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CAN A HUMAN CAPITAL-BASED SIX FACTOR MODEL PERFORM BETTER THAN FAMA-FRENCH FIVE FACTOR MODEL? AN EMPIRICAL STUDY ON ASSET PRICING IN PAKISTAN

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ABSTRACT

This study compares the human capital based six factor model with the Fama-French five factor model in the context of Pakistan. For this purpose, we collected data from 170 non-financial firms listed on the Pakistan stock exchange based on market capitalization from 2010 to 2020. We employed Fama-Macbeth two-pass approach. This study finds that the six-factor model outperforms the five-factor model of Fama and French to explain variations in portfolio returns. The findings motivate investors and academicians to include human capital as a factor in asset pricing models to improve the estimation of the required rate of return of a security and/or portfolio.

Keywords: Fama-Macbeth, human capital, Pakistan stock exchange, Asset pricing.

1. INTRODUCTION

In recent past, asset pricing has attracted the interest of many researchers. Despite the wide range of asset pricing models that have emerged since (Sharpe, 1964), (Lintner, 1965) and (Mossin, 1966) proposed the capital asset pricing model (henceforth, the CAPM). According to Markowitz (1952) selecting securities can be divided into two stages (i.e., observation and experience). The first step begins with accessible knowledge and leads to constructing views about future stock performance. The second talks about how investors construct portfolio to maximize expected return with undiversified risk. According to Basu (1977) and Banz (1981) leaving anything out of a good model is difficult. Although CAPM has made significant progress in asset pricing, it has certain drawbacks as a single-factor model that uses one risk factor to explain the expected rate of return of an asset (Zhang et al., 2021).

Fama and French (1993) added two additional factors (namely size and book to market ratio) in CAPM. They proposed a three-factor asset pricing model (FF3FM). The proposed model better explains

the variation in excess portfolio returns. Following that, Carhart (1997) proposed the 4-factor model (hereafter, C4FM) which included an additional momentum factor based on the Jegadeesh & Titman (1993) momentum strategy, it outperformed FF3FM for explaining the variability in asset returns. Novy-Marx (2013) constructed profit expectation factor which strongly relates to stock returns. Similarly, Aharoni et al. (2013) finds significant correlation between firms' investment and excess stock returns. Fama and French (2008) find that firms with high profitability report abnormal high returns, and there is little evidence that firms with low profitability report low returns. Based on Williams's (1938) and Modigliani and Miller (1961) dividend discount model (DDM), Fama and French (2015) proposed five-factor model (FF5FM) with additional two factors (namely profitability and investment). Roy and Shijin (2018) proposed new six-factor asset pricing model which includes human capital. The model explains substantial amount of the portfolio return variations.

The Pakistan stock exchange is extremely volatile due to political upheaval and poor macroeconomic

performance (Arby, 2004). PSX emerging stock market (Ayub, 2002). When the financial sector was expanded in the 1990s, foreign investors were allowed to make portfolio investments in PSX, which considerably enhanced market capitalization and performance. PSX is now ranked third in the world's emerging equities market. In 2000, the SECP (Security Exchange Commission of Pakistan) created and implemented many regulations and policies that helped stabilize the market and boost investor confidence.

We can see that the five-factor model applicability in different stock markets varies greatly. In terms of the Pakistan stock market, it has yet to be determined whether the Six-factor model's analytical ability is superior to that of the Five-factor model. In this context, the purpose of this study is to conduct an empirical study to test the application of both five and six models for explaining excess portfolio returns and compare the differences in the analytical capacity of both models. Looking at the literature available on the assets pricing model in Pakistan, no prior study has been conducted on the comparison of the six-factor model of Roy and Shijin (2018) and FF5FM employing Fama and Macbeth (1973) two pass methodology.

This paper contributed to the existing literature in the following ways: First, this study examines whether human capital captures the variation in portfolio returns. Second, we examine the efficiency and validity of both models in Pakistan stock market. To the best of our knowledge, no comprehensive study on asset pricing models incorporating human capital is being conducted in Asian emerging markets, particularly in Pakistan. To the best of our knowledge, this is the first study in Pakistan to compare FF5FM and human capital based six factor model.

The remainder of the paper is structured as follows. Section 2 is a review of the existing literature. Section 3 discuss the methodology. Section 4 contains empirical findings and discussion. Section 5 concludes the study and provides recommendations for the future research.

2. LITERATURE REVIEW

Fama and French (1993, 1995, 1998, 2002, 2015-2017) developed the stock anomaly hypothesis rationally and consistently. They created a logical framework for conducting research and creating proposals. Fama and French (2015) developed the five-factor model by incorporating two new components into the three-factor model profitability and investment factors to three-factor model. The profitability component is RMW (robust minus weak)

whereas the investment factor is CMA (conservative minus aggressive). Similarly, Fama and French (2018) propped six factor model which includes momentum factor. Financial analyst and investors use their understanding of the factors influencing stock returns and the risks associated to select assets and construct portfolios that maximize returns (Gregory et al., 2013).

Zaremba and Czapkiewicz (2017) compared the CAPM, FFC4M, FF3F, and FF5F models and concluded that considering the present anomalies, the FF5F model best-described portfolio results several studies confirm the validity of FF5FM in several stock markets (see e.g., Ozkan, 2018; Racicot et al., 2018; Qi, 2017; Guo et al., 2017; Chiah et al., 2016; Huynh, 2018; Paliienko, 2019).

Several studies confirm the validity of FF5FM for explaining the variability in asset returns (Racicot and Rentz, 2016; Sutrisno and Ekaputra, 2016; Kubota and Takehara, 2018; Dutta, 2019). However, Foye (2018) finds that FF5FM outperformed FF3FM in Eastern Europe and Latin America but not in Asian emerging markets. According to Huynh (2018) FF3FM failed the GRS (Gibbons-Ross-Shanken) test. Further, it documents that optimal asset pricing model is still ongoing. Cox and Britten (2019) discussed the FF5FM's performance on the Johannesburg Stock Exchange (JSE). They concluded that it has similar explanatory power to the three-factor size-value model. The employment of models that can more precisely justify variations in profitability and explain anomalies in asset pricing. Similarly, price discrepancies could result from market failure or poor specification of preceding models, particularly CAPM (Paliienko et al., 2020).

