



Testing Five Factor CAPM on Pakistan's Stock Exchange: How Risk and Return and Interlinked?

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ABSTRACT

The study is conducted to test Five Factor CAPM on Karachi Stock Exchange which include impact of market risk (RM), size effect (SMB) in terms of market capitalization, value effect (HML) in terms of book to market ratio, profitability (RMW) in terms of earning per share and investment (CMA) in terms of annual growth in assets. Data for RM, SMB, HML, RMW and CMA is taken from Karachi Stock Exchange from the year 2000 to 2015. Four windows having different year from year 2000 to 2015 are constructed to conduct the research by using Fama and Macbeth (1973) Methodology. Overall results shows that all the independent variables RM, SMB, HML, RMW and CMA have significant impact on the excess return of portfolios. By considering the various factors for portfolio returns for the first windows all the indicators have insignificant outcomes accepting the null hypothesis; factors have impact on stock returns (Fama & French, 2015). Due to the volatility in the stock prices of small companies the stated facts are in consistent with the argument that small firms outperform big firms. It means big firms provide lower stock return comparatively to the small companies. The value stocks which have high book to market ratio yields more returns with respect to growth stocks which have high book to market ratio (Fama & French, 1992). Profitability also has significant impact on the returns of portfolios, the companies who earn more profitability (Robust) provide more return as compared to the companies who have poor or less profitability (Weak). The investment made by the companies during the year also have significant impact on returns. The companies having high annual assets growth rate by reinvesting their retained earnings in new ventures or projects, they generate less returns as compared to companies having low annual asset growth rate. So, from above discussion it is established that Five Factor CAPM model hold in Karachi Stock Exchange (KSE).



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1. Introduction

There are two major parts of the CAPM: capital market line and security market line. The capital market line represents entirely obtainable portfolios which consist of risky and risk-free assets. The capital market line shows the relationship between expected return of the security and the associated risk. The security market line shows the relationship between expected returns and market risk. CAPM is criticized because of the assumption on which it is developed, as CAPM says that investors are rewarded return only because of bearing systematic risk and it ignores unsystematic risk. CAPM is held only for a single period. CAPM is useful in only ideal words, as assumptions under which CAPM is developed do not persist in real

world. Many researchers empirically test the CAPM and on their results they criticize it and identify anomalies present in CAPM. (Banz, 1981), (Bhandari, 1988), (Fama & French, 1992), (Groenewold Fraser, 1997), concluded that there are also other factors, size and value effect which also influence the returns of securities. Other studies also concluded that return is also explained by size and value of the firm. In 1993 Fama and French presents three factor model by adding two more factors size and value, as they consider that size and value are important factors which can used to measure the risk factor. Size factor shows that small companies which are referred as small caps yield more profit in the long run as compared to the big companies (large cap) (Groenewold Fraser, 1997).

Haugen and Baker (1996) conducted the studies to examine the relationship between growth in investment and expected return, they conclude from their research that the firms that invest more they yield less returns, but the companies which have low investment growth they yield more return. (Daniel, Grinblatt, Titman, & Wermers, 1997) (Wermers, 1999), (Nofsinger & Sias, 1999), (Grinblatt & Keloharju, 2000), (Chen, Hong, & Stein, 2002), (Gompers, Ishii, & Metrick, 2001), and further studies suggest that when there are higher expected return for shorter period of time then the investors tend to buy the those stocks and when there is low expected return for short period of time then the investors have the intensions to sell the stocks of that particular of the firm.

Haugen and Baker (1996) and (R. B. Cohen, Gompers, & Vuolteenaho, 2002) proved from their research that the firms which are more profitable they give more expected return. There is also evidence that profitability and investment add to the description of average returns. Fama and French added two additional factor profit and investment in their three-factor model to determine the expected return. The three-factor model ignored profitability and investment as they are significant variable which determines the average return.

Earlier studies provide evidence that book to market ratio and size effect have significant power to explain the expected return of the stocks, but there are also studies that prove that profitability and investment have also effect on the expected returns. The dividend model helps us to understand the relationship between expected return and variables including book to market ratio, profitability and investment. High the book to market ratio, high will be the expected return. If all the other variable books to market ratio and growth in assets are kept constant, then higher will be the expected earning of the firm refers higher will be expected return. And if the growth in assets is high while other variable (book to market ratio and profitability) low will be the expected returns of the stocks of that particular firm (Fama & French, 2015).

As the momentum effect was considered an anomaly which were included in their factor capita assets pricing model by Carhart, if this effect is added in the five-factor capital asset pricing model then this will cause a very minute effect to explain the expected return of the stocks. The reason of this poor power of explaining expected return is that when portfolio is sorted in five factor capital assets pricing model then they do not represent high momentum tilts. Although considering the momentum effect in the five factor capital asset pricing model will give a better insight but it will leave the small size firms to explain the expected return with reference to momentum effect (Fama & French, 2016). This research is conducted to test the Five Factor CAPM model on the Karachi Stock Exchange which is known as Pakistan's Stock Exchange.

1.1 Research Objectives

As risk and return associated with any security or portfolio is determined by various model but five factors CAPM give the better framework to calculate risk and return. Fama and French take into the account the effect of profitability and investment on the expected return as these factors were ignored by single factor CAPM model and three factor CAPM model. Till right now there is not any study conducted at Karachi Stock Exchange for five factor CAPM model, this research is being conducted to test the five-factor capital asset pricing model in Pakistan (Karachi Stock Exchange (KSE)) which will help the investor in Pakistan to invest in any security and formulate portfolio in better way. This study has the following objectives:

- To measure the impact of market, size effect, value effect (book to market ratio), profitability and investment on the expected return of the securities.
- This research will help the investors to estimate the expected return in better way.

