A Test of the Five-Factor Model in Pakistan

Ranjeeta Sadhwani
Lecturer-Finance and PhD Scholar
Sukkur IBA University, Sukkur,
Pakistan

Dr. Mujeeb U Rehman Bhayo
Assistant Professor-Finance
Sukkur IBA University, Sukkur,
Pakistan

Dr. Niaz Ahmed Bhutto
Professor-Economics
Sukkur IBA University, Sukkur, Pakistan

Abstract

This paper aims to explore variations in expected return captured bysize, value, investment and profitability in Pakistani stock market and to analyze average returns patterns captured by three-factor and five-factor models of asset pricing of Fama and French (1993, 2016). Using the returns data and accounting measures from Data stream for 490 listed firms for the period of July-2000 to December-2015, we find no any return premium in Pakistan's stock market. The returns on the factors of size (SMB), market, value (HML), operating profitability (OP), and investment (CMA) are approximately zero. Moreover, GRS test for Pakistan's stock market demonstrate the supremacy of Five-factor model in explaining average returns pattern as compare to three-factor model.

Keywords:

Fama and French three-factor model, Fama and French five-factor model, Asset pricing test, Book to market value, profitability, investment.

Introduction

Investors invest in efficient securities depending upon the information they have. Markowitz (1952) argue that the selection of securities can be allocated in two stages, observation and experience. The first stage, observation, starts with available information and leads to the formation of beliefs on the future performance of stock whereas, the second stage of experience begins with beliefs on the future performance of securities and ends with the selection of stock portfolio. Markowitz (1952) analyzes thesecond stage and demonstrate that investors can make a portfolio to maximize expected return while having some undiversified level of risk, emphasizing that the risk is intrinsic for having a return on the portfolio.

Many factors affect the expected return of a security, which includescompany-specific factors and market factors. Security's exposure to the company-specific factors can be diversified by including it into a portfolio. For the Market risk, Sharpe (1964) and Black (1972), among others, propose the Capital Asset Pricing Model (CAPM). This model has been utilized for many years to describe the

correlation between risk and expected returns of securities. It uses beta as a measure of market risk in a linear relationship between risk and return.

Despite its initial success in capturing variation in cross-sectional stock returns (see Black, 1972; Fama and Macbeth, 1973), different researchers identify excess returns on anomaly variables that CAPM fails to explain. One of them, the price-earnings (P/E) ratio is identified by Basu (1977). He shows that the High P/E portfolios have a lowerrisk-adjusted rate of return than the portfolios having low P/E. Banz (1981) argue that Size, measured as total market capitalization of stock, can explain the variability in stock returns in presence of beta. They find a negative relationship between the size of a firm and its stock returns. Rosenberg et.al (1985) shows a positive relation between the book to market value (B/M) and expected stock returns for the US market, Chan et al. (1991) find similar results in Japanese stock market. Fama and French (1992) synthesize the findings of all of the above-mentioned anomalies by examining them in a single study. They show that it is not only beta that explain the variations in stock's returns and find that the two other variables size and B/M also explain this cross-section variation in average stock returns of the firm.

Afterwards, Fama and French (1993) proposed three-factor asset pricing model and use two new factors; Size (small minus big (SMB)) and Value (high minus low (HML)) along with market factor. They measure SMB factor by subtracting the returns of small stock portfolios from the returns of big stocks' portfolios. Similarly, the HML factor is measured by taking the difference in returns of high book to market portfolio and low book to market portfolio. Fama and French (1993, 1996) demonstrate that three-factor model successfully captures variations in expected stock returns sorted on both book to market and size. Moreover, Fama and French (2012) examine this model for an international sample of 23 countries and find similar results.

There are very few empirical studies as; (Ali Raza et.al, 2011; and Qamar et.al, 2013) that test the validity of CAPM in Karachi Stock exchange of Pakistan. (Attiya and Eatzaz, 2008; Hanif and Bhatti, 2010) find that CAPM is not applicable to the stock market of Pakistan and the findings of Ibrahim et.al (2012) also shows that CAPM is not an effective model to measure risk and expected a return in the stock market of Pakistan. Iqbal and Brooks (2007) show that beta and Fama-French factors explain the variation in Pakistan's equity market and daily data shows the more reliable relationship between risk and return. Abbas et.al (2014) test the validity of three-factor model in in Pakistan's stock market, and find that this model explains more variations in return as compare to CAPM (Muneer et al., 2017).

