Economics Bulletin

Volume 37, Issue 4

Asset Pricing in a Developing Economy: Evidence from Pakistan

Nawazish Mirza
SP Jain School of Global Management

Krishna Reddy
Australian Institute of Business

Abstract

This study provides a comparative account of three asset pricing models for a developing economy. Like most developing markets Pakistan stock exchange (PSX) is also subject to market making activities by few large investors, non-synchronous trading, loose monitoring controls and small market size. We find no support for capital asset pricing model, however, size and value based risk factors were observed to be significant. The four factor momentum model proved to be superior suggesting pricing of momentum in stock returns. As asset pricing models are vital in financial decision making, this research has important implications for financial managers and investors.

This work has been fully supported by the Croatian Science Foundation under the project number 9481 Modelling Economic Growth – Advanced Sequencing and Forecasting Algorithm". "Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of Croatian Science Foundation.
Citation: Nawazish Mirza and Krishna Reddy, (2017) "Asset Pricing in a Developing Economy: Evidence from Pakistan", *Economics Bulletin*, Volume 37, Issue 4, pages 2483-2495
Contact: Nawazish Mirza - nawazish.mirza@spjain.org, Krishna Reddy - Krishna.Reddy@aib.edu.au.
Submitted: October 08, 2017. **Published:** November 19, 2017.

1. Introduction

Markowitz (1952) laid the foundation of the development of asset pricing models with his proposition of "Portfolio Selection". Building on the research work of Markowitz, Treynor (1961, 1963), Sharpe (1964), Linter (1965) and Mossin (1966), independently proposed Capital Asset Pricing Model (CAPM). Given an asset's non-diversifiable risk (market risk/systematic risk represented by the quantity beta), if an investor forms well-diversified portfolio, then CAPM can be used to quantify the relationship between the beta of an asset and its corresponding expected return. When the investor is exposed to the systematic risk while investing in the portfolio, the beta of the portfolio is the defining factor in terms of the expected return. The CAPM assumes that stock's beta is the only risk factor which is priced in stock returns.

Fama and French (1992) proposed an extension of the CAPM. They observed that two types of stocks performed better than the market. These include the glamour/growth and value stocks. The stocks with high book to market value were termed as value stocks and the stocks with low book to market value stocks were termed as growth stocks. They observed that the high book value to market value firms tend to be persistently financially distressed and low book value to market value firms were associated with sustained profitability and future growth. Moreover the stocks with small market capitalization (small size firms) tend to be more profitable than large stocks. However, the returns of the investors holding the high book to market value stocks and the stocks with small market capitalization were compensated for holding less profitable, riskier stocks.

Jegadeesh and Titman (1993) introduced behavioral innovations in asset pricing and suggested that the investment strategies that involve taking a long position in well performing stocks; or short position in poorly performing stocks on the basis of the past performance over the period of past three to twelve months tend to produce significantly positive abnormal returns of about one percent per month for the following year. Carhart (1997) and Liew and Vassalou (2000) augmented the Fama and French three-factor model with a momentum factor WML, Winners minus losers[1]. Winners are the stocks with the highest prior period's average returns, and the losers are the stocks with the lowest average returns in the previous period. WML is a risk factor which measures the momentum premium.

This research is a comparative study of three widely used asset pricing models namely Capital asset pricing model (CAPM), Fama and French-three factor model, and momentum based four factors model[2]. The asset pricing propositions under study are an important input for estimation of investment appraisals, project feasibility and cost of equity capital. Pakistan stock exchange[3] (PSX) is a developing stock market about which research literature based on the asset pricing proposition is rare as compared to the developed markets. The purpose of this study is to explore the asset pricing dynamics in a developing stock. The developing markets have special features that are distinct from developed markets. These include market making activities by few

[1] Winner stocks are also termed as "up". Similarly loser stocks are also termed as "down". For the purpose of this research winner stocks represent up and loser stocks represent down.