According to Foye and Valentini (2020), Indonesia has yet to create a mature financial reporting framework, as a result of which accounting-based characteristics (probability and investment) are unable to completely explain the average return of portfolios. To build a new five-factor model, M. N. López-García (2021) included the MOM momentum element and new memory component, pointing out that the memory component is more significant than MOM.

Campbell (1996) emphasizes human capital factor in combination with value and size strategies. Kim et al. (2011) demonstrated that human capital incorporates the predictive capability of value and size strategies. Mayers (1972) described the importance of human capital in asset return predictability, indicating that approximately 75% of the consumption is based on labor income, making human capital an important

component of aggregate wealth. According to Belo et al. (2017), there is a strong relationship between asset price and labor economics literature. The empirical findings imply that the premiums in cross-sectional returns are determined by the characteristics of the labor factor, which are usually neglected in capital asset pricing.

Kuehn et al. (2017) studied the behavior of labor-financial market interaction to identify the determinants of stock returns. According to Shijin et al. (2012) human capital accounts for a considerable amount of asset return variation. Roy and Shijin (2018) explored the role of human capital in asset pricing. It finds that human capital subsumes the explanatory power of size and value strategies in return for the predictability. Maiti and Vukovic (2020) document that modified five-factor model including human assets outperformed FF3FM and FF5FM.

In terms of the literature gap, much work has been done in developed and emerging economies to examine the efficacy of CAPM, FF3FM, and FF5FM. However, little work has been carried out that examines the role of human capital in the assets pricing model. Moreover, there have been limited studies conducted that examine the efficiency of FF3FM and FF5FM through Fama and Macbeth's (1973) time series regression methodologies in the context of Pakistan. With the aforementioned limitation in the literature gap, studying the role of human capital in the assets pricing model in Pakistan is still unexplored. This study has been conducted to fill the gap in the extant literature.

3. DATA METHODOLOGY

We collect data of 170 non-financial firms listed on the Pakistan stock exchange (PSX). Further, we take monthly share price data from business recorder website for the period of July 2010- June 2020. Similarly, for factor construction we take annual data for five factors, namely size, value, profitability, investment and human capital are collected for portfolio construction from the Balance Sheet Analysis (BSA), report published by the State Bank of Pakistan (SBP) from June 2010 to June 2019. Similarly, we take monthly stock market index data from the business recorder website. Whereas, for estimation of market risk premium we take twelve-months treasury bill rates (risk free rate) published by the State Bank of Pakistan.

Table 3.1. Variables Description

Variables	Description	References
Size	Market capitalization is used as a proxy of size.	F&F (1993)
HML	Book-equity to the market value of equity is used as a proxy for value-factor.	F&F (1993)
RMW	Operating profit (EBIT) minus interest expense divided by the book value of equity is used as a proxy for the Profitability factor.	F&F (2015)
CMA	Annual change in total assets is used as a proxy for investment factors.	F&F (2015)
LwMHg	Annual salaries and wages payable mentioned in fiscal year annual report, end year t-1 to final year t is used as a proxy of labor income growth rate factor.	Roy& Shijin (2018)

3.1 Portfolio Formation

This study created 32 (2x2x2x2 sorted) portfolios in which companies were divided into categories based on size (SMB), value (HML), profitability (RMW), investment (CMA), and human capital premium (LwMHg).

Size Premium (SMB) = $1/16 * [(SLWCLw - BLWCLw) + (SLWCHg - BLWCHg) + (SLWALw - BLWALw) + (SLWAHg - BLWAHg) + (SLRCLw - (BLRCLw) + (SLRCHg - (BLRCHg) + (SLRALw - BLRALw) + (BLRALw - BLRAHg) + (SHWCLw - BLWCLw) + (SHWCHg - BHWCHg) + (SHWALw - BHWALw) + (SHWAHg - BHWAHg) + (SHRCLw - BHRCLw) + (SHRCHg - BHRCHg) + (SHRALw - BHRALw) + (SHRAHg - BHRAHg)]$

Value Premium (HML) = $1/16 * [(SHWCLw - SLWCLw) + (SHWCHg - SLWCHg) + (SHWALw - SLWALw) + (SHWAHg - SLWAHg) + (SHRCLw - SLRCLw) + (SHRCHg - SLRCHg) + (SHRALo - SLRALo) + (SHRAHg - SLRAHg) + (BHWCLo - BLWCLo) + (BHWCHg - BLWCHg) + (BHWALo - BLWALo) + (BHWAHg - BLWAHg) + (BHRCLo - BLRCLo) + (BHRCHg - BLRCHg) + (BHRALo - BLRALo) + (BHRAHg - BLRAHg)]$

Profitability Premium (RMW) = $1/16 * [(SLRCLw - SLWCLw) + (SLRCHg - SLWCHg) + (SLRALo - SLWALo) + (SLRAHg - SLWAHg) + (SHRCLo - SHWCLo) + (SHRCHg - SHWCHg) + (SHRALo - SHWALo) + (SHRAHg - SHWAHg) + (BLRCLo - BLWCLo) + (BLRCHg - BLWCHg) + (BLRALo - BLWALo) + (BLRAHg - BLWAHg) + (BHRCLo - BHWCLo) + (BHRCHg - BHWCHg) + (BHRALo - BHWALo) + (BHRAHg - BHWAHg)]$

Investment Premium (CMA) = $1/16 * [(SLWCLw - SLWALw) + (SLWCHg - SLWAHg) + (SLRCLw - SLRALw) + (SLRCHg - SLRAHg) + (SHWCLw - SHWALw) + (SHWCHg - SHWAHg) + (SHRCLw - SHRAHg) + (SHRCHg - SHRAHg) + (BLWCLw - BLWALw) + (BLWCHg - BLWAHg) + (BLRCLw - BLWALw) + (BLRCHg - BLWAHg) + (BHWCLw - BHWALw) + (BHWCHg - BHWAHg) + (BHRCLw - BHRALw) + (BHRCHg - BHRAHg)]$

