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APPLICATION OF FAMA AND FRENCH FIVE FACTOR MODEL OF ASSET PRICING: EVIDENCE FROM PAKISTAN STOCK MARKET

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ABSTRACT

Assets pricing is one of the most debated domains of finance as pricing of securities plays an important role in the investment strategies of stock market players. This study tests the applicability of the Fama and French (2015) five factor model in the Pakistani stock market to explain the time series variation in excess portfolio returns. For portfolio sorting, we use data from June 2000 to June 2013 for 120 firms on the basis of market capitalization listed on the Pakistan Stock Exchange. We formulate 16 portfolios on the basis of size, book to market ratio, operating profitability and investment i.e. small minus big (SMB), high minus low (HML), robust minus weak (RMW), and conservative minus aggressive (CMA) along with marker risk factor are considered as four risk factors. For empirics, we apply the Fama and Macbeth (1973) two pass regression technique with the finding that the five factor model is an appropriate model for assets pricing in explaining risk adjusted time series portfolio variations. These findings have implications for investments in the Pakistani stock market listed stocks.

JEL Classification: G1, G110

Keywords**:** Asset pricing, Fama and French five-factor model, Pakistan Stock Exchange, Portfolio returns, Portfolio sorting

1. INTRODUCTION

Assets pricing is one of the most debated domains of finance. It is because investors are interested in calculating the fundamental price of financial assets. Fundamental price is then compared with

prevailing market prices of assets for taking investment decisions. Pricing of securities plays a very important role in stock market player investment strategies. Investments in financial assets such as stocks are considered as risky; therefore, investors seek investment opportunities that compensate them for taking higher risk. Most multifactor models are risk adjusted returns models where fundamental prices, based on systematic risk factors reflect risk adjusted returns. However, prevailing market prices do not always reflect risk adjusted returns. Therefore, to know risk adjusted returns, investors are interested in multifactor asset pricing models as securities providing them returns greater, less or equal to systematic risks. A number of asset pricing models have been presented by past researchers; one of them is the Capital Asset Pricing Model (CAPM) of Sharpe (1964). CAPM is a single factor model defining markets risk as a source of systematic risk. The systematic risk factors of market risk are business risk, financial risk, liquidity risk, and country risk. After CAPM, multifactor models evolved like the Fama and French (1993) three factor model, Fama and French (1995), Fama and French (1996), Arbitrage pricing theory (APT) by Ross (1976) and the four factor model by Carhart (1997), alternative three factor model of CNZ (2010), and five factor model of Fama and French (2015) to calculate the risk adjusted returns, based on systematic risk. The multifactor model assumes that there are more than one sources of systematic risk. Sources of systematic risk other than market risk, considered by various multifactor models are size, book to market factor, momentum, profitability, and investment factors.

Our contribution in this paper is as follows. First, the study is conducted on the Pakistani equity market representing the emerging economies. Reason for selecting an emerging country is based on the fact that in developed countries, substantial studies are conducted on the Fama and French (2015) five factor model (see for example Chiah, Chai, and Zhong, 2015; Nichol and Dowling, 2014; Guo, Zhang, Zhang, and Zhang, 2017). However, in emerging economies, there is no evidence regarding its application (Hakim, Hamid, and Meera, 2015). Second, the study contributes in the area of knowledge by empirically testing the applicability of the five factor model proposed by Fama and French (2015) for determining risk adjusted returns in the context of an emerging economy such as Pakistan, and by applying the Fama and Macbeth (1973) through two pass regression methodology. Finally, we apply linear relationship between excess portfolio returns over risk free rate of returns and

market premium, size premium, value premium, profitability premium and investment premium.

2. LITERATURE REVIEW

2.1 EVOLUTION OF ASSET PRICING MODELS

Markowitz (1952) provided the foundation for the asset pricing model by exploring the domain of asset allocation on returns basis (Rehman and Shahzad, 2017; Rehman and Shah, 2016). Based on the foundations provided by Markowitz (1952), Sharpe (1964), Lintner (1965) and Mossin (1966) devised a model known as Capital Asset Pricing Model (CAPM). CAPM measures expected return of a security that compensates an investor by taking systematic risk. CAPM is a single factor model highlighting only one source of systematic risk i.e. market risk (Hakim, Hamid and Meera, 2016). The systematic risk factors of market risk also include business, financial, liquidity and country risks. After CAPM multifactor models like Arbitrage Pricing Theory (APT) by Ross (1976) and Carhart (1997) model emerged. Capital asset pricing model of Sharpe (1964) is a single factor asset pricing model whereas Arbitrage Pricing Theory (APT) assumes that expected return is based on multi factors. The multifactor model assumes that there is more than one source of systematic risk. Sources of systematic risk other than market risk include size, book to market ratio, momentum, profitability and investment levels. Later, the Efficient Market Hypothesis (EMH) was presented by Fama (1970) based on the capital asset pricing model of Sharpe (1964), Lintner (1965) and Mossin (1966). He was of the view that security prices fully reflect all available information if expected returns on securities are generated on the basis of the two parameter model of Sharpe, Lintner and Mossin. This is because all information can be adjusted in the form of additional returns by taking additional systematic risk and the stock market may be in equilibrium. However equity markets are not always efficient to reflect all available information and there may exist arbitrage opportunities for investors. This indicates the limitation of CAPM of not measuring the expected returns according to single risk factor. Later, Ross (1976) proposed the Arbitrage Pricing Theory (APT) which explains that expected return is not only based on single factor (market risk premium) but rather depends on multi factors.