[2] For more on validity of factor models in non US economies, please see Chui and Wei (1998), Rouwenhourst (1998), Lam (2002), Beltratti and Di Tria (2002), Gaunt (2004), Jarjir (2007), Hon, M. T. and I. Tonks (2007) and Mirza and Shahid (2008)

[3] Historically, there were three stock exchanges in Pakistan. These were Karachi stock exchange, Lahore stock exchange and Islamabad stock exchange. In 2016, they merged to form Pakistan stock exchange.

large investors, dormant stocks and loose monitoring controls. Most developing economies face political instability, high foreign debt and strong currency turbulence. Generally developing economies have small financial markets with the presence of thin trading (low level of active trading), informational inefficiency, lack of transparency, and have a severe reaction to panics. Subsequently, the overall investors' activity revolves around a few stocks causing non-synchronous trading. Therefore, it would be interesting to analyze the relevance of these asset pricing models in PSX. The research findings would have policy and academic implications that would facilitate corporate financial managers and stock market investors to make appropriate analyses of the risk and return relationship of their investment strategies, enabling them to make rational investment decisions.

2. Research Methodology

The aim of this study was to empirically test the validity of the three most widely used asset pricing models for PSX. The sample period we consider for this study is from 1st July 1990 – 30th June 2015. This is the period for which digital data is available for PSX. The sample firms included companies from all of the industrial sectors. We do not include financial firms owing to their specific risk factors that are not comparable with other firms. In order to avoid thinly traded stocks, only the stocks with non zero returns for at least 90% of the trading days, were included in the sample. The selected firms should have daily price data, book value, market value of equity and market capitalization available for the sample period. The secondary data were collected from PSX website. In order to estimate the intra-day returns, the daily closing prices were used. The true market portfolio within the framework of various asset pricing models is not observable for the purpose of empirical testing. The use of synthetic market portfolio is common in empirical research of asset pricing models. Therefore, as a proxy for market portfolio, KSE 100 index was used as a synthetic market portfolio. To homogenise daily portfolio returns with risk free, we use overnight interbank rates to proxy risk free. The fundamental data on book value and number of shares outstanding were extracted from financial statements. Table 1 represents the year wise sample composition.

2.1 Portfolio Formation

Liew and Vassalou (2000) formed portfolios based on High book value to market value minus low book value to market value (HML), small market capitalization to big market capitalization (SML) and Up minus Down (UMD), in an attempt to capture all three risk factors, namely, size, book value to market value and momentum risk factors. For this study Liew and Vassalou's portfolio formation methodology was followed with a slight modification. In order to construct the Book to Market Portfolios, the stocks were ranked and categorized into three groups based on the break points of bottom 30% - Low (L). Middle 40% - Medium (M) and top 30% - High (H), book value to market value ratios. The stocks with High Book to Market ratio in time (t) were included in the top sub group in time (t+1), and so on. To form the Size Portfolios the selected sample stocks were ranked on market capitalization (price times no. of shares outstanding), in order to make two sub groups based on the break points of Top 50% - Big (B) and Bottom 50% - Small (S). The stocks with High Market Capitalization in time (t) were included in the top sub group in time (t+1), and so on. To form the Momentum sorted portfolios, the daily returns (R_i) of all the selected stocks were tabulated. Then those stocks were ranked on the basis of their returns in order to make two groups. The Up stocks (U) in time (t+1) were the

Table 1: YoY Sample Size 1990 to 2015

Year	No of Firms	Year	No of Firms
1990	250	2003	473
1991	255	2004	500
1992	259	2005	500
1993	259	2006	480
1994	275	2007	480
1995	280	2008	475
1996	280	2009	475
1997	320	2010	508
1998	320	2011	508
1999	370	2012	512
2000	392	2013	512
2001	430	2014	515
2002	452	2015	515

Table 2: Portfolio Construction Procedure

Market Capitalization	Book to Market	Momentum	Portfolios
Big MV	High B/M	Up	BHU
		Down	BHD
	Medium B/M	Up	BMU
		Down	BMD
	Low B/M	Up	BLU
		Down	BLD
Small MV	High B/M	Up	SHU
		Down	SHD
	Medium B/M	Up	SMU
		Down	SMD
	Low B/M	Up	SLU
		Down	SLD

stocks with the top 50% - highest average returns out of all the stocks in time (t) and Down stocks (D) in time (t+1) were the stocks with the Bottom 50% - lowest average returns out of all the stocks in time (t). In this way twelve equally weighted size, book to market and momentum sorted portfolios were constructed: HBU, HBD, HSU, HSD, MBU, MBD, MSU, MSD, LBU, LBD, LSU, and LSD[4]. Table 2 depicts the portfolio construction methodology.

