1993) find that there is evidence supporting the existence of the momentum effect on the variation of the cross sectional expected returns of stocks. They conclude that in the short run, stocks considered to be past winners out perform those that are considered to be past losers and so, going long on past winners and going short on past losers leads to significant abnormal returns being earned. The Carhart (1997) four-factor model was found to better explain the cross-sectional variations of expected return of stocks.

This research intended to test whether these asset-pricing models, can explain the expected returns on stocks traded in the Kenyan Stock Market.

A few studies have been conducted to test the CAPM in the Nairobi Securities Exchange (NSE) but the Fama and French (1993) three-factor model and the Carhart's (1997) four-factor model are yet to be tested on the NSE, from a portfolio perspective. After testing CAPM, Nambuwani (2008), concludes that during the period 2003 to 2007, the empirical work on the NSE supports CAPM to a large extent though not fully. However, he tested CAPM empirically from an individual stock perspective unlike the Fama and French (1993) who tested CAPM from a portfolio perspective. Also, since Carhart's (1997) Four-factor model, which also includes the momentum effect was developed and tested on the United States Stock Markets, it is important that its robustness be tested using data from stock markets from developing countries such as the NSE, from a portfolio perspective.

Although some models can explain the expected return of an asset with risk to some degree, there is no model that can explain the expected return in a complete manner. The choice of working with these three asset-pricing models was aimed at getting different test result based on empirical study. To the knowledge of the researchers, no study has been conducted to test whether the CAPM, Fama and French (1993) Three-factor model and the Carhart's (1997) Four-factor model, can explain the expected returns on Kenyan equity stocks, from a portfolio perspective. This gap in research necessitated this study. Specifically, the study set out to: test whether CAPM explains the expected returns of stock portfolios in the NSE; test whether the Fama and French (1993) three-factor model explains the expected returns of stock portfolios in the NSE and test whether the Carhart's (1997) four-factor model explains the expected returns of stock portfolios in the NSE.

The remainder of this paper is organised as follows: Section two (2) reviews prior research while section three (3) outlines the research design, how the sample was selected and highlights the variables. Section four (4) presents the results while section five (5) presents the conclusions.

2. Literature Review

Modern Portfolio Theory

The modern portfolio theory was first introduced by Markowitz (1952) in his research article about portfolio selection. Since then, his work has been fundamental for all other kinds of investment decisions topics as it pertains to the importance of diversification in order to minimize the risk and maximize on the portfolio return. This is referred to as the mean-variance analysis. Markowitz (1952) presents an investment rule that is considered to be reasonable as investors want to maximize their wealth and generate a high utility as possible. The rule states that an investor should diversify his portfolio among those securities that are expected to generate the highest return.

According to Markowitz (1952), the number of securities in a portfolio plays a crucial role because the more the securities included in a portfolio, the closer will the expected return be to the actual return. Moreover, when you add a risky asset with a low correlation into a portfolio, the overall portfolio risk reduces. This statement however is somehow limiting considering that, even by adding risky assets into a portfolio, the overall portfolio risk reduces but it cannot be eliminated entirely. Due to the fact that not the entire portfolio risk can be diversified away no matter how many securities are added into the portfolio, makes it possible to divide the risk into two groups namely: systematic risk and un-systematic risk (Rustam & Nicklas, 2010). Un-systematic risk is that risk that can be eliminated through diversification. It is also referred to as firms-unique risk or firm-specific risk involves risk factors connected to a specific firm or company (Rustam & Nicklas, 2010). Systematic risk on

the other hand is that risk that cannot be eliminated through diversification. It is influenced by overall market conditions such as changes in the macro-economic factors (Sharpe, 1964).

Stock Market Anomalies

A market anomaly is an empirical fact that is not supported by the prevailing theory (Berk, 1995). According to Schwert (2002), a market anomaly is an empirical finding that cannot be explained by the available and maintained theories within the asset-pricing area of study. Moreover, market anomalies either unearth inefficiencies in the market or misspecifications in an asset pricing model that explains the expected return of an asset. If a market anomaly is uncovered that indicates an inefficient market, will also put a strain on the reliability of an asset pricing model that assumes that the market is efficient. However, for a market anomaly to indicate an inefficient market it must be possible for an investor to profitably trade on it, otherwise it is not economically significant and would therefore not imply market inefficiency (Rustam & Nicklas, 2010). It is possible for an anomaly to disappear after it has been discovered because traders take advantage of it to earn arbitrage gains thereby adjusting prices to the level where the anomaly ceases to exist (Rustam & Nicklas, 2010)

