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A Study for Validity of Multifactor Asset Pricing Models for Pakistan Stock Exchange

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Abstract

This study contributes to the literature extension on two widely studied multifactor models of asset pricing through testing the (Fama &French, 1993) 3-factor model and the (Carhart, 1997) 4-factor model for Pakistan Stock Exchange (PSX). The objective of this study is to test the validity of Fama & French 3-factor model and Carhart 4-factor model for the period of July 2012 to June 2018 for a sample of 98 companies listed in Pakistan Stock Exchange. The similar methodology of Fama & French (1993) is used for portfolio formation and 6 portfolios are formed and their value weighted excess returns are used as dependent variables. The regression results of Fama & French 3-factor model indicate its validity in explaining stock return variation but with insignificant intercept values. The Carhart 4-factor model regression results are also similar to that of Fama & French 3-factor and show no noticeable increase in the explanatory power of model by adding the momentum factor. Hence, from the results presented in the study it can be concluded that both size and value factors exist in PSX but do not favor the existence of momentum factor indicating less responsiveness of market towards this factor. Thus, from adjusted R2 and F values, both the models were found valid and can be used to explain the stock return variations.

Keywords: Multifactor Asset Pricing Models, (Fama & French, 1993) 3-Factor Model, (Carhart, 1997) 4-Factor Model, Pakistan Stock Exchange

Introduction

Background of the Study

In the equity markets around the world and for those who plan to invest in stocks, there is always a need of a balanced model of asset pricing with concerns regarding the risk- return relationship. Because this model helps the investors in explaining and estimating the stock returns and risk associated with them for making decisions to invest in those stocks or not. Therefore, valid asset pricing models are of utmost importance for investing in securities by individual and institutional investors. The mostly known, used and the first model for asset pricing in capital markets is, Capital Asset Pricing Model (CAPM) presented by (Sharpe, 1964) and (Lintner, 1965). CAPM comes up with some assumptions of efficient market in considering the relationship of risk and return.

In 1970's CAPM was widely used and appreciated for its measurement of risk with only one factor i.e., systematic risk but from 1980's to 1990's, questions were raised on the adequacy of CAPM in explaining stock returns. Meanwhile many anomalies of CAPM were shown by different researchers which could not be neglected. These are, the anomaly of size by (Banz, 1981), (Keim, 1985) and (Reinganum, 1981). (Stattman, 1980) and(Rosenberg, Reid, & Lanstein, 1985) in their studies found the effect of book to market ratio. Anomaly of earning price effect by (Basu, 1983), (L. K. C. Chan, Hamao, & Lakonishok, 1991) and anomaly of momentum of returns by (Jegadeesh & Titman, 1993).

CAPM neglects all the above non-market factors of momentum, b/m ratio and size and based only on market risk. So, the excessive returns by these non-market factors lead to anomalies. These

anomalies guided the future researcher in building multifactor models for explaining stock returns and many more models were proposed which have better explanatory power.

In 1993 (Fama & French, 1993) came up with their 3-factor model based on their prior research (Fama & French, 1992) , expanding the CAPM with two other risk factors of size and value of firms which should be accounted in the model to increase its explanation power of stock returns variation. Although, many studies supported the validity and better explanatory power over CAPM but afterwards researchers brought forward the fact that more risk factors should be incorporated in the model to increase its performance. So, (Carhart, 1997) proposed his 4-factor model adding a additional momentum factor in the (Fama & French, 1993) 3-factor model based on the momentum strategy document by (Jegadeesh & Titman, 1993) and found it better than the 3-factor model in explaining stock returns variation when tested on mutual funds. Therefore, this study is aimed to be conducted to test the validity of these multifactor models for Pakistan Stock Exchange. Thus, helping the investors and financial analysts in explaining and estimating the stock returns and risk associated with them for making investment decisions

Objectives of the Study

- To test that the Fama and French (1993) 3 factor model is valid for PSX
- To test that the Carhart (1997) 4 factor model is valid for PSX

Literature Review

Fama & French Three Factor Model

When CAPM became deficient in explaining security prices, numerous studies were conducted for alternative models to cover deficiencies of CAPM.