2. Literature Review

There are some factors that are not considered by the Capital Asset Pricing Model (CAPM) of (Sharpe, 1966) and (Lintner, 1965) these factors are referred as anomalies. (Banz, 1981) concluded that the companies which have low market capitalization they give more returns, the companies which have high book to market ratio they also yield more returns. (Ball & Brown, 1968) determined that earnings are the bottom line for any firm at that is measured by net income subtracted all the expenses, and this has a relationship with the expected return of the firms. (Ikenberry, Lakonishok, & Vermaelen, 1995) when new stocks are issued by the firms, which means growth in investment, then the expected returns of these firms is less than the firms which growth rate is low.

(Haugen & Baker, 1996) conducted the studies to examine the relationship between growth in investment and expected return, they conclude from their research that the firms that invest more they yield less returns, but the companies which have low investment growth they yield more return. (Daniel et al., 1997) (Wermers, 1999), (Nofsinger & Sias, 1999), (Grinblatt & Keloharju, 2000), (Chen et al., 2002), (Gompers et al., 2001), and further studies suggest that when there are higher expected return for shorter period of time then the investors tend to buy the those stocks and when there is low expected return for short period of time then the investors have the intentions to sell the stocks of that particular of the firm. (Haugen & Baker, 1996) and (R. B. Cohen et al., 2002) proved from their research that the firms which are more profitable they give more expected return.

W. M. Cohen, Nelson, and Walsh (2000) also found that allocation in securities made by the investors based on how well cash flows are generated by the firms. The new information regarding the expected cash flows impact the decisions of the investor to buy the stocks of any company. When information about dividend and cash flows float in the financial market then the stocks behave in the same direction as the news, when there are news regarding the increase in cash flows and dividend then the prices of the stocks moves in upward direction and vice versa (R. B. Cohen et al., 2002). Many studies like (Barberis, Shleifer, & Vishny, 1998) (Daniel, Hirshleifer, & Subrahmanyam, 1998) (Hong & Stein, 1999) also agreed with the above views regarding cash flows but (Fama, 1998) said that these findings were only because of the sample selected for study, there is positive relationship between the profitability and return but this relationship is insignificant.

Further research indicated that earnings has incremental influences as compared to the book to market ratio. There is much literature available which shows that the price of the stocks has a relationship with the news regarding the expected cash flows of the firms. (Vuolteenaho, 2002) from the study he examined the relationship among the returns, expected cash flows new and the buying and selling behavior of the individuals and instituted regarding those stocks. He concludes that when there is a news regarding the positive cash flows of the stocks, then individuals and institutes tend to buy the stocks and when there is a new regarding low expected return of the stocks then investors tend to sell the stocks of those companies.

Vuolteenaho (2002) argued that when it is expected that there will be positive cash inflows for any firm then the stock prices of that firm tend to be rise, which shows that there is positive relationship between the profitability and return of the firms. (Fairfield, Whisenant, & Yohn, 2003) and (Titman, Wei, & Xie, 2004) conducted the studies to examine the relationship between growth in investment and expected return, they conclude from their research that the firms that invest more they yield less returns, but the companies which have low investment growth they yield more return. (Daniel & Titman, 2006) show that expected stocks returns are negatively correlated with the new issuance of the stocks of the companies. (Fama & French, 2006) examine the impact of profitability, book to market ratio (B/M) and investment on the expected return of the stocks by means of dividend discount model. This study provide very important information regarding the relationship between these variables, the expected return

which are associated with are stocks have positive relationship with the book value and the profitability of the firm.

But the growth in the equity of the company (investment) is negatively correlated with expected return. The reason of this negative relation of expected return and investment may have the reason, then there is increase in the equity this may be because of new investment which is made by retained earning or new stocks may be issued (Fama & French, 2006) diagnosed many errors in the measurement of the proxies for investment and profitability which were used in their research. (Fama & French, 2008) revise their study because they consider that the significant results may be because of the book to market ratio, which may reinforce the relationship between profitability and investment. Book to market ratio also has the ability to explain the profitability and investment of any firm.

So (Fama & French, 2008) conducted another study by taking only future investment and profitability as independent variable to observe their impact on the expected return of the stocks. The result of the study shows that there is a negative relationship between the growth in assets and expected return of the firms. The profitable firms generate more returns as compare the firms which have low profitability. (Pontiff & Woodgate, 2008) proved from their studies that the firms which issue more stocks in a particular year then they are supposed to give less returns for the investors who are purchasing these stocks of the firm.

It means when there is any growth in investment then the stocks yield less expected returns. The stocks which give more returns for last six months they will continue to yield more for next few periods of time. And the stocks which give more returns they will provide more returns for next few months. Like these patterns which have influence on the returns, profitability and investment remain unexplained by the Fama and French three factor model. (Novy-Marx, 2013), finds through his study that the earning which is represented by different variables like gross profit (all revenues less cost of goods sold) has association with expected return of the companies. Gross profit is measured by the value of the total assets (book value) and to measure net income book value of equity of the company is used as a proxy.

The results of the studies shows that both variables gross profit and net income has equal power to explain the impact on expected return of the securities. The net income can be said a good indicator of profitability to measure the impact on excess return is because of the reasons; the investor or shareholder not only consider the cost of goods sold but all the expenses that can influence the dividend (Ball, Gerakos, Linnainmaa, & Nikolaev, 2014) "Analysts have focused on earnings quite a bit as a measure of profitability, but I don't think it is very informative. It treats many things that I think of as investment—things you should be doing because they increase your future profitability, like investing in your labor force—as expenses," says Novy-Marx. "Such expenses reduce GAAP earnings, making the company appear less profitable. Gross profits is the cleanest accounting measure of true economic profitability." (DeMuth, 2013) also represents a relationship between net income and returns of the securities.

Fama and French incorporated Modigliani valuation formula to investigate the impact the book to market ratio and profitability have the positive relation with expected return but the investment has significantly negative relationship with expected return (Aharoni, Grundy, & Zeng, 2013). (Aharoni et al., 2013) empirically test the variables, these variables are measure on firm level. The results shows that there is a strong positive relation between the expected return and profitability and growth in investment shows the negative relationship with expected return.