Existing literature also identify large numbers of anomalies that put a big question on the validity of CAPM and the Efficient Market Hypothesis (see Basu, 1977) for price to earnings (P/E) anomaly, Benz (1981) for size anomaly, Basu (1983) for Earnings Price anomaly, Bhandari (1988) for debt to equity anomaly and Rosenberg, Reid and Lanstein (1985) for book to market value of equity anomaly). Connor (1984) provided a new and equilibrium version of arbitrage pricing theory of Ross as a special case. Both arbitrage pricing theory and the equilibrium version of APT are similar for predicting stock prices and return of portfolios. Wei (1988) provides a competitive equilibrium form of arbitrage pricing theory and suggest that for asset pricing, only market portfolio should be added in the model. Therefore, it represents itself as an extension and integrated form of the CAPM and APT models. Fama and French (1992) studied the combined role of market beta, size, leverage, earnings-price (E/P) ratio and book to market equity for cross sectional variations in expected returns of stocks of NYSE, AMEX, and NASDAQ. They reported that size and book to market equity along with market beta can explain cross sectional variations in expected stock returns. These two variables (size and book to market value of equity) also absorb the effect of leverage and earnings to price ratio to explain cross sectional variations in expected returns.

The work of Fama and French (1993) extend to include bond markets whereas Fama and French (1995) examine size and book to market factors in earnings and returns. Later Fama and French (1996) offer multifactor explanation for asset pricing anomalies followed by Fama and French (1998) testing different markets around the world and reporting value stocks being more profitable than the growth stocks. The work of Fama and French (2006) is based on the profitability, investment and average returns suggesting that expected stock returns are associated with book to market value, expected profitability and investment. According to them, people earn abnormal returns due to anomalies such as net stock issues, accruals, momentum, asset growth and profitability.

2.2 LITERATURE ON PRICING MODELS IN EMERGING MARKETS

Literature regarding asset pricing models on emerging markets include the work of Galagedera (2007), Bhatti and Hanif (2010), Khan et al. (2012), and Shamim, Yousaf and Shaikh (2014). Our study dissects these anomalies by dividing stocks into three size

groups namely micro, small and big in cross section regression. Mirza and Shahid (2008) tested the Fama and French three factor model for explaining cross sectional variation in expected stock returns of companies listed on the Pakistan Stock Exchange. Their results conclude that the three factor model is capable of explaining cross sectional variations in expected stock returns for most of the portfolios. The coefficient of size premium is positive for small stock portfolios and negative for big stock portfolios. Positive coefficient of small stocks and negative coefficient of big stocks signify that small stocks earn higher returns than big stocks. Value premium is negative for low book to market stock portfolios and positive for high book to market stock portfolios indicating that stocks with high book to market ratio earn higher returns than stocks with low book to market ratio. It provides an evidence of size and value premium in the Pakistan Stock Exchange. According to Hanif and Bhatti (2010), CAPM provides accurate results for few observations as only 7.7 percent observations support the validity of CAPM. Galagedera (2007) who reviewed the single factor model, multi factor model and conditional CAPM concluded that if the data are normally distributed, then single factor models are preferable whereas if the data are not normally distributed then multifactor models provide better results. Also CAPM with higher order co-moments is proposed as an alternative to the single-factor CAPM. Shamim et al. (2014) suggest that standard CAPM does not provide valid results. The findings of Khan et al. (2012) show that CAPM is not applicable in Pakistan and suggest that CAPM is not an operational model to measure risk and required return. Therefore, investors do not rely on CAPM for taking investment decisions.

Chen et al. (2010) conducted a study on the three factor model of asset pricing and report that the factors are different from those of Fama and French (1993). These include investment premium and profitability premium along with market premium i.e. a low minus high investment factor and a high minus low ROA factor. Their new three factor model outperforms traditional assets pricing models in explaining a wide range of anomalies in the cross section of returns. The model also appeared to be different from Fama and French (1993) as it does not interpret investment and ROA as risk factors but link the expected returns to firm characteristics without assuming mispricing. Hassan and Javed (2011) conducted a study testing the Fama and French three factor model on the Pakistani equity market and revealed that value stocks outperform growth

stocks whereas size premium show inconsistent results. This is because small stocks portfolios are high risk and return portfolios; however, average of SMB factor reports contradictory results.

Traditional CAPM is also found valid for the Pakistani equity market as it is significantly and positively associated to portfolio returns. This study concludes that the Fama and French three factor model considerably explains portfolio returns. Their results suggest that explanatory power of traditional CAPM ranges from 24 to 66 percent for different portfolios whereas the explanatory power of the Fama and French three factor model ranges from 63 to 82 percent. The explanatory power of Fama and French (1993) three factor model is significantly higher than that of the traditional CAPM due to inclusion of size and value factors. Fama and French (2015) extended their three factor model to five factors by adding two more risk factors (the profitability and investment factor). According to Fama and French (2015), their five factor model performed better than the three factor model of asset pricing by explaining average stock returns; however value premium turned out to be a redundant factor for explaining the average returns of stocks.