Fama & French (1993) in their studies proposed a 3-factor model for explaining returns. In their paper they identified risk factors related to stock returns. The overall market factor of CAPM the firm's size factor and b/m ratio factor of firms. All these three are the risk factors associated with returns on stocks, because the variation in the returns are due to these factors and much of the average stock returns are also explained by these factors. They find out profit of firm related to its size and firms with small market capitalization tend to low returns than the firms with big market capitalization. Hence, there is an inverse relationship between average of returns and size. Also, the firms with high b/m ratio have low returns on stocks, on the other hand firms with low b/m ratio (higher stock price/ low book value) are persistent with high stock returns. The main theme of this study is that size and b/m ratio, should proxy for factors of risk in return of rationally priced stocks.

All NYSE, Amex stocks from 1963 – 1991 and NASDAQ (after 1972) were used for the portfolio formation. In each (t) year's June they split all the stocks into small (S) and big (B) based on the market capitalization (which is share price * No. of shares) using NYSE size median. They also sort all stocks according to book-to-market ratio (b/m) with 30% bottom as low (L), 40% middle as medium (M) and 30% top as high (H). The (b/m) ratio of stocks is shareholders equity book value divided by market capitalization (size). The book shareholders equity for fiscal ending in year (t-1) was divided by market capitalization of December end of year (t-1) excluding firms with negative book value. This sorting decision of 2 size (market capitalization) and 3 value (b/m ratio) groups was based on their prior research (Fama & French, 1992). From the sorted groups 6 portfolios were formed which were SL, SM, SH, BL, BM, BH. Value weighted monthly returns of these portfolios were calculated form (t) year's July to (t+1) year's June with reformation in June (t+1). Firms with stock price of (t-1) year's December and (t) year's June and book value of (t-1) year with at least 2 years data were included in the tests.

The mimicking portfolio SMB (small-big) was used to mimic the size risk factor of returns and HML (high-low) portfolio mimics the value (b/m) risk factor of returns. To proxy market factor risk the market portfolio return minus the risk-free rate (RM-RF) was used.

They concluded that other than market risk, size and value also affects the expected stock returns. The following model was presented by (Fama & French, 1993)

$$\boldsymbol{E(Ri) - Rf = \alpha i + \beta i[E(Rm) - Rf] + siE(SMB) + hiE(HML) + \epsilon}$$

The above-mentioned coefficients of beta are sensitivity coefficients, expressing the multiple regression slopes of $E(Ri) - Rf$,$Rm - Rf$, SMB and HML. SMB is the size risk factor, HML is the book to market risk factor of returns.

This model was tested in many countries and found valid. (Lam, 2002) finds this 3-factor model significant for 100 companies from Hong Kong stock exchange from 1980-1997. (Ajili, 2003) after comparing the (Fama & French, 1993) model and (Daniel & Titman, 1997) model on a sample from 1976 - 2001 of French market, the results favored the 3-factor model of (Fama & French, 1993). He concludes that the dependent variable of six portfolios was on average 90.5% successful to explain expected returns. (Cao et al. 2005) compared 3 factor model with CAPM by using 367 stocks of Shanghai Stock Exchange from 1999 to 2002 and found significant results regarding its explanatory capacity. (O'Brien et al.2008)compared 3 factor model with CAPM for the Australian Market from 1982-2006. The analysis indicates the pricing of both SMB and HML, while HML is more significant. Results of J-statistics also supports the acceptance of null hypothesis. So, it is concluded that the 3-factor model can explain 70% variation in portfolio returns. A comparison and validation of CAPM, 3-factor model and 4-factor model for the Swedish equity market by (Rehnby, 2016). The results showed that CAPM on average explains 52% variations in stock returns while with the average of 56.9% the variations in stock returns were explained by the 3-factor model. So, the 3-factor model have better explanatory power than CAPM. (Unlu, 2013) in his evidence supporting multifactor asset pricing models used the monthly data for the period from July 1992 to June 2014 for Istanbul stock exchange. The results indicate the applicability of Fama – French 3-factor model. The value of adjusted R^2 shows that average 77% variation in the stocks of ISE is explained by this model. (Connor & Sehgal, 2001) tested the 3-factor model empirically for Indian stock market with a sample of 364 listed companies out of 8000 companies of India for the period of June 1989 to March 1999. They find the results in consistence with the Fama – French 3-factor model, because the results confirmed the size and value factors in the Indian stock market. (Xu & Zhang, 2014) in their study find out the extent to which the variation in the returns of tradable shares of Chinese stock market is explained by the Fama – French 3-factor model. The results are positive that 93.6% of variations can be explained by this model. (Al-Mwalla & Karasneh, 2011) studied the validity of Fama – French 3-factor model for the period June 1999 to June 2010 in the Amman stock exchange. They found the 3-factor model was better able to explain the stock return variation and have superior explanatory power than the single factor CAPM.

