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Testing The Fama-French Five-Factor Model In Explaining Stock Returns Variation At The Lusaka Securities Exchange

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Abstract— *The search for a better asset pricing model has always been a subject of interest in the asset pricing literature. For decades, finance professionals, researchers, and practitioners have been studying possible ways to explain the relationship between the expected return on an asset and its risk factors. Several stock valuation models have been developed to deal with stock pricing among them is modern portfolio theory by Markowitz by (Markowitz 1952). The capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1968). The three factor model of Fama and French (1992). In 2015, Fama and French modified their three factor model into a five factor model (Fama and French 2015). The five factors in the model are,risk premium, size, book to market, profitability and investment. All these models have been trying to find the best way to value capital assets like stocks.*

From the above, it can be observed that there is an ongoing problem in the field of finance relating to stock valuation and return which from 1952 to now researchers have not solved because the existing old models of solving the problem are not appropriate for some reason. Due to this, researchers in various countries are in the process of testing the promising latest Five Factor model by Fama and French (2015) of trying to solve the stock return problem. This research therefore sought; to test the performance of the five factor model in the Zambian case when evaluated in terms of the standard statistical thresholds,

Five Factor model by Fama and French (2015) add profitability and investments to the three factors (risk, size and market to book value) to the in the Fama and French three factor model. Secondary data for seven years from 2008 to 2014 was collected from the Lusaka Securities Exchange and Bank of Zambia. Using the Fama and French methodology and multiple regression technique to analyze the quantitative data, the results suggest that; when evaluated by itself in terms of standard statistical thresholdshe Fama and French Five Factor model is good for use in practical purposes at the Lusaka Securities exchange

Keywords—*Fama and French five factor model*

INTRODUCTION

Capital markets play an important role in the development of an economy and are an integral part of financial systems (Adjasi & Biekpe, 2006). In the capital market, the manner in which securities are priced is a core issue and it has attracted the attention of researchers for long. The risk-return relationship performs a central role in the pricing of securities and consequently helps in making judicious investment decision. In the financial market, when one invests money into an asset, one hopes to get a higher return in the future. Investment, therefore, always includes a sacrifice of some resources today and an expectation of a greater benefit from them in the future. In addition, the return of the most financial asset, including bonds, equities, derivatives, is directly derived from its price in the market (Nghiem, 2015). As prices vary from asset to asset, returns vary also in the majority of case because the price of an asset in the future is not exactly known at the time of investment. Therefore, investors always attempt to find some ways to predict the return of an asset to choose the asset into which they should invest(Nghiem, 2015). One of ways of predicting returns is the use of, asset pricing models. Many researchers have investigated the relationship between expected return and the conditional variance of aggregate wealth. This has led to a long tradition of theoretical and empirical work on the relationship between risk and return. After the construction of Modern Portfolio Theory by Markowitz (1952), different models have been developed in order to relate excess portfolio returns to excess market portfolio returns. One of the earliest attempts in this regard was made in the 1960s, which led to the creation of the Capital Asset Pricing Model (CAPM) independently by Sharpe(1964), Lintner (1965), and Mossin (1966). However, an empirical study by Fama and French (1992) shows that the covariance of portfolio return and market return does not explain the changes on portfolio excess returns. They found that covariance has little or no power in terms of explaining cross-sectional variations in equity returns.

The Fama and French three-factor asset pricing model was developed as a response to poor performance of the CAPM in explaining realized returns. Fama and French (1993) argued that anomalies relating to the CAPM are captured by the three-factor model. They introduced a three-factor model by augmenting the risk –factor by the CAPM with two mimicking factors that capture the return premiums associated with Size and book to market value. The three-factor model has since become a benchmark model in the asset pricing literature.

Most recently, however, Fama and French (2014) introduced a five-factor model by augmenting the three-factor model with two mimicking factors that capture the return premiums associated with profitability and investment. This is motivated by the valuation theory and recent empirical findings on the strong profitability and investment effects in asset returns. Fama and French (2014) find that the five-factor model outperforms the three-factor model in explaining the cross-section of stock. This research therefore sought to test the Fama and French (2015) five factor model at the Lusaka Securities Exchange in Zambia.

