TESTING THE CAPITAL ASSET PRICING MODEL AFTER CURRENCY REFORM: THE CASE OF ZIMBABWE STOCK EXCHANGE

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ABSTRACT

The Capital Asset Pricing Model (CAPM) endeavors to explain the relationship between risk and the expected rate of return on capital markets. It offers powerful and intuitively pleasing predictions about how to quantify risk. The model has been subject to various tests since its inception. Most of the earlier studies are in support of the model whereas recent studies have provided evidence against it and have revealed that beta alone is not a suitable determinant of asset pricing and that a number of other factors could explain the cross-section of returns. This article focuses on examining the ability of the CAPM beta to explain the variation in stocks' returns. The study was carried out for the period 19 February 2009 to 31 December 2012 for 65 stocks listed on the Zimbabwe Stock Exchange (ZSE). Time series regression and cross-sectional regression were used to test the relationship between expected returns and risk. Portfolios were used rather than individual stocks because the use of individual stock returns for the estimation of beta coefficients introduces an estimation error in the values of beta, as well as, introducing a bias in the regression coefficients. The validity of the CAPM was further tested statistically by using the t-test. The results showed that the high beta-high returns relationship was not exhibited by the stocks data and the slope of the Security Market Line (SML) was not equal to the market risk premium. CAPM did not fully hold although there was a linear relationship between returns and beta coefficients. In addition, it was noted that non-systematic risk had no effect on expected returns.

Keywords: *CAPM, stock market, beta, portfolios.*

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INTRODUCTION

The pricing of securities like bonds and equities that trade in the capital market is one of the most important areas of finance and investments and greatly affects the economic life of both institutional investors and individuals. This study focuses on the pricing of the industrial stocks that are publicly listed on the ZSE. Individuals and Institutional investors are directly or indirectly involved in the ZSE. Individuals might invest their surplus income directly in the stock market or indirectly through investment funds and mutual funds. Institutional investors, on the other hand, handle large amounts of money that they invest on the stock market on behalf of their investors in pursuit of specific objectives. As individuals and institutions trade in the stock market they are faced with a set of issues, for example, how much to invest in a particular stock, which particular stock to invest in and most importantly at what price should they buy or sell that stock. Individuals need some benchmark or criteria which they can use to ascertain if their funds are being well invested. Institutional investors also need some benchmark to measure the performance of their fund managers. On the other hand, companies who wish to finance their new projects by issuing out new stock need to know at what price they should issue out the new stock, and the price at which that new stock can be absorbed in the stock market affects their decision on whether to continue or not with the new investment project (Bodie, Kane and Marcus, 2003). The CAPM, which has been subject to many empirical tests since inception, addresses this problem through relating the expected rate of return from a security to its systematic risk. It makes some assumptions about the behavior of the investors and the operations of the capital market, and basing on those assumptions derives a specific linear relationship between the expected rate of return and the risk. This relationship according to CAPM should hold for every individual security or any combination of individual securities in order for the capital market to be in equilibrium (Bodie, Kane and Marcus, 2003). The CAPM has played an important role in modern finance and, in particular, in modern capital theory. It is still being extensively used in evaluating the performance of managed portfolios and assets and estimating the cost of capital for firms even though, it is about five decades old. The model introduces easy mechanism for corporate managers and investors to evaluate their investments. All that investors and corporate managers need to do, as indicated by the model, is to evaluate and compare the expected return to the required return. If the expected result is otherwise unfavourable, it is necessary to call off intentions for potential investment in the particular asset. CAPM offers powerful and intuitively pleasing predictions about how to quantify risk and the relationship between expected return and risk (Fama and French, 1992). The model relates the expected rate of return of an individual asset or a portfolio of assets to a measure of its systematic risk as measured by beta. The beta of an asset or portfolio of assets captures that aspect of investment risk which cannot be eliminated by diversification.