Fama and French (2006) showthat after controlling the estimated investment and profitability, firms having higher book to market also have higher expected returns. Whereas expected returns are higher for high expected profitability firms after controlling for the estimated book to market value and investment. Higher expected investment implies lower expected returns while controlling B/M and expected profitability. Aharoni et.al (2013) show that returns are positively associated with both the book to market and profitability, however, investment and returns are negatively associated with each other. Haugen and Baker (1996) also find similar results between investment and returns.

Later on, Fama and French (2015) introduced two other factors of investment and profitability and find that the new five-factor model captures the pattern in the average stock returns better than three-factor model. They utilize the Investment and profitability factor to explain variability in expected return by analyzing the dividend discount model. Fama and French (2015b) test this five-factor model in international markets, by examining this model in four regions of Asia Pacific, North America, Europe and Japan. They find that for the Asia Pacific, Europe, and North America, average returns for small stock increase with book to market and profitability but average returns and investment show negative relation with growth stock (low book to market value). The similar relationship is shown for larger stocks but is not much strong.

Racicot and Rentz (2016) analyze the five-factor model effectively explain the returns if we use OLS (Ordinary Least Square) econometric estimator instead of GMM (Generalized Method of Moment) technique. Sutrisno and Ekaputra (2016) validated the five-factor model in Indonesian market. They show that the model explains variation in excess stock returns of portfolio better than the three-factor model, although the effect of excess returns is weak for investment and profitability factors.

In this regard, we motivate this paper to check the validity of five-factor model in Pakistan and to find out that whether five factors can explain the variations in return better than Fama and French three-factor model and CAPM or not. This study may be helpful for investors in an investment decision by efficiently measuring the expected returns on securities. This could be done by using the five-factor model as it incorporates the profitability and investment along with size and value of the firm. The model may be useful in making investment decisions, measuring the performance of the portfolio, and in measuring the risk and

returns in Pakistan's context. The study also add value toasset pricing literature through explaining the value, size, profitability, and investment factors in average returns on Pakistan's market (Khan et al., 2013).

The rest of the paper is organized as follows. Section 2 defines the data and methodology. Section 3 contains portfolio construction. Section 4 shows summary statistics of portfolios return and section 5 concludes the paper.

Sample data and Methodology

To test the hypothesis, this study uses Multivariate regression model.

Hypothess: Intercept α_p is equal to zero for all securities

$H_1: \alpha \neq 0$

The factor models for PSX all shares will be applicable if the intercept is not significant ($\alpha = 0$) and all coefficients of the slope are statistically significant if these are different from zero.

The Asset Pricing Models

Capital Asset Pricing Model (CAPM)

This is one of the pioneering asset pricing model suggested by Sharpe (1964), Lintner (1965) and Black (1972) for measuring expected return and systematic risk. CAPM examines the association between market risk and returns on security.

The equation for CAPM is:

$$r_e = r_f + \beta_p(r_m - r_f)$$

Where, r_e is the expected stock returns, r_f is the risk free rate, β_p is measure of market risk (Beta), $(r_m - r_f)$ is the equity market premium.

The Three-factor model (FF3)

After the CAPM model, Fama and French (1992) suggest that only beta cannot determine the expected return, other variables can be included to increase the explanatory power of the CAPM. They include Size and book to market equity (B/M) as two new factors and proposed three-factor model in their work in 1993:

$$R_{pt} - R_{ft} = \alpha_p + b_p Mkt_t + s_p SMB_t + h_p HML_t + e_{pt}$$

Where $\mathbf{R}_{pt}$ is portfolios' return, $\mathbf{R}_{ft}$is the risk free rate, $Mkt_t$is excess return on market portfolio, SMB_t is a return on small stocks minus big stocks portfolio, $HML_t$is high book to market equity stocks minus low book to market equity stocks (value portfolio and growth portfolio).

The Five-Factor Model

After the evidence from Titman Wei and Xie (2004), Novy Mark (2013), and others, that Fama and French (1993) three-factor model is not sufficient to explain variations in expected returns, Fama and French (2016) add two more factors in three factors model namely; profitability and investment to come up with five-factor model.

$$R_{pt} - R_{ft} = \alpha_p + b_p Mkt_t + s_p SMB_t + h_p HML_t + r_p RMW_t + c_p CMA_t + e_{pt}$$

Where, R_{pt} is portfolio's return, $R_{ft}$is the risk free rate, $Mkt_t$is return on a value weight market portfolio minus risk free rate (Rmt-Rft), SMB_t return on small stocks minus return on big stocks portfolio, HML_t is high book to market equity stocks minus low book to market equity stocks (value portfolio and growth portfolio), RMW_t is return on robust profitability stocks minus weak profitability stocks, CMA_t is stocks' return of low investment company minus return on high investment company stocks (conservative and aggressive), e_{pt} is error term And b_p, s_p, h_p, r_p, c_i are slope coefficient.