Size Effect Anomaly

Banz (1981) argued that firm size as measured by market capitalization, is an explanatory variable to abnormal return that is not captured by asset pricing models, suggestively the CAPM. Moreover, this firm size effect which is also, commonly referred to as, the small firm effect, is not stable over time and the degree of abnormal returns that is yielded by the small firms is subject to variations (Banz, 1981). Berk (1995) also finds that the market capitalization of a firm has got a significant explanatory power on the expected returns and since it is not captured by the CAPM, it can be included as an explanatory variable in an asset pricing model to capture the return not originally explained. Fama and French (1992) also find the size anomaly to be significant and they state that it acts as a proxy for risk and should be included in an asset pricing model, indicating that small firms are considered to be more risky than large firms.

Book-to-Market Equity Anomaly

Fama and French (1992) find that there is a strong relationship between the book-to-market equity ratio and the stock performance. Firms with high book-to-market equity ratio tend to outperform those with low book-to-market equity ratio in terms of returns. This implies that the book-to-market equity ratio is a market anomaly; however, there is no consistency between researchers as to why it exists. Researchers have suggested that it exists because of risk compensation; implying that firms with high book-to-market equity are more risky and hence they should compensate the investor with a higher return. Companies that have a high book-to-market equity ratio tend to have poor historical performance and hence they are considered to be riskier (Fama, 1998). According to Lakonishok, Shleifer and Vishny (1994), value stocks have a higher return than growth stocks because of the investor behavior as shaped by their expectations and not because of the underlying risk. Investors are said to overrate information and thereby preferring to invest in stocks from companies with good historical performance, which causes their prices to increase making them growth stocks.

Momentum Effect

According to Jegadeesh (1990), the momentum effect is where stocks considered as being past winners, with a high return the previous month, continued to generate abnormal returns the following month whereas the stocks considered past losers in a given month continue to perform poorly the following month. Jegadeesh and Titman (1993) investigated further the momentum effect over a longer time horizon of three to twelve months and they find that again the past winners outperformed the past losers in terms of returns thereby strengthening their theory of the existence of the momentum effect anomaly in the financial markets. Rouwenhorst (1998) and Chan, Jegadeesh and Lakonishok (1996) also find that the momentum effect last for about a year and it is not at all related to the size of the firms.

The CAPM

CAPM was developed by Sharpe (1964), Lintner (1965) and Black (1972) from the Markowitz's (1952) mean-variance analysis. The fundamental principle about Markowitz mean-variance analysis is to assist in the selection of efficient portfolios; portfolios that maximize on returns and minimize risk. The CAPM expresses a positive relationship between an asset's returns and its systematic risk as measured by beta. The resulting regression line that describes this relationship is known as the Security Market Line. The CAPM was developed on the basis of some assumptions namely; investors borrow and lend at the risk free rate, investors are risk averse and try to maximize their wealth, investors choose their portfolios based on the risk and expected return over a single period, there are no taxes and transaction costs and finally, investors have homogenous views and expectations regarding an asset's variables such as standard deviation, expected return and correlation (Sharpe, 1964). The formula for the CAPM as presented by Sharpe (1964) and Lintner (1965) is as follows:

$$E(RP_{it}) = RF_t + \beta_{it}(RM_t - RF_t)$$

Where $E(RP_{it})$ measures the expected return on asset i during period t . β_{it} measures the Beta value for asset i while $(RM_t - RF_t)$ measures the market premium.

The fact that beta only reflects the systematic risk is because investors are assumed diversified

portfolios thereby eliminating the non-systematic risk (Sharpe, 1964). Despite the fact that the CAPM is popular and widely used, it's a theory that has come under a lot of criticism. According to Berk (1995), CAPM does not hold in reality because of the flaws of the model itself or how the model is applied while being tested empirically. Fama and French (1992), also state that CAPM's unrealistic assumptions such as lending and borrowing at the risk free rate, makes it subject to criticism. Fama and French (1992) also argue that the beta measure used in the CAPM does not sufficiently capture the expected return of an asset because market anomalies such as the firm size effect or the book-to-market equity effect are not accounted for in it.