Five factor capital asset pricing model gives us the opportunity to handle the anomalies which were inheriting by the Fama French three factor CAPM model. The success of the five factor model is associated with the slopes of robust minus weak (RMW) which represents the profitability and conservative minus aggressive (CMA) which represents the investment. The firms which investment growth is low referred as conservative and they yield more returns and the firms with high growth rate referred as aggressive and they give less returns with respect to conservative growth rate. The firms which give more profitability they give more return and the firm which earn less profit they give less rate of return. These factors were ignored by the three factor capital asset pricing model. (Fama & French, 2016). (Hou, Xue, & Zhang, 2014)

provide evidence that five factor capital asset pricing model give us a better insight to understand the expected return of the stocks as compared to the three factor and four factor capital asset pricing model.

3. RESEARCH METHODOLOGY

In this quantitative research study the secondary time series data for all the variables is collected from 2000 to 2015. The monthly index of the stocks to calculate the monthly returns are used taken from the official website of KSE (Karachi Stock Exchange: www.kse.com.pk). Data for the book value of the companies and market equity will be collected from the audited annual reports of the respective companies, KSE annual Reports and KSE data portal . The Monthly rate of return for each stock in the sample is calculated as follows:

$$R_{it} = \ln (P_{it} / P_{it-1}) \dots \dots \dots (3.1)$$

Where R_{it} : is the rate of return of stock i at month t . P_{it} : is the monthly price index of the stock i at month t . P_{it-1} : is the monthly price index of the stock i at month $t-1$. In order to calculate the rate of return for the market, this study used the equally weighted index for KSE (Karachi Stock Exchange) as proxy for the market portfolio rate of return, using the same above equation the market rate of return is calculated. This study uses the 12- month treasury bills as a proxy for the risk-free rate of return which is taken from the website of state bank of Pakistan.

3.1 Sample Selection

The sample is selected from all the companies listed at the KSE. Following are some rules and limitation that have been kept in mind during sampling

- The selected stock must be a listed at KSE.
- The data of monthly price index, book value, market equity, total assets, profitability and volume traded must be available for the stocks.
- During the sample period the selected stocks must be traded for more than 90% of trading Days.
- As the history of KSE-100 index is short only those companies are selected which are listed throughout this period following Javid and Ahmad (2008).

3.2 Portfolios Construction Procedures

In order to construct the SMB, HML and RMW & CMA factors, this study used similar constructing mimicking that used by Fama and French (1996), in January of each year all stocks on the study sample are ranked based on the firm size stocks are assigned into two portfolios of size (Small (S) and Big (B)) based on split point which is 50%, that means the highest 50% stocks are the big and the lowest 50% stocks are the small. The same stocks are independently resorted into three portfolios based on the book to market equity, Based on the break point for the bottom 30 % (Low), middle 40% (Medium), and top 30% (High), based on the intersection between two market capitalization groups (Small & Big) and three Books to market equity groups (L, M and H).

3.3 Variables Description

Now we form six value weighted portfolios SH, SM, SL, BH, BM & B/L.as the intersection of size and book to market Ratio. SH shows the small companies having high book to market ratio, BL shows the big companies having low book to market ratio and so on. Note that the number of firms in each portfolios varies. In the study dependent variable is expected return and independent variable includes, market beta (RM), small minus low (SMB) which is size effect, high minus low (HML) which is value effect, robust minus weak (RMW) which refers profitability and conservative minus aggressive (CMA) which represents the investment.

Market risk is measure by taking the difference of market return and risk free return. Market return is measured from the market index from KSE from year 2000 to 2014 and risk

free return is the return which is offered on the treasury bills. The risk free return is taken from the available data on the official web site of State Bank of Pakistan (SBP). According to sample of this study risk free rate of treasury bills is taken from year 2000 to 2014. The market return less the risk free rate of treasury bills is the proxy to measure the market risk.

3.3.1 Market Risk

Market risk is measure by taking the difference of market return and risk-free return. Market return is measured from the market index from KSE from year 2000 to 2014 and risk-free return is the return which is offered on the treasury bills. The risk-free return is taken from the available data on the official web site of State Bank of Pakistan (SBP). According to sample of this study risk free rate of treasury bills is taken from year 2000 to 2014. The market returns less the risk-free rate of treasury bills is the proxy to measure the market risk.

3.3.2 Size (Small minus Big) and Value (High Minus Low)

The proxy used for the size is market capitalization. The companies which have more market capitalization are refer as big companies (big cap firms) and the companies which have low market capitalization are refers as small companies (small caps firm). SMB & HML is constructed in the following way, first all the companies are sorted from small to big on the basis of their market capitalization. Then all the stocks are divided in to two parts by establishing a cut point at 50%. The first fifty percent companies before the cutting point are the small firms (S) and remaining fifty percent companies after the cutting point are refers as big firm (B). After the first sortation on the basis of size, both small companies (S) and big companies (B) are again sorted on the basis of their high book to market ratio (H) to low book to market ratio (L).

The small companies (S) from the first sortation which are again sorted on the basis of their book to market ratio from high to low are divided into three clusters, first group consists of thirty percent of companies which are small caps (S) but have high book to market ratio (H), second cluster consist of the middle forty percent of the companies which are small caps (S) but have medium book to market ratio (M) and third cluster consist of last thirty percent of the companies which are small caps (S) but have low market to book ratio (L). SL, SM, and SH are calculated by taking the weighted average of monthly returns.

The same procedure is applied for the companies which have more market capitalization and refers as big caps (B). These big caps (B) companies are again sorted on the basis of their high book to market ratio (H) to low book to market ratio (L), they are divided in three groups and calculated the BH, BM and BL by taking the weighted average of monthly return of the big companies (B). This same procedure is conducted for each year from 2000 to 2015 to calculate SMB with help of below written formula.