Labor income growth Premium (LwMH) = $1/16 * [(SLWCLw - SLWCHg) + (SLWALw - SLWAHg) + (SLRCLw - SLRCHg) + (SLRALw - SLRAHg) + (SHWCLw - SHWCHg) + (SHWALw - SHWAHg) + (SHRCLw - SHRCHg) + (SHRALw - SHRAHg) + (BLWCLw - BLWCHg) + (BLWALw - BLWAHg) + (BLRCLw - BLRCHg) + (BLRALw - BLRAHg) + (BHWCLw - BHWCHg) + (BHWALw - BHWAHg) + (BHRCLw - BHRCHg) + (BHRALw - BHRAHg)]$

3.2 Fama-Macbeth (Fmb) Two-Pass-Regression

3.2.1 Fama-French Five-Factor Model FMB time series regression model:

$$R_t - R_{ft} = \alpha + b_m(MKT_t) + b_s(SMB_t) + b_h(HML_t) + b_r(RMW_t) + b_c(CMA_t) + \varepsilon_t \quad (1)$$

FMB two-pass regression model:

$$R_t - R_{ft} = \alpha + b_m(\beta MKT_t) + b_s(\beta SMB_t) + b_h(\beta HML_t) + b_r(\beta RMW_t) + b_c(\beta CMA_t) + \varepsilon_t \quad (2)$$

3.2.2 Six Factor Asset Pricing Model FMB time series regression model:

$$R_t - R_{ft} = \alpha + b_m(MKT_t) + b_s(SMB_t) + b_h(HML_t) + b_r(RMW_t) + b_c(CMA_t) + b_l(LwMHg_t) + \varepsilon_t \quad (3)$$

FMB two pass regression model:

$$R_t - R_{ft} = \alpha + b_m(\beta MKT_t) + b_s(\beta SMB_t) + b_h(\beta HML_t) + b_r(\beta RMW_t) + b_c(\beta CMA_t) + b_l(\beta LwMHg_t) + \varepsilon_t \quad (4)$$

Whereas $R_t - R_{ft}$ represent excess portfolio-returns, MKT_t represent market, SMB_t represent size HML_t

represent value, RMW_t represent profitability, CMA_t represent investment and $LwMHg_t$ represent human capital premium. ε_t represent the error term.

4. EMPIRICAL RESULTS AND DISCUSSION

Table 4.1. Summary statistics of portfolios

Portfolio	Mean	SD	Max	Min
SLWCLw	0.052	0.183	1.303	-0.245
SLWCHg	0.028	0.1	0.363	-0.15
SLWALw	0.021	0.102	0.486	-0.201
SLWAHg	0.023	0.107	0.352	-0.213
SLRCLw	0.023	0.105	0.539	-0.229
SLRCHg	0.028	0.151	1.06	-0.183
SLRALw	0.017	0.115	0.492	-0.261
SLRAHg	0.021	0.098	0.405	-0.191
SHWCLw	0.024	0.109	0.442	-0.173
SHWCHg	0.023	0.147	1.06	-0.234
SHWALw	0.024	0.113	0.526	-0.206
SHWAHg	0.008	0.093	0.368	-0.147
SHRCLw	0.002	0.101	0.414	-0.203
SHRCHg	0.037	0.15	1.06	-0.218
SHRALw	0.025	0.115	0.453	-0.232
SHRAHg	0.012	0.101	0.389	-0.244
BLWCLw	0.015	0.102	0.423	-0.173
BLWCHg	0.012	0.083	0.275	-0.178
BLWALw	0.018	0.092	0.359	-0.194
BLWAHg	0.021	0.086	0.413	-0.205
BLRCLw	0.022	0.085	0.255	-0.135
BLRCHg	0.021	0.094	0.389	-0.221
BLRALw	0.016	0.091	0.413	-0.203
BLRAHg	0.021	0.101	0.341	-0.292
BHWCLw	0.017	0.094	0.468	-0.142
BHWCHg	0.035	0.111	0.601	-0.179
BHWALw	0.026	0.112	0.446	-0.222
BHWAHg	0.026	0.086	0.33	-0.143
BHRCLw	0.017	0.086	0.398	-0.155
BHRCHg	0.022	0.089	0.443	-0.109
BHRALw	0.029	0.104	0.413	-0.236
BHRAHg	0.027	0.111	0.471	-0.231

Table 4.1 shows summary statistics of thirty-two portfolios sorted by size, value, profitability, investment and human capital. According to size-sorted portfolios, the risk returns of ten small-size portfolios outperform ten big-size portfolios (i.e., the risk and returns of SLWCLw, SLWCHg, SLWALw, SLWAHg, SLRCLw, SLRCHg, SLRALw, SHWCLw, SHRCLw, and SHRCHg are larger than risk and returns of BLWCLw, BLWCHg, BLWALw, BLWAHg, BLRCLw, BLRCHg, BLRALw, BHWCLw, BHRCLw, and BHRCHg).

The value sorted portfolio reveals that five out of the eight value stock portfolios outperform, growth stock portfolios in terms of risk and returns. (i.e., SHWCLw, SHWCHg, SHWALw, SHRCHg, SHRALw, BLWCLw, BLWCHg, BLWALw, BLRCHg, BLRALw).

Based on the profitability-sorted portfolio analysis, three out of the four high profit portfolios exhibit higher risk-return profiles compared to the risk and returns associated with the low profitable portfolios. Specifically, SHRCHg, SHRALw, and SHRAHg all demonstrate more substantial risk-return profiles in contrast to SHWCHg, SHWALw, and SHWAHg.

The investment-oriented portfolio assessment reveals that the risk-return dynamics of conservative stock portfolios surpass those of aggressive stock portfolios. For instance, SHRCHg exhibits greater risk-return characteristics than SHRAHg.

Similarly, when considering labor income growth rate sorted portfolios, it becomes evident that the risk-return attributes of portfolios with lower labor income growth rates outweigh those of their corresponding portfolios with higher labor income growth rates. This is confirmed by the fact that the risk and returns of SHRCLw are superior to the risk and returns of SHRAHg.

Table 4.2. Descriptive statistics of Six factors

	MKT	SMB	HML	RMW	CMA	LwMHg
Mean	-0.018	0.002	0.008	-0.008	0.003	0.003
SD	0.059	0.037	0.023	0.028	0.038	0.033
Min	-0.275	-0.066	-0.083	-0.094	-0.122	-0.17
Max	0.129	0.173	0.064	0.084	0.195	0.081

Table 4.2 provides factors' descriptive. It shows that the mean value of market and profitability premium is negative, whereas it is positive for size, value, and human capital factors.