Fama and French (1993) Three-factor Model

CAPM is infamously known to be unable to explain the book-to-market equity effect and size effect on stock returns together with other market anomalies. In fact, this is the reason as to why they are called market anomalies because CAPM cannot explain them (Rustam & Nicklas, 2010). Fama and French (1992) finds that beta alone cannot explain the cross sectional variations of stocks' expected returns. Taking into consideration the size effect anomaly, book-to-market anomaly and the earnings-price ratio anomaly, Fama and French (1992), test whether the expected return on stocks can be explained given those factors are included in an asset-pricing model. They find that the book-to-market equity and the size effect anomalies explain the differences in stock returns. However, they find that the book-to-market equity and the earnings-price ratio are related and so including the earnings-price ratio in the asset pricing model would only make it redundant.

In the same study, Fama and French (1992) find that there was no significant relation between the expected returns on the United States stocks and their betas. Propelled by their findings in 1992, Fama and French (1993) form a three-factor asset-pricing model that includes the market premium, size effect and the book-to-market equity anomaly. Their reason for adding the market premium into the model was due to the fact that stock returns were on average above the one-month Treasury bill rate. They find that the model was outperforming the CAPM as it had a better explanatory power relative to it. The Fama and French (1993) Three-factor model is shown below:

$$E(RP_{it}) = RF_t + \beta_i(RM_t - RF_t) + \beta_s(SMB) + \beta_h(HML)$$

Where $E(RP_{it})$ measures the expected return on asset i during period t . $(RM_t - RF_t)$, SMB and HML measures the market premium, Size premium and the book-to-market premium respectively while, β_i , β_s and β_h measure the factor sensitivities for Market premium, size premium and book-to-market premium respectively.

Connor and Sehgal (2001), find that the Fama and French (1993) three-factor model explains better the variations in expected returns of stocks in the Indian stock market relative to the CAPM. However, Misirli and Alper (2009), finds that CAPM outperforms the Fama and French (1993) three-factor model on the Istanbul Stock Exchange.

Carhart's (1997) Four-factor Model

Fama and French (1996) find that their three-factor model was not explaining the relationship between stocks considered to be short term winners and their continued earnings of abnormal returns relative to short term loser stocks. This market anomaly was referred to as the momentum effect. After that study, Carhart (1997), decided to modify the three-factor model, by adding one more factor to it, which would capture a one year momentum effect on stock returns. This new asset-pricing model was named the Carhart's (1997) four-factor model and it is stated as follows:

$$E(RP_{it}) = RF_t + \beta_i(RM_t - RF_t) + \beta_s(SMB) + \beta_h(HML) + \beta_w(WML)$$

Where $E(RP_{it})$ measures the expected return on asset i during period t . $(RM_t - RF_t)$, SMB , HML and WML measures the market premium, Size effect premium, book-to-market premium and the momentum effect premium respectively while, β_i , β_s , β_h and β_w measure the factor sensitivities for Market premium, size premium, book-to-market premium and the momentum effect premium respectively.

According to Carhart (1997), the four-factor model does a better job at explaining the expected return on stocks because it substantially reduces the average pricing errors of the three-factor model and the CAPM. Conversely, Avramov and Chordia (2006) find that the momentum effect factor inclusion into the three-factor model does not help in explaining the expected returns on stocks in the New York Stock Market and the NASDAQ in the short run.

3. Research Method

This research intended to determine whether, the independent variables propounded by the three asset-pricing models being studied, explain the expected returns on stocks. These variables include excess market return, size effect, book-to-market equity and the momentum effect. The quantitative research strategy was preferred because these variables were measured using processed market returns data for stocks traded on the Nairobi Securities Exchange (NSE) during the period January 2009 to December 2013.

This study intended to test the three asset-pricing models using portfolios of stocks traded in the NSE. The targeted population was the 48 stocks that were being actively traded in the NSE under the Main Investment Market Segment (MIMS), within the period January 2009 to December 2013. The researchers considered this as

a rather small number to warrant any sampling because it would lead to the formation of portfolios that contained only a few stocks. Therefore, this study worked with all the stocks contained in the target population and no sampling procedures were conducted.