SMB = Small minus Big = Average Returns of Small Size firms minus Average Returns of Big Size companies

$$= 1/3 (SH + SM + SL) - 1/3 (BH + BM + BL) \dots\dots\dots (3.2)$$

SMB is calculated for each year from 2000 to 2015 with help of above procedure.

3.3.3 Value Effect (High minus Low)

It is the difference between the returns of high book to market ratio (B/M) of the stocks and low book to market ratio (B/M) of the stocks. HML (High minus Low) represent the risk factor of return rate that involve with ratio book to market value (B/M) effect. From above mention sortation to calculate SMB, HML each month is calculated by taking the difference between average return rate of two portfolios that has B/M high (SH and BH) with average return rate of two portfolios has B/M low (SL and BL). SH is the small caps companies which have high book to market ratio (H) and SL are the companies which have small capitalization (S) and have low book to market ratio (L), BH are the companies which are big caps (B) but have high book to market ratio (H), BS are the big caps (B) companies which have low book to market ratio (L). HML is calculated with help of below written formula.

$$\begin{aligned} \text{HML} &= \text{High minus Low} = \text{Average Returns of High Book to Market ratio (B/M)} \text{ minus} \\ &\quad \text{Average return of companies have Low book to market ratio (B/M) ratio} \\ &= 1/2 (SH + BH) - 1/2 (SL + BL) \dots\dots\dots (3.2) \end{aligned}$$

3.3.4 Profitability (Robust minus weak)

Profitability is measured by annual revenues less cost of goods sold, interest expenses, general and admin expenses during the financial year and this all is divided by book equity at the end of the year, which is earning per share (EPS) (Fama 2014). Earnings per share is used proxy for the profitability. The portfolio of the stocks with robust profitability less the portfolio of the stocks with weak profitability give RMW (robust minus weak). To calculate the RWM the following procedure is followed. First all the companies are sorted according to their market capitalization (small to big) and then divide these companies into two groups by establishing cut point at 50% as it was done to calculate SMB.

The small companies (S) which are obtained from previous sortation are again sorted on the basis of earning per share (EPS) from robust to weak. This group of small companies sorted on earning per share is divided into three clusters. First cluster consists of thirty percent small companies (S) with robust profitability (R). Second cluster consist of middle forty present small caps (S) and third cluster consists of last small caps (S) with has weak profitability (W). From above technique we calculate SR and SW by taking weighted average of monthly returns of the companies. The big caps (B) are also sorted on the basis of profitability robust to low as in case of small caps (S). These big caps (B) sorted on the basis of profitability are divided into three clusters. First cluster comprises of thirty percent big caps (B) which have robust profitability (R) the last thirty percent big caps (B) which have weak profitability (W) and middle forty percent big caps (B) which have medium profitability. So from above BR and BW are calculated by taking the weighted average of monthly return of the companies, finally CMA is calculated according to below written formula.

RMW = Robust minus Weak = Average of high earning per share minus Average of Low earning per share

$$= 1/2 (SR + BR) - 1/2 (SW + BW) \dots\dots\dots (3.3)$$

RMW is calculated for each year from 2000 to 2015 with help of above procedure.

3.3.5 Investment (Conservative minus Aggressive)

The returns of the portfolios of the stocks of low investment less the return of the portfolios of the stocks with high investment gives conservative minus aggressive (CMA). For investment, growth in assets is used as proxy. Growth in assets is calculated by dividing the assets in current year by total assets in previous year then take the natural logarithm of obtained value (Fama 2014) according to below written formula.

$$Ait = \ln (Ait / Ait-1) \dots\dots\dots (3.4)$$

Ait: is growth in assets of the companies for year i. Ait: is the assets of the companies i for year t. Pit-1: is assets of the company i at year t-1. In order to calculate annual growth in assets of the companies.

CMA is calculated by following procedure. First the companies are sorted on the basis of their market capitalization and formed two groups. First group consists of fifty percent of small firms refers as small caps (S) and other second group comprises of remaining fifty percent big firms. The small firms (S) are again sorted on the basis of annual growth in assets from aggressive (A) to conservative (C). Then these small caps (S) sorted on the basis of growth in assets is divided into three groups. The first group consists of the thirty percent of the small companies (S) which have aggressive growth in assets, second group consists of last thirty small companies (S) which have conservative growth in assets (C). SC and SA are calculated by taking weighted average of monthly return of the companies.

The big companies (B) are also sorted on the basis of growth in assets from aggressive (A) to conservative (C). On the basis of annual growth in assets the sorted big companies (B) are divided into three groups, First group comprises of thirty percent of big companies (B) which have aggressive annual growth in assets (A) and second group comprises of last thirty percent of the big companies which have conservative (C) growth in assets. And forty percent companies which have medium growth in assets. From above procedure BA and BC are

calculated by taking the weighted average of monthly return of the companies. From below written formula CMA is calculated.

$$\begin{aligned} \text{CMA} &= \text{Conservative minus Aggressive} = \text{Average of High growth in assets minus average of Low growth in assets} \\ &= 1/2 (\text{SC} + \text{BC}) - 1/2 (\text{SA} + \text{BA}) \dots\dots\dots (3.5) \end{aligned}$$

CMA is calculated for each year from 2000 to 2015 with help of above procedure.

3.4 Research Model

The regression model will be used in this research. The equation of the model is given be

$$R_{it} - R_F = \alpha_i + \beta_p (R_M - R_F) + \beta_{SMB} (R_{SMB}) + \beta_{HML} (R_{HML}) + \beta_{RMW} (R_{RMW}) + \beta_{CMA} (R_{CMA}) + \epsilon_{it} \dots\dots\dots (3.6)$$

In this equation R_{it} is the return on security or portfolio i for period t , R_F is the risk-free return, R_{Mt} is market return, SMB_t is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks, HML_t is the difference between the returns on diversified portfolios of high and low B/M stocks, RMW_t is the difference between the returns on diversified portfolios of stocks with robust and weak profitability, and CMA_t is the difference between the returns on diversified portfolios of the stocks of low and high investment firms, which is called conservative and aggressive, and ϵ_{it} is a zero-mean residual.