Similarly, the mean of market premium is also highest in absolute terms but is a highly volatile factor, among others. Sadhwani et al. (2019) also reported a negative value of the market factor. It usually occurs when interest rates are high in a country like Pakistan or market downturn situations. The positive mean value of size, value, investment, and human capital factor indicates that returns of small, value, conservative investment, and low investment in human capital are higher than big, growth, aggressive investments, and high investment in human capital.

Table 4.3. Correlation Matrix

	MKT	SMB	HML	RMW	CMA	LwMHg	VIF
MKT	1						1.017
SMB	0.048	1					1.148
HML	0.046	0.136	1				1.092
RMW	0.091	0.026	0.091	1			1.087
CMA	-0.182*	.306**	0.048	0.112	1		1.175
LwMHg	0.102	0.168	-0.231*	.258**	-0.227*	1	1.193

*, ** indicates that correlation is significant at the 0.05 and 0.01 level

Table 4.3 provides correlation among explanatory variables to test for the likelihood of the presence of multicollinearity. Therefore, we further test the VIF (variance inflation factor). According to Hair et al. (2010) multicollinearity exists among variables whose value of VIF is greater than 4. Therefore, no multicollinearity exists as the value of VIF is less than four among all explanatory variables.

Table 4.4. Regression result of the Five-factor model

Portfolio	Intercept	MKT	SMB	HML	RMW	CMA	Adj. R ²	F-Statistic
SLWCLw	0.03* (2.24)	1.00*** (4.47)	1.77*** (4.80)	-1.66*** (-2.96)	-1.86*** (-4.04)	1.31** (3.60)	0.42	18.49***
SLWCHg	0.01 (1.30)	0.84*** (6.63)	0.66*** (3.17)	-0.90*** (-2.86)	-0.86*** (-3.32)	0.43** (2.08)	0.39	16.31***
SLWALw	0.01** (2.01)	1.20*** (11.26)	0.53*** (3.03)	-0.64** (-2.40)	-0.58*** (-2.64)	-0.31* (-1.81)	0.58	33.81***
SLWAHg	0.01 (1.10)	0.92*** (7.08)	0.96*** (4.45)	-0.75** (-2.30)	-0.87*** (-3.25)	-0.41** (-1.96)	0.44	19.60***
SLRCLw	0.01 (0.79)	0.93*** (6.65)	0.45** (1.96)	0.01 (0.03)	0.29 (1.01)	0.71*** (3.13)	0.33	12.78***
SLRCHg	0.00 (0.20)	0.78*** (4.51)	1.65*** (5.77)	0.41 (0.95)	0.59* (1.66)	1.54*** (5.48)	0.49	23.94***
SLRALw	0.01 (0.86)	1.05*** (7.57)	0.99*** (4.35)	-0.99*** (-2.84)	0.05 (0.17)	-0.64*** (-2.83)	0.45	20.48***
SLRAHg	0.00 (0.56)	0.74*** (5.76)	0.78*** (3.69)	-0.51 (-1.59)	0.37 (1.41)	-0.42** (-2.03)	0.32	12.33***
SHWCLw	0.01 (0.94)	0.99*** (7.31)	0.83*** (3.71)	0.46 (1.34)	-0.91*** (-3.25)	0.35 (1.59)	0.40	17.20***
SHWCHg	0.00	1.05***	1.48***	1.64***	0.01	1.46***	0.56	31.54***

SHWALw	0.01 (0.96)	0.92*** (6.57)	0.93*** (4.03)	0.94*** (2.67)	-1.00*** (-3.48)	-0.48** (-2.11)	0.42	18.31***
SHWAHg	-0.01 (-1.31)	0.79*** (7.12)	0.92*** (5.05)	0.67** (2.41)	-0.18 (-0.77)	-0.52*** (-2.89)	0.46	20.90***
SHRCLw	0.00 (0.21)	0.82*** (5.86)	0.66*** (2.88)	-0.04 (-0.12)	0.30 (1.05)	0.43* (1.90)	0.29	10.91***
SHRCHg	0.02 (1.56)	0.94*** (5.85)	1.47*** (5.58)	1.41*** (3.50)	1.25*** (3.80)	1.29*** (4.95)	0.56	30.80***
SHRALw	0.01 (1.38)	1.01*** (6.76)	0.79*** (3.21)	0.50 (1.32)	-0.29 (-0.96)	-0.40* (-1.64)	0.35	13.95***
SHRAHg	-0.01 (-0.75)	0.86*** (7.43)	1.10*** (5.75)	0.52* (1.80)	0.01 (0.05)	-0.68*** (-3.62)	0.49	23.97***
BLWCLw	0.00 (0.07)	0.99*** (7.51)	0.13 (0.61)	-0.58* (-1.76)	-0.98*** (-3.62)	0.38* (1.80)	0.36	14.65***
BLWCHg	0.00 (-0.66)	0.95*** (9.15)	-0.01 (-0.08)	-0.13 (-0.50)	-0.49** (-2.27)	0.29* (1.73)	0.41	17.59***
BLWALw	0.00 (-0.04)	0.65*** (4.85)	0.06 (0.26)	0.06 (0.19)	-0.57** (-2.05)	-0.19 (-0.86)	0.18	6.14***
BLWAHg	0.01 (0.94)	0.83*** (7.64)	0.11 (0.62)	-0.03 (-0.11)	-0.45** (-1.99)	-0.25 (-1.43)	0.36	14.38***
BLRCLw	0.01 (0.92)	0.85*** (7.75)	0.07 (0.39)	-0.62** (-2.26)	0.07 (0.29)	0.47*** (2.63)	0.37	14.72***
BLRCHg	0.01 (1.14)	0.97*** (7.93)	-0.09 (-0.42)	-0.21 (-0.68)	0.36 (1.45)	0.34* (1.73)	0.36	14.16***
BLRALw	0.00 (0.50)	0.95*** (8.25)	-0.05 (-0.25)	-0.28 (-0.97)	0.45* (1.89)	0.12 (0.62)	0.39	15.94***
BLRAHg	0.01* (1.83)	1.17*** (10.61)	-0.05 (-0.26)	-0.12 (-0.45)	0.81*** (3.57)	0.28 (1.59)	0.53	27.74***
BHWCLw	0.00 (-0.10)	0.88*** (6.91)	-0.31 (-1.47)	0.63** (1.97)	-0.65*** (-2.49)	0.92*** (4.44)	0.31	11.81***
BHWCHg	0.02** (1.94)	0.92*** (5.89)	-0.31 (-1.19)	0.59 (1.52)	-1.10*** (-3.45)	0.69*** (2.75)	0.24	8.72***
BHWALw	0.02* (1.89)	1.11*** (7.72)	0.27 (1.15)	0.41 (1.15)	-0.51* (-1.72)	-0.35 (-1.50)	0.37	14.93***
BHWAHg	0.01 (1.15)	0.79*** (6.62)	-0.05 (-0.26)	0.36 (1.19)	-0.67*** (-2.73)	0.34* (1.73)	0.27	9.66***
BHRCLw	0.00 (0.56)	0.96*** (8.92)	-0.10 (-0.56)	-0.17 (-0.62)	-0.15 (-0.70)	0.17 (0.97)	0.39	16.52***
BHRCHg	0.00 (0.63)	0.79*** (6.42)	-0.32 (-1.55)	0.27 (0.86)	-0.16 (-0.64)	0.59*** (2.93)	0.25	8.74***
BHRALw	0.01* (1.79)	0.92*** (6.68)	0.21 (0.92)	0.73** (2.10)	0.49* (1.71)	0.01 (0.06)	0.31	11.79***
BHRAHg	0.02* (1.88)	1.08*** (7.43)	0.39 (1.63)	0.14 (0.40)	-0.10 (-0.32)	-0.17 (-0.73)	0.34	13.07***