Data and Variables

To test the hypothesis, stocks' returns and accounting data for companies listed on Pakistan Stock Exchange (PSX) is collected from Datastream for 15 years from July 2000 to November 2015 due to unavailability of complete data before July 2000.

In this study, the dependent variable is excess market portfolio return whereas the explanatory variables are market risk, size, value, profitability, and investment of the firm. The Market risk premium is the excess market return. Size (SMB) is the difference between returns of the small stock portfolios and big stock portfolios. Banz (1981) find that size factor explain the variation in returns and shows that expected stock returns and size are negatively associated with each other. We use Market capitalization as a proxy for size.

The factor HML is the difference in returns on portfolios having a high book to market (value stock) and low book to market (growth stock). Rosenberg, Reid et al. (1985) show a positive association between expected returns and book to market, whereas Chan, Hamao et al. (1991) find that the variation in Japanese stocks average expected a return on Japanese stocks is explained by B/M. The factor, Operating profitability (RMW) is the difference in returns between the stocks with robust profitability and stocks having weak profitability. Fama and French (2016) calculated this factor as the ratio of operating profitability to book equity. Novy-Marx (2013) finds that despite having high valuation ratios,

return on the profitable firm is higher than unprofitable firms. Operating profitability is used as a measure of profitability of the firm. The factor investment (CMA), is the difference between stock's return with conservative and aggressive investment. It is measured as the annual growth rate of assets. Aharoni et al. (2013), Fama and French (2006) examined the negative relationship between average return and investment. Asset growth rate is used as a proxy to measure investment of firm.

Portfolio Construction

Right Hand Side (RHS) Factors

The portfolios created from 3x3 sorts on SMB, Book to Market, OP or Inv are the RHS explanatory returns. We categorize stocks on the basis of size each year in June. The breakpoints for B/M, OP and Inv are 30th and 70th percentiles. All accounting variables are for fiscal year $t-_1$ and size is for the end of the calendar year $t-_1$. The intersection of the independent 3x3 sorts results in nine portfolios, namely SG, SN, SV, MG, MN, MV BG, BN and BV, where S, M, and B indicates the small, medium or big stocks and G, N and V indicates the growth, neutral and value stocks respectively.

From the month of July t to June t+1, we calculate the monthlyvalue-weighted return for each portfolio. Size is the average return on three small minus three big stock portfolio which is created from 3x3 Size - B/M sorts. Value and growth stocks are created for small and big stocks, HMLs = SV – SG, andHML_B = BV – BG, and HML is the average of HMLs and HML_B. Moreover, other two factors; profitability and investment are created similar to that of HML but OP (operating profitability) is sorted from returns on robust to weak profitable stocks and investment (growth rate of total assets) sorted from return on conservative to aggressive stocks. While constructing CMA and RMW, two other size factors (SMBInv and SMBOP) are produced and sverage of $SMB_{B/M}$, SMB_{op} and SMB_{inv} is the value *SMB*.

Left Hand Side (LHS) factors

For asset price regression, 9 portfolios are created for each Size-OP, Size-Inv and Size-B/M at the end of June each year. The breakpoints for size are 7^{th} and 13^{th} percentiles of market capitalization and the breakpoints for OP, Inv and B/M, are 30^{th} and 70^{th} percentiles in 3x3 sort. Moreover, the nine value weighted Size-OP, Size-Inv, and Size-B/M portfolios are constructed by the intersection of the independent 3x3 sort on Book to market and size, OP and size, and Inv and size.

Summary Statistics

4.1 Summary statistics for return factors

In Table 1, we reports the summary statistics (mean, SD and t-statistics) for the mean of all the factor returns. The equity premium (average market return) is very low (-0.08% per month, t = -1.38) and also have very high standard deviation which shows the volatility in returns is high. Size premium (average SMB return) is 0.16% per month and profitability premium (average RMW returns) is 0.17% per month. Investment premium (average CMA returns) are having highest mean that is 0.37% whereas value premium (average HML returns) is 0.05% which is lowest among all factors. But none of the factors is statistically significant and it shows that premium does not exist in Pakistan.

Table 1: Summary statistics for monthly returns from July 2000 to November 2015.