Nichol and Dowling (2014) conducted a study to test performance of the Fama and French three factor model (FF3), three factors model of Chen et al. (2010) and Fama and French five factor model (2015). Fama and French (2015) five factor model include investment and profitability; however these differ regarding the construction of factors. According to Fama and French (2015), profitability refers to the change in operating profit (EBIT) whereas investment refers to change in the book value of total assets. Chen et al. (2010) assume profitability as returns on total assets and investment as change in inventory and tangible assets. They used the Fama and Macbeth (1973) two step methodology for testing while controlling for delisting bias. Their analysis shows that the return of profitability factors of both Fama and French (2015) and Chen et al. (2010) is positive and significant and larger from other factors in both models; however investment premium for both models is not significantly different from zero. First pass regression analysis shows that among these three models, Fama and French (2015) performs better in explaining variations in expected returns. The second stage Fama and Macbeth results show that all of the three models fail to pass the chi-square test but results are consistent with first pass regression. Chen et al. (2010) has the poorest performance among these three models. Chiah et al. (2015) provide evidence that the

addition of profitability and investment factors enhance the explanatory power of the Fama and French three factor model. The five factor model explains more asset pricing anomalies but is not capable to completely explain variations in expected returns.

From the above review of existing literature it is evident that the asset pricing domain has attracted much of attention of practitioners and academicians in Pakistan. But it is not much explored in Pakistan. Very few studies are available in the context of Pakistani equity market on asset pricing particularly on the Fama and French three factor model (1993). This study is an attempt to update the existing literature of the Fama and French three factor model of asset pricing in the context of Pakistan by testing the applicability of the five factor model of asset pricing.

3. METHODOLOGY

3.1 SOURCES OF DATA

This study used secondary data obtained from various financial statements of "balance sheet analysis" published by the State Bank of Pakistan (1999-2004, 2004-2009 and 2008-2013). Monthly closing stock prices were obtained from the website of business recorder, while stock market index data were attained from the Yahoo finance website. Six-month treasury-bill rate has been used as a proxy of risk free rate of returns. The data on treasury-bill rates were taken from monthly statements (Market Treasury Bill Auction Results) of the State Bank of Pakistan.

Population of the study includes all non-financial companies listed on the Pakistan Stock Exchange in each year of 2000 to 2013. Non-random sampling technique is used for obtaining the studied sample. Sample is selected on the basis of market capitalization for 120 companies. This is because 120 companies are sufficient for sorting of portfolios on the basis of size, book to market ratio, profitability and investment. The whole sample of 120 firms was divided into two categories: 60 small firms, and 60 big firms. Share price data were collected for the 14-year period from June 2000 – June 2014.

3.2 PORTFOLIO FORMATION

In order to sort portfolio according to the size, market capitalization is calculated at the end of June for the year t+1 (i.e. for the year July,

2000 to June 2001, market capitalization at the end of June, 2000 was calculated) and then sorted from small market capitalization to large market capitalization and divided into two groups based on market capitalization. Whole sample of 120 firms is selected and then divided into two categories, i.e. small and big, each having 60 small firms and 60 large firms. The first group was characterized as small group and second was designated as big group. Size sorted portfolio was further sorted according to book to market value from low book to market value to high book to market value and divided into two groups on basis of book to market value of equity. The first group was labeled as low book to market value group and second group was named as high book to market value group. These groups are called value sorted portfolios. Value sorted portfolios are once again arranged on the basis of operating profitability from low operating profitability to high operating profitability and separated into two groups on the basis of operating profit. First group is titled as weak profitability group while next group is called the robust profitability group. These portfolios are known as profitability sorted portfolios. Profitability sorted portfolio are then organized according to investment in assets from low investment companies to high investment companies and alienated into two groups on the basis of investment. One group is known as conservative investment group and next group is termed as the aggressive investment group. Portfolios are revised each year spanning from 2000 to 2013.

To segregate the factor premiums from each other, the four factors are designed as zero-investment mimicking portfolios, built from 16 sub portfolios as follows. Details for all abbreviations of these 16 portfolios are explained in the appendix.

$$\begin{aligned}\mathrm{SMB} = 1/8 * [&(\mathrm{SLWC} - \mathrm{BLWC}) + (\mathrm{SLWA} - \mathrm{BLWA}) + (\mathrm{SLRC} \\ &- \mathrm{BLRC}) + (\mathrm{SLRA} - \mathrm{BLRA}) + (\mathrm{SHWC} \\ &- \mathrm{BHWC}) + (\mathrm{SHWA} - \mathrm{BHWA}) + (\mathrm{SHRC} \\ &- \mathrm{BHRC}) + (\mathrm{SHRA} - \mathrm{BHRA})]\end{aligned}$$

$$\begin{aligned}\mathrm{HML} = 1/8 * [&(\mathrm{SHWC} - \mathrm{SLWC}) + (\mathrm{SHWA} - \mathrm{SLWA}) + (\mathrm{SHRC} \\ &- \mathrm{SLRC}) + (\mathrm{SHRA} - \mathrm{SLRA}) + (\mathrm{BHWC} \\ &- \mathrm{BLWC}) + (\mathrm{BHWA} - \mathrm{BLWA}) + (\mathrm{BHRC} \\ &- \mathrm{BLRC}) + (\mathrm{BHRA} - \mathrm{BLRA})]\end{aligned}$$