2.2 Model Specification (CAPM-Single Factor Model)

According to the Capital Asset Pricing Model (CAPM), given an asset's non-diversifiable risk (market risk/systematic risk represented by the quantity beta), if an investor forms well-diversified portfolio, then CAPM can be used to quantify the relationship between the beta of an asset and its corresponding expected return. According to CAPM when the investor is exposed to the systematic risk while investing in the portfolio, the beta of the portfolio is the defining factor in terms of the expected return. The CAPM assumes that market beta is the only risk factor which is priced in stock returns.

The single factor CAPM can be expressed as follows:

$$R_{it} = R_f + (R_{mt} - R_f)\beta_{1t} \quad \ldots (1)$$

Where R_{it} represents the expected return on a stock i in time t, R_f represent the risk free rate of return, R_{mt} - R_f represents the market risk premium. The coefficient β_{1t} is the risk sensitivity of returns for market risk.

In order to test the CAPM, a multiple regression framework will be used by transforming the above equation into a simple time series model as follows:

$$R_{it} - R_f = \alpha_i + (R_{mt} - R_f)\beta_{1t} + \in_t \quad \ldots (2)$$

$$ER_{it} = \alpha_i + (R_{mt} - R_f)\beta_{1t} + \in_t \quad \ldots (3)$$

Where $ER_{it} = R_{it} - R_f$ represents the excess return on stock in time t, α_i is the intercept of the regression equation representing the non-market return component, $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock i. For the purpose of simplification, it is assumed that $\in_t$ has a multivariate normal distribution and is independently and identically distributed over time. The coefficient β_{1t} is the risk sensitivity of returns for market risk premium.

The above model represents the single factor model for an individual stock. This model can be used for portfolios of stocks as well. By replacing i with a p to represent a portfolio of stocks, the single factor model CAPM for portfolios can be expressed as follows:

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[4] High book value to market value, big market capitalization and Up (HBU), High book value to market value, big market capitalization and Down (HBD). High book value to market value, small market capitalization and Up (HSU), High book value to market value, small market capitalization and Down (HSD), Medium book value to market value, big market capitalization and Up (MBU), Medium book value to market value, big market capitalization and Down (MBD), Medium book value to market value, small market capitalization and Up (MSU), Medium book value to market value, small market capitalization and Down (MSD), Low book value to market value, big market capitalization and Up (LBU), Low book value to market value, big market capitalization and Down (LBD), Low book value to market value, small market capitalization and Up (LSU), Low book value to market value, small market capitalization and Down (LSD).

$$ER_{pt} = \alpha_p + (R_{mt} - R_f)\beta_{1t} + \in_t \quad \ldots \quad (4)$$

Where ER_{pt} is the excess return of the portfolio in time t, α_p is the average of all individual alphas of the stocks included in the portfolio.

2.3 Model Specification (Fama and French-Three Factor Model)

Fama and French proposed that Size and Value premium should be priced and stated that market risk beta is not the only risk factor that affects the returns of the stocks.

Augmented CAPM with Size and Value factor can be expressed as follows:

$$R_{it} = R_f + (R_{mt} - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} \quad \ldots (5)$$

Where R_{it} represents the expected return on a stock i in time t, R_f represents the risk free rate of return, R_{mt} - R_f represents the market risk premium, SMB is the size premium and HML is the value premium. The coefficients β_{1t}, β_{2t} and β_{3t} are the risk sensitivities of returns for market risk, size and value. In order to test the FF three factor model, a multiple regression framework was used by transforming the above equation into a simple time series model as follows:

$$ER_{it} = \alpha_i + (R_{mt} - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + \in_t \quad \ldots (6)$$

Where $ER_{it} = R_{it} - R_f$ represents the excess return on stock i in time t, α_i is the intercept of the regression equation representing the non-market return component, $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock i. FF three factor model for an individual stock can also be expressed for a portfolio by replacing i with p:

$$ER_{pt} = \alpha_p + (R_{mt} + R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + \in_t \quad \ldots (7)$$

Where ER_{pt} is the excess return of the portfolio in time t, α_p is the average of all individual alphas of the stocks included in the portfolio.