Values in () represent T-statistics. ***, **, and * denote significant levels of 1%, 5%, and 10%, accordingly.

Table 4.4 presents the regression findings of the five-factor model. Within this model, the excess portfolio returns of 32 portfolios are regressed upon the five specific factors: MKT, SMB, HML, RMW, and CMA. An interesting observation arises in relation to SMB. It is notable that SMB displays statistical significance within the context of all sixteen small-size portfolios, achieving a significance level of 5%. Additionally, SMB shows a positive correlation with excess portfolio returns in this context. Conversely, its significance diminishes when it comes to all sixteen large-size portfolios. This contrast in SMB's significance across the two portfolio sizes indicates that, within the Pakistani context, portfolios comprising smaller companies tend to outperform those composed of larger companies in terms of risk-adjusted returns.

Similarly, HML is significantly and positively related to portfolio returns of six High-B/M stock portfolios out of sixteen stock portfolios at a 5% significance level, and HML is significantly and negatively related to portfolio returns of Low-B/M stock portfolios for six out of sixteen Low-B/M portfolios. It demonstrates that in Pakistan portfolio of value stock (High-B/M value stocks) outperforms value stocks (low B/M value stocks) in terms of risk-adjusted return.

Similarly, RMW is significantly and positively related to portfolio returns of robust stocks for two out of sixteen robust, profitable stock portfolios and significantly and negatively related to portfolio returns of weak stocks for thirteen out of sixteen weak profitable portfolios. The significance and positive relation of RMW with portfolio returns of robust, profitable stock portfolios show that in Pakistan robust portfolio outperformed weak portfolio.

CMA is significantly and positively related to portfolio returns of ten conservative stock portfolios out of sixteen conservative stock portfolios and significantly and negatively related to portfolio returns of six out of sixteen aggressive stock portfolios. The result shows that in Pakistan conservative portfolio outperformed aggressive portfolio Pakistan. The value of adjusted R^2 range from 18% to 58% which show the predictive power of five risk factors in the model for explaining the variability in excess portfolio returns.