(J. Iqbal & Brooks, 2007) also compared CAPM with (Fama & French, 1993) 3 factor model for (KSE) Karachi Stock Exchange by using three different data frequencies of 89 stocks from 1999-2005. Thus, they concluded that this model can explain cross – sectional variation in the stock returns of KSE. (Abbas, Khan, Aziz, & Sumrani, 2014) empirically tested the 3-factor model's applicability from 2004 to 2014 and sample of stocks listed in KSE-100 index. Thus, this model was found good in explaining cross - section of average returns. (A. Iqbal, AliPeter, & D'Abreo, 2017) tested the 3-factor model's application for PSX covering 40 – listed companies, using bi-annual data

from 1983 – 2012. They interpreted that the 3-factor model explains returns in its simplified form on long term horizon better than CAPM.

Carhart Four Factor Model

This model was developed by (Carhart, 1997) it demonstrate that the persistence in risk adjusted and mean returns of mutual funds were explained by common-factors of returns in stocks and expenses of investment . (Carhart, 1997) argued that Fama & French, three factor model might not explain the effect of momentum as explained by (Jegadeesh and Titman, 1993). They documented the strategy to buy well past performers and sell poor performer stocks. The returns are positive (12% p/a) over a 9-month holding period (3 – 12 months). They find that this increase was not due to the market risk or delaying reaction of price. They analyzed winner – looser stocks portfolios with zero-cost 36 months after the formation for the period 1965 – 1989 and positive returns for each month in a year after the portfolio formation. But the performance of these winner – loser portfolios show that in the preceding year, the excess of the returns disappears in the following two years. The motivation behind the study was that the 3-factor model was not capable in explaining variation of portfolios which were sorted on momentum of past returns. This fact was based on his previous research, also documented by (Fama & French, 1996) and (Chan, Jegadeesh, & Lakonishok, 1996) as they examined that whether the future returns were predicted by past returns and were due to when market under reacts to information. The large drift in predicted future returns was not explained even after controlling the size, value and market risk factors. Thus, the market becomes inefficient when it reacts slowly to information and leads to momentum anomaly. The findings suggested a gradual response of market towards information.

(Carhart, 1997) used monthly data of all diversified mutual funds for the period Jan 1962 – Dec 1993. So, the data was free from survivor biasness. The performance of all NYSE, Amex and Nasdaq managed portfolios of stocks was evaluated. The construction of this 4-factor model was based on the 3-factor of Fama – French plus another factor which captures the anomaly of momentum indicated by (Jegadeesh & Titman, 1993). The size and value factors were similar as of Fama – French and the momentum factor (PR1YR) constructed by subtracting the past 11-month (one month lagged) returns of the bottom 30% stocks from the returns of the top 30% stocks. The average returns of 10 equally weighted portfolios were used for calculating the factor and were reformed on monthly basis. The descriptive statistics of the 4-factor model was also supportive that the stock return variation can be explained by this model because there was high level of variance in the size (SMB), value (HML) and momentum (PR1YR) portfolios formed with zero-investment. This indicates the model's explanatory power for time series. The high value of mean for the returns of these factors shows that the cross-section variations could be accounted by these factors. Also, low correlation between factors indicates the absence of multicollinearity and the factor loadings were not affected by it. The portfolios were created accordingly and gained return each year.

So, Mark Carhart added a momentum factor in Fama – French 3-factor model (WML) winner minus loser and presented the following regression model.

$$riT = \alpha$$

Here, the additional PR1YR is highest 30% return and lowest 30% returns of past 11 months. The findings show that the persistence of short term in returns of mutual funds can be explained by this model. The strategy to buy past top performer funds and sell past bottom performer funds give 8% returns per year indicates the success of this strategy.