3.5 Empirical Methodology Fama Macbeth Procedure

First major study in KSE-Pakistan for CAPM is by Ahmad and Zaman in 1999. They test the risk-return relationship and conclude that stock return follows cyclical trend. Ahmad and Qasim (2004) claim that positive shocks are more pronounced compared to negative ones for same market. Iqbal and Brooks (2007) report presence of non-linear risk-return relationship. Javid and Ahmad (2008) test CAPM in conditional settings and advocate use of conditional-CAPM compared to conventional CAPM. Recently, Iqbal *et.al.* (2010) compare single-factor CAPM with Fama-French multi-factor CAPM and conclude that the latter is more convincing for Pakistan market. However, all of them do not address the five factor CAPM model.

This study chooses Karachi Stock Exchange (KSE)-Pakistan as a sample. KSE is an important emerging market showing typical characteristics of high turnover and high price volatility. All the companies listed in KSE whose data is available are taken as a sample with an estimation window from 2000 to 2015. As the history of KSE-100 index is short only those companies are selected which are listed throughout this period following Javid and Ahmad (2008). To validate results, our empirical analysis encompasses monthly data as underlined by previous studies like Fama and MacBeth (1973) and Fama and French (1992).

This research carries out the test of the multifactor model on individual stock returns following Fama and MacBeth (1973). This approach involves two steps: risk estimation and testing. In a first pass, the systematic risk measure, beta, is estimated using time series regression of asset returns on market portfolio returns. In a second pass, assets' excess returns are regressed on the underlying assets' betas obtained from the first pass. The slope and intercept obtained from running these cross-sectional regressions are averaged out and tested for statistical significance.

Fama MacBeth (1973) procedure is most widely used and historically important method to test CAPM. Its widespread acceptance is primarily motivated to fact that FMac (1973) allow betas to vary with time (Campbell *et al.* (1997) and Elton *et al.* (2003)). FMac (1973) procedure also caters for measurement error by building portfolios in a peculiar way. Moreover, they use beta of previous time period as an instrumental variable to cater for selection bias. These reasons make FMac (1973) two-step approach an obvious choice to test CAPM. FMac (1973) use two-step approach by forming pre-ranking beta portfolios and testing for post-ranking beta portfolios. This study adopts FMac (1973) procedure and makes necessary changes to better serve the results of this study. Firstly, first pass of FMac (1973) procedure is performed which is based on the Black, Jensen and Scholes (1972) methodology as follows:

$$R_{it} - R_{Ft} = \alpha_i + \beta_i (R_{Mt} - R_{Ft}) + \epsilon_{it} \dots\dots\dots (3.7)$$

Where R_{it} is return of stock i at time t , R_{Ft} is return of treasury bills, a_i is y-intercept, β_i is beta of stock i and ϵ_{it} is the error term. It is supposed that mean of residuals of asset i at time t is zero;

$E(\epsilon_{it}) = 0$ and covariance between risk premium and residuals is also equal zero; $\text{cov}(R_{Mt} - R_{Ft}, \epsilon_{it}) = 0$.

The abovementioned procedure will be apply on below five Factor CAPM model

$$R_i - R_F = a_i + \beta_p (R_M - R_F) + \beta_{SMB} (R_{SMB}) + \beta_{HML} (R_{HML}) + \beta_{RMW} (R_{RMW}) + \beta_{CMA} (R_{CMA}) + \epsilon_{it} \dots \dots \dots (3.8)$$

Firstly, this study estimates betas of the respective stocks and then resorted again based on beta based Fama MacBeth (1973) procedure. All the portfolios are built and ranked from highest to lowest beta portfolios. This procedure is repeated again by firstly sorting stocks on beta into portfolios and then resorts these portfolios on beta basis portfolios ranked from highest to lowest beta portfolios. These two sets of portfolios each are used in first pass to yield beta of portfolios.

Subsequently, FMac (1973) perform second pass for each month via cross-sectional analysis of portfolio beta and portfolio return. And eventually, they test for intercept and portfolio beta parameter, non-linearity and idiosyncratic underlying framework for their famous two-pass regression approach. To study relationship between expected return and beta, FMac (1973) use following equation for this purpose. For cross-sectional second pass, this study use White estimator to make the t -stat robust. To study relationship between expected return and beta, FMac (1973) use following equation for this purpose

$$R_{Pt} = \alpha_0 + \alpha_1 R_{Mt} + \epsilon_{Pt} \dots \dots \dots (3.9)$$

Where R_{Pt} is portfolio returns, α_0 is intercept, α_1 depict risk-return relationship, α_1 is portfolio market beta and ϵ_{Pt} residuals for portfolio p at time t .

To test the five factors model the following equation will be used

$$R_{Pt} = \alpha_0 + \alpha_1 R_{Mt} + \beta_p (R_M - R_F) + \beta_{SMB} (R_{SMB}) + \beta_{HML} (R_{HML}) + \beta_{RMW} (R_{RMW}) + \beta_{CMA} (R_{CMA}) + \epsilon_{Pt} \dots \dots \dots (3.10)$$

Where R_{Pt} is portfolio returns, α_0 is intercept, α_1 depict risk-return relationship, α_1 is market beta, β_p , β_{SMB} , β_{HML} , β_{RMW} and β_{CMA} are the coefficient of small minus big, high minus low, robust minus weak profitability and conservative minus aggressive investments and ϵ_{Pt} residuals for portfolio p at time t .