Literature Review

Researchers in various countries are in the process of testing the promising latest Five Factor model by Fama and French (2015) of trying to solve the stock pricing problem. Despite it being very new some studies have been done to test the model.

Fame and French (2015) tested the performance of the five-factor model for the United States market using the data from July 1963 to December 2013. Their results suggested that a five-factor model performs better than the three-factor model of Fama and French (1993). They also showed that the model's performance is not affected by the way the factors are calculated. They concluded that with two additional factors the three factor model becomes redundant.

Cakici (2015) used three factor, four factor and five factor models to explain the returns on

portfolios using regional as well as global factors .The results were that there was strong evidence for the five-factor model in North America, Europe, and Global markets. similar to the results for the United States stock market, but the results for Profitability and Investment suggested that these two new factors either do not exist or are much weaker in Japan and Asia Pacific portfolios. The test was for 23 countries in North America, Europe, Japan, and Asia Pacific. Monthly stock data for all 23 countries was used. The sample period was December 1989 to December 2014.

Chiah, Chai, Zhong, and Li, (2016) tested the Five Factor Fama and French (2015) model in Australia. Using an extensive sample over the period 1982 to 2013, they investigated the performance of the five-factor model in pricing Australian equities. Using regression analysis they found that the five-factor is able to explain more asset-pricing anomalies than the three-factor model, which supports the superiority of the five-factor model. In contrast to that documented in Fama and French (2015), the book-to-market factor was found to remain its explanatory power in the presence of the investment and profitability factors. The analysis of this study was conducted for ordinary stocks traded on the Australian Securities Exchange at the monthly level from January 1982 to December 2013.

In their study, Harshita, Singh, and Yadav, (2015) tested and compared the performance of three asset pricing models; the Capital Asset Pricing Model, the three factor model of Fama and French (1993),and the five factor model of Fama and French (2015) on the Indian stock market using a period of fifteen years – from October 1999 to September 2014. The models were tested on portfolios formed on four firm characteristics – market capitalization, ratio of book-to-market equity, profitability, and investment. They found that the three factor model performed better than the Capital Asset Pricing Model in all the cases.

In another similar study Eid and Martins, (2015) tested the five factor model in Brazilian market, they wanted to understand if there were any similarities and divergences of the Brazilian market in comparison with the American stock market where Fama and French based their Five factor Model. Their results showed that the Fama and French Five Factor model performs better than previous work in three-factor model.

Nguyen, Ulku and Zhang (2015) tested the five factor model in Vietinam their results of models showed that the Fama and French five factor model performed better than the CAPM and the three-factor in explaining the average returns. The analysis of this study was conducted for all common stocks traded on Hochiminh and Hanoi Stock Exchanges at monthly and daily frequency from August 2007 to July 2015.

Data and Methodology

This study used annual data ranging from 2008 to 2014 covering the period of 7 years. Extending the period would have meant limiting the number of companies as only about 13 companies were listed by the year 2005 as the Zambia stock market is relatively new. Hence seven year period was deemed appropriate in order to capture more firms that were listed on the Lusaka Securities Exchange later than 2007. This period is comparable to that used by similar research like Chandra, and Idrus (2015) in the study of Testing Fama and French Three Factors in Indonesia ,Shaker and Elgiziry (2014) in their study of a comparison of asset pricing models in the Egyptian Stock Market , Nghiem (2015), in the study of Risk-return relationship. As at 2014, Lusaka Securities Exchange had a population of 22 companies the study intended to pick all of the 22 companies; however a sample of 16 firms out of 22 firms listed was picked. The 16 companies were picked because they had traded at Lusaka Securities exchange by 2008 and their financial data was available. Of the 6 that were not picked 3 were listed after 2008 while the other 3 had limited financial data. The market and financial data was gathered from Lusaka Securities Exchange while the treasury bills rate were collected from

bank of Zambia. The data set used it included annual stock closing prices which were used to calculate the individual stock expected returns found by dividing the stock price in the current year by the stock price in the previous year, this is similar to Fama and French (1992) Were the same formula was used. Other data included annual treasury Bills rates obtained from Bank of Zambia which was used as a proxy for risk-free rates of returns , annual Lusaka Securities Exchange market price index as a proxy for return on market portfolio and the, market capitalization found by multiplying the shares outstanding at the yearend by the share price. From the financial statement the following was obtained; Book-to-market equity (denoted by B/M) which is the ratio of book equity to market equity at the year end. Book equity was picked from the financial statements while the market equity was market capitalization for each company (Chiah, Chai, Zhong, and Li, (2016), Fama and French (1992, 2015))