Many studies also supported this model, (Liew & Vassalou, 2000) in their study examined the profitability of (SMB, HML, WML) factors and macroeconomic risk factors for 10 developed countries. The results show that the (SMB, HML and WML) risk factors were priced in all the coun-

tries. So, they concluded that the WML factor was also significant but a much little than the SMB and HML factors. (L'Her, Masmoudi, & Suret, 2004) tested the Fama – French 3-factor model augmented by Carhart's momentum factor for Canada. The findings show that the annual average premium for all the 4 risk factors was positive i.e., market factor with 4.52%, size factor with 5.08%, b/m factor with 5.09% and momentum factor with 16.07%. Thus, this study found the 4-factor model valid for Canada. (Naceur & Chaibi, 2007) in their evidence for the best model for calculating the cost of capital for the Tunisian Stock Exchange (TSE), Carhart's 4-factor model was selected. They used monthly data from the period July 2000 to June 2005. The results showed that mostly the big companies of financial institutions sector were at high risk because higher returns were required by them. They concluded that Carhart's 4-factor model was best for cost of capital estimation in comparison with other models. (Lam, Li, & So, 2010) tested the validity of (Fama & French, 1993) model augment with momentum factor for Hong Kong. The sample consists of 689 non-financial companies listed in Hong Kong Stock Exchange with monthly returns data for the period July 1981 – June 2001. The results found this model with significant power in capturing average returns variation. The regression results showed the significance of coefficients and insignificance of intercepts and standard deviation of residual with a high value of adjusted R^2, supporting its applicability. Thus, the findings validate the 4-factor model for Hong Kong Stock Exchange.

(Unlu, 2013) in his evidence supporting multi-factor asset pricing models tested (Carhart, 1997) 4-factor model. The monthly data are shown for the period from July 1992 to June 2011 for Istanbul Stock Exchange. The results indicate the validity of (Carhart, 1997) model. The value of adjusted R^2 show that on average 79.6% variation in the stock of ISE was explained by this model which was greater than the 3-factor model. A comparison and validation of CAPM, 3-factor model and 4-factor for the Swedish Equity Market by (Rehnby, 2016). The regression results show that the (Carhart, 1997) 4-factor model better performed with an average explanatory power of 61.2% which was greater than the single factor model and a little more than the 3-factor model. (Hossan & Abedin, 2019) tested the validity of (Carhart, 1997) 4-factor model for Dhaka Stock Exchange Bangladesh. They used monthly data of 109 sample companies from 2005 – 2014. The findings revealed that momentum effect was significant and positively related only to small, big and up portfolios. The R^2 values and F-statistics were also supportive. Thus, they concluded that the predictability of this model was accurate to explain stock returns in DSE without any abnormality in the market.

(Rehman, 2011) in her comparison of CAPM, ICAPM, (Fama & French, 1993)3-factor model and Carhart 4-factor model for Karachi Stock Exchange Pakistan. The study used daily returns data of industrial firms listed on KSE for the period July 1997 – June 2007. The coefficients of momentum (UMD) factor were significant at 1% level with positive values for all the UP portfolios and negative values for all the DOWN portfolios. This confirmed that momentum factor exists in KSE. The higher adjusted R^2 values of this model than CAPM and 3-factor model concluded its greater explanatory power than the prior models. (Rafique & Taj, 2013) explored the market risk factor (RM-RF), size risk factor (SMB), value risk factor (b/m) ratio and momentum risk factor (WML) on firms of Karachi Stock Exchange 100-index. A sample of 102 stocks listed on KSE 100-index was used to the period 2005 – 2012. The momentum factor was found significantly priced with 5% level for all portfolios excluding the (S/L) portfolio which was significant at 10% level. Thus, the empirical findings of this study validated the explanatory power of model for KSE. (Yahya, 2015) comparatively analyzed CAPM, 3-factor model and 4-factor model for KSE. Monthly returns of 134 stocks listed in KSE from January 2002 to April 2014 to form 25 portfolios based on size, value and past momentum. he concluded on the basis of results presented in this study

that both the (Fama & French, 1993) 3-factor model and (Carhart, 1997) 4-factor model can significantly predict the return variation of stocks listed in Pakistan Stock Market (KSE) but adding the momentum factor had no alarming effect as it does not increased the model's explanatory power in this market.