3.5.1 First Stage - Time-series Regression

The first step of Fama Macbeth procedure is to run a time series regression of each portfolio excess return on the independent variables RM, SMB, HML, RMW and CMA for different year window. As the results are shown in appendix Estimate equation is

$$R_{it} - R_F = a_i + \beta_p (R_M - R_F) + \beta_{SMB} (R_{SMB}) + \beta_{HML} (R_{HML}) + \beta_{RMW} (R_{RMW}) + \beta_{CMA} (R_{CMA}) + \epsilon_{it} \dots \dots \dots (4.1)$$

3.5.2 Second Stage- Crosse Section Regression

The betas which are obtain form the first pass regression, they are treated as independent variable and cross sectional regression is run against the excess return of each portfolio with their respected betas. From this regression we obtain lambdas. The following equation is used for second pass regression.

$$R_{Pt} = \alpha_0 + \alpha_1 \beta_p + \alpha_2 \beta_{SMB} + \alpha_3 \beta_{HML} + \alpha_4 \beta_{RMW} + \alpha_5 \beta_{CMA} + \epsilon_{Pt} \dots \dots \dots (3.12)$$

4. Results of First Pass Regression for Year 2000 to 2014

The results of first pass regression for the year 2000 to 2014 are shown in the table 6.6. The coefficient of RM has value -0.013 with t statistics 2.98 and p value .006. These

values show that the results are significant even at 1% of level of significance. The results shows that the results are significant as the p value which is less than 10% and this value is consistent with the established criteria that p value should be less than 10% and t statistics should be greater than 2.

On this basis the null hypothesis can be rejected even at 1% level of significance. RM has impact on the expected returns. The second variable which small minus big (SMB) has the coefficient value -0.00152 with t statistics 0.92 and probability value 36%. On the basis of these statistics it can be concluded that the alternative hypothesis can be rejected as this is inconsistent with the set criteria that the p value should be less than 10% and the t statistics should be more than 2. SMB has no impact on the expected return of the portfolio even at 10% significant level. The third independent variable high minus low (HML) has coefficient -0.0044 and t statistics 1.32 and probability 0.19. So on the basis of these statistics null hypothesis will not be rejected even at 10% level of significance as this is inconsistent with the criteria that p value should be less than 10% and p value should be greater than 2. So the high minus low (HML) has no impact on expected returns of the portfolio.

For the RMW has the coefficient -0.0092 with t statistics 1.64 and p value 0.11 which shows that these results are insignificant and the null hypothesis cannot be rejected even at 1% of level of significance. The p values is 0.0005 which is consistent with the set criteria that the p value should be less than 10% and the t statistics should be greater than 2. So this shows that the null hypothesis cannot be rejected and RWM has no impact on the expected return. For the CMA have the coefficient -0.0098 with t statistics 2.20 and p value 0.03 which shows that these results are significant even at 5% of level of significance. The p values is 0.03 which also shows that the null hypothesis can be rejected as this is consistent with the established criteria that p value should be less than 10% and p value should be greater than 2 so CMA has impact on the expected return.

The intercept have the value 0.013 with t statistics 3.37 and p value 0.0000 which represents that this value of coefficient is significant even at 1% of level of significance. The p values is 0.000 which also shows that the null hypothesis can be rejected as this is consistent with the established criteria that p value should be less than 10% and p value should be greater than 2, which shows that intercept has significant results. The value of F statistics is 7.99 with p value .00000 which represents that model is good to fit even at the 1% level of significance as it is consistent with the established criteria that F statistics should be greater than 4 or the p value should be less than 10%.

According to the above mention criteria it is concluded that model is good to fit as the F value is 7.99 with probability value .0000% so the impact of independent variable RM, SMB, HML, RMW and CMA on the expected return of the portfolio can be measured with a model that is good to fit. The R square for first pass regression for the year 2000 to 2014 is 0.62, so this shows that 62% of the variation is because of the independent variable which include RM, SMB, HML, RMW and CMA. The remaining 38% variation is because of the factors which are not included in the model.

Table 1
First Pass Regression Results for Year 2000 to 2014

Variable	Coefficient	t-Statistic	Prob.
C	0.013977	3.378333	0.0025
RM	-0.013796	-2.985273	0.0064
HML	-0.004401	-1.323631	0.1981
RMW	-0.009293	-1.649269	0.1121
CMA	-0.009882	-2.202492	0.0375
R-squared	0.624868		
Adjusted R-squared	0.546715		
F-statistic	7.995487		
Prob(F-statistic)	0.000149		

So from above discussion the 62% variation in the expected returns of 30 portfolio is because of the independent variables including market risk (RM), small minus big (SMB), high minus low (HML), robust minus weak (RMW) and conservative minus aggressive (CMA). Adjusted R square show is the adjusted value of R square as per the sample size of the study. The value of adjusted R square is 0.54. It represents that when the value of R square are

adjusted as per sample size then the 71% variation in the dependent variable is because of the dependent variable. So 54% variation in the expected return of the portfolio is because of the independent variables which includes market risk (RM), small minus big (SMB), high minus low (HML), robust minus weak (RMW) and conservative minus aggressive (CMA).

4.1 Results of Second Pass Regression

30 portfolios are constructed as sample and five pools are created from year 2000 to 2014, these portfolios are sorted on basis of book to market ratio (B/M), size in terms of market capitalization, profitability in terms of earning price per share (EPS) and investment in terms of annual growth in assets. For finding in above table stated that null hypothesis "time series average for estimation of lambdas linked up with the five factors; market return, size in terms of market capitalization (SMB), Value in terms of Book to Market Ratio (HML), Profitability in terms of Earning per Share (RMW) and Investment in terms of annual growth in Assets (CMA) are equal to the risk premium (actual)" is not rejected.

The main assumption for the acceptance of null hypothesis is that value of Lambda's for Market Risk (RM) Small minus Big (SMB), High minus Low (HML) and Robust minus Weak (RMW) and Conservative minus Aggressive (CMA) has insignificant outcome at 0.1% level of significance stating the fact that outcomes of these factors are statistically different from zero or all the explanatory variables have fact on portfolios returns.