LITERATURE REVIEW

The Sharpe-Lintner model builds upon the portfolio theory introduced by Markowitz and Tobin 1959 and 1958 respectively, which in turn is built on the expected utility model of (Von Nuemann and Morgenstern, 1953). Portfolio theory also known as Markowitz's model is concerned with how an investor should allocate his wealth among the different assets available in the market, given that he is a one-period utility maximiser. In the Markowitz's model, an investor selects a portfolio at the beginning of a time period that produces a stochastic return at the end of that time period. The Markowitz's model assumes investors are risk averse and they are only concerned with the first two moments of the distribution of their one-period investment returns, that is, the mean and the variance, when selecting among portfolios. As a result, investors select mean-variance efficient portfolios, that is portfolios with minimum portfolio variance for a given portfolio return and with the maximum portfolio return for a given portfolio variance. The Sharpe-Lintner model then derives the equilibrium relationship between expected return and risk for assets and portfolios using the characteristics of the investor wealth allocation decision. The Markowitz's model provides an algebraic condition on asset weights in mean-variance efficient portfolios. The CAPM converts this algebraic statement into a testable forecast about the relation between risk and expected return by identifying a portfolio that must be efficient if asset prices are to clear the market of all assets (Javid, 2008). Ansari, Naeem and Zubairi (2005) stated that, the market rewards risk bearing, according to CAPM, since people are generally risk averse and in order to induce people to hold the total amount of risky assets in a financial system the risk premium for the aggregate of all risky assets must be positive. Investors are compensated with a higher expected return only by accepting systematic risk, that is, the market rewards efficient risk bearing. In particular, it suggests that higher-beta assets or portfolios are expected to give higher expected returns than lower-beta assets or portfolios because they are more risky (Elton and Gruber, 1995). The component of the asset's risk that is uncorrelated with the market can be diversified away and does not demand a risk premium. Intuitively, in a rational and competitive market investors diversify all non-systematic risks otherwise this would force them out of the market. If, on the contrary, the CAPM does not hold, then the rationality of the asset's markets will have to be reconsidered. Early studies were largely supportive of the Sharpe-Lintner CAPM, stating a linear relationship between return and systematic risk as measured by beta which is a constant. Early studies of (Blume, 1970; Black, Jensen and Scholes, 1972; Blume and Friend, 1973; Fama and MacBeth, 1973) on testing CAPM reported evidence consistent with the mean-variance efficiency of the market portfolio. Chen (2003) investigated the applicability of CAPM on the Taiwan Stock market and found evidence supporting the use of CAPM and reported that the relationship between stock returns and beta is significant and the coefficient of determination of the regression is high for all the sectors under study. Canegrati (2008) studied the relationship between the sign of market returns and beta coefficients within six sectors of stocks listed on the Milan Stock Exchange and the evidence showed that the intercept was equal to zero, supporting CAPM theory which assumes that the only relevant variable in the regression is the excess return on the market portfolio. As a consequence of this, it was concluded that betas completely capture the cross-sectional variation of expected excess returns and can be seen as a measure of asset risk. Tests using a fifteen-year sample of monthly returns examined the relation between the sign of market returns and beta coefficients and detected existence of an ex-post positive (when the market is at an up state) and negative (when the market is at a low state) relationships between returns and betas.

Fama and French (2004) stated that empirical work since the late 1970s challenged the Sharpe-Lintner CAPM. In particular, evidence mounts that much of the cross-sectional variation in assets return is unrelated to market beta. Yang and Donghui (2006) conducted a study on 100 companies listed on the Shanghai Stock Exchange during the period 2000 to 2005 and they concluded that CAPM does not give a valid description of the stock market. The expected returns and betas were linearly related with each other during the entire period as supposed by the CAPM. However, the results offered evidence against CAPM hypothesis for the intercept, which should equal zero and the slope that should equal to the average market risk premium. Michailidis et al (2006) provided evidence against the CAPM on data of 100 companies listed on the Athens Stock Exchange for the period of 1998 to 2002. The tests refuted the CAPM's prediction that the intercept should equal zero and the slope should equal the excess returns on the market portfolio. Yang and Donghui (2006) conducted a test on 100 companies listed on the Shanghai Stock Exchange during the period 2000 to 2005 and concluded that CAPM does not give a valid description of the Chinese Stock Market. The results offered evidence against CAPM hypothesis for the intercept, which should equal zero and the slope that should equal to the average risk premium. However, there was a linear relationship between the expected returns and betas during the entire period. Javid and Ahmad (2008) carried out a test on the Karachi Stock Exchange and they investigated therisk and return relationship of 49 listed companies during the period July 1993 to December 2004. The empirical findings were against the standard CAPM as a model for explaining asset pricing in the Karachi Stock Exchange. The critical condition of CAPM that there is a positive trade-off between risk and return was rejected and some role of residual risk was identified in pricing risky assets. In a study by Nikolaos (2009) to test the validity of CAPM it was indicated that it was not valid. However, beta was found to be compatible to the model as it was a significant coefficient for measuring returns. Krish (2010) conducted a study and the objective was to test the validity of CAPM theory in Indian capital market and the stability of beta and found evidence against the CAPM hypothesis as well as the stability of systematic risk. Jecheche (2011) investigated the validity of the CAPM on the ZSE using monthly stock returns of 28 firms considered the most traded for the period 2003 to 2008 and the results showed that there is a linear relationship between return and risk. However, the results were inconsistent with the theory's hypothesis that higher beta stocks yield higher returns and that the slope of the security market line is the market risk premium and from these findings, Jecheche concluded that the empirical investigation did not fully uphold with the CAPM on the ZSE.