Profitability (denoted by OP) is the ratio of earnings before taxes to book equity at the yearend .This definition is in line with the definition of Fama and French (2015) who defined profitability as the annual revenues minus cost of goods sold, interest expense, and selling, general, and administrative expenses, all divided by book equity.Investment (denoted by Inv) is change in total assets of the previous year end divided by total assets at the end of the current year (Chiah, Chai, Zhong, and Li, (2016), Fama and French (1992, 2015))

Portfolio Construction

In order to first establish the explanatory power of the five-factor model, in the spirit of Fama and French (1993, 2014), three types of portfolios namely, size and book-to-market, size and profitability, and size and investment portfolios were formed and the expected returns from these portfolios were used as dependent variable in the test. The portfolios were constructed in the following manner. At the end of each year stocks were allocated to five Size groups (Small to Big) using Lusaka Securities Exchange market capitalization breakpoints. Stocks were also allocated independently to five Book to Market (B/M) groups (Low to High), again using Lusaka Securities Exchange breakpoints. The intersections of the two sorts produce 25 value-weight Size-B/M portfolios. Table 6.1 shows averages of yearly returns in excess of the Bank of Zambia Treasury bill rate based on first portfolio type size and Book to Market value. The second and third sort, size-profitability and Size-investment were constructed in the similar manner to the size book values only that instead of book value profitability and investment was used. The profitability variable was calculated by finding the ratio of profit before tax and book value which was denoted by share holders equity. The investment variable was calculated by finding the change in total assets from the year end of year t-1 to year end of year t, divided by total assets at the year end of year t-1 . Table 1 shows averages of yearly returns in excess of the Bank of Zambia Treasury bill rate based on size – book to market, profitability and investment.These were used as a dependent variable.

Factors definition and formulation

Having calculated the excess average return (representing the dependent variable ER-RF), the next step was to construct the five factors (representing independent variables). This study closely followed the empirical design of prior research in order to enhance comparability .

The risk premium factor (Rm-Rf) was calculated by subtracting the bank of Zambia annual treasury bills rate from the Rm factor which was calculated by dividing the Lusaka Securities Exchangeclosing price index for the previous into the current year's price index (Rm1/Rm0) this is similar to Eraslan (2013), Muthoni (2013) and Fama and French (1992) were the same formula was used.

To construct the SMB (Size), HML (Book/Market), RMl (profitability) and CML (investment) factors, the study closely followed the methodology outlined in Fama and French (1993, 2014,15), and Brailsford et al.

(2012). To create the SMB (small minus big) and HML (high minus low) factors, six portfolios from the intersections of two size and three book-to market portfolios were formed. To do this, at the end of each year, stocks were first ranked according to their market capitalization. They were then allocated into two size portfolios using the median. The largest 8 stocks in terms of market capitalization were classified as large and the remaining 8 stocks were classified as small. In this approach, large stocks comprised about 93 %, while small stocks comprised approximately 7% of the total market capitalization.

Second, the big stocks were divided into 3 groups using the 30th and 70th percentile of the book-to-market ratio (which is the ratio of book equity to market equity at the yearend.) following Brailsford et al. (2012b). Stocks with book-to market ratios below or equal to the 30th percentile were classified as growth stocks (represented by BL) and stocks with book-to-market ratios higher than the 70th percentile were classified as value stocks(represented by BH). The remaining were classified as neutral stocks (represented by BN). In the same manner, small stocks were divided in to 3 groups using the 30th and 70th percentile of the book-to-market ratio Stocks with book-to market ratios below or equal to the 30th percentile were classified as growth stocks (represented by SL) and stocks with book-to-market ratios higher than the 70th percentile were classified as value stocks(represented by SH). The remaining stocks were classified as neutral stocks (represented by SN). This independent size and book-to-market sorts resulted in six portfolios (SL, SN, SH, BL, BN and BH).Basing on individual stock annual expected return, average value-weighted returns on each of the six portfolios were calculated .This procedure was done for each of the seven years under review. From that, two mimicking portfolios, SMB BM (this was called SMB BM because it is based on market to book value) and HML were created. SMB BM was the average return on the three small size portfolios minus the average return on the three big size portfolios (Small Minus Big). HML was the average return on the two high book-to-market portfolios minus the average return on the two low book-to-market portfolios (High Minus Low), these factors from the six size and book-to-market portfolios captured the return premiums associated with size and book-to-market. The two formulae below summarize how SMB BM and HML were calculated.