Small Minus Big (SMB)

SMB capture the risk factor in returns related to firm size. It is the difference between the average returns on portfolios of small stocks and average returns on portfolios of big stocks, constructed to be neutral vis-à-vis book to market ratio and momentum.

$$SMB = [\frac{HSU + HSD + MSU + MSD + LSU + LSD}{6} - \frac{HBU + HBD + MBU + MBD + LBU + LBD}{6}]$$

High Minus Low (HML)

HML accounts for the risk factor that is related to firm value. It is the difference between the average returns on portfolios of high book to market ratio stocks and average returns on portfolios of low book to market ratio, constructed to be neutral vis-à-vis size and momentum. The stocks with high book to market ratio are called value stocks where as the stocks with low book to market are called growth stocks.

$$HML = [\frac{HSU + HSD + HBU + HBD}{4} - \frac{LBU + LBD + LSU + LSD}{4}]$$

2.4 Model Specification (Carhart - Four Factor Model)

Carhart (1997) and Liew and Vassalou (2000) augmented the Fama and French three-factor model with a momentum factor WML, Winners minus losers. Winners are the stocks with the highest last year's average daily returns, excluding the most recent month, and the losers were the stocks with the lowest last year's average daily returns. Winner stocks are also termed as "up". Similarly loser stocks are also termed as "down". For the purpose of this research winner stocks represented up and loser stocks represented down. UMD is a risk factor which measures the momentum premium. Augmented CAPM with Size, Book to Market value and Momentum Factor, can be expressed as follows:

$$R_{it} = R_f + (R_{mt} - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + (UMD)\beta_{4t} \quad \ldots (8)$$

Where R_{it} represents the expected return on a stock i in time t, R_f is the risk free rate of return, R_{mt} - R_f represents the market risk premium, SMB is the size premium, HML is the value premium and WML is the momentum premium. The coefficients β_{1t}, β_{2t}, β_{3t} and β_{4t} are the risk sensitivities of returns for market risk, size, value and momentum. In order to test the Carhart four factor model, a multiple regression framework is used by transforming the above equation into a simple time series model as follows:

$$ER_{it} = \alpha_i + (R_{mt} - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + (UMD)\beta_{4t} + \in_t \quad \ldots (9)$$

Where $ER_{it} = R_{it} - R_f$ represents the excess return on stock in time t, α_i is the intercept of the regression equation representing the non-market return component, $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock i. Carhart four factor model for an individual stock can also be expressed for a portfolio by replacing i with p:

$$ER_{pt} = \alpha_p + (R_{mt} - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + (UMD)\beta_{4t} + \in_t \quad \ldots (10)$$

Where ER_{pt} is the excess return of the portfolio in time t, α_p is the average of all individual alphas of the stocks included in the portfolio.

Up Minus Down (UMD)

Up in time *(t+1)* are the stocks with the top 50% - highest average daily returns out of all the stocks in time *(t)* and Down in time *(t+1)* are the stocks with the Bottom 50% - lowest average daily returns out of all the stocks in time (t). *UMD* is the average of daily returns of all the equally weighted portfolios that are Up minus the average of daily returns of all the equally weighted portfolios that are Down.

$$UMD = [\frac{HSU + HBU + MSU + MBU + LSU + LBU}{6} - \frac{HSD + HBD + MSD + MBD + LSD + LBD}{6}]$$

3. Empirical Results and Analysis

Table 3 reports the individual CAPM regressions on twelve size, book to market and momentum sorted portfolios. The CAPM assumes that market beta is the only risk factor that can explain the cross-sectional variation of the expected stock returns. However, the empirical results of the tests of CAPM revealed a weak relationship between the average portfolio returns and market beta. The coefficients of all of the twelve portfolios are insignificant with an exception of only one portfolio, BHD, which was significant at 10% significance level. The regression