Table 4.5. Regression result of six-factor model

Portfolio	Intercept	MKT	SMB	HML	RMW	CMA	LwMHg	Adj. R ²	F Statistic	BLWCLw	BLWCHg	BLWALw	BLWAHg	BLRCLw	BLRCHg	BLRALw	BLRAHg	BHWCLw	BHWCHg	BHWALw	BHWAHg	BHRCLw	BHRCHg	BHRALw	BHRAHg			
SLWCLw	0.03** (2.12)	0.93*** (4.35)	1.91*** (5.40)	-1.25** (-2.28)	-1.46*** (-3.24)	1.52*** (4.32)	1.45*** (3.64)	0.48	19.27***	0.00 (-0.10)	0.96*** (7.43)	0.19 (0.90)	-0.40 (-1.21)	-0.81*** (-2.96)	0.48** (2.25)	0.64*** (2.68)	0.40	14.06***										
SLWCHg	0.01 (1.30)	0.84*** (6.58)	0.66*** (3.13)	-0.91*** (-2.81)	-0.87*** (-3.23)	0.42** (2.03)	-0.02 (-0.10)	0.39	13.48***	0.00 (-0.65)	0.95*** (9.09)	-0.02 (-0.10)	-0.14 (-0.53)	-0.50** (-2.24)	0.29* (1.67)	-0.04 (-0.20)	0.41	14.54***										
SLWALw	0.01* (1.88)	1.17*** (11.32)	0.58*** (3.43)	-0.47* (-1.80)	-0.42* (-1.92)	-0.23 (-1.36)	0.58*** (3.02)	0.61	31.70***	0.00 (-0.21)	0.62*** (4.70)	0.12 (0.53)	0.25 (0.73)	-0.39 (-1.41)	-0.10 (-0.45)	0.64*** (2.61)	0.22	6.51***										
SLWAHg	0.01 (1.12)	0.93*** (7.05)	0.95*** (4.37)	-0.78** (-2.32)	-0.90*** (-3.23)	-0.43** (-1.99)	-0.09 (-0.39)	0.43	16.24***	0.01 (0.80)	0.83*** (7.63)	0.11 (0.59)	-0.51* (-1.83)	0.18 (0.76)	0.53*** (2.94)	0.39* (1.94)	0.38	13.19***										
SLRCLw	0.00 (0.54)	0.87*** (6.84)	0.56*** (2.69)	0.36 (1.11)	0.62*** (2.33)	0.88 (4.24)	1.21*** (5.13)	0.45	17.39***	0.01 (1.12)	0.97*** (7.85)	-0.08 (-0.40)	-0.20 (-0.63)	0.38 (1.45)	0.35* (1.73)	0.04 (0.18)	0.35	11.70***										
SLRCHg	0.00 (0.41)	0.83*** (4.96)	1.56*** (5.63)	0.13 (0.30)	0.32 (0.91)	1.40*** (5.11)	-0.99*** (-3.17)	0.53	23.21***	0.00 (0.46)	0.94*** (8.14)	-0.03 (-0.18)	-0.24 (-0.82)	0.49** (1.98)	0.13 (0.71)	0.13 (0.62)	0.38	13.28***										
SLRALw	0.00 (0.64)	0.99*** (7.75)	1.09*** (5.19)	-0.67** (-2.05)	0.35 (1.31)	-0.48** (-2.29)	1.11*** (4.68)	0.54	23.83***	0.01* (1.78)	1.16*** (10.48)	-0.04 (-0.20)	-0.09 (-0.34)	0.84*** (3.57)	0.30* (1.64)	0.10 (0.48)	0.53	23.00***										
SLRAHg	0.01 (0.76)	0.77*** (6.16)	0.72*** (3.49)	-0.70** (-2.18)	0.19 (0.74)	-0.52*** (-2.52)	-0.65*** (-2.79)	0.36	12.19***	0.00 (-0.34)	0.84*** (6.91)	-0.23 (-1.16)	0.87*** (2.80)	-0.42* (-1.65)	1.04*** (5.22)	0.83*** (3.70)	0.38	13.22***										
SHWCLw	0.01 (0.73)	0.94*** (7.44)	0.92*** (4.45)	0.76** (2.35)	-0.62** (-2.33)	0.50** (2.41)	1.04*** (4.45)	0.49	20.00***	0.02* (1.98)	0.92*** (5.91)	-0.32 (-1.25)	0.54 (1.34)	-1.16*** (-3.50)	0.67*** (2.60)	-0.19 (-0.66)	0.24	7.30***										
SHWCHg	0.00 (0.38)	1.10*** (7.44)	1.39*** (5.66)	1.33*** (3.51)	-0.28 (-0.91)	1.30*** (5.35)	-1.08*** (-3.93)	0.61	32.19***	0.01* (1.76)	1.07*** (7.66)	0.34 (1.48)	0.63* (1.76)	-0.30 (-1.03)	-0.24 (-1.07)	0.75*** (2.88)	0.41	14.62***										
SHWALw	0.01 (0.81)	0.88*** (6.46)	0.99*** (4.39)	1.13*** (3.25)	-0.81** (-2.81)	-0.38* (-1.71)	0.68*** (2.70)	0.45	17.32***	0.01 (1.33)	0.82*** (6.96)	-0.10 (-0.51)	0.21 (0.68)	-0.82*** (-3.28)	0.26 (1.35)	-0.53** (-2.41)	0.30	9.36***										
SHWAHg	-0.01 (-1.25)	0.79*** (7.15)	0.90*** (4.93)	0.62** (2.19)	-0.22 (-0.93)	-0.54*** (-2.97)	-0.15 (-0.75)	0.45	17.44***	0.00 (0.48)	0.95*** (8.79)	-0.08 (-0.43)	-0.09 (-0.33)	-0.08 (-0.36)	0.21 (1.17)	0.26 (1.32)	0.40	14.15***										
SHRCLw	0.00 (-0.01)	0.77*** (5.79)	0.74*** (3.38)	0.21 (0.62)	0.54* (1.94)	0.56*** (2.55)	0.89*** (3.59)	0.36	12.19***	0.00 (0.50)	0.77*** (6.29)	-0.27 (-1.35)	0.41 (1.30)	-0.03 (-0.12)	0.66*** (3.28)	0.49** (2.14)	0.27	8.27***										
SHRCHg	0.02* (1.73)	0.97*** (6.14)	1.41*** (5.42)	1.22*** (3.02)	1.08*** (3.22)	1.20*** (4.61)	-0.65** (-2.22)	0.57	27.38***	0.01* (1.65)	0.88*** (6.64)	0.29 (1.32)	0.98*** (2.89)	0.73*** (2.59)	0.14 (0.64)	0.87*** (3.53)	0.38	12.90***										
SHRALw	0.01 (1.22)	0.96*** (6.72)	0.87*** (3.68)	0.76** (2.06)	-0.05 (-0.15)	-0.27 (-1.14)	0.90*** (3.39)	0.41	14.60***	0.02* (1.85)	1.07*** (7.33)	0.40* (1.66)	0.18 (0.47)	-0.07 (-0.21)	-0.16 (-0.65)	0.11 (0.40)	0.33	10.84***										
SHRAHg	-0.01 (-0.80)	0.85*** (7.32)	1.11*** (5.79)	0.57* (1.91)	0.06 (0.23)	-0.66*** (-3.45)	0.16 (0.74)	0.49	19.99***																			

Note: Refers to notes under Table 4.4

Table 4.5 reports the regression output of the six-factor model. In the six-factor model, the six factors, i.e., MKT, SMB, HML, RMW, CMA, and LwMHg, are regressed on excess portfolio returns of 32 portfolios. It is observed that SMB (size premium) is significantly and positively related to excess portfolio returns for all the sixteen small-size portfolios at a 5% significance level. But SMB is insignificant for all sixteen big size portfolios. It demonstrates that in Pakistan, small companies outperform big companies in terms of risk adjusted returns.

Similarly, it is observed that HML is significantly and positively related to the portfolio returns of seven out of sixteen High-B/M stock portfolios at 5% significance level, and HML is significantly and negatively related to six out of sixteen Low-B/M portfolios. It demonstrates that in Pakistan portfolio of value stock (High-B/M value stocks) outperforms the portfolio of growth stocks (low B/M value stocks).

RMW is significantly and positively related to portfolio returns of robust stocks for five out of sixteen robust, profitable stock portfolios and significantly and negatively related to portfolio returns of weak stocks for ten out of sixteen weak profitable stock portfolios. It shows that a portfolio of robust, profitable earns higher risk-adjusted returns in Pakistan than portfolio of weak profitable stocks.