SMBB/M= (SH+ SN+ SL)/ 3 – (BH+ BN+ BL) / 3

HML= (SH+ BH) / 2 – (SL+ BL) / 2 = [(SH– SL) + (BH - BL)] / 2

Following the same approach as the book to market, portfolios relating to profitability and investment were created only that Profitabilty and investment was used in place of book to market value.From the proftabuily, two mimicking portfolios, SMBOP (this was called SMBOP because it is based on profitability) and RMl were created. SMBOP was the average return on the three small size portfolios minus the average return on the three big size portfolios (Small Minus Big). RML was the average return on the two robust profitability portfolios minus the average return on the two weak profitability portfolios (Robust Minus Weak), these factors from the six size and profitability portfolios captured the return premiums associated with size and profitability. The two formulae below summarize how SMBOP and RMl were calculated.

SMBOP= (SR+ SN+ SW) / 3 – (BR+ BN+ BW) / 3

RMW= (SR+ BR) / 2 – (SW+ BW) / 2 = [(SR– SW) + (BR - BW)] / 2

From the investment , two mimicking portfolios, SMB Inv (this was called SMB Inv because it is based on investment) and CMl were created. SMB Inv was the average return on the three small size portfolios minus the average return on the three big size portfolios (Small Minus Big). CMl was the average return on

the two aggressive investment portfolios minus the average return on the two conservative investment portfolios (Aggressive Minus Conservative), these factors from the six size and investment portfolios captured the return premiums associated with size and investment. The two formulae below summarize how SMB Inv and CMA were calculated.

SMBInv= (SC+ SN+ SA) / 3 – (BC+ BN+ BA) / 3

CMA= (SC+ BC) / 2 – (SA + BA) / 2 = [(SC– SA) + (BC - BA)] / 2

The overall SMB factor defined as the average returns of the three SMB portfolios.(SMB BM, SMB OP and SMB Inv) was calculated basing on the formula below

SMB= (SMBB/M+ SMBOP +SMB Inv) / 3

Table 2: below shows the summary of the five factors Risk(Rm-Rf),Size(SBM),Book to market(HML),Profitability(RMl) and Investment(CMl) calculated for the period 2008 to 2014.

Diagnostic test

It is important to carry out diagnostic tests before proceeding to estimate the parameters of the models because diagnostic tests reveal whether or not there are problems that would lead to inaccurate estimated parameters. If there such problems and inaccurate parameters are estimated, this would ultimately lead to wrong or rather inaccurate results, and hence wrong or inaccurate conclusions and recommendations.The data and Model was checked for Normality of dependent variable, Multicollinearity , serial correlation Heteroscedasticty, Normality of residuals.

Serial correlation,

Results

Having done the diagnosis, the following four statistical tests were done. This part discusses how the Fama and French Five factor model was tested against statistical thresholds which included T- tests, F-statistic, Coefficient of determination (Adjusted R-squared) and the root mean squared error using regression which was run on the excess return of the portfolios sorted on Book to Market, Profitability and investment.

Table 3 shows the results.The first statistical test was to know if all the independent variables jointly explain the variation .The results reviewed that, more than 50% of the variable coefficients were significant.The F statistic of 22.6445 with the P value of 0.000 was observed for Size - Book to market value, 29.8081 with the P value of 0.000 for Size-profitability and18.8128 with the P value of 0.000 for Size- investment portfolio sortings. This indicated that all the five variables (risk premium, book to market value, size, profitability and investment) jointly explained some variation in the Price (expected returns).