$$\text{RMW} = 1/8 * [(\text{SLRC} - \text{SLWC}) + (\text{SLRA} - \text{SLWA}) + (\text{SHRC} - \text{SHWC}) + (\text{SHRA} - \text{SHWA}) + (\text{BLRC} - \text{BLWC}) + (\text{BLRA} - \text{BLWA}) + (\text{BHRC} - \text{BHWC}) + (\text{BHRA} - \text{BHWA})]$$

$$\text{CMA} = 1/8 * [(\text{SLWC} - \text{SLWA}) + (\text{SLRC} - \text{SLRA}) + (\text{SHWC} - \text{SHWA}) + (\text{SHRC} - \text{SHRA}) + (\text{BLWC} - \text{BLWA}) + (\text{BLRC} - \text{BLRA}) + (\text{BHWC} - \text{BHWA}) + (\text{BHRC} - \text{BHRA})]$$

Market risk premium can be defined as (MKT) = (R_{mt}- R_{ft})

where

R_{Mt} = $Ln(K_{SE}/K_{SE_{t-1}})$
R_{Ft} = Risk free rate of return
SMB = Returns of portfolio of small firms minus returns of portfolio of big firms.
HML = Returns of portfolio of firms with high book to market ratio minus returns of portfolio of firms with low book to market ratio.
RMW = Returns of portfolio of firms with robust operating profit minus returns of portfolio of firms with low operating profit.
CMA = Returns of portfolio of firms with conservative investment minus returns of portfolio of firms with aggressive investment.

Fama and Macbeth first pass regression equation (1) is written as follows:

$$(1) \quad R_{it} - R_{Ft} = a + b_i(R_{Mt} - R_{Ft}) + S_i(SMB_t) + h_i(HML_t) + r_i(RMW_t) + c_i(CMA_t) + e_i$$

As an extension of equation (1), Fama and Macbeth second pass regression equation (2) is written as:

$$(2) \quad R_{it} - R_{Ft} = a + b_i(\beta - MKT_t) + S_i(\beta - SMB_t) + h_i(\beta - HML_t) + r_i(\beta - RMW_t) + c_i(\beta - CMA_t) + e_i$$

where

a = Intercept
$R_{it} - R_{Ft}$ = Excess returns of *i* portfolio for the period *t*
$R_{Mt} - R_{Ft}$ = Market premium at time *t*
SMB_t = Small minus big i.e. Size premium at time *t*
HML_t = High minus low book to market ratio i.e. Value Premium at time *t*
RMW_t = Robust minus weak i.e. Profitability premium at time *t*
CMA_t = Conservative minus aggressive i.e. Investment premium at time *t*

Fama and French five factor model considers SMB, HML, RMW and CMA along with market premium to explain the portfolio returns. Statistical properties of portfolios sorted on Size-B/M-EBIT and Investment are reported in Table 1.

TABLE 1
Descriptive Statistics of Size-B/M-EBIT-Investment Sorted Portfolios.

Portfolios	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
BHRA	1.176	1.344	24.791	-40.836	9.133	-0.854	5.472
BHRC	0.792	1.065	30.288	-31.178	9.369	-0.288	4.613
BHWC	0.434	0.065	33.570	-38.566	8.882	-0.118	5.511
BHWA	0.513	0.488	25.341	-50.585	9.026	-1.121	8.668
BLRA	1.053	0.854	21.143	-40.505	7.597	-1.007	7.895
BLRC	0.760	1.268	20.386	-26.939	7.022	-0.478	4.228
BLWC	-0.020	0.064	15.854	-17.808	6.715	-0.307	3.054
BLWA	0.715	0.499	23.091	-29.144	7.378	-0.328	4.366
SHRA	1.028	1.071	19.606	-24.738	8.714	-0.211	2.922
SHRC	0.735	0.369	22.799	-23.429	8.299	0.047	3.080
SHWA	0.730	0.281	23.473	-30.570	8.888	-0.365	4.039
SLRC	0.626	0.615	23.441	-29.384	7.703	-0.298	4.408
SHWC	-0.026	-0.399	20.141	-31.436	8.160	-0.240	3.579
SLRA	0.679	1.623	22.279	-36.070	7.990	-0.743	5.769
SLWA	-0.377	-0.425	21.389	-31.804	6.700	-0.419	5.801
SLWC	0.220	0.344	23.389	-20.357	7.135	-0.012	3.690

Note: Values of mean, median, maximum, minimum, and standard deviation are in percentages.

From Table 1, for size sorted portfolios, it is observed that returns as well as risk of big stock portfolios i.e. BHRA, BHRC, BHWC and BLWA are larger than the returns and risk of small stock portfolios i.e. SHRA, SHRC, SHWC and SLWA. Whereas returns and risk for small stock portfolio i.e. SLWC is larger than returns and risk of big stock portfolio i.e. BLWC. The standard deviation of all of the above mentioned portfolios support the risk based explanation of higher returns. While the behavior of these portfolios i.e. SHWA and BHWA, SLRC and BLRC, and SLRA and BLRA are inconsistent and do not support the risk based explanation of higher returns. Therefore, it can be concluded that in Pakistan portfolio of big stocks outperform portfolio of small stocks on the basis of risk adjusted returns.