CMA is significantly and positively related to portfolio returns of thirteen out of sixteen conservative stock portfolios and significantly and negatively related to portfolio returns of five out of sixteen aggressive stock portfolios. It shows that in Pakistan, conservative stocks outperform aggressive stocks. LwMHg is significantly and positively related to portfolio return of twelve out of sixteen low labor income growth stocks and significantly negatively related to portfolio return of five out of sixteen high labor income growth stocks. It demonstrates that in Pakistan portfolio of low labor income growth stocks outperforms the portfolio of high labor income growth stocks. The value of adjusted R^2 range from 22%-61% which show the predictive power of six risk factors in the model for explaining the variability in excess portfolio returns.

Table 4.6. Two-pass regression of the five-factor model

Portfolio	β_0	β_1	β_2	β_3	β_4	β_5	AjR ²	FStat
SLWCLw	-0.02 (-0.17)	0.13 (1.50)	-0.03 (-1.07)	0.01 (0.46)	-0.01 (-0.66)	-0.02 (-0.48)	0.01	1.15
SLWCHg	0.12** (1.98)	-0.16* (-1.81)	0.01 (0.51)	0.00 (-0.11)	0.04 (1.30)	0.05 (1.33)	0.02	1.32
SLWALw	0.05 (0.46)	-0.06 (-0.62)	0.03 (0.43)	0.00 (-0.04)	0.00 (0.12)	0.04 (0.58)	-0.05	0.26
SLWAHg	-0.11 (-0.71)	0.11 (0.89)	-0.03 (-0.86)	0.00 (-0.02)	-0.01 (-0.43)	-0.05 (-1.01)	-0.01	0.83
SLRCLw	-0.07 (-1.44)	-0.01 (-0.15)	0.06 (1.44)	0.01 (0.64)	-0.02 (-1.31)	0.03 (0.78)	0.00	1.07
SLRCHg	0.08 (1.05)	-0.12* (-1.90)	-0.01 (-0.45)	0.02 (0.71)	0.00 (-0.17)	0.01 (0.51)	0.05	1.87
SLRALw	0.25* (1.73)	-0.19 (-1.55)	-0.08** (-2.21)	0.03 (0.77)	0.00 (-0.05)	0.04 (0.91)	0.03	1.43
SLRAHg	0.10 (1.22)	-0.06 (-1.15)	-0.04 (-0.81)	0.00 (0.04)	0.00 (-0.15)	0.07 (1.60)	-0.01	0.86
SHWCLw	-0.17 (-1.34)	0.04 (0.43)	0.02 (0.38)	0.07 (1.60)	-0.03 (-0.73)	0.07 (1.08)	-0.01	0.91
SHWCHg	-0.10* (-1.82)	0.03 (0.52)	-0.05 (-1.12)	0.02 (0.71)	-0.04* (-1.93)	0.05** (1.96)	0.03	1.55
SHWALw	-0.07 (-0.69)	-0.13 (-1.66)	0.13** (2.40)	0.00 (0.03)	-0.01 (-0.22)	0.07*** (2.76)	0.08	2.53**
SHWAHg	0.09 (0.95)	-0.10 (-1.14)	0.06 (1.10)	-0.06 (-1.55)	0.09 (2.18)	0.02 (0.65)	0.00	1.05
SHRCLw	-0.01 (-0.14)	0.03 (0.38)	-0.03 (-1.06)	0.00 (0.15)	-0.04 (-1.60)	0.04 (0.64)	-0.01	0.88
SHRCHg	-0.13 (-1.51)	0.15* (1.73)	0.06 (1.19)	0.04 (1.42)	-0.06* (-1.79)	-0.08* (-1.72)	0.05	1.80
SHRALw	0.10 (0.81)	-0.13** (-2.05)	0.01 (0.23)	0.04 (1.25)	0.06 (1.12)	0.05* (1.89)	0.04	1.72
SHRAHg	-0.15* (-1.86)	0.14** (1.99)	0.00 (-0.12)	0.04 (0.91)	-0.01 (-0.39)	-0.03 (-0.66)	0.01	1.14
BLWCLw	-0.05 (-0.44)	0.01 (0.09)	0.01 (0.27)	0.02 (0.55)	0.02 (0.57)	0.09 (1.14)	-0.01	0.86
BLWCHg	-0.04 (-0.55)	-0.01 (-0.12)	0.06 (1.59)	0.04 (1.61)	0.00 (-0.18)	0.08 (1.76)	0.07	2.27**
BLWALw	-0.02 (-0.43)	-0.05 (-0.99)	0.05 (0.68)	0.05 (1.25)	0.00 (-0.08)	0.01 (0.34)	-0.02	0.60
BLWAHg	-0.04 (-0.50)	-0.01 (-0.05)	0.01 (0.16)	0.04 (1.09)	-0.04 (-1.13)	0.00 (-0.10)	-0.04	0.37
BLRCLw	0.04 (0.62)	-0.03 (-0.47)	-0.01 (-0.29)	0.01 (0.23)	-0.04* (-1.76)	-0.03 (-0.97)	0.02	1.27
BLRCHg	0.24***	-0.21***	0.00	0.06**	-0.02	-0.01	0.14	3.74***

BLRALw	(3.09)	(-2.84)	(0.02)	(2.11)	(-0.61)	(-0.45)		
BLRAHg	0.01 (0.07)	-0.04 (-0.47)	0.00 (0.05)	0.00 (0.13)	0.01 (0.25)	0.03 (0.44)	-0.04	0.41
BHWCLw	-0.20* (-1.85)	0.19** (1.98)	0.05 (1.47)	0.04 (1.32)	-0.01 (-0.18)	-0.04 (-1.20)	0.04	1.63
BHWCHg	-0.03 (-0.41)	-0.06 (-0.48)	0.01 (0.36)	0.03 (0.82)	-0.04 (-1.04)	0.02 (0.81)	0.01	1.24
BHWALw	-0.06 (-0.98)	-0.03 (-0.44)	-0.01 (-0.50)	0.01 (0.49)	-0.01 (-0.62)	0.06** (2.07)	0.08	2.39**
BHWAHg	0.08 (0.83)	-0.06 (-0.59)	-0.06 (-1.40)	-0.01 (-0.46)	-0.02 (-0.69)	0.04 (0.77)	0.02	1.41
BHRCLw	0.02 (0.50)	-0.06 (-0.90)	-0.04* (-1.81)	-0.02 (-0.72)	-0.02 (-0.77)	0.00 (0.09)	0.01	1.21
BHRCHg	0.14 (2.29)	-0.15*** (-2.56)	-0.02 (-0.39)	-0.06 (-1.18)	-0.01 (-0.19)	-0.05 (-1.17)	0.03	1.49
BHRALw	-0.09* (-1.89)	0.12 (1.59)	0.08 (1.04)	-0.02 (-0.51)	-0.01 (-0.55)	0.03 (0.59)	-0.02	0.65
BHRAHg	0.07 (0.84)	-0.09 (-0.86)	-0.05 (-0.96)	0.00 (-0.06)	0.01 (0.38)	0.03 (0.73)	0.00	0.99
	-0.06 (-0.82)	0.03 (0.46)	0.00 (-0.09)	0.03 (1.09)	-0.01 (-0.14)	-0.02 (-0.39)	-0.02	0.60