intercept (α) of eight out of twelve portfolios were significant. This implies that for these eight portfolios, the CAPM significantly understates the returns of the portfolios. The model fails to explain all variation in excess returns and there are some other variables in addition to market risk premium which needs to be added in the CAPM. The portfolios for which the CAPM understates the returns are generally smaller in size. Only one (out of six) small portfolio, SLD, has a significant regression intercept. The three big portfolios having an insignificant regression intercept were also winners. The results suggest that there might be some other factors affecting the returns. This is contrary to the proposition of Sharpe that the market risk is the only risk factor that can explain the cross-sectional variation of the expected returns of an asset. The overall research findings confirmed that market risk is not the only risk factor that can explain the cross-sectional variation of expected returns.

Table 4 presents the empirical results of the 12 individual Fama-French regressions on twelve portfolios sorted on size, book to market ratio and momentum. As was the case with the CAPM regressions, beta of market risk premium was found insignificant for all twelve portfolios. The coefficients of size factor SMB (β_2) were found significant for five (out of six) portfolios with small size companies. The coefficients of SHU, SLD, SMD, SMU were significant at 1%. However the coefficient of SLU was significant at 10%. The coefficients were significant at 1% for all six portfolios with big size companies i.e. BHD, BHU, BLD, BLU, BMD and BMU. The results highlighted that the coefficients of SMB (β_2) were positive for each of six (out of twelve) portfolios that had small companies stocks; but these coefficients were negative for each of six (out of twelve) portfolios that had big companies stocks. This evidence indicates an existence of size premium. The coefficients of value factor HML (β_3) for four portfolios that include companies with low and medium book to market ratio and big size companies, i.e. BLD, BLU, BMD, BMU, were significant at 1% and were negative. Whereas the coefficients of HML (β_3) were significant at 1% and negative for only two out of six portfolios with low book to market ratio and small size companies i.e. SLD and SLU. Moreover the coefficients of HML (β_3) on all of the portfolios (four out of twelve) that include companies with high book to market ratio i.e. BHD, BHU, SHD and SHU were found significant at 1% and were positive. This highlighted existence of value premium. Hence, HML is a significant explanator of returns on high book-to-market ratio portfolios, but not as significant for low book to market portfolios and for medium book to market ratio portfolios with big size companies and low book to market portfolios for small size companies.

The results supported Fama and French's proposition and confirmed that even in Pakistan the small companies due to the narrow scope of their business, are less diversified and have less financial flexibility to respond to unexpected events that affect the overall performance of the market. Moreover small size companies are more sensitive to shocks and market volatility. Subsequently, the small size companies are greatly affected by various risk factors. Therefore, the investors require a size premium (additional return) while making an investment in small companies because of their higher exposure to risk associated with the nature of the small companies. Investors also require a value premium (additional return from low book to market ratio stocks) because a high book to market ratio depicts a relatively high book value of firm as compared to its market value signifying that the market will not place a high value for stocks with high book-to-market ratio due to present distress it is facing or investors' expectations about the future predictability of returns of such stocks.

Table 3

CAPM: Single Factor Regressions on 12 Portfolios Sorted for Size, Book to Market ratio and Momentum

This table reports the results of individual CAPM regressions on 12 size, book-to-market and momentum sorted portfolios for the sample period according to:

$$ER_{pt} = \alpha_p + (R_{mt} - R_f)\beta_{1t} + \in_t$$

Where ER_{pt} is the excess return of the portfolio in time *t*, α_p is the average of all individual alphas of the stocks included in the portfolio. α_p is the intercept of the regression equation representing the non-market return component, R_m - R_f represents the market risk premium. The coefficient β_{1t} is the risk sensitivity of returns for market risk, $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock *i*. For the purpose of simplification, it is assumed that $\in_t$ has a multivariate normal distribution and is independently and identically distributed over time. Column 1 and 2 reports the estimates of α_p and β_{1t} . Column 2 and 3 reports the t statistics of the estimates of α_p and β_{1t} . Whereas Column 5 reports the R^2 .