CONTRIBUTION TO EMPIRICAL LITERATURE

The paper differs from the previous studies carried in that it tests the validity of CAPM on the ZSE after the currency reform (Mazviona and Nyangara, 2013).

DATA

The study covers the period from 19 February 2009 to 31 December 2012. The time period was selected because it is the period after which the multicurrency system was introduced in the Zimbabwean economy. The selected sample consists of 65 stocks that are included in the ZSE Industrial market index. Each series consists of 201 observations of the weekly closing prices.

STATEMENT OF HYPOTHESIS

The primary objective of this article is to test the empirical validity of the CAPM on the ZSE under the following hypothesis:

H_0: The CAPM holds on the ZSE.

H_1: The CAPM does not hold on the ZSE.

METHODOLOGY FOR TESTING CAPM

The methodology adopted in this article is based on (Black, Jensen and Scholes, 1972) which utilize a time series concept to establish the relationship between risk and return and hence testing the CAPM. The approach has been used by other researchers that include (Ansari, 2000; Yang, 2006; Michailidis et al, 2006; Jecheche, 2011), it involves forming portfolios and regressing them on beta. In addition, a test of non-linearity was conducted based on (Fama and Macbeth, 1973). The methodology was motivated by (Miller and Scholes, 1972) who found that analysis of individual security returns to estimate beta coefficients introduced error and bias and therefore the methodology employed in this article addresses the issue by analysis of portfolios.

TESTS

The sample period was 4 years. Due to the short observation period, a one year initial estimation period was used to estimate the beta of the portfolios, and a one year testing period to compute the results as shown in Table 1. Time series test of the CAPM is based on the time series regressions of portfolio returns on market return (Black, Jensen and Scholes, 1972) which can be expressed by the equation below:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad \text{……………………..(1)}$$

Where:

R_{it} is the rate of return on portfolio or asset *i* at time t,

R_{mt} isthe rate of return on the market portfolio at time t,

β_i is the beta of portfolioor asset *i*,

ε_{it} is the is random disturbance term in the regression equation at time t.

The intercept α_i is the estimated expected return by the time series if the market is neutral.

PORTFOLIO FORMATION

The true beta of stocks must have been used for forming portfolios, but all the stocks' betas were estimated betas and ranking the stocks into portfolios by estimated betas would have introduced a selection bias. High estimated beta stocks were more likely to have a positive measurement error in estimating beta. This would have introduced a positive bias into beta for high beta portfolios and a negative bias into the estimate of the intercept (Elton and Gruber, 1995). Black, Jensen and Scholes (1972) used a grouping combination method to solve the measurement bias and estimated betas for the previous year and used these in the grouping of the next year portfolios in order to mitigate statistical errors from the beta estimation. Combining stocks into portfolios diversifies away most of the firm specific part of returns thereby enhancing the precision of the estimates of beta and the expected rate of return on the portfolios on securities. This mitigates statistical problems that arise from measurement error in the beta estimates. The spread in betas across portfolios is maximized, as well,by grouping stocks into portfolios so that the effect of beta on return can be clearly examined. The sample period was divided into 2 study periods, with each period comprising of 3 years. The first period was from 19 February 2009 to 31 December 2011 and the second period was from 1 January 2010 to 31 December 2012. The outline of the study is shown in Table 1.