Table 1: Sample Distribution

Market Sectors	Population	Percentage	Sample Size
MIMS			
Agricultural	3	100%	3
Commercial & Services	12	100%	12
Finance & Investment	15	100%	15
Industrial & Allied	18	100%	18
TOTAL	48		48

This study adopted a quantitative research strategy that entails the analysis of objective statistical data. Therefore, the researchers intended to use secondary data on Kenyan stocks prices, to test these models. The equity stocks closing price data, which were used in this study, were collected from the NSE, tabulated and converted into monthly holding period returns. This data enhanced the measurement of the portfolio expected returns, size effect, book-to-market equity and the momentum effect variables, which were used to test the asset pricing models being studied. The data on the NSE all share index and the Central Bank of Kenya's 91-day Treasury bill were used as a proxy to the market return and the risk free rate respectively

Monthly holding period returns for all equity stocks listed under the MIMS in the NSE were computed using closing price data and used to measure the factor premiums. To test these asset pricing models under study, the multivariate time series regression method was preferred where the dependent variables were regressed on the factor premiums. This therefore implied that if the independent variables proposed by the models explain the expected returns on the stocks, the intercept coefficient of the time series regression, would not be significantly different from zero (Rustam & Nicklas, 2010).

The explanatory variables for the three models under the study were the $(RM_t - RF_t)$, **SMB**, **HML** and **WML** and they are demonstrated below:

CAPM:

$$E(RP_{it}) - RF_t = \alpha + \beta_i (RM_t - RF_t) + e_t$$

Fama and French (1993) Three-factor model:

$$E(RP_{it}) - RF_t = \alpha + \beta_i (RM_t - RF_t) + \beta_s (SMB) + \beta_h (HML) + e_t$$

Carhart's (1997) Four-factor model:

$$E(RP_{it}) - RF_t = \alpha + \beta_i (RM_t - RF_t) + \beta_s (SMB) + \beta_h (HML) + \beta_w (WML) + e_t$$

Where $E(RP_{it}) - RF_t$ measures the excess return on portfolio *i* during period *t*. $(RM_t - RF_t)$, **SMB**, **HML** and **WML** measures the market premium, Size premium, book-to-market premium and the momentum effect premium respectively while, β_i , β_s , β_h and β_w measure the factor sensitivities for Market premium, size premium, book-to-market premium and the momentum effect premium respectively. The ' α ' value and the e_t represent the intercept coefficient and the error term respectively.

Using the Fama and French (1993) approach, the SMB and the HML were measured as follows. First, the stocks market capitalizations were computed, and then ranked according to their size, from small to big. The ranking for each stock according to size was done on December of every year under the study. The stocks below the median market capitalization formed the "Small" portfolio while the stocks above the median market capitalization formed the "Big" portfolio accordingly. Stocks were also be independently ranked according to their book-to-market equity ratio and three book-to-market equity sorted portfolios were formed namely: low, medium and high where the low book-to-market equity portfolio consisted of the bottom 30%, the medium book-to-market equity consisted of the middle 40% and the high book-to-market equity consisted of the top 30% of the book-to market equity ratio ranked stocks. As per the Fama and French (1993) approach, the book-to market equity ratio is computed as follows: Book equity for the company's fiscal year ending in the calendar year *t* -1 divided by the market equity or capitalization for that company, at the end of the calendar year *t* - 1 i.e. end of December in the year *t* -1.

Six portfolios were formed at the intersection of the aforementioned size and the book-to-market equity ratio sorted portfolios as shown below: **Portfolio "S / L"**- Portfolio of stocks contained in the small market capitalization group that are also contained in the low book-to-market equity group. **Portfolio "S / M"** represented portfolio of stocks contained in the small market capitalization group that are also contained in the medium book-to-market equity group. **Portfolio "S / H"** represented portfolio of stocks contained in the small

market capitalization group that are also contained in the high book-to-market equity group. **Portfolio “B / L”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the low book-to-market equity group. **Portfolio “B / M”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the medium book-to-market equity group. **Portfolio “B / H”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the high book-to-market equity group.

Computation of SMB:

$$SMB = \{(S/L + S/M + S/H) - (B/L + B/M + B/H)\}/3$$

Computation of HML:

$$HML = \{(S/H + B/H) - (S/L + B/L)\}/2$$

Computation of WML

To test the momentum effect, six portfolios were formed at the beginning of every financial year under the study period as per the Carhart’s (1997) approach. Stocks were ranked according to their twelve months’ past returns and then grouped into three categories from highest to lowest where the top one-third represented the portfolio “winners”. The middle one-third represented portfolio “neutral” while the bottom one-third represented the portfolio “losers”.