	MKT	SMB	HML	RMW	CMA
Mean	-0.80	0.16	0.05	0.17	0.37
Stdev	7.91	4.32	3.92	3.70	3.51
t-stats	-1.38	0.51	0.17	0.63	1.44

Factors are constructed for Pakistan. To construct HML, portfolios are constructed in the month of June of every year t by sorting of stocks in three groups of market capitalization and three groups of book to market equity. The breakpoints are the 7^{th} and 13^{th} percentile of the total market capitalization and for book to market equity breakpoints are 30^{th} and 70^{th} percentiles of year t-1. The independent 3x3 sorts on Size and book to market equity produce nine value weight portfolios, SG, SN, SV, MG, MN, MV BG, BN and BV where S, M and B indicates the small, medium or big stocks and G, N and V indicates the growth, neutral and value stocks. $SMB_{B/M}$ is the average return on three small stocks portfolios minus the average return on three big stocks portfolios. Value and growth stocks are constructed for small and big stocks, HMLs = SV – SG and HML_B = BV – BG and HML is the average of HMLs and HML_B. The other two factors; profitability and investment are constructed in the same way as of HML but OP (operating profitability to B/M) sorted from returns on robust to weak stocks and investment sorted from return on conservative to aggressive stocks. While constructing RMW and CMA, two additional size factors (SMB_{OP} and SMB_{Inv})are produced and the overall size factor (SMB) is calculated as average of $SMB_{B/M}$, SMB_{OP} and SMB_{inv}. Mkt is the return on market portfolio minus Treasury bill rate. Mean and Std Dev are the mean and standard deviation of the returns and t-Mean is the ratio of mean to its standard error.

Summary statistics for test portfolios

Five-factor model is designed to describe variations in average returns of these portfolios. The results in Table 2 shows the excess returns for LHS portfolios used in asset pricing test and these portfolios shows that how average returns of factors (value, profitability, and investment) vary with size.

In Panel A of Table 2, Size-B/M sorts show that value effect does not exist in small stocks as return are decreasing from low B/M to high B/M but it exists in big stocks which are 0.113% per month. In Size-OP sorts, average return decreases with OP in big stocks quantile and are inconsistent for all other quantile based on size suggesting no clear relationship between Size and OP.In Size-Inv sorts, average return increases with Inv for small stocks and the premium is 0.2875 whereas the relation is inconsistent for other quintiles.

In Panel B of Table 2, there are average excess return 2x2x2 sort portfolios and the effects are more visible in three sorts portfolio as compare to two sorts portfolio. In 2x2x2 the Book to market (B/M), OP and size, the average return for big stock increases with B/M in every OP quintile whereas, for small stocks, average returns increase with B/M in low OP quintile. In Size, B/M and Inv sort, the average return for big stocks increase with B/M in every Inv quintile whereas, for small stocks, average returns increase with B/M in low Inv quintile only. We find a positive association between Inv and book to market; investment premium is greater in B/M (value) stocks. In Inv, OP sand size sorts, there is a consistent relation between average stocks of big stocks. Average returns for big stocks increase with the OP in low Inv and B/M quintile.

Table 2: Average monthly excess returns on portfolios from 3x3 and 2x2x2 sorts from July 2000 to November 2015.

Panel A: *Size – B/M, Size – OP and Size – Inv* portfolios

	Low	2	High	Low	2	High
Size-BM		**Mean**			**SD (Mean)**	
Small	1.432	1.125	0.873	7.908	7.848	6.859
2	1.055	1.203	0.781	6.356	7.971	8.237
Big	**0.672**	**0.599**	**1.326**	8.451	9.404	10.544
Size-OP	Low	2	High	Low	2	High
Small	0.978	1.142	0.935	7.709	7.673	6.967
2	1.014	1.220	1.002	8.605	8.200	7.189
Big	1.169	1.017	0.360	9.703	8.882	9.063
Size-Inv	Low	2	High	Low	2	High
Small	**1.147**	**1.185**	**0.860**	8.887	6.994	6.808
2	0.796	1.361	1.029	9.469	7.460	7.097
Big	0.302	0.691	0.957	9.089	8.904	8.313

Panel B: Portfolios formed on *Size, B/M and OP* ; *Size, B/M and Inv*; *Size, OP and Inv*

			Mean				**SD (Mean)**	
BM	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
OP	**Small**		**Big**		**Small**		**Big**	
Low	0.471	1.485	0.491	0.710	7.877	8.907	8.205	9.163
High	1.437	1.266	0.581	1.586	6.936	8.709	8.443	9.817
Inv								
Low	-0.558	0.456	-0.538	-0.319	9.932	10.599	10.074	10.809
High	0.407	0.237	-0.448	0.557	9.018	10.750	10.532	11.523
Inv								
OP								
Low	-1.588	-0.573	-1.567	-1.348	12.726	13.117	12.742	13.282
High	-0.622	-0.792	-1.478	-0.473	11.885	13.490	13.314	13.995