For B/M sorted portfolios, it is observed that returns as well as risk of High B/M stock portfolios i.e. BHRA, BHRC, BHWC, SHRA, SHRC and SHWA are larger than the returns and risk of Low B/M stock portfolios i.e. BLRA, BLRC, BLWC, SLRA, SLRC and SLWA. The standard deviation of all of the above mentioned portfolios support the risk based explanation of higher returns. While the behavior of these portfolios i.e. BHWA and BLWA and SHWC and SLWC are inconsistent and do not support the risk based explanation of higher returns. Hence it can be concluded that in Pakistan portfolio of value stocks outperform portfolio of growth stocks on the basis of risk adjusted returns.

For operating profitability sorted portfolios, it is observed that returns as well as risk of robust operating profitable stock portfolios i.e. BHRA, BHRC, BLRA, BLRC, SHRC, SLRC and SLRA are larger than the returns and risk of weak operating profitable stock portfolios i.e. BHWA, BHWC, BLWA, BLWC, SHWC, SLWC and SLWA. The standard deviation of all of the above mentioned portfolios support the risk based explanation of higher returns. The behavior of portfolios SHRA and SHWA are inconsistent and do not support the risk based explanation of higher returns. And so it can be concluded that in Pakistan portfolio of stocks with high operating profit in general outperform portfolio of stocks with low operating profit on the basis of risk adjusted returns.

Whereas for investment sorted portfolios it is observed that returns as well as risk of aggressive investment stock portfolios i.e. BHWA, BLRA, BLWA, SHRA, SLRA and SHWA are larger than the returns and risk of conservative investment stocks portfolios i.e. BHWC, BLRC, BLWC, SHRC, SLRC and SHWC. While risk and

return of conservative stock portfolio i.e. SLWC is larger than SLWA. The standard deviation of all of the above mentioned portfolios support the risk based explanation of higher returns. However, the behavior of portfolios BHRC and BHRA are inconsistent and do not support the risk based explanation of higher returns. Consequently, it can be concluded that in Pakistan portfolio of stocks with aggressive investment outperform portfolio of stocks with conservative investment on the basis of risk adjusted returns. Out of all of the 16 portfolios, three portfolios (i.e. BLWC, SHWC and SLWA) gave negative average returns. The negative mean returns of these portfolios are due to those stocks of the respective portfolio that have weak operating profit.

Table 2 indicates that average market premium, value premium and profitability premium is positive whereas size premium and investment premium are negative. Market premium is found more volatile in contrast with size premium, value premium, profitability premium and investment premium. Market premium is also larger than the value premium, profitability premium and investment premium. Negative SMB indicates that average returns of big stock outperformed average returns of small stocks. Positive HML indicates that average returns of value stocks are larger than average returns of growth stocks. Positive RMW indicates that average returns of high profitable stocks outperformed low profitable stocks and negative CMA indicates that average returns of high investment stocks are larger than average returns of low investment stocks.

TABLE 2
Descriptive Statistics: Fama and French Five Factors

	MKT	SMB	HML	RMW	CMA
Mean	1.030	-0.230	0.220	0.580	-0.250
Median	1.210	-0.040	0.130	0.530	-0.050
Maximum	23.580	13.320	10.410	9.820	10.750
Minimum	-46.050	-14.500	-14.430	-7.340	-7.420
Std. Dev.	8.130	3.520	3.410	2.620	2.700
Skewness	-1.181	-0.145	-0.083	0.362	0.166
Kurtosis	9.267	5.328	5.946	4.168	4.210

Note: Values of mean, median, maximum, minimum, and standard deviation are in percentages.

Factors descriptive statistics i.e. SMB, HML, RMW and HML supports the explanation of descriptive statistics of size, value, operating profitability and investment sorted portfolios for explaining portfolio returns.

Table 3 shows the correlation among explanatory variables to observe the likelihood of Multicollinearity. Correlation matrix has shown that the correlation between market risk factor with size and value factors is high but within tolerable limits as detected by the variance inflation factor (VIF). Market premium is negatively correlated with size premium and strength of correlation is high whereas it is positively correlated with value premium and its strength of correlation is significant. Correlation among other risk factors is negligible. So it can be inferred that correlation is within tolerable limits; in conclusion, no multicollinearity exists among explanatory variables.

TABLE 3
Correlation Matrix of Fama and French Five Factors

	MKT	SMB	HML	RMW	CMA
MKT	1				
SMB	-0.510*	1			
HML	0.600*	-0.322	1		
RMW	0.235	-0.213	0.040	1	
CMA	-0.060	0.037	-0.054	-0.213	1

Note: *indicates significant relationship

Table 4 shows the results of regression analysis of the Fama and French five factor model for 16 portfolios. All of the 16 portfolios are sorted on the basis of size, book to market ratio, operating profitability and investment in total assets. One by one, all of the 16 portfolios are regressed on market premium, size premium and value premium, operating profit premium and investment premium to explain the relationship between portfolio excess returns and market premium, size premium, value premium, operating profit premium and investment premium.