Thereafter the six portfolios were formed at the intersection of the size effect portfolios and momentum effect portfolios as shown below: **Portfolio “S/L”** represented portfolio of stocks contained in the small market capitalization group that are also contained in the losers group. **Portfolio “S/N”** represented portfolio of stocks contained in the small market capitalization group that are also contained in the neutral group. **Portfolio “S/W”** represented portfolio of stocks contained in the small market capitalization group that are also contained in the winners group. **Portfolio “B/L”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the losers group. **Portfolio “B/N”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the neutral group. **Portfolio “B/W”** represented portfolio of stocks contained in the big market capitalization group that are also contained in the winners group.

$$WML = \{(B/W + S/W) - (B/L + S/L)\}/2$$

Explained variable

The three models that were tested in this study, as shown above, try to explain the expected return on a portfolio. Therefore, the expected monthly return on each portfolio, for each of the years under the study period was computed. Thereafter, the excess returns for each of the six size and the book-to-market sorted portfolios were computed and then regressed on the explanatory variables for each of the three models being tested.

4. Findings

Mean Monthly Excess Portfolio Returns and Standard Deviations

As depicted in Table 2 below, it can be observed that the small cap portfolios’ S/H and S/M are outperforming the big size or large cap portfolios B/H and B/M, with regard to average monthly excess return with the exception of portfolio S/L. However, it was difficult to determine whether portfolios considered to have a high Book-to-Market outperformed those with a low Book-to-Market because it can be observed that portfolio S/H outperformed S/L whereas portfolio B/H was clearly outperformed by portfolio B/L.

Table 2: Average monthly excess portfolio returns and standard deviations

	H	M	L		H	M	L
	Mean Excess Returns				Std. Deviation		
S	3.393	5.7121	-11.073		55.7753	45.4023	23.7473
B	-6.2964	-0.0874	7.017		23.577	43.3305	68.7868
	W	N	L		W	N	L
	Mean Excess Returns				Std. Deviation		
S	19.4923	6.8315	-21.183		59.4505	37.8499	36.2165
B	18.9915	7.2146	-17.04		54.7583	38.7131	43.9488

Testing the CAPM

The excess returns of each of the six portfolios were regressed against the market premium, for the study period, and the results of the test, pertaining to the alpha value or intercept coefficient and the slope coefficient are displayed in Table 3 below.

Table 3: The CAPM Test

Portfolio	$\alpha(t)$	$\beta_i(t)$	$R^2(\text{adj } R^2)$	F-stat
S/H	34.10 (3.218)	-4.08 (-3.885)	0.245 (0.231)	15.095
S/M	35.69 (4.47)	-3.98 (-5.035)	0.36 (0.341)	25.350
S/L	2.17 (0.483)	-1.76 (-3.951)	0.25 (0.237)	15.613
B/H	12.42 (3.447)	-2.49 (-6.966)	0.51 (0.503)	48.521
B/M	30.88 (4.259)	-4.12 (-5.727)	0.42 (0.404)	32.802
B/L	35.31 (2.525)	-3.76 (-2.713)	0.14 (0.119)	7.359

For CAPM to be valid, the intercept coefficient must not be significantly different from zero. However, it can be observed that the intercept coefficients for portfolios' S/H, S/M, B/H, B/M and B/L were all significantly different from zero based on their t-values which were larger than the critical t-value. Therefore, the test of CAPM in this case is indicating that when tested from a portfolio perspective, the evidence in support of it in the NSE is weak.

Test of the Fama and French (1993) Three-factor model

To test this model, the Market premium, SMB and HML were computed. The excess returns of each of the six portfolios sorted for size and Book-to-Market were regressed against these three factor premiums and the alpha values and the factor sensitivities were estimated as intercept and slope coefficients respectively.