Excess monthly returns for portfolio of two 3x3 sorts is constructed at the end of June of each year. The breakpoints for Size are 7th and 13th percentiles of total market capitalization. The intersections of Size and B/M sorts produce 9 *Size-B/M* value weight portfolios. In the same way *Size-OP* and *Size-Inv* portfolios are produced as *Size-B/M* except that *OP* (operating profitability) or *Inv* (investment) is included in place of B/M. Panel B shows average excess returns for 2x2x2 sorts of the portfolios. Stocks are allocated on the basis of two size groups (Small and Big) using the 7th and 13th percentiles of total market capitalization as breakpoints. Small and Big stocks are then individually allocated to two *OP* quartiles and two *Inv* quartiles. The intersection of three sorts produce 8 *Size, B/M and OP*; *Size, B/M and Inv*; *Size, OP and Inv* portfolios.

Asset pricing test

To explain expected returns by the asset pricing model, the intercept should be zero. We use GRS statistic (Gibbons, Ross and Shanken, 1989) to test the hypothesis and the null hypothesis is that intercept for all test assets is zero. Three-factor model, which include *Mkt, SMB, HML as return factors* and five-factor model, which include *MKT, SMB, HML, RMW,* and *CMA* as a return factors, are examined through GRS statistics. This test will also be helpful in analyzing the relative performance of two mentioned models (FF3 and FF5). Model is evaluated by including average absolute intercept, A$|\alpha_i|$ and the ratios that measures the dispersion of intercept produced by model and the measures are: the ratio of average absolute value of intercepts to average absolute value of r_i ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$) and the ratio of average squared intercept to average squared value of r_i, ($\frac{A_{\alpha_i 2}}{A_{r_i 2}}$). If ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$) and($\frac{A_{\alpha_i 2}}{A_{r_i 2}}$)have low values then it shows thatintercept dispersion is lower as compare to to the dispersion of factors average returns and it will be good for model. And for $\frac{As2(\alpha i)}{A_{\alpha_i 2}}$, high values are good because it shows that dispersion of intercept estimates is due to sampling error.

In Panel A of Table 3, for *Size-B/M* portfolios, ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$) and($\frac{A_{\alpha_i 2}}{A_{r_i 2}}$)are low for three factor model as compare to five factor model which shows the amount of dispersion that cannot be explained by model. ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$) for FF3 is about 8.1% and for FF5 it is 8.7% and ($\frac{A_{\alpha_i 2}}{A_{r_i 2}}$)is 2.9% for FF3 and 3.2% for FF5. $\frac{As2(\alpha i)}{A_{\alpha_i 2}}$is 0.664 for FF3 model and 0.620 for FF5 model and it shows that most of the unexplained dispersion is because of sampling error. For *Size-OP* and *Size-Inv,* ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$), $\left(\frac{A_{\alpha_i 2}}{A_{r_i 2}}\right)$and $\frac{As2(\alpha i)}{A_{\alpha_i 2}}$are high for three factor model as compare to five factor model. $\frac{As2(\alpha i)}{A_{\alpha_i 2}}$in all sort portfolios except *Size-B/M* is near to 1 which shows that most of the unexplained dispersion is because of sampling error.

GRS statistics value in 3x3 portfolios is near to 1 and *p-value* is not significant, which shows that we do not reject null hypothesis: intercept for all test assets in the model is zero. This shows that models can be used to explain variation in returns though the difference is not significant in both models ((FF3 and FF5). The result can also be confirmed byAdjusted R^2 which tells the variation explained by explanatory variables after adjustment of a number of predictors. While comparing both models we can analyze that adjusted R^2 is higher for the five-factor model as compare to three-factor model but the difference is not significant.

In Panel B of Table 3, ($\frac{A_{|\alpha_i|}}{A_{|r_i|}}$) and($\frac{A_{\alpha_i 2}}{A_{r_i 2}}$)for *Size-Inv-BM,Size-OP-BM,Size-OP-Inv* are low for three factor model as compare to five factor model which shows the unexplained amount of dispersion by the model. The value of $\frac{As2(\alpha i)}{A_{\alpha_i 2}}$is very low, ranges between0.044 to 0.065, shows that only very little amount of dispersion left unexplained because of sampling error. The variations in average returns cannot be explained significantly when three sort portfolios are formed. Significant value of *p*(GRS) shows that we are fail to reject null hypothesis (intercept for all test assets in model is zero) and we can conclude that the three sorts portfolios are explaining less variations in context of Pakistan.