Theoretical Framework

Three Factor Model

$$E(Ri) - Rf = \alpha i + \beta i[E(Rm) - Rf] + siE(SMB) + hiE(HML) + \epsilon \quad \textbf{(1)}$$

Four Factor Model

$$E(Ri) - Rf = \alpha i + \beta i[E(Rm) - Rf] + siE(SMB) + hiE(HML) + wiE(WML) + \varepsilon \quad \textbf{(2)}$$

$E(Ri) - Rf$ (Excess return of 6 portfolios over risk-free rate)

$E(Rm) - Rf$ (Market premium i.e. market return over risk-free rate)

$E(SMB)$ (Size premium)

$E(HML)$ (Value premium)

$E(WML)$ (Momentum, earning premium)

Coefficients of beta *(βi, si, hi, wi)* in the above equations represents their sensitivity and expressing multiple regression slopes of E (Ri) - Rf and Rm-Rf, SMB, HML, and WML

Hypothesis

H0 = (αi =0) the(αi) coefficients of two multifactor models is equal to zero. H1= (αi ≠0) the (αi) coefficients of two multifactor models is not equal to zero.

As (Fama & French, 1996) zero hypothesis is tested for possible acceptance or rejection which is the basic objective of this study that multifactor models can be used for explaining stock prices in Pakistan Stock Exchange.

As indicated by (Jensen, Black, & Scholes, 1972) and (Fama & French, 1993) if alpha value of the models is different than zero significantly, it means that the model has an error of pricing and also a factor or some factors which is not explained by the model.

Methodology

According to (Fama & French, 1993, 1996)returns are calculated from July 2012 to June 2018 and for preventing the results to look bias the book to market ratio is calculated by dividing the book equity of December of year (t-1) with the market capitalization of December of year (t-1). The portfolios are formed in June of each year (t) paired with data of balance sheet in previous year's December (t-1).

Formation of Portfolios

Again (Fama & French, 1993, 1996)methodology is used for the formation of portfolios. So, all sample stocks are divided according to market capitalization (ME) i.e. stocks below ME median as Small (S) and above ME as Big (B). On the other hand, according to Book to Market equity stocks will also be grouped into three portfolios as (H) 30%of High, (M) 40% of Medium and (L) 30% of low stocks. By the intersection of these 2 size and 3 book to market portfolios, 6 portfolios are created which are S/L, S/M, S/H, B/L, B/M, B/H and their returns is the dependent variable in time series regression.

These portfolios are used to account the risk factors (independent variables) as given the regression equation of the model which are,

Market Risk Factor (Rm-R f)

Market Premium is estimated as the excess of market portfolio return (proxied by KSE-100 index monthly closing values) to the *risk-free rate*.

Size Risk Factor (SMB)

To account the size risk factor, small minus big (SMB) is estimated by subtracting the average returns of three big size portfolios from average returns of three small size portfolios.

$$SMB = \frac{[(S/L + S/M + S/H) - (B/L + B/M + B/H)]}{3}$$

Value Risk Factor (HML)

To account the value risk factor, high minus low (HML) is estimated by subtracting the average returns of two portfolios with low b/m ratio from the average returns of two portfolios with high b/m ratio.

$$HML = \frac{[(S/H + B/H) - (S/L + B/L)]}{2}$$

Momentum factor's calculation is according to,(Fama & French, 2008),(L'Her et al., 2004) and (Lam et al., 2010) again the 2 size sorted portfolios and 3 portfolios sorted on WML risk factor as winner (W) with best 70% return, Neutral (N) with average 40% and Loser (L) with lowest 30%. With this interaction 6 equally weighted portfolios are obtained. Stocks are arranged between each July of year (t) and June of year (t-1) and their performances between months (t-2 and t-12).

Momentum Risk Factor (WML)

The above mentioned 6 portfolios are used to estimate the winner minus loser (WML) by subtracting the loser stocks portfolio from winner stocks portfolio.

$$WML = \frac{[(s/w + s/l) - (b/w + b/l)]}{2}$$

The value weighted excess returns of (S/L, S/M, S/H, B/L, B/M, B/H) portfolios to the risk-free rate are used as the dependent variable in time series regression.