Table 1: Portfolio Formation, Estimation and Testing Periods

	Period 1	Period 2
	2009 to 2011	2010 to 2012
Portfolio formation period	2009	2010
Initial estimation period	2010	2011
Testing period	2011	2012

The first step was to estimate a beta coefficient for each stock using weekly returns that correspond to each Portfolio Formation Period, 2009 and 2010. The beta was estimated by regressing each stock's weekly return against the market index return according to equation 1. Based on the estimated betas, the 65 stocks were grouped into 8 portfolios; of which 7 of them comprised of 8 stocks each and the other portfolio comprised of 9 stocks. The first portfolio, that is, portfolio 1 had stocks with the lowest betas and the last portfolio, that is, portfolio 8 had stocks with the highest betas. The second step was to calculate average portfolio returns of stocks (R_{pt}) ordered according to their beta coefficients computed by equation 1 and calculate the portfolios' betas. The portfolio returns were computed using the following equation;

$$R_{pt} = \frac{\sum_i R_{it}}{k}$$

where,

k is the number of stocks included in each portfolio (k=1…8),

p is the number of portfolios (p=1…8),

R_{it} is the excess return on stocks that form each portfolio comprised of k stocks each.

The portfolio betas were calculated using the following equation;

$$R_{pt} = \alpha_i + \beta_p R_{mt} + \varepsilon_{it} \text{ ……………………..(2)}$$

Where:

R_{pt} is the average portfolio return at time t,

β_p is the estimated portfolio beta.

ε_{it} is random disturbance term in the regression equation at time t.

Fama and MacBeth ran a monthly cross-sectional regression of return of the portfolios on the estimated betas to test the CAPM. Average return of portfolio *p* is the mean of its return in the defined period, and the portfolio beta β_p is the slope in the time series regression of the returns of portfolio R_p on the market's return R_m .

The third step was to estimate the ex-post Security Market Line (SML) for each Testing Period, that is, 2011 and 2012, by regressing the portfolio returns for 2011 and 2012 against the portfolio betas estimated in 2010 and 2011 respectively. The relation examined was;

$$R_p = \gamma_0 + \gamma_1 \beta_p + \varepsilon_p \text{ ……………………….(3)}$$

Where:

R_p is the average return on a portfolio p,

β_p is beta of portfolio p,

ε_p is the is random disturbance term in the regression equation.

γ_1 is the market price of risk, the risk premium for bearing one unit of beta risk,

γ_0 is the zero-beta rate, the expected return on an asset which has a beta of zero.

If the CAPM is true, γ_0 should be greater than zero, the risk free rate, and the slope of SML, γ_1, is the market portfolio's average risk premium.

The following equation was used to test for non-linearity between average portfolio returns and the estimated betas:

$$R_p = \gamma_0 + \gamma_1 \beta_p + \gamma_2 \beta_p^2 + \varepsilon_p \text{ ……………………….(4)}$$

According to the CAPM hypothesis, portfolios' returns and its betas are linearly related with each other, that is, γ_2 should be equal to zero if CAPM is valid.

The researcher also examined whether the expected return on assets were determined by systematic risk only and were independent of the non-systematic risk, as measured by the residual variance (Bodie, Kane and Marcus, 2003). The following equation was examined;

$$R_p = \gamma_0 + \gamma_1 \beta_p + \gamma_2 \beta_p^2 + \gamma_3 \delta_{\varepsilon p}^2 + \varepsilon_p \text{ ……… (5)}$$

Where:

γ_2 measures the potential non-linearity of the return,

γ_3 measures the explanatory power of non-systemic risk.

$\delta^2_{\varepsilon p}$ measures the residual variance of portfolio return.

If the CAPM hypothesis is true, that is, stock returns are determined by systematic risk only, γ_3 should be equal to zero.

The estimated parameters allowed for the testing of a series of hypotheses regarding the CAPM and these are:
H_{10}: $\gamma_0 \rangle 0$ that is, there is a positive price of risk in the capital markets (Elton and Gruber, 1995).

H_{20}: $\gamma_1 \rangle 0$, that is, there is a positive market risk premium in the capital markets.

H_{30}: $\gamma_2 = 0$, that is, there are no non-linearities in the security market line.

H_{40}: $\gamma_3 = 0$, that is, residual risk does not affect expected returns.