Table 3: Summary asset pricing test for portfolios form 3x3 and 2x2x2 sorts for the month of July 2000 to November 2015 Panel A: 3x3 portfolios

Model Factors	GRS	p(GRS)	A$\|\alpha_i\|$	$\frac{A_{\|\alpha_i\|}}{A_{\|r_i\|}}$	$\frac{A_{\alpha_i 2}}{A_{r_i 2}}$	$\frac{As2(\alpha i)}{A_{\alpha_i 2}}$	A(R^2)
Size –B/M							
3F	1.125	0.348	0.147	0.081	0.029	0.664	0.834
5F	1.282	0.250	0.157	0.087	0.032	0.620	0.838

Size – OP							
3F	1.121	0.351	0.044	0.026	0.024	0.862	0.831
5F	1.041	0.409	0.111	0.065	0.022	0.793	0.862
Size – Inv							
3F	0.679	0.727	0.107	0.060	0.022	0.960	0.820
5F	0.851	0.571	0.097	0.055	0.015	0.890	0.853

Panel B: 2x2x2 portfolios

	GRS	p(GRS)	$AI\alpha_iI$	$\frac{A_{I\alpha_iI}}{A_{IriI}}$	$\frac{A_{\alpha_i2}}{A_{ri2}}$	$\frac{As2(\alpha i)}{A_{\alpha_i2}}$	$A(R^2)$
Size-Inv-BM							
3F	3.716	0.000	1.449	0.499	0.254	0.064	0.604
5F	4.297	0.000	1.530	0.527	0.283	0.054	0.636
Size-OP-BM							
3F	5.824	0.000	2.415	0.949	0.223	0.048	0.697
5F	5.736	0.000	2.524	0.993	0.242	0.044	0.702
Size-Op-Inv							
3F	6.113	0.000	1.408	0.495	0.255	0.065	0.595
5F	5.639	0.000	1.503	0.528	0.285	0.052	0.645

The table shows summary tests of asset pricing models for 3x3 and 2x2x2 sort portfolios. The results are shown for the three factor model of Fama and French (1993) in which the explanatory return are Mkt, SMB and HML and the five factor model in which the explanatory return are *Mkt, SMB, HML, RMW* and *CMA*. The *GRS* statistics and its *p-value* test that whether the expected values of all 9 portfolios for 3x3 sort and 8 portfolios for 2x2x2 sorts intercept are zero in the regression. Average absolute value of intercepts, $AI\alpha_iI$**,** theaverage absolute value of intercepts over the average absolute value of r_i (average return on portfolio minus average value weight market portfolio return).$\frac{A_{I\alpha_iI}}{A_{IriI}}$ and the average squared intercept over average squared value of r_i, $\frac{A_{\alpha_i2}}{A_{ri2}}$ and average of the estimates of variance of sampling error for intercepts over $A\alpha_{i^2}$ and adjusted regression ($AR^{2)}$ are also shown.

To test whether imitating risk factors of FF3 and FF5 may capture the cross-section variation in expected returns, we regress monthly excess return from two sort and three sort portfolios. If these factors explain the variation, the intercept is expected to be indistinguishable from zero and the factors can be used as a proxy for capturing risk.

Panel A in Table 4 reports the intercepts and t-statistics of 3x3 portfolios. Most of the intercepts are not significantly zero but are close to zero. This shows that the some of the variationsare left unexplained in these regressions. Whereas Panel B of Table 4 reports the intercepts and t-statistics of 2x2x2 portfolios. And the results show that the intercepts are indistinguishable from zero, therefore we can conclude that three sort portfolios are not explaining the variations in expected returns.

Table 4: Results for three factor intercepts and five factor intercepts of 3x3 and 2x2x2 sorts for the month of July 2000 to November 2015.

Panel A: Intercepts ofthree factor and five factor model for *Size-B/M, Size-OP* and *Size-Inv.*

	A			t(α)		
	Low	**2**	**High**	**Low**	**2**	**High**
Size-BM						
3F						
Low	0.509	0.140	-0.044	1.524	0.599	-0.354
2	0.298	0.286	-0.184	1.350	1.166	-0.995
High	-0.060	-0.217	0.593	-0.508	-0.904	1.350
5F						
Low	0.584	0.222	-0.067	1.739	0.943	-0.529
2	0.289	0.302	-0.181	1.284	1.225	-0.998
High	-0.093	-0.195	0.552	-0.777	-0.892	1.233
Size-OP						
3F						
Low	0.054	0.280	-0.043	0.167	1.306	-0.273
2	-0.287	0.501	0.168	-0.975	1.968	0.901
High	-0.422	-0.068	0.214	-1.103	-0.360	1.099
5F						
Low	0.268	0.338	-0.101	0.992	1.559	-0.649
2	-0.175	0.578	0.122	-0.670	2.256	0.654
High	-0.103	-0.033	0.109	-0.310	-0.192	0.725
Size-Inv						
3F						
Low	0.074	0.197	-0.006	0.251	0.685	-0.039
2	0.025	0.253	0.135	0.080	1.058	0.718
High	0.494	0.253	-0.462	1.397	1.556	-1.513
5F						
Low	-0.295	0.338	0.048	-1.182	1.182	0.317
2	0.145	0.268	0.168	0.493	1.149	0.884
High	0.150	0.233	-0.180	0.534	1.424	-0.712