(Gibbons, Ross, & Shanken, 1989)F-test is recommended for determining the alpha value in these types of studies. As presented by (Fama & French, 1996).

$$J = \frac{(T-N-1)}{N}\left(1 + \frac{\widehat{\mu_m^2}}{\widehat{\sigma_m^2}}\right)^{-1}\hat{\alpha}\widehat{\Sigma^{-1}}\hat{\alpha}$$

Formulas

Portfolio Return = $R_{pt} = \ln (P_t/P_{t-1})$

Market Return = $R_{mt} = \ln (I_t/I_{t-1})$ I is monthly KSE-100 index

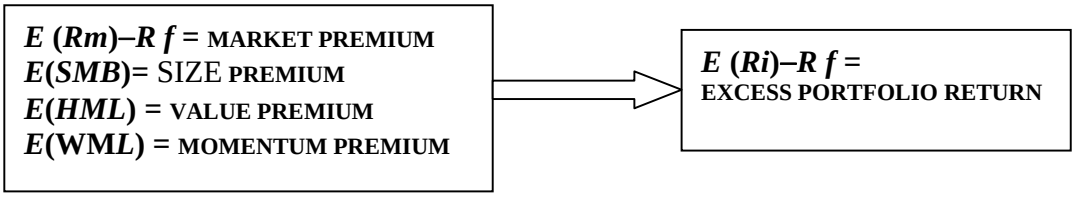
Market Capitalization= Share price * no. of outstanding shares

Book to Market Ratio = book value/ market value

Data Collection & Variables of Study

Monthly data for stock returns (end day price), Closing Index and market capitalization data is collected from the website of Business Recorder Pakistan. Balance Sheet Data of the sample stocks is collected from the websites of Business Recorder Pakistan and Pakistan Stock Exchange. For the risk-freerate a 3-month Treasury bill rate is taken from State Bank of Pakistan Auction data and converted into monthly rate with the help of following formula.

$$[R_f = (1 + \acute{R}_q)^{(\frac{1}{3})} - 1]$$



Sampling

The sample of 98 companies is taken from the companies included in KSE-100 index re-composed and implemented from April 2018. KSE-100 index is the best representative of the overall market, according to market capitalization and based on all sectors and represents 85% of the total capitalization of all companies listed on the Pakistan Stock Exchange. The firms which have negative Book equity are excluded from the sample. The sample is based on data availability of stocks. The time of this study is from 2012 to 2018.

Results

Table 1. Mean, Standard Deviation

	Observations	Mean	St. Deviation
RM-RF	72	-0.010	0.049
SMB	72	0.002	0.041
HML	72	0.002	0.059
MOM	72	0.056	0.054
SL	72	-0.009	0.088
SM	72	-0.001	0.088
SH	72	-0.001	0.075
BL	72	-0.003	0.065
BM	72	-0.007	0.058
BH	72	-0.007	0.068

Table 2. Correlation of variables

	RM-RF	SMB	HML	MOM
RM-RF	1			
SMB	0.078	1		
HML	0.4207	-0.1081	1	
MOM	-0.1362	0.3308	-0.3039	1

Tables 1 and 2 represent Mean, Standard Deviation and Correlation of variables and from table 2 no multicollinearity is observed because all the values are less than 0.7.

Table 3. The regression results of (Carhart, 1997) 4-factor model.

(Ri)-Rf	*α*	*β*	*s*	*h*	Ad. R2	F
SL	0.000	1.084	1.229	-0.803	0.831	117.010
	(0.962)	(0.000)	(0.000)	(0.000)		(0.0000)

(Ri)-Rf	*α*	*β*	*s*	*h*	Ad. R2	F
SM	0.009	1.097	0.622	-0.054	0.446	20.030
	(0.288)	(0.000)	(0.002)	(0.718)		(0.0000)
SH	0.006	0.936	0.870	0.264	0.760	76.110
	(0.213)	(0.000)	(0.000)	(0.002)		(0.0000)
BL	0.008	0.964	-0.262	-0.772	0.546	29.500
	(0.118)	(0.000)	(0.045)	(0.000)		(0.0000)
BM	0.003	1.041	-0.113	0.017	0.768	79.480
	(0.399)	(0.000)	(0.173)	(0.789)		(0.0000)
BH	0.003	1.112	0.097	0.161	0.760	75.930
	(0.454)	(0.000)	(0.322)	(0.036)		(0.0000)

The results reported in table 3 are the regression results of (Carhart, 1997) 4-factor model.