The second statistical test was to assess the percentage of variation in the dependent variables (Price) that could be explained by changes in the independent variables of the model. Adjusted R square was used to assess the variation.The average coefficient of determination (adjusted R square) ranged from 0.79 to 0.96 overall average of 0.9. for individual portfolio sortings of Size - Book to market value, Size- profitability and Size-investment .This result indicated that 90% of the variation in the dependent variable, price could be explained by changes in the five factors.This results are similar to Chiah, Chai, Zhong, and Li, (2016), Harshita, Singh, and Yadav, (2015)andNguyen, Ulku and Zhang (2015)

The third statistical test was to assess the forecasting power of the five factor model. Ex post forecasting as used by Nghiem (2015) was performed. It was observed that expected return (ER) and the forecasted expected (ERF) moved in the same direction for all portfolio sortings.The average deviation of the estimates from the observed values which was measured by the root mean squared error was 0.4572 , 0.1670 and 0.2576 from portfolio sortings of Size - Book to market value, Size- profitability and Size- investment respectively.The overall

average root mean squared error was 0.2939.This result indicated that the model could be used for forecasting .Simmilar to Nghiem (2015)

Conclusion

1. This research has tested the Fama and French Five factor model ,against statistical thresholds. The F-test indicated that the Five Factor model is good for use in practical purposes because all the five factors jointly explained some variation in the Price for all portfolio sorting. The Adjusted R-squared test indicated that the Five Factor model was good for practical purposes because its average value (0.9) for all individual portfolio sortings indicated that a high percentage (90%) in the changes of the dependent variable could be attributed to the changes in the independent variables used in the model.

The Root mean squared error indicated that the Five Factor model was good for practical purposes in forecasting because the expected return (Price) and the forecasted expected return (Price) moved in the same direction with the average Root mean squared error of 0.29.

REFERENCES

[1] Adjasi, C. K. D., & Biekpe, N. B. (2006). Cointegration and dynamic causal links amongst African stock markets. Investment Management and Financial Innovations, 3(4), 102–116.

[2] Cakici, N., Tan, S., 2014. Size, Value and Momentum in developed country equity returns:Macroeconomic and Liquidity Exposures. Journal of International Money and Finance 44, 179-209.

[3] Chandra, T. (2015). Testing Fama & French Three Factors Model within the Context of Indonesia Stock Exchange.

[4] Chiah, M., Chai, D., Zhong, A., & Li, S. (2016). A Better Model? An Empirical Investigation of the Fama-French Five-factor Model in Australia. International Review of Finance, 1–33. https://doi.org/10.1111/irfi.12099

[5] Eid Jr, W., & Martins, C. C. (2015). Pricing Assets with Fama and French 5-Factor Model: a Brazilian market novelty, (October), 0–13.

[6] Fama, Eugene F., and Kenneth R. French, 1992, "The cross-section of expected stock returns," Journal of Finance, 46, 427–466.

[7] Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.

[8] Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. Journal of Financial Economics, 116(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

[9] Harshita, Singh, S., & Yadav, S. S. (2015). Indian Stock Market and the Asset Pricing Models. Procedia Economics and Finance, 30(15), 294–304. https://doi.org/10.1016/S2212-5671(15)01297-6

[10] Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 7(1), 77–91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

[11] Nghiem, L. (2015). Risk-return relationship: An empirical study of different statistical methods for estimating the Capital Asset Pricing Models (CAPM) and the Fama-French model for large cap stocks. Retrieved from http://arxiv.org/abs/1511.07101

[12] Nhu Nguyen, Numan Ulku, J. Z. (2015). The Fama-French Five Factor Model: Evidence From Vietnam. Journal of Chemical Information and Modeling, 53(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

[13] Shaker, M. A., & Elgiziry, K. (2014). Comparisons of Asset Pricing Models in the Egyptian Stock Market. Accounting and Finance Research, 3(4), 24–30. https://doi.org/10.5430/afr.v3n4p24

[14] Adjasi, C. K. D., & Biekpe, N. B. (2006). Cointegration and dynamic causal links amongst African stock markets. Investment Management and Financial Innovations, 3(4), 102–116.

[15] Cakici, N., Tan, S., 2014. Size, Value and Momentum in developed country equity returns:Macroeconomic and Liquidity Exposures. Journal of International Money and Finance 44, 179-209.