This table shows the intercepts of factors. Stocks are divided in two size groups (Small and Big) at the end of June in each year. Small and big stocks are independently allocated to three *B/M, OP* and *Inv* quintiles for 3x3 portfolios. Panel A shows the intercepts and t-statistics of three factor and five factor model for two sorts.

Table 4

Panel B: Intercepts of three factor and five factor model for Size-OP-BM, Size-Inv-BM and Size-OP-Inv

	A				t(α)			
	Low	High	Low	High	Low	High	Low	High
Size-OP-BM								
3F	**Small**		**Big**		**Small**		**Big**	
Low	-3.011	-2.130	-2.788	-2.661	-5.325	-4.351	-5.528	-5.278
High	-1.961	-2.272	-2.710	-1.785	-3.782	-3.706	-5.212	-3.263
5F								
Low	-3.034	-2.092	-2.849	-2.752	-5.257	-4.199	-5.540	-5.504
High	-2.147	-2.476	-2.860	-1.984	-4.168	-4.033	-5.511	-3.610
Size-Inv-BM								
3F	**Small**		**Big**		**Small**		**Big**	
Low	1.439	1.547	1.615	1.642	4.034	3.895	4.672	4.495
High	1.452	1.621	0.762	1.512	4.243	3.971	2.755	3.333
5F								
Low	1.442	1.635	1.609	1.614	4.191	4.382	4.663	4.695
High	1.565	1.819	0.866	1.687	4.543	4.593	3.107	3.856
Size-OP-Inv								
3F	**Small**		**Big**		**Small**		**Big**	
Low	1.480	1.322	0.999	1.015	3.978	3.061	2.795	2.383
High	1.570	1.723	2.000	1.155	4.483	5.027	5.791	3.881
5F								
Low	1.601	1.620	1.057	1.271	4.797	4.121	3.420	3.221
High	1.448	1.825	1.968	1.232	4.190	5.283	5.690	4.094

This table shows the intercepts of factors. Stocks are divided in two size groups (Small and Big) at the end of June in each year. Small and big stocks are independently allocated to two *B/M, OP* and *Inv* quintiles (from low to high) for 2x2x2 sort portfolios. Panel B shows the intercepts and t -statistics of three factor and five factor model for three sorts.

Conclusion

This study examines the variation in expected return captured by Book to market equity, Size, Investment, and profitability in Pakistan's stock market. To check this, market returns and accounting data is collected from Thomson Reuters DataStream for 490 listed companies of Pakistan Stock Exchange (PSX) from July 2000 to November 2015. By using the market return and accounting data, we create two sets of different portfolios as test assets; nine portfolios are formed by independent 3x3 sorts of Size-OP, Size-Inv, and Size-B/M and eight portfolios are formed by 2x2x2 sorts of Size-Inv-BM, Size-OP-Inv and Size-OP-BM.

For 3x3 sort portfolios, average returns and B/M are negatively associated with each other for small stocks whereas we find the presence of value premium in big stocks. This shows that for small stocks, the return may not vary with a book to market but there is no value premium. In Size-OP sorts, average returns decrease with OP in big stocks quantiles and it inconsistent for all other size quintiles. Big stocks with high operating profitability tend to earn low expected returns. Investment premium is present in small stocks but it does not present in big stocks. These results show that the portfolios mostly explain the cross-section variation in only some of the quintiles. When portfolios are formed on the basis of 2x2x2 sorts, the effect of return for big stocks becomes clearer and effect of OP is also prominent in three sort portfolios. GRS statistic results show that five-factor model capture more cross-sectional variation in portfolio returns than the three-factor model and the intercepts are close to zero for two sort portfolios which are more significant for five-factor model. But GRS statistics results are not significant for 2x2x2 sort portfolios and the returns are low then the model prediction which shows that three sort portfolios are not explaining the variation in expected returns.