Table 4: Fama and French (1993) Three-factor Model Test

	$\alpha(t)$	$\beta_i(t)$	$\beta_s(t)$	$\beta_h(t)$	$R^2(\text{adj } R^2)$	F-stat
S/H	27.90 (3.322)	-3.17 (-3.717)	-3.17 (3.437)	0.45 (3.83)	0.58 (0.548)	20.005
S/M	36.67 (4.861)	-4.05 (-5.293)	0.555(3.204)	0.01 (0.128)	0.49 (0.45)	13.795
S/L	1.54 (0.329)	-1.67 (-3.503)	0.066(0.612)	0.05 (0.69)	0.27 (0.222)	5.469
B/H	10.15 (2.889)	-2.18 (0.132)	-0.01 (-0.008)	-0.01 (2.707)	0.13 (0.558)	20.762
B/M	33.09 (4.465)	-4.43 (-0.694)	-0.12 (-0.695)	-0.14 (-1.405)	0.45 (0.417)	12.209
B/L	22.89 (2.315)	-2.28(-2.271)	-1.59 (-7.038)	0.52 (0.381)	0.42 (0.588)	23.401

From **Table 4** above, it can be observed that all portfolios, except for Portfolio S/L, had intercept coefficients were indeed statistically different from zero based on their t-values suggesting the possibility of there being other factors other than those proposed. However, portfolio S/L has a higher R^2 value of 0.27 relative to that of the same portfolio under the CAPM test. Moreover, its F-statistic of 5.469 higher than the critical F-value of 2.80 implying that at least one factor sensitivity, is significantly different from zero, at the 5% level. Ultimately, due to the fact that most intercept coefficients for the portfolios tested under this model are not significantly different from zero, it can be concluded that, the evidence in support of the this model, in the NSE, seems to be inconclusive.

Testing the Carhart's (1997) Four-factor Model

In this model, the WML was computed using six portfolios that were sorted for size and past performance. Thereafter, the excess portfolios returns were regressed against the market premium, SMB, HML and WML. The estimated regression coefficients were displayed in the table below.

Table 5: Carhart's (1997) Four-factor model test for portfolios sorted of size and past performance

	$\alpha(t)$	$\beta_i(t)$	$\beta_s(t)$	$\beta_h(t)$	$\beta_w(t)$	$R^2(\text{adj } R^2)$	F-stat
S/W	16.44 (2.024)	-3.57 (-5.350)	.94 (6.183)	.33 (3.666)	.80 (6.99)	.78 (.758)	37.759
S/N	25.02 (2.763)	-2.11 (-2.831)	.26 (1.531)	.18 (1.819)	-.05 (-.423)	.32 (.257)	5.062
S/L	10.78 (1.358)	-2.82 (-4.325)	.18 (1.232)	.08 (.945)	-.28 (-2.46)	.43 (.377)	8.110
B/W	7.01 (.825)	-2.24 (-3.208)	-1.01 (-6.391)	.09 (.899)	.73 (6.070)	.71 (.687)	26.846
B/N	31.57 (3.807)	-2.97 (-4.362)	-.36 (-2.347)	.17 (1.860)	-.06 (-.059)	.46 (.404)	8.969
B/L	12.67 (1.406)	-2.99 (-4.038)	-.26 (-1.54)	.34 (3.319)	-.19 (-.192)	.50 (.454)	10.778

Table 5 above indicates that the intercept coefficients for portfolios' S/L, B/W and B/L are not significantly different from zero based of their t-statistics, at the 5% level. This is a major improvement relative to the CAPM and the Fama and French (1993) Three-factor Model which were only able to explain one portfolio's expected returns. However, based on the slope coefficients, it can be observed that as for portfolio S/L, it's only the market premium and momentum factors that are significant, based on their t-statistics while portfolio B/W's regression output is indicating that it's the market premium, size premium and the momentum effect factors that are significant going by their t-statistics. In the case of portfolio B/L, it's only the market and size premium factors that are significant. However their R^2 values are higher relative to the other two models.

The Carhart's (1997) Four-factor model was also tested on portfolios that were sorted for size and Book-to-

Market. The regression output was presented in **Table 6** below:

Table 6: Carhart's (1997) Four-factor model test of portfolios sorted for size and book-to-market.

	α (t)	β_i (t)	β_s (t)	β_h (t)	β_w (t)	R^2 (adj R^2)	F-stat
S/H	12.56 (1.288)	-2.99 (-3.741)	.71 (3.927)	.46 (4.244)	.37 (2.668)	.64 (.603)	18.869
S/M	12.56 (2.959)	-3.95 (-5.265)	.59 (3.456)	.03 (.242)	.23 (1.805)	.52 (.476)	11.691
S/L	8.35 (1.487)	-1.74 (-3.782)	.04 (.416)	.04 (.586)	.16 (-2.054)	.34 (.275)	5.457
B/H	8.13 (1.859)	-2.16 (-6.012)	.01 (.074)	.13 (2.739)	.05 (.784)	.59 (.554)	15.588
B/M	38.81 (4.233)	-4.49 (-5.963)	-.14 (-.802)	-.15 (-1.469)	-.14 (-1.057)	.47 (.419)	9.46
B/L	.93 (.085)	-2.03 (-2.248)	-1.53 (-7.431)	.54 (4.393)	.53 (3.378)	.69 (.667)	24.558