	α	β_1	$t(\alpha)$	$t(\beta_1)$	R^2
BHD	-0.000541	-0.042992	-1.406005	-1.877207	0.001447
BHU	0.004725	-0.012977	12.54184***	-0.579174	0.000138
BLD	-0.000352	-0.017944	-1.137062	-0.975529	0.000391
BLU	0.001591	-0.002504	5.193214***	-0.137396	0.000008
BMD	-0.0005	0.000728	-1.598541	0.039123	0.000001
BMU	0.001607	0.014995	5.110243***	0.80192	0.000264
SHD	-0.000898	0.020155	-3.287359***	1.240932	0.000633
SHU	0.001528	-0.00569	4.018142***	-0.251605	0.000026
SLD	-0.000338	-0.026453	-0.821494	-1.081084	0.00048
SLU	0.001786	0.02045	4.58947***	0.883665	0.000321
SMD	-0.000597	0.005838	-2.078563**	0.341958	0.000048
SMU	0.001575	-0.006484	5.168736***	-0.357892	0.000053

* Significant at 10%

** Significant at 5%

*** Significant at 1%

Table 4

Fama and French: Three Factor Regressions on 12 Portfolios Sorted for Size, Book to Market ratio and Momentum

This table reports the results of individual Fama and French three factor regressions on 12 size, book-to-market and momentum sorted portfolios for the sample period according to:

$$ER_{Pt} = \alpha_P + (R_m - R_f)\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + \in_t$$

Where ER_{pt} is the excess return of the portfolio in time t, α_p is the average of all individual alphas of the stocks included in the portfolio. α_p is the intercept of the regression equation representing the non-market return component, R_{mt} - R_f represents the market risk premium. The coefficients β_{1t}, β_{2t} and β_{3t} are the risk sensitivities of returns for market risk, size and value. $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock i. For the purpose of simplification, it is assumed that $\in_t$ has a multivariate normal distribution and is independently and identically distributed over time. Column 1, 2, 3 and 4 reports the estimates of α_p, β_{1t}, β_{2t} and β_{3t}. Column 5,6 and 7 reports the t statistics of the estimates of α_p and β_{1t}, β_{2t} and β_{3t}. Whereas Column 8 reports the $Adj\ R^2$.

	α	***β1***	***β2***	***β3***	***t(α)***	***t(β1)***	***t(β2)***	***t(β3)***	***Adj R2***
BHD	0.000464	-0.03159	-0.873827	0.378647	0.19607	-1.588728	-23.34167***	11.00823***	0.24735
BHU	-0.00352	-0.002414	-0.778903	0.443453	-1.3282	-0.12329	-21.12855***	13.09216***	0.236407
BLD	0.001604	-0.009201	-0.891626	-0.381885	0.64219	-0.594482	-30.59953***	-14.26403***	0.292411
BLU	-0.0017	0.006286	-0.902185	-0.401615	-0.6613	0.414618	-31.60438***	-15.31225***	0.307818
BMD	0.004716	0.010356	-0.891509	-0.14654	1.91363	0.649588	-29.70166***	-5.31358***	0.265505
BMU	-0.00166	0.023568	-0.809378	-0.177835	-0.6468	1.424019	-25.97484***	-6.211502***	0.216875
SHD	0.002888	0.021094	0.003358	0.259728	1.08218	1.322183	0.1118	9.410884***	0.035789
SHU	-0.00019	-0.005897	0.254819	0.718042	-0.0729	-0.281183	6.453112***	19.79083***	0.13985
SLD	0.000219	-0.032381	0.271141	-0.752593	0.5815	-1.449493	6.446474***	-19.47438***	0.166919
SLU	-0.00203	0.016488	0.128116	-0.664036	-0.8147	0.763163	3.149579***	-17.76708***	0.128728
SMD	0.001459	0.005524	0.056369	0.08764	0.5246	0.324049	1.756405*	2.972102***	0.003024
SMU	-0.00487	-0.007822	0.138767	0.065443	-1.8168	-0.433118	4.081255***	2.094823**	0.00634