The table 4.1 for the year 2000 to 2001 shows value of coefficient (Lambdas) of RM, SMB, HML, RMW and CMA are -0.014, -0.003, 0.0009, 0.0007 and 0.0005 respectively and t statistics for coefficient of RM, SMB, HML, RMW and CMA are -.53 & -.70. 0.36, 0.17 and .068 respectively. As the coefficient of RM is -0.14 with t statistics -0.53, these results are in favor to not reject the null hypothesis. It refers that RM has significant impact on the excess return of the portfolio. The value of coefficient of SMB is -0.53 with the s statistics is -0.70 so this shows that the results are insignificant even at 1% level of significant, so the null hypothesis cannot be rejected. This refers that the small minus big (SMB) has significant impact on the returns of the portfolio, so any change in the SMB will significantly cause variation in the returns of the portfolios.

Table 2
Results of Fama Macbeth Regression

	□	□□RM	□□SMB	□□HML	□□RMW	□□CMA	R Seq	Adj. R seq
2000 to 2001	-0.001 (-.047)	-0.014 (-0.53)	-0.003 (-0.70)	0.0009 (0.36)	0.0007 (0.17)	0.0005 (.068)	0.599	0.516
2002 to 2004	0.048 (3.94)	-0.012 (-0.69)	-0.013** (-2.43)	-0.002 (-0.78)	0.015 (3.04)	-0.013** (-2.67)	0.890	0.867
2005 to 2007	0.034 (3.89)	-0.025*** (-1.56)	-0.002 (-0.59)	-0.012*** (-1.45)	-0.008 (-1.16)	0.0036 (0.55)	0.763	0.713
2008 to 2010	-0.014 (-1.052)	-0.015 (-0.61)	-0.003 (-0.58)	0.0008 (0.140)	-0.004 (-0.74)	-0.004 (-1.29)	0.728	0.672
2011 to 2014	0.000 (0.005)	0.007 (0.58)	0.005 (0.84)	-0.002 (-0.76)	-0.003 (-0.70)	0.0058 (0.93)	0.737	0.682
2000 to 2014	0.014 (2.199)	-0.014*** (-1.41)	-0.002 (-0.34)	-0.004 (-0.56)	-0.009 (-0.79)	-0.010** (-1.82)	0.625	0.547

Table 4.1 Results of Fama Macbeth Regression (Outcomes for Cross sectional analysis are presented for intercept and portfolio risk return relationship in 05 pools are presented. Results for full samples are given in 2000 to 2014. Results for t-statistics are given in brackets. *, ** and *** states the significance at 01, 05 and 10% respectively)

The independent variable high minus low (HML) has coefficient -0.17 and t statistics 0.36, so again on basis of this t statistic the null hypothesis that HML has impact on returns of the portfolio cannot be rejected. The high minus low (HML) has the ability to have influence on the returns of the portfolio. The robust minus weak (RMW) has coefficient value 0.007 with t statistics 0.17, this value shows that the null hypothesis cannot be rejected even at 10% level of significance. So the results are highly insignificant and the robust minus weak (RMW) significantly explain the variation in the excess returns of the portfolios. The last independent variable in this year window which is conservative minus aggressive (CMA) has the coefficient value 0.0005 and the t value is 0.68. So again at this value of t statistics shows that results are insignificant and null hypothesis is accepted, it means that conservative minus aggressive has significant impact on the excess returns of the portfolio even at 1% level of significance.

So from above discussion all the independent variables market risk (RM), small minus big (SMB), high minus low (HML), robust minus weak (RMW) and conservative minus aggressive (CMA) have ability to impact the portfolio returns. The intercept has value -.001 with t statistics -.047 which is insignificant. The value of adjusted R-Square is 0.599, which is adjusted value of R Square as per the sample size of the study. Adding more entities of observation in the present study will definitely provide the better value of Adjusted R-Square. For the year 2002 to 2004 the coefficient of RM has t statistics -.69 which refers that null hypothesis, which states that independent variables have the impact on the returns of the portfolio returns, cannot be rejected even at 10% level of significance.

So market risk (RM) has impact on excess returns of the portfolio. The coefficient high minus low (HML) has t statistics -0.78, which refers that null hypothesis, which states that independent variables have the impact on the returns of the portfolio returns, cannot be rejected even at 10% level of significance. So high minus low (HML) has impact on excess returns of the portfolio. For the coefficient of small minus big (SMB) the t statistics is -2.43 which means that at 5% of significant level null hypothesis can be rejected but at 1% significant level the null hypothesis cannot be rejected, which refers that small minus big (SMB) has significant impact on the excess return of portfolio at 1% significance level.

Same is the case with coefficient of conservative minus aggressive (CMA) which has value -0.013 and t statistics -2.67. The mean value of lambdas is significant from zero at 5% level of significance, null hypothesis will be rejected at this level of significance, so at this level the conservative minus aggressive has not any impact on the returns of the portfolio. But the null hypothesis cannot be rejected at 1% significant level, so CMA has impact on the excess return of the portfolio at 1% level of significance. From above discussion the market risk (RM), high minus low (HML) significantly have impact on the portfolio returns even at 10% level of significance but the independent variable small minus big and conservative minus aggressive are significant at 5% level of significance but at 1% level of significance the null hypothesis cannot be rejected so at this level of significance the small minus big (SMB) and conservative minus aggressive (CMA) significantly affect the portfolios returns.

So all the explanatory variables significantly explain the portfolio returns. The intercept value is .048 which has t value 3.94, this show intercept is insignificant. In the second pool the collective effect of all the predictors for the portfolio returns in terms of coefficient of multiple determination is 0.890 which explains major variation of response data around the mean value. The value of adjusted R Square after the consideration of all the unit of observation is 86%.