Again, just like the previous test of this model, it can be observed that this model was able to explain the returns on portfolios' S/H, S/L, B/H and B/L based on the significance of their estimated coefficients which therefore superimposes its superiority over the other two models under the study, in regards to the NSE. The intercept coefficients for these four portfolios are not significantly different from zero based on their t-statistics which implies that the factors proposed by Carhart (1997) are indeed explaining the returns on stock portfolios in the NSE. The slope coefficients for portfolios S/H and B/L have got t-statistics that are significantly different from zero at the 5% level and their R^2 values of 0.64 and 0.69 respectively are also quite high implying that the explanatory power of the model is also quite high. However, for portfolio S/L, it's only the market premium and the momentum factors that are significant based on the t-statistic of their coefficients. The F-statistic of portfolios' S/H, S/L, B/H and B/L are all greater than the F-critical value of 2.6 implying that at least one coefficient is significantly different from zero.

5 Discussions, Conclusions and Recommendation

Test of the CAPM

The findings indicate that the evidence in support of the CAPM, from a portfolios perspective is weak. This is due to the fact that the alpha values for portfolios S/H, S/M, B/H, B/M and B/L were not significantly different from zero. This indicated that there was a possibility of the existence of other factors not captured by the market premium. This implies that it didn't quite capture the risk adjusted premium that an investor would demand for having invested in a risky stock. This is consistent with the findings of Fama and French (1992) who find no significant relationship between the returns on stocks traded in the US and their betas during the period 1963 to 1990. However, Rustam and Nicklas (2010) find CAPM to be the only model that explained stock returns better than other models in the Stockholm Stock Exchange suggesting that beta is still a good measure of risk which is in fact contradictory to the findings of this study.

However, despite the fact that the CAPM's validity is not coming out strongly in this study, it is also worthy to note that its single factor, market premium, when used together with other factors such as those suggested by Fama and French (1993) and Carhart (1997) boosts significantly, the asset-pricing model's explanatory power. This probably indicates the reason as to why; all other asset pricing models under study were built out on CAPM.

Test of the Fama and French (1993) Three-factor Model

The findings are showing that when this model is tested in the NSE, from a portfolios perspective, the evidence in support of it is weak. The alpha values for portfolios S/H, S/M, B/H, B/M and B/L were not significantly different from zero. This therefore indicated the possibility of existence of other factors not captured by the risk adjusted premiums in the model. However, based on the adjusted R^2 values for portfolio S/L, it can be noted that the addition of the inclusion of the size and book-to-market factors in the model significantly boosts the explanatory power of the model relative to the CAPM. This is consistent with the findings of Connor and Sehgal (2001) who find that the CAPM does not explain the cross section expected returns on stocks traded in the Indian Stock Markets but the Fama and French (1993) Three-factor Model does. However, the findings of this study were contradictory to the findings of Misirli and Alper (2009), whom after comparing the Fama and French (1993) Three-factor Model, CAPM and other asset pricing models built out on the Fama and French (1993) Three-factor Model, on stock market data from the Istanbul Stock Exchange, conclude that the CAPM in fact outperforms the Fama and French (1993) Three-factor Model which was quite interesting.

Test of the Carhart's (1997) Four-factor Model

As for the portfolios that were sorted for size and past performance, the researcher finds that the alpha values for portfolios S/L, B/W and B/L were indeed not significantly different from zero. This is a significant improvement relative to the findings from the test of the CAPM and the Fama and French (1993) Three-factor Model. However, as for portfolio S/L, it's only the market premium and the Book-to-Market factors that were observed to have significant.

Also, as for the portfolios that were sorted for size and Book-to-Market, the researcher finds that portfolios S/H, S/L, B/H and B/L have got alpha values that are not significantly different from zero. This again was a significant improvement when compared to the findings from the test on portfolios that were sorted for size and past performance. Moreover, it was observed that portfolios S/H and B/L slope coefficients were significantly different from zero. Overall, this model was found to capture most of the factors that explain the variation in returns on portfolios of stocks traded in the NSE and its adjusted R^2 values indicated a significantly higher explanatory power of this model relative to the other two models under the study.