From the regression results as presented in Table 4, it is found that the coefficient of market premium is positive and significant at the 5% level of significance for all of the 16 portfolios. This means that market premium has significant linear relationship

with portfolio returns for all portfolios and it is consistent with the conventional assets pricing model (i.e., CAPM).

TABLE 4
Regression Results of Fama and French Five Factor Model

Dependent variable	Intercept	MKT	SMB	HML	RMW	CMA	Adj. R^2	*F*-Statistics
SLWC	-0.006***	0.852*	1.066*	-0.424*	-0.569*	0.382*		
	(-1.713)	(13.629)	(8.833)	(-3.161)	(-3.851)	(2.770)	0.575	46.267*
SLWA	-0.013*	0.747*	0.959*	-0.365*	-0.646*	-0.218		
	(-3.329)	(11.673)	(7.765)	(-2.662)	(-4.275)	(-1.541)	0.496	33.921*
SLRC	-0.008**	0.768*	1.054*	-0.237	0.666*	0.651*		
	(-1.967)	(10.703)	(7.613)	(-1.538)	(3.930)	(4.111)	0.519	37.058*
SLRA	-0.010**	0.743*	1.087*	-0.497*	0.405**	-1.112*		
	(-2.260)	(10.147)	(7.703)	(-3.169)	(2.341)	(-6.889)	0.536	39.635*
SHWC	-0.009	0.765	0.904	0.620	-0.803	0.383		
	(-2.474)	(12.262)	(7.513)	(4.637)	(-5.454)	(2.784)	0.678	71.236*
SHWA	-0.005	0.765*	1.032*	0.888*	-0.737*	-0.832*		
	(-1.447)	(12.355)	(8.632)	(6.683)	(-5.038)	(-6.088)	0.731	91.757*
SHRC	-0.006	0.755*	1.332*	0.650*	0.176	0.506*		
	(-1.513)	(11.403)	(10.434)	(4.580)	(1.124)	(3.467)	0.650	62.882*
SHRA	-0.007	0.762*	1.230*	0.735*	0.343**	-0.346**		
	(-1.624)	(11.120)	(9.309)	(5.003)	(2.123)	(-2.294)	0.658	65.329*
BLWC	-0.008**	0.687*	0.334**	-0.303**	-0.698*	0.410*		
	(-2.059)	(10.307)	(2.595)	(-2.123)	(-4.437)	(2.794)	0.460	29.480*
BLWA	-0.004	0.780*	0.331**	-0.278***	-0.777*	-0.608*		
	(-0.964)	(11.438)	(2.513)	(-1.903)	(-4.820)	(-4.041)	0.527	38.261*
BLRC	-0.008**	0.702*	-0.084	-0.108	0.301**	0.215***		
	(-2.586)	(13.192)	(-0.813)	(-0.948)	(2.394)	(1.833)	0.682	72.463*
BLRA	-0.007**	0.877*	-0.084	-0.418*	0.152	-0.307*		
	(-2.348)	(17.942)	(-0.891)	(-3.991)	(1.320)	(-2.847)	0.771	113.489*
BHWC	-0.008**	0.771*	-0.018	0.620*	-0.549*	0.445*		
	(-2.160)	(12.305)	(-0.148)	(4.612)	(-3.710)	(3.219)	0.725	88.963*
BHWA	-0.011*	0.789*	0.057	0.612*	-0.386**	-0.549*		
	(-2.848)	(12.500)	(0.468)	(4.524)	(-2.591)	(-3.945)	0.729	91.015*
BHRC	-0.010*	0.856*	0.075	0.551*	0.311**	0.422*		
	(-2.763)	(13.988)	(0.634)	(4.201)	(2.152)	(3.126)	0.764	109.094*
BHRA	-0.009**	0.694*	0.052	0.694*	0.480*	-0.615*		
	(-2.235)	(10.881)	(0.419)	(5.075)	(3.190)	(-4.371)	0.730	91.280*

Note: Values in parentheses indicates t-statistics.
*, **, *** indicate significance at 1%, 5% and 10%, respectively.

From Table 4 it is found that SMB is significantly and positively related to portfolio returns of small stocks. And SMB is insignificantly influencing the returns of big stock portfolios except BLWC and BLWA and SMB is also significantly and positively related to it. Therefore, it can be concluded that behavior of SMB is not consistent for big stock portfolios whereas SMB is significantly and positively related to portfolio returns of small stock portfolios. So it provides evidence that in Pakistan the portfolio of small stock

outperforms portfolio of big stock on the basis of risk adjusted returns. These results for SMB are according to the results provided by Fama and French (1992, 1993, 2015).

As far as HML is concerned it is observed that value premium is significantly and positively related to portfolio returns of high B/M stocks while significantly and negatively related to portfolio returns of low B/M stocks except SLRC, BLWA and BLRC that are not influenced by HML. So the behavior of HML is not consistent for portfolio returns of low B/M stocks. Therefore it can be inferred that for the Pakistani stock market, the risk adjusted return of portfolio of stocks with high book to market ratio outperformed risk adjusted returns of portfolio of stocks with low book to market ratio. This results and interpretations are in track with those provided by Fama and French (1992, 1993, 2015).