[16] Chandra, T. (2015). Testing Fama & French Three Factors Model within the Context of Indonesia Stock Exchange.

[17] Chiah, M., Chai, D., Zhong, A., & Li, S. (2016). A Better Model? An Empirical Investigation of the Fama-French Five-factor Model in Australia. International Review of Finance, 1–33. https://doi.org/10.1111/irfi.12099

[18] Eid Jr, W., & Martins, C. C. (2015). Pricing Assets with Fama and French 5-Factor Model: a Brazilian market novelty, (October), 0–13.

[19] Fama, Eugene F., and Kenneth R. French, 1992, "The cross-section of expected stock returns," Journal of Finance, 46, 427–466.

[20] Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.

[21] Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. Journal of Financial Economics, 116(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

[22] Harshita, Singh, S., & Yadav, S. S. (2015). Indian Stock Market and the Asset Pricing Models. Procedia Economics and Finance, 30(15), 294–304. https://doi.org/10.1016/S2212-5671(15)01297-6

[23] Lintner, J., 1965. The valuation of risk assets and the selection of risky investments in stock portfolios

and capital budgets. The Review of Economics and Statistics 47, 13–37.

[24] Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 7(1), 77–91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

[25] Nghiem, L. (2015). Risk-return relationship: An empirical study of different statistical methods for estimating the Capital Asset Pricing Models (CAPM) and the Fama-French model for large cap stocks. Retrieved from http://arxiv.org/abs/1511.07101

[26] Nhu Nguyen, Numan Ulku, J. Z. (2015). The Fama-French Five Factor Model: Evidence From Vietnam. Journal of Chemical Information and Modeling, 53(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

[27] Shaker, M. A., & Elgiziry, K. (2014). Comparisons of Asset Pricing Models in the Egyptian Stock Market. Accounting and Finance Research, 3(4), 24–30. https://doi.org/10.5430/afr.v3n4p24

[28] Sharpe, W. F. (1964). Capital asset prices: A theroy of market equilibrium under conditions of risk. The Journal of Finance, 19(3), 425–442. https://doi.org/10.2307/2329297

Tables

Table 1: Average yearly returns in excess of the Bank of Zambia Treasury bill rate based on size and book to market value ,Size profit and Size investment.

Size	B/M Low	2	3	4	High B/M
Small	0.79	0.77	0.86	0.77	0.84
2	0.88	0.88	1.00	0.89	0.95
3	0.72	0.71	0.83	0.70	0.77
4	0.84	0.83	0.92	0.83	0.88
Big 5	0.89	0.88	0.96	0.87	0.93

Size	Profit Low 1	2	3	4	5 High
Small 1	0.92	1.02	0.94	1.06	1.12
2	0.87	0.97	0.87	1.01	1.08
3	0.91	1.01	0.94	1.05	1.10
4	0.91	1.02	0.96	1.06	1.12
Big 5	0.84	0.93	0.84	0.97	1.01

Size	Investment Low 1	2	3	4	5 High
Small 1	1.05	1.02	1.05	1.13	0.99
2	0.92	0.86	0.89	0.98	0.85
3	1.06	1.02	1.08	1.14	0.99
4	0.90	0.92	0.98	1.03	0.89
Big 5	0.92	0.89	0.91	0.98	0.87

Table 2: summary RM,SBM, HML, RMW and CMA for the period 2008 to 2014.

Year	Risk (Rm-Rf)	Size (SBM)	Book-Market (HML)	Profit(RML)	Investment(CML)
2008	1.29	-0.47	-0.02	1.58	0.43
2009	0.96	-0.16	0.28	-0.08	0.27
2010	0.94	0.26	0.59	0.08	0.04
2011	1.03	0.08	-0.02	-0.09	0.01
2012	0.83	0.12	0.35	0.13	0.11
2013	1.26	-0.35	0.11	0.51	-0.56
2014	1.2	-0.37	0.2	0.16	0.2

Table 3 Test against statistical thresholds

Statistical Test	Critical value	P value 0.05
F test all portfolio sorting	22.6445 , 29.8081, 18.8128	0.000
Average Adjusted R square	0.90	
Average Root mean squared error	0.29	