This was consistent with the findings of Nartea, Ward and Djajadikerta (2009) in that, by adding the momentum effect factor to the Fama and French (1993) Three-factor Model, did in fact capture the effect of past returns on the New Zealand Stock Exchange. However, Avramov and Chordia (2006) find that the momentum factor does not help in explaining neither the returns of the past three, six nor twelve months' return, which therefore is inconsistent with what this study finds.

Recommendations

This study is highly recommended to the finance academia as its findings will help shape their way of thinking as they endeavor to find an asset-pricing model that can explain the expected returns of stocks in the NSE entirely. Also, investors can also base their investment decisions partly on the findings of this study in trying to determine whether a portfolio of stocks traded in the NSE are correctly valued or mispriced. This will enable them to identify profitable opportunities in the market in case they arise and be able to take advantage of them as the market converges to the correct position. The capital markets regulatory bodies should also take into consideration the findings of this study as it will assist greatly in their efforts of ensuring that the market is operating efficiently. It can enable them identify any gaps in the market and this will enhance the implementation of corrective measures deemed necessary in an endeavor to boost investor confidence in the financial markets.

References

- Avramov, D. & Chordia, T. (2006). Asset pricing models and financial market anomalies. *The Review of Financial Studies*, 19(3), 1001-1040.
- Banz, R.W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, 9(1), 3-18.
- Berk, J. B., (1995). A Critique of Size Related Anomalies. *Review of Financial Studies*, 8(2), 275-286.
- Black, F. (1972). Capital Market Equilibrium with restricted borrowing. *The Journal of Business*, 45(3), 444-455.
- Carhart, M., (1997). On persistence in Mutual Fund Performance. *The Journal of Finance*, 5 (1), 57-82.
- Chan, L. C. K., Jegadeesh, N., & Lakonishok, J. (1996). Momentum strategies. *The Journal of Finance*, 51(5), 1681-1713.
- Connor, G., & Sehgal, S. (2001). Test of the Fama and French model in India. *Financial Markets Group Discussion paper, No.379*.
- Fama, E., & French, K. (1992). The cross-section of expected stock returns. *The Journal of Finance*, 47(2), 427-465.
- Fama, E., & French, K. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33, 3-56.
- Fama, E., & French, K. (1995). Size and Book-to-Market Factors in Earnings and Returns. *The Journal of Finance*, 50 (1), 131-155.
- Fama, E., & French, K. (1996). Multifactor Explanations of Asset Pricing Anomalies. *The Journal of Finance*, 51(1), 55-84.
- Jegadeesh, N. (1990). Evidence of predictable behavior of security returns. *The Journal of Finance*. 45(3), 881-898.
- Jegadeesh, N. & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance*, 48(1), 65-91.
- Kothari, S., Shanken, J. & Sloan, R.G. (1995). Another Look at the Cross-Section of Expected Stock Returns. *The Journal of Finance*, 50(1), 185-224.
- Lakonishok, J., Shleifer, A. & Vishny, R. (1994). Contrarian Investment, Extrapolation, and Risk. *The Journal of Finance*, 49(5), 1541-1578.
- Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, 47(1), 13-37.
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77-91.
- Misirli, G.A. & Alper, C.E. (2009). Drivers of expected returns in Istanbul Stock Exchange: Fama and French factors and coskewness. *Applied Economics*, 41(20), 2619-2633.
- Nambuwani, A.W. (2008). *An evaluation of the capital asset pricing model for the Nairobi Securities Exchange*:

- an econometric approach*. Unpublished Masters in Art Economics dissertation, University of Nairobi
- Nartea, G.V., Ward, B. D., Djajadikerta, H. D. (2009). Size, BM and momentum effects and the robustness of the Fama-French three-factor model: Evidence from New Zealand. *International Journal of Managerial Finance*, 35, 179-200.
- Rustam, V., & Nicklas, B. (2010). Cross-section of Stock Returns: Conditional vs. Unconditional and Single Factor vs. Multifactor Models. Retrieved from <http://www.essays.se/essay/cfc7cb72d3/>
- Schwert, G. W. (2002). Anomalies and market efficiency. *Handbook of the economics of Finance*, 1, 939-974
- Sharpe, W. (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. *The Journal of Finance*, 19(3), 425-442.

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