Whereas RMW is significantly and negatively related to portfolio returns of low profitable stocks and significantly and positively related to portfolio returns of high profitable stocks except SHRC and BLRA that are insignificant for RMW. So it means portfolio returns will be high for high profitable stocks and portfolio returns will be low for low profitable stocks. The same results and interpretation is also provided by Fama and French (2015).

However, CMA is significantly and positively related to portfolio returns of low investment stocks while significantly and negatively related to portfolio returns of high investment stocks except SLWA that is insignificant for CMA. So it is concluded that average returns of the portfolio are high for low investment stocks and portfolio returns are low for high investment stocks. This result for investment factor supports Fama and French (2015). The same results and interpretation is also provided by Fama and French (2015).

Range of adjusted R-square is from 46.02% to 77.10%. It means that from 46.02% to 77.10% of variation in portfolio returns is explained by variations in market premium, size premium, value premium, operating profit premium and investment premium. Probability value of F-statistics is also found statistically significant at the 5% level of significance for all of the 16 portfolios. This means that market premium, size premium, value premium, operating profit premium and investment premium has significant linear relationship with portfolio returns for all portfolios and it is consistent with the Fama and French five factor model. Therefore, the Fama and French five factor model is found valid as it is significantly explaining

portfolio returns in the equity market of Pakistan. But still the Fama and French five factor model does not completely explain all of the variations in expected portfolio returns as the intercept term is found significant for 11 (i.e., SLWA, SLRC, SLRA, SHWC, BLWC, BLRC, BLRA, BHWC, BHWA, BHRC and BHRA) out of 16 portfolios. The significance of intercept signifies that there is room for including further sources of systematic risk factor in the five factor model.

TABLE 5
Fama and Macbeth Two Pass Regression

Dependent variable	Intercept	β-MKT	β-SMB	β-HML	β-RMW	β-CMA	Adj. R^2	F-Statistic
SLWC	-0.026	0.060	0.017	0.046	-0.003	0.079**	0.065	2.806**
	(-0.319)	(0.944)	(0.541)	(1.457)	(-0.110)	(-2.241)		
SLWA	0.039	-0.011	0.003	0.026	0.003	0.091*	0.056	2.554**
	(0.528)	(-0.191)	(0.089)	(0.921)	(0.100)	(2.895)		
SLRA	0.084	-0.027	0.009	0.012	-0.030	0.093**	0.029	1.792
	(0.948)	(-0.3920)	(0.268)	(0.362)	(-0.936)	(2.462)		
SHWC	0.081	-0.044	0.011	0.038	-0.010	0.116*	0.046	2.261***
	(0.878)	(-0.612)	(0.312)	(1.065)	(-0.317)	(2.942)		
SLRC	0.087	-0.018	0.015	-0.004	-0.039	0.082**	0.048	2.321**
	(1.119)	(-0.299)	(0.496)	(-0.145)	(-1.393)	(2.464)		
SHWA	0.138	-0.071	0.028	0.024	-0.054	0.121*	0.043	2.183***
	(1.429)	(-0.952)	(0.744)	(0.646)	(-1.553)	(2.929)		
SHRC	0.120	-0.038	0.010	0.011	-0.032	0.134*	0.092	3.660*
	(1.358)	(-0.554)	(0.300)	(0.315)	(-0.999)	(3.562)		
SHRA	0.131	-0.069	(0.011)	0.009	-0.035	0.114*	0.038	2.045***
	(1.353)	(-0.916)	(-0.299)	(0.245)	(-0.999)	(2.745)		
BLWC	-0.001	0.014	0.016	0.046	-0.005	0.073**	0.035	1.953***
	(-0.010)	(0.236)	(0.542)	(1.583)	(-0.194)	(2.238)		
BLWA	0.074	-0.015	0.006	0.006	-0.018	0.091**	0.036	1.967***
	(0.864)	(-0.230)	(0.171)	(0.190)	(-0.586)	(2.495)		
BLRC	0.074	-0.043	0.012	-0.007	-0.019	0.044	-0.021	0.454
	(0.980)	(-0.737)	(0.415)	(-0.249)	(-0.708)	(1.365)		
BLRA	0.033	0.026	0.012	0.007	-0.012	0.073**	0.042	2.158***
	(0.409)	(0.407)	(0.389)	(0.235)	(-0.427)	(2.099)		
BHWC	0.051	-0.010	-0.006	-0.002	-0.018	0.065	0.000	0.994
	(0.545)	(-0.132)	(-0.171)	(-0.054)	(-0.524)	(1.622)		
BHWA	0.099	-0.038	-0.016	-0.013	-0.015	0.095**	0.017	1.456
	(0.965)	(-0.480)	(-0.415)	(-0.326)	(-0.409)	(2.167)		
BHRC	0.123	-0.048	-0.006	-0.007	-0.034	0.108**	0.037	2.018***
	(1.261)	(-0.635)	(-0.170)	(-0.186)	(-0.984)	(2.591)		
BHRA	0.103	-0.047	-0.005	-0.020	-0.002	0.073***	-0.005	0.863
	(1.009)	(-0.596)	(-0.119)	(-0.519)	(-0.053)	(1.681)		

Note: Values in parentheses indicate t-statistics.
*, **, *** indicate significance at 1%, 5% and 10%, respectively.