DISCUSSION OF RESULTS

PORTFOLIO RETURNS AND BETA

Average portfolio returns were calculated using data for 2010 and the portfolio betas were estimated using equation 2. Table 2 shows the results;

Table 2: Portfolio Betas

	Average returns	Beta	Standard error
Portfolio 1	0.090%	0.604	0.363
Portfolio 2	0.576%	-0.291	0.492
Portfolio 3	-0.856%	0.616	0.120
Portfolio 4	-0.672%	0.851	0.120
Portfolio 5	0.348%	0.538	0.221
Portfolio 6	0.197%	0.659	0.298
Portfolio 7	-0.661%	0.942	0.186
Portfolio 8	-0.168%	1.162	0.205

From Table 2, portfolio 8 which had the highest beta value of 1.162 yielded lower returns of

-0.168%, whilst portfolio 6 with a lower beta value of 0.659 yielded higher returns of 0.197%. The results did not support the hypothesis presented by CAPM that high beta portfolios yield higher returns and low beta portfolios yield lower returns.

ESTIMATION OF THE SECURITY MARKET LINE

The estimates of beta for 2010 and the average portfolio returns for 2011 were then used to estimate the Security Market Line according to equation 3. Below is a table showing the results of the cross-sectional regression;

Table 3: Statistics of the Estimation of the SML

	Parameters	Standard error	t-value	p-value
γ_0	0.576	0.482	1.195	0.277
γ_1	-0.822	0.515	-1.595	0.162

γ_0 was not significantly different from zero since the p-value, 0.277, was greater than 0.05 and γ_1 was not significantly different from zero, since the p-value, 0.162 was greater than 0.05. According to CAPM hypothesis, γ_0 should be equal to the risk free rate and γ_1 should be equal to the market risk premium hence, H_{10} and H_{20} were rejected at 5% level of significance.

TEST FOR NON-LINEARITY

Equation 4 was used to test for non-linearity and the results are shown in Table 4.

Table 4: Test results for Non-Linearity

	Parameters	Standard error	t-value	p-value
γ_0	0.576	0.459	1.255	0.265
γ_1	-0.631	0.513	-1.230	0.274
γ_2	-0.445	0.351	-1.269	0.260

The value of the y-intercept, γ_0, was not significantly different from zero since the p-value, 0.265, was greater than 0.05, therefore, H_{10} was rejected. The p-value for γ_1, 0.274, was greater than 0.05 and hence γ_1 was not significantly different from zero and H_{20} was rejected at 5% level of significance. The t-test results for γ_2 showed that, it was not significantly different from zero since its p-value, 0.26 was greater than 0.05, thus showing that the relationship between portfolio returns and betas was linear. The results were consistent with the CAPM hypothesis.

TEST FOR NON-SYSTEMATIC RISK

The test for non-systematic risk was carried out using equation 5. The table below shows the results of the test;

Table 5: Test results for Non-Systematic Risk

	Parameters	Standard error	t-value	p-value
γ_0	-1.080	1.173	-0.921	0.409
γ_1	0.538	0.902	0.597	0.583
γ_2	-0.166	0.364	-0.455	0.673
γ_3	6.847	4.545	1.506	0.206

The value of γ_0, from the results above was not significantly different from zero which was contradictory to the CAPM hypothesis. The p-value for γ_1 was greater than 0.05 thus γ_1 was not significantly different from zero, thus rejecting H_{20}. The value of γ_2 was not significantly different from zero, thus providing evidence for CAPM. The p-value for γ_3, 0.206, was greater than 0.05, hence γ_3 was not significantly different from zero. H_{40} was not rejected at 5% level of significance.

Since γ_3 was not significantly different from zero, non-systematic risk had no effect on portfolio returns during the first period of analysis, providing evidence for CAPM. Period 1 results revealed that there was a linear relationship between portfolio expected returns and that non-systematic risk did not explain variation between portfolio returns. However, the high beta-high returns relationship was rejected and the slope of the SML was not significantly different from zero, that is, it was not equivalent to the market risk premium.

EMPIRICAL ANALYSIS OF PERIOD 2

The same procedure was used to test the CAPM for period 2. Table 6 shows the portfolio betas and portfolio returns. The results of the tests for period 2 are shown in Table 7.