This study also has few limitations. The primary limitation of this study is that we have constructed two sets of

portfolios based 3x3 and 2x2x2 portfolio sorts due to the lack of availability of data, while traditionally the 5x5 and 2x4x4 portfolio sorts are used to test these models. Another limitation is that we do not sub-sample the data and the results may vary mainly because of the financial crisis.

References

Abbas, N., Khan, J., Aziz, R., & Sumrani, Z. (2014). A Study to Check the Applicability of Fama and French, Three-Factor Model on KSE 100-Index from 2004-2014. International Journal of Financial Research, 6(1), 90.

Aharoni, G., Grundy, B., & Zeng, Q. (2013). Stock returns and the Miller Modigliani valuation formula: Revisiting the Fama French analysis. Journal of Financial Economics, 110(2), 347-357.

Banz, R. W. (1981). The relationship between return and market value of common stocks. Journal of financial economics, 9(1), 3-18.

Basu, S. (1977). Investment performance of common stocks in relation to their price- earnings ratios: A test of the efficient market hypothesis. The journal of Finance, 32(3), 663-682.

Black, F. (1972). Capital market equilibrium with restricted borrowing. The journal of business, 45(3), 444-455.

Chan, L. K., Hamao, Y., & Lakonishok, J. (1991). Fundamentals and stock returns in Japan. The Journal of Finance, 46(5), 1739-1764.

Fama, E. F., & MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. Journal of political economy, 81(3), 607-636.

Fama, E. F., & French, K. R. (1992). The cross- section of expected stock returns. the Journal of Finance, 47(2), 427-465.

Fama, E. F., French, K. R., Booth, D. G., & Sinquefield, R. (1993). Differences in the risks and returns of NYSE and NASD stocks. Financial Analysts Journal, 49(1), 37-41.

Fama, E. F., & French, K. R. (2006). The value premium and the CAPM. The Journal of Finance, 61(5), 2163-2185.

Fama, E. F., & Kenneth, R. French, 2015b. Choosing factors, working paper, University of Chicago.

Fama, E. F., & French, K. R. (2016). Dissecting anomalies with a five-factor model. The Review of Financial Studies, 29(1), 69-103.

Gibbons, M. R., Ross, S. A., & Shanken, J. (1989). A test of the efficiency of a given portfolio. Econometrica: Journal of the Econometric Society, 1121-1152.

Hanif, M., & Bhatti, U. (2010). Validity of CAPM: Evidance from KSE. European Journal of Economics, Finance & Administrative Sciences, (20).

Haugen, R., Baker, N. (1996).Commonality in the determinants of expected stock returns. Journal of Financial Economics 41, 401–439.

Iqbal, J., & Brooks, R. (2007). Alternative beta risk estimators and asset pricing tests in emerging markets: The case of Pakistan. Journal of Multinational Financial Management, 17(1), 75-93.

Javid, A. Y., & Ahmad, E. (2008). Testing multifactor capital asset pricing model in case of Pakistani market.

Jawaid, S. A. R. S. T., Arif, I., & Qazi, F. (2011). Validity of capital asset pricing model in Pakistan: Evidence from Karachi Stock Exchange. African Journal of Business Management, 5(32), 12598.

Khan, F., Muneer, S. & Anuar, M. A. (2013). Relationship between Stock Prices and Economic Variables: Sectoral Analysis. Actual Problems of Economics, 5(143), 544-553

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, 13-37.

Markowitz, H. (1952). Portfolio selection. The journal of finance, 7(1), 77-91.

Muneer, S., Ali, A. & Ahmad, R. A. (2017). Impact of Financing on Small and Medium Enterprises (SMEs) Profitability with Moderating Role of Islamic Finance. Information Management and Business Review, 9(2), 25-32

Novy-Marx, R. (2013). The other side of value: The gross profitability premium. Journal of Financial Economics, 108(1), 1-28.

Racicot, F. E., & Rentz, W. F. (2016). Testing Fama–French's new five-factor asset pricing model: evidence from robust instruments. Applied Economics Letters, 23(6), 444-448.

Rizwan Qamar, M., Rehman, S., & Shah, S. A. (2013). Applicability of Capital Assets Pricing Model (CAPM) on Pakistan Stock Markets. International Journal of Management and Business Research, 4(1), 1-9.

Rosenberg, B., Reid, K., & Lanstein, R. (1985). Persuasive evidence of market inefficiency. The Journal of Portfolio Management, 11(3), 9-16.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. The journal of finance, 19(3), 425-442.

Titman, S., Wei, K., Xie, F., (2004). Capital investments nd stock returns. Journal of Financial and Quantitative Analysis 39, 677–700