As mentioned above the asset pricing model is valid when alpha α of all dependent portfolios differs significantly than zero. From the examination of table 3 it is seen that except for the SL portfolio all the intercept values are different from zero with higher p-values. The regression coefficient *(βi, si, hi)* for all the portfolios are significant with favorable p-values less than 0.05 except for size factor coefficient for BM and BH portfolios and the value factor coefficients for SM and BM because these portfolios are not used in the construction of SMB and HML factors. The F-values for all the portfolios shows the significance of this model in explaining stock return variation with significant p- values. Further the values of adjusted R^2 for each of the portfolios show that on average this model explains 68.5 % variation of stock returns. Thus, on the basis of results presented in table 3 it is concluded that this model is found valid in explaining stock return variation.

The results reported in table 4 are the regression results of (Fama & French, 1993) 3-factor model.

Table 4. The regression results of (Fama & French, 1993) 3-factor model.

(Ri)-Rf	*α*	*β*	*s*	*h*	*w*	Ad. R2	F
SL	-0.010	1.095	1.157	-0.762	0.179	0.839	93.220
	(0.133)	(0.000)	(0.000)	(0.000)	(0.040)		(0.0000)
SM	0.010	1.095	0.636	-0.062	-0.034	0.438	14.820
	(0.389)	(0.000)	(0.003)	(0.691)	(0.836)		(0.0000)
SH	-0.002	0.945	0.811	0.297	0.144	0.766	59.140
	(0.723)	(0.000)	(0.000)	(0.001)	(0.108)		(0.0000)
BL	0.004	0.969	-0.294	-0.754	0.079	0.543	22.110
	(0.609)	(0.000)	(0.034)	(0.000)	(0.465)		(0.0000)
BM	-0.003	1.047	-0.152	0.039	0.098	0.772	61.080
	(0.620)	(0.000)	(0.080)	(0.546)	(0.153)		(0.0000)
BH	-0.003	1.119	0.051	0.187	0.114	0.764	58.290
	-0.589	(0.000)	(0.618)	(0.018)	(0.161)		(0.0000)

From the examination of table 4 it is seen that except for the SL portfolio all the intercept values are different from zero with higher p-values. The regression coefficient *(βi, si, hi, w)* are sig-

nificant for all the portfolios with favorable p-values less than 0.05 except for size factor coefficient for BM and BH portfolios, the value factor coefficients for SM and BM portfolios and the coefficient of momentum factor for all the portfolios are insignificant with p-values greater than 0.05 F-values shows the significance of this model for all the portfolios with significant p- values in explaining variation of stock return. The values of adjusted R^2 show that on average this model explains 68.69% variation in returns which is almost similar to the (Fama & French, 1993) 3-factor model indicating that the explanatory power of the 3-factor model does not increases to a noticeable extent by adding the momentum factor to it for Pakistan Stock Exchange (PSX). However, it can also be used in explaining stock return variations. Thus, based on the results presented in table 4 it is concluded that this model is found valid in explaining stock return variation.

Conclusion

The objective of this study is to test the validity of Fama & French 3-factor model and Carhart 4-factor model for the period July 2012 to June 2018 for a sample of 98 companies listed in Pakistan Stock Exchange. The similar methodology of (Fama & French, 1993) is used for portfolio formation and 6 portfolios are formed and their value weighted excess returns are used as dependent variables.

The regression results of Fama & French 3-factor model shows that market factor is found positive and significant for all portfolios. The size factor is found positive for all portfolios except BL and BM and significant except BM and BH. The value factor is found positive for all except SL, SM and BL portfolios and significant for all expect SM and BM portfolios. However, the overall results indicate its validity in explaining stock return variation but with insignificant intercept values. The Carhart 4-factor model regression results are also similar to that of Fama & French 3-factor that market factor is found positive and significant for all portfolios. The size factor is found positive for all portfolios except BL and BM and significant except BM and BH. The value factor is found positive for all except SL, SM and BL portfolios and significant for all expect SM and BM portfolios. The momentum factor is found positive for all except SM and found insignificant for all except SL portfolio. The results also show no noticeable increase in the explanatory power of model by adding the momentum factor. Hence, from the results presented in the study it can be concluded that both size and value factors exist in PSX but does not favors the existence of momentum factor indicating less responsiveness of market towards this factor. Thus, from adjusted R^2 and F values, both the models were found valid and can be used to explain the stock return variations.

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