For the year 2005 to 2007 coefficients of RM, SMB, HML, RMW and CMA are -0.025, -0.002, -0.012, -0.008 and 0.0036 respectively and have following t statistics -1.55, -.59, -1.42, 1.16, 0.55 respectively. As RM which have coefficient value -0.025 t statistics are -1.55 which refers that we can reject null hypothesis at 10% level of significant so at significance level of 10% market risk (RM) has not any ability to cause the dependent variable, but the null hypothesis cannot be rejected at 1% and 5% level of significance, so it implies that at this level of significance the independent variable market risk (RM) has impact on the portfolio returns. For HML the t statistics is -1.42 which indicates that null hypothesis can be rejected at 10% level of significant, at this level the high minus low (HML) has not any impact on the portfolio returns. But the null hypothesis cannot be rejected at 1% and 5% level of significance. It implies that at 1% and 5% level of significance the high minus low (HML) has

the ability to influence the portfolio returns. For the small minus big (SMB) coefficient value is -0.002 and associated t value is -0.59.

The null hypothesis at this value cannot be rejected it refers that small minus big (SMB) has impact on the dependent variable portfolio returns even at 10% level of significance. The independent variable robust minus weak (RMW) has the coefficient value -0.008 and t value is -1.16, at this t value the null hypothesis cannot be rejected even at 10% level of significance, so robust minus weak has significant impact on the portfolio returns even at 10% level of significance. The last independent variable in this year window is conservative minus aggressive (CMA) which has coefficient value 0.0036 and associated t value is 0.55 so the null hypothesis cannot be rejected and this independent variable has significant impact of the portfolio returns of portfolio even at 10% level of significance.

So from above discussion the independent variables SMB, RMW and CMA have impact on the dependent variable portfolio return even at 10% level of significance. But market risk (RM) and high minus low (HML) have not any impact of on the portfolio return at 10% level of significance, but these variables influence the portfolio returns at 5% and 1% level of significance. The third pool the collective effect of all the predictors for the portfolio returns in terms of coefficient of multiple determination is 0.763 which explains major variation of response data around the mean value. The value of adjusted R Square after the consideration of all the unit of observation is 71 %.

For the pool from year 2008 to 2011 the t statistics are -0.61, -0.58, 0.14, -0.74 and -1.29 for coefficient of RM, SMB, HML, RMW and CMA respectively. According to the results the null hypothesis for RM, SMB, HML, RWW and CMA cannot be rejected. So all the independent variables have significant impact on the portfolio results. The intercept value is -.014 with is insignificant t value. The intercept value is -.014 which has t value -1.052 which is insignificant. In the fourth pool the collective effect of all the predictors for the portfolio returns in terms of coefficient of multiple determination is .73 which explains major variation of response data around the mean value. The value of adjusted R Square after the consideration of all the unit of observation is 67 %.

For the year 2011 to 2014 the t statistics are 0.58, 0.84, -0.76, -0.70 and 0.93 for coefficient of RM, SMB, HML, RMW and CMA respectively. All these results shows that the null hypothesis cannot be rejected and all the value of lambdas are not significantly different from zero and they have impact on the portfolio return. The intercept value .0001 with t value .005 which shows that intercept is insignificant. The Collective effect of all the predictors for the portfolio returns in terms of coefficient of multiple determination is .73 which explains major variation of response data around the mean value. The value of adjusted R Square after the consideration of all the unit of observation is 68%.

If second pass regression is run for whole date from 2000 to 2015, the t statistics for coefficient of RM, SMB, HML and RMW are -1.41, -0.34, -0.56, -0.79 and -1.80 respectively. From these results we cannot reject the null hypothesis for SMB, RMB and RMW which refers that these independent variables have significant impact on the returns of the portfolio. For RM statistics is -1.41 so on this t value the null hypothesis at 10% significance level can be rejected but at 1% and 5% level of significance level the null hypothesis cannot be rejected, so lambdas belongs to RM is not significantly from zero.

The t For the coefficient of CMA t statistics is -1.82 so on significant level of 5% we can reject the null hypothesis but at significant level of 1% we cannot reject the null hypothesis so at this level of significant the CMA has impact on the return of the portfolios. So all the explanatory variables have significant impact on the portfolios return on 1% level of significance. The value of R-Square is 0.62 explains the total variation in portfolio returns as per the selected 05 factors. The adjusted value of R-square is 54% as per the sample size of the study.

From the above discussion it is concluded that all the independent variable including market risk, size effect, value effect, profitability and investment have the influence on the expected return of the portfolios. The above finding are consistent with the results which are

concluded by (Fama & French, 1992), (Fama & French, 2006), (Fama & French, 2008) (Aharoni et al., 2013) (Aharoni et al., 2013), (Fama & French, 2015). As all the variables, market risk, size effect, value effect, profitability and investment have impact on the return of the securities.

5. Conclusion

The study is conducted to test Five Factor CAPM on Karachi Stock Exchange which include impact of market risk (RM), size effect (SMB) in terms of market capitalization, value effect (HML) in terms of book to market ratio, profitability (RMW) in terms of earning per share and investment (CMA) in terms of annual growth in assets. Data for RM, SMB, HML, RMW and CMA is taken from Karachi Stock Exchange from the year 2000 to 2015. Four windows having different year from year 2000 to 2015 are constructed to conduct the research by using Fama and Macbeth (1973) Methodology. Overall results shows that all the independent variables RM, SMB, HML, RMW and CMA have significant impact on the excess return of portfolios. By taking into account the various factors for portfolio returns for the first windows all the indicators have insignificant outcomes accepting the null hypothesis; factors have impact on stock returns (Fama & French, 2015)

Due to the volatility in the stock prices of small companies the stated facts are in consistent with the argument that small firms outperform big firms. It means big firms provide lower stock return comparatively to the small companies. The value stocks which have high book to market ratio yields more returns with respect to growth stocks which have high book to market ratio (Fama & French, 1992). Profitability also have significant impact on the returns of portfolios, the companies who earn more profitability (Robust) provide more return as compare to the companies who have poor or less profitability (Weak). The investment made by the companies during the year also have significant impact on returns. The companies having high annual assets growth rate by reinvesting their retained earnings in new ventures or projects, they generate less returns as compare to companies having low annual asset growth rate. So from above discussion it is established that Five Factor CAPM model hold in Karachi Stock Exchange (KSE).

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

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