Table 6: Portfolio Betas and Average Returns

	Average returns	Beta	Standard error
Portfolio 1	-0.257%	0.287	0.202
Portfolio 2	-0.619%	0.017	0.144
Portfolio 3	-0.634%	0.058	0.129
Portfolio 4	-0.208%	-0.212	0.113
Portfolio 5	-0.778%	0.030	0.000
Portfolio 6	-0.288%	-0.090	0.000
Portfolio 7	-0.363%	-0.004	0.000
Portfolio 8	-0.214%	0.866	0.000

Portfolio 3 which had a higher beta of 0.058 yielded lower returns of -0.634% whereas portfolio 2 with a lower beta of 0.017 yielded higher returns of -0.619%. This did not support the high beta- high returns relationship stipulated by CAPM.

Table 7: Test results

		Parameter	Standard error	t-value	p-value
SML test	γ_0	-0.442	0.088	-5.036	0.002
	γ_1	0.183	0.263	0.694	0.514
Non-linearity test	γ_0	-0.469	0.086	-5.447	0.003
	γ_1	-0.567	0.638	-0.890	0.414
	γ_2	1.045	0.818	1.278	0.257
Non-systematic risk test	γ_0	-0.747	0.146	-5.101	0.007
	γ_1	-0.711	0.493	-1.442	0.223
	γ_2	1.535	0.667	2.301	0.083
	γ_3	12.207	5.737	2.128	0.100

SML TEST

The results indicated that the value of γ_0, was significantly different from zero since the p-value, 0.002, was less than 0.05, H_{10} was not rejected. The value of γ_1 was not significantly different from zero since the p-value, 0.514 was greater than 0.05, and H_{20} was rejected at 5% level of significance.

NON-LINEARITY TEST

The p-value for γ_0 , 0.003, was less than 0.05, hence the value of γ_0 was significantly different from zero. This was consistent with CAPM. The value for γ_1 was not significantly different from zero since its p-value, 0.414, was greater than 0.05, H_{20} was rejected. The results also showed that γ_2 was not significantly different from zero, as its p-value, 0.257, was greater than 0.05 and H_{30} was not rejected. The results from this test indicated that portfolio expected returns were linearly related to portfolio betas, thus supporting the CAPM hypothesis.

NON-SYSTEMATIC RISK TEST

The results for the non-systematic risk test revealed that γ_0 was significantly different from zero, providing evidence for CAPM hypothesis. The p-value for γ_1, 0.223, was greater than 0.05, hence the value of , γ_1 was not significantly different from zero, and H_{20} was rejected. The value of γ_2 was not significantly different from zero since its p-value was greater than 0.05 thus providing evidence in support of CAPM, that is H_{30} was not rejected. The value for γ_3 was also not significantly different from zero, as its p-value, 0.1, was greater than 0.05, therefore H_{40} was not rejected. The results revealed that non-systematic risk did not affect expected portfolio returns, thus providing evidence in support of the CAPM hypothesis. The results from period 2 showed that there was a linear relationship between expected portfolio returns and portfolio betas and non-systematic risk had no effect on expected portfolio returns. However, the slope of the SML was not significantly different from zero and the portfolio returns and the betas did not exhibit the high beta-high returns relationship. These results contradicted the CAPM hypothesis.

CONCLUSION

The portfolio returns and portfolio betas did not exhibit the high beta-high return relationship; therefore the results provided evidence against CAPM. The results for period 1 revealed that the intercept and the slope of the SML were not significantly different from zero whereas the results from period 2 revealed that the intercept is different from zero but the slope of the market line is not significantly different from zero. The CAPM hypothesis says that the intercept should be greater than zero, and equal to the risk free rate, and the slope should be greater than zero. Therefore, period 1 results were in contradictory to the hypothesis and period 2 results were contradictory to the hypothesis that the slope of the SML should be equal to the risk free rate. The results were similar to those obtained by (Yang and Donghui, 2006) from their study on the Shanghai Stock Exchange and results obtained by (Michailidis et al, 2006) on the Athens Stock Exchange. The tests refuted the CAPM's prediction that the slope of the SML should be equal to the market risk premium. The findings from the study revealed that a linear relationship existed between expected returns and beta coefficients, providing support for the CAPM hypothesis. The results were consistent to (Fama and MacBeth, 1973; Yang and Donghui, 2006) and even though their results provided evidence against CAPM, they acknowledged that the returns and beta coefficients were linearly related. The results from both study periods showed that non-systematic risk does not affect expected returns, which was consistent with the CAPM hypothesis.

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