Note: Values in parentheses indicate t-statistics. ***, **, * indicate significant at 1%, 5% and 10%, respectively. β_0 = Intercept, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = coefficients of MKT, SMB, HML, RMW, CMA

Table 4.7. Two-pass regression of six-factor model

Portfolio	β_0	β_1	β_2	β_3	β_4	β_5	β_0	AjR ²	F Stat
SLWCLw	0.04 (0.26)	0.07 (0.57)	-0.04 (-1.19)	0.02 (0.57)	-0.03 (-0.86)	-0.01 (-0.29)	-0.02 (-0.56)	0.00	1.01
SLWCHg	0.14** (2.04)	-0.21* (-1.84)	0.02 (0.65)	0.00 (0.03)	0.05 (1.36)	0.06 (1.49)	-0.02 (-0.69)	0.01	1.17
SLWALw	0.03 (0.16)	-0.04 (-0.32)	0.03 (0.37)	0.00 (-0.02)	0.01 (0.19)	0.04 (0.62)	0.01 (0.23)	-0.06	0.22
SLWAHg	-0.11 (-0.70)	0.11 (0.88)	-0.03 (-0.80)	0.00 (-0.02)	-0.01 (-0.43)	-0.05 (-0.98)	0.00 (0.00)	-0.02	0.68
SLRCLw	-0.11** (-2.00)	0.01 (0.12)	0.07 (1.62)	0.00 (-0.22)	-0.02 (-1.43)	0.02 (0.46)	0.03 (1.56)	0.02	1.31
SLRCHg	0.08 (1.02)	-0.12 (-1.65)	-0.01 (-0.43)	0.02 (0.63)	0.00 (-0.17)	0.01 (0.51)	0.00 (0.02)	0.04	1.53
SLRALw	0.25	-0.19	-0.08*	0.03	0.00	0.05	0.00	0.01	1.18

Table 4.6 and 4.7 present the derived outcomes from Fama and Macbeth's two-pass regression approach. These outcomes are achieved through a two-stage process. In the initial stage, we compute betas by conducting regressions involving the six factors against each of the 32 portfolios. This procedure incorporates a rolling regression mechanism using a 36-month window. Subsequently, the second stage involves regressing the betas acquired from the first stage against the excess returns of each of the 36 portfolios. This step aims to anticipate forthcoming excess portfolio returns based on preceding betas (β).

The estimated findings in tables 4.6 and 4.7 illustrate that the explanatory capacity of the model is situated within a lower range. Specifically, the F-statistics and P-values stemming from the two-pass regression exhibit insignificance across the majority of the portfolios. This outcome implies that historical betas (β) do not hold the capability to effectively predict or forecast future excess portfolio returns.

The study's empirical results align with prior research. Acaravci and Karaomer (2017) find that FF5FM effectively explain excess portfolio return variations. Sathwani et al. (2019) note FF5FM's superior ability to capture cross-sectional portfolio return variation compared to FF3FM. Similarly, Ali et al. (2019) establish FF5FM as the optimal model for anomaly portfolio returns, outperforming alternatives.

Roy and Shijin (2018) emphasize human capital's role in predicting return variations for optimal portfolios. Shijin et al. (2012) demonstrate a causal link between asset returns and labor income. Maiti and Balakrishnan (2018) confirm the six-factor model's efficacy in capturing excess portfolio return variations across size, value, profitability, investment, and human capital.

Maiti and Vukovic (2020) discover the six-factor model's superiority over FF3FM and FF5FM in explaining asset return variability. This study aligns with empirical evidence, affirming that market, size, value, profitability, and investment premium significantly impact excess portfolio returns. Notably, the study underscores human capital's substantial role in explaining asset return variation, reinforcing Roy and Shijin's (2018) findings, specifically in Pakistan's context.

5. CONCLUSION

This study examined the validity and application of FF5FM and six-factor assets pricing model for stock returns traded on PSX from June 2010 to June 2019. Moreover, this study compares the efficiency of both models, which are the Five-factor model of Fama and French (2015), and Six factor model (adding human capital) of Roy and Shijin (2018), in Pakistan equity market by applying Fama and Macbeth (1973) two-pass time series regression methodology. This study finds human capital (proxy by salaries and wages) as a significant factor for most portfolios. It concludes that the human capital component accounts for a significant portion of asset return variation. Both models are viable for the Pakistan stock market, as both models significantly explain variation for sorted portfolios according to the outcomes of these risk factors.

Furthermore, market, size, value, profitability, and investment premium are relevant for various portfolios, even though the labor-income growth rate contributes significantly to the Fama and French-Five factor models. Furthermore, we compared Fama-French five-factor model and the six-factor assets pricing model and found six factor model superior than FF5FM in Pakistan equity market for explaining time-series variation in risk-adjusted portfolios.

This study motivates all types of investors and portfolio managers to consider the human capital components with the other five factors of the Fama and French model while investing in stocks traded on the Pakistan stock exchange. This study collect data for the period from 2010 to 2020. The study scope is limited to Pakistan stock market. Therefore, future research can take larger data sets to construct portfolios with 25 size, value, profitability and investment, as presented in Fama and French Papers (1992, 1993, 2015). Further research can also be conducted to examine the efficiency of assets pricing models in the Covid-19 outbreak or by taking the data of developed and developing markets.

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Tarikh : 20 Januari 2023

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Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

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Saya yang menjalankan amanah,

Setuju.

27.1.2023

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