Betas for the five factors of Fama and French are obtained through first pass regression analysis as reported in Table 5 and then those betas are regressed on excess portfolio returns over risk free rate of returns and coefficients, standard errors, *t*-statistics for betas factors are obtained along with adjusted *R*-square, *F*-statistics and *p*-value of *F*-statistics are attained from the second pass regression analysis as reported in Table 5. The results in Table 5 show that past betas cannot be used to predict future returns as the coefficients of past beta factors are insignificant at the 5% level of significance almost for all portfolios. Value of adjusted *R*-square is very low and the *p*-value of *F*-statistics is insignificant for all portfolios, indicating that past beta factors are not explaining future returns.

4. CONCLUSION

This study is conducted to measure the linear relationship between excess portfolio returns over risk free rate of returns and market premium, size premium, value premium, profitability premium and investment premium. It is intended to test the applicability of the Fama and French five factor model for explaining time series variation in excess portfolio returns for the Pakistani equity market. For sorting of portfolios, data of 14 years from June 2000 to June 2013 had been collected from various financial statements of "balance sheet analysis" published by the State Bank of Pakistan. Data of monthly stock prices were collected from the website of business recorder whereas data of six-month treasury bill rates had been taken from the monthly statements of the State Bank of Pakistan. The largest 120 firms by market capitalization, out of all companies listed on the Karachi stock market, were used as the sample for analysis.

Total of 16 portfolios are formed that are sorted on the basis of size, book to market ratio, operating profitability and four risk factors are constructed i.e. SMB, HML, RMW and CMA along with market risk factor. The Fama and Macbeth (1973) two pass regression techniques have been applied for the purpose of obtaining required analysis. It is concluded that in Pakistan the portfolio of small stocks outperforms portfolio of big stocks, portfolio of stocks with high book to market ratio outperform portfolio of stocks with low book to market ratio, portfolio of stock with robust operating profitability outperform portfolio of stock with low operating profitability and portfolio of stock with conservative investment

outperform portfolio of stock with aggressive investment on the basis of risk adjusted returns. The HML is found redundant. As we excluded the HML from the model, the adjusted *R*-square improved. The same results and interpretation are also provided by Fama and French (2015).

From the second pass regression analysis of Fama and Macbeth, it is analyzed that past betas cannot be used to predict future returns as the coefficients of past beta factors are insignificant almost for all portfolios. Value of adjusted *R*-square is very low and the *p*-value of *F*-statistic is insignificant for all portfolios, indicating that past beta factors are not explaining future returns.

In Pakistan, size premium, value premium, profitability premium and investment premium are priced by the market. So these factors must be considered during assets pricing. Investors must incorporate these factors in taking investment decision. The results of this study warrant all type of investors, fund managers, and analysts to include profitability premium and investment premium along with market premium and size and value premium for valuation purpose, capital budgeting and project appraisal.

One of the most important limitations of this study is data constraint. Data needed for this study is not available electronically for long term; hence data were collected and arranged only for 14 years. Secondly sample size was not enough to construct portfolio of 25 sizes and value, 25 sizes, value and profitability and 25 sizes, value, profitability and investment sorted portfolios as found in Fama and French (1992, 1993, 2015). Another limitation is that the scope of this study is limited to Pakistan that is a developing country and results of this study are not compared with other developing countries.

Although the five factor model is an appropriate asset pricing model, there still seems to be a gap not yet explained by the Fama and French five factor model as the intercept term for most of the portfolios has turned out significant in this study. Therefore, based on previous literature it is suggested to future researcher to check the liquidity factor, value at risk factor and informational factors along with the Fama and French five factors. There may be chances of further improvement after incorporating these factors in the Fama and French five factor model. Furthermore, financial bankruptcy can be calculated through the Altman Z-score (1968) and Ohlson O-score (1980) as a proxy for financial distress to identify high risk and low risk companies and for applying the five factor

model to test whether these premium earned contributed to risk or not.

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APPENDIX

SLWC = Returns of portfolio of companies having small size, low book to market ratio, weak profitability, and conservative investments.

BLWC = Returns of portfolio of companies having big size, low book to market ratio, weak profitability, and conservative investments.

SLWA = Returns of portfolio of companies having small size, low book to market ratio, weak profitability, and aggressive investments.

BLWA = Returns of portfolio of companies having big size, low book to market ratio, weak profitability, and aggressive investments.

SLRC = Returns of portfolio of companies having small size, low book to market ratio, robust profitability, and conservative investments.

BLRC = Returns of portfolio of companies having big size, low book to market ratio, robust profitability, and conservative investments.

SLRA = Returns of portfolio of companies having small size, low book to market ratio, robust profitability, and aggressive investments.

BLRA = Returns of portfolio of companies having big size, low book to market ratio, robust profitability, and aggressive investments.

SHWC = Returns of portfolio of companies having small size, high book to market ratio, weak profitability, and conservative investments.

BHWC = Returns of portfolio of companies having big size, high book to market ratio, weak profitability, and conservative investments.

SHWA = Returns of portfolio of companies having small size, high book to market ratio, weak profitability, and aggressive investments.

BHWA = Returns of portfolio of companies having big size, high book to market ratio, weak profitability, and aggressive investments.

SHRC = Returns of portfolio of companies having small size, high book to market ratio, robust profitability, and conservative investments.

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