* Significant at 10%

** Significant at 5%

*** Significant at 1%

Table 5 reports the empirical results of the 12 individual four-factor regressions on the twelve size, book to market and momentum sorted portfolios. The four-factor model in this table is the Fama-French model augmented with the momentum factor, UMD. With regard to the market betas, the coefficients of SMB and the coefficients of HML, the results were very similar to those of the Fama-French regressions in table 7. The market risk factor was insignificant for all of the twelve portfolios. This evidence depicted that the market risk premium alone fails to explain the risk and return relationships for the portfolios even for the momentum four factor model. SMB is significant for all of the big (six out of twelve) and five out of six small sized portfolios with an exception of SHD, and HML is significant for all (four out of twelve) high book-to-market portfolios i.e BHD, BHU, SHD and SHU. The coefficients of all of the portfolios with big size companies and small size companies had similar signs as well, i.e. positive for small size companies and negative for big size companies, highlighting the existence and validity of size premium. Moreover the companies with high book to market ratio stocks had positive coefficients indicating a value premium. The coefficients of UMD (β_4) on all of the twelve portfolios were significant at 1% level of significance. Moreover the coefficients of UMD (β_4) for six out of twelve portfolios with companies that are Up, i.e. BHU, BLU, BMU, SHU, SLU, SMU were positive. Whereas the coefficients of UMD (β_4) for the remaining six portfolios that were Down were negative. These findings support the existence of momentum premium. The adjusted R^2 for all of the portfolios also showed significant improvement. The highest reported adjusted R^2 was 33% for BLU portfolio.

Moreover out of twelve portfolios only two portfolios, i.e. SLD and SMD had a significant regression intercept. Given these regression results it can be concluded that the momentum factor significantly increased the explanatory power of the model and explained the risk and return relationship better than CAPM and FF three factor model. The research evidence confirmed that investment strategies that involve taking a long position in well performing stocks and short position in poorly performing stocks on the basis of the past performance over the period of twelve months tend to produce significantly positive abnormal returns for the following year. These return continuation pattern indicated an existence of momentum in return of individual stocks, which implied positive correlation between past and future stock returns. It should be noted that the number of firms in each of the twelve portfolios varied each year during the sample period due to the rebalancing of the portfolios each year. Findings of the research revealed that three risk factors, i.e. size premium, value premium and momentum premium were priced in the KSE, and momentum premium was found to have the highest average annual premium among all other risk factors. It can be concluded that CAPM failed to capture all the systematic risks, which leaves part of the systematic risks which were related to firm characteristics such as the size, book-to-market ratio and the momentum effects.

In developing markets, the market index is misrepresented due to thin trading. Active trading exists in only a few stocks. Moreover the market index is value weighted and is therefore dominated by the stocks which are actively traded in the market. These factors lead to an insignificant market risk premium. The failure of CAPM in developing markets may be due to the fact that the market index does not reflect the overall market's dynamics.

Table 5

Momentum: Four Factor Regressions on 12 Portfolios Sorted for Size, Book to Market ratio and Momentum

This table reports the results of individual Fama and French three factor regressions on 12 size, book-to-market and momentum sorted portfolios for the sample period according to:

$$ER_{Pt} = \alpha_P + RP_t\beta_{1t} + (SMB)\beta_{2t} + (HML)\beta_{3t} + (UMD)\beta_{4t} + \in_t$$

Where ER_{pt} is the excess return of the portfolio in time *t,* α_p is the average of all individual alphas of the stocks included in the portfolio. α_p is the intercept of the regression equation representing the non-market return component, R_{mt} - R_f represents the market risk premium. The coefficients β_{1t}, β_{2t}, β_{3t} and β_{4t} are the risk sensitivities of returns for market risk, size, value and momentum premium. $\in_t$ represents the error term which is the random return component due to unexpected events related to a particular stock *i*. For the purpose of simplification, it is assumed that $\in_t$ has a multivariate normal distribution and is independently and identically distributed over time. Column 1, 2, 3, 4 and 5 reports the estimates of α_p , β_{1t}, β_{2t}, β_{3t} and β_{4t}. Column 6, 7 and 8 reports the *t* statistics of the estimates of α_p and β_{1t}, β_{2t}, β_{3t} and β_{4t}. Whereas Column 9 reports the $Adj\ R^2$.

	A	β_1	β_2	β_3	β_4	*t*(α)	*t*(β_1)	*t*(β_2)	*t*(β_3)	*t*(β_4)	*Adj R2*
BHD	0.000246	-0.025371	-0.840364	0.429072	-0.561891	0.726538	-1.328602	-23.33107***	12.91962***	-14.38695***	0.306164
BHU	0.002646	-0.009911	-0.819243	0.382666	0.677354	0.98219	-0.538617	-23.60412***	11.95769***	17.99865***	0.325985
BLD	-0.000109	-0.006886	-0.879171	-0.363118	-0.209127	-0.400341	-0.448768	-30.37687***	-13.60721***	-6.6639***	0.304829
BLU	0.000415	0.002677	-0.921606	-0.430881	0.326102	1.581475	0.180645	-32.96926***	-16.71757***	10.75886***	0.339031
BMD	-0.000423	0.0125	-0.879974	-0.129158	-0.19368	-1.509105	0.789437	-29.46475***	-4.690375***	-5.9809***	0.275866
BMU	0.000334	0.019828	-0.829499	-0.208156	0.337856	1.163277	1.222843	-27.12102***	-7.381255***	10.18757***	0.248656
SHD	6.91E-05	0.025684	0.028057	0.296945	-0.414715	0.252897	1.665421	0.964499	11.07125***	-13.14823***	0.099483
SHU	-0.000435	-0.013092	0.216106	0.659705	0.650048	-1.23035	-0.655667	5.737892***	18.99714***	15.91772***	0.220778
SLD	0.002151	-0.024343	0.314396	-0.687412	-0.726305	5.739569***	-1.150588	7.878397***	-18.68228***	-16.78529***	0.253199
SLU	-0.000341	0.005862	0.070936	-0.7502	0.960125	-0.990873	0.3021	1.93822*	-22.23125***	24.19423***	0.297632
SMD	0.000766	0.011253	0.087199	0.134097	-0.517669	2.660221***	0.691989	2.842768***	4.741354***	-15.56443***	0.093065
SMU	0.000489	-0.012527	0.113449	0.027291	0.42513	1.572706	-0.713046	3.423551***	0.893195	11.83174***	0.0601

* Significant at 10%

** Significant at 5%

*** Significant at 1%

On the other hand, Fama and French three factor model perform better in developing markets because this model takes into account the factors based on firm characteristics, i.e. size and value premium. Carhart's four factor momentum model is also relevant because this model takes into account the trading strategies related to Up and Down stocks in addition to the stocks firm characteristics.

4. Conclusion

The purpose of this study was to explore the asset pricing dynamics in a developing stock market. The empirical results of the tests of CAPM revealed a weak relationship between the average portfolio returns and market beta. These research findings were in consistent with the research findings of Black, Jensen and Scholes (1972), Chui and Wei (1998), Lam, S.K. (2002), Leledakis, Davidson and Karathanassis (2003) and Mirza and Shahid (2008). We believe that like most developing markets, the market index in PSX is misrepresented due to thin trading. Active trading exists in only a few stocks. Moreover the market index is value weighted and is therefore dominated by the stocks which are actively traded in the market. These factors lead to an insignificant market risk premium. It can be concluded that the failure of CAPM in developing markets may be due to the fact that the market index in does not reflect the overall market's dynamics. This might be the reason why market risk premium was insignificant in all of the four models tested in this study.

The empirical findings of Fama and French three factor model were in support of the FF proposition. As was the case with the CAPM regressions, market beta was insignificant and for all twelve portfolios. The positive coefficients of all portfolios with small size companies stocks indicated that size factor was priced in the returns. Moreover the positive coefficients of the portfolios with high book to market ratio stocks indicated that the value factor was also priced in the returns. Fama and French three factor model performed better than CAPM in Karachi Stock exchange because the three factor model takes into account the factors based on firm characteristics, i.e. size and value premium. The Four Factor model: Augmented CAPM with Size, Book to Market value and Momentum Factor takes into account the trading strategies of the investor. The empirical tests of the four factor model revealed that if the investors use momentum trading they could earn abnormal profits. The portfolios with Up stocks (stocks with the highest returns in time t) had positive coefficients which indicated that when past winners were bought and losers were sold; this trading strategy yielded abnormal profits.

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