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A Comparison of Competing Asset Pricing Models: Empirical Evidence from Pakistan

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Abstract: In recent years, the rapid and significant development of emerging markets has globally led to insight from potential investors and academicians seeking to assess these markets in terms of risk inheritance. Therefore, this study aims to explore the validity and applicability of the capital asset pricing model (henceforth CAPM) and multi-factor models, namely Fama–French models, in Pakistan's stock market for the period of June 2010–June 2020. This study collects data on 173 non-financial firms listed on the Pakistan stock exchange, namely the KSE-100 index, and follows Fama-MacBeth's regression methodology for empirical estimation. The empirical findings of this study conclude that small portfolios (small-size companies) earn considerably higher returns than big portfolios (large-size companies). Ultimately, the risk associated with portfolio returns is reported to be higher for small portfolios (small-size companies) than for big portfolios (large-size companies). According to the regression output, the CAPM was found to be valid for explaining the market risk premium above the risk-free rate. Similarly, the FF three-factor model was found to be valid for explaining time-series variation in excess portfolio returns. Later, we added human capital into FF three- and five-factor models. This study found that the human capital base six-factor model outperformed the other competing asset pricing models. The findings of this study indicate that small portfolios (small-size companies) earn more returns than big portfolios (large-size companies) to reward the investor for taking extra risks. Investors may benefit by timing their investments to maximize stock returns. Company investment in human capital adds reliable information, replicates the value of the company and, in the long term, helps investors make rational decisions.

Keywords: capital asset pricing model; Fama–French models; human capital; Karachi stock exchange

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1. Introduction

Investment decisions, such as whether to invest or not or how to efficiently allocate hard-earned money in different financial securities, are always one of the most prioritized decisions for investors around the globe. That is why asset pricing is a most important and controversial area in the financial economics literature.

Since Markowitz (1952)'s portfolio theory, academicians and practitioners have tried to develop a better asset pricing model. A better model would estimate the intrinsic values in a realistic way that is very close to prevailing market prices, thereby reducing anomalies compared to less efficient models (Zada et al. 2018). Thus, comparing alternative asset pricing models is crucial and necessary for choosing the best model among alternative competing models.

Sharpe (1964) provided the first asset pricing model, i.e., CAPM (the capital asset pricing model), for estimating the fundamental price of securities. It is a one-factor model with only a market factor. Later on, Ross (1976) proposed Arbitrage Pricing Theory (APT), which resulted in the development of a multi-factor model. Since APT, many asset pricing anomalies were identified by many researchers in different regions of the world (e.g., the price-to-earnings ratio (P/E) of Basu (1977), size anomaly of Banz (1981), size anomaly of Reinganum (1981), earnings price anomaly of Basu (1983), value anomaly of Rosenberg et al. (1985), Fama and French (1987) stock volatility, leverage anomaly of Bhandari (1988), dividend anomaly of Fama and French (1988), momentum anomaly of Jegadeesh and Titman (1993), and book-to-market anomaly of Kothari and Shanken (1997) in search of models that would be better than CAPM.

Fama and French (1993) developed their influential three-factor model (FF3FM) by combining size and value anomalies with CAPM. The FF3FM is an extension of CAPM, and has been found to be a better model than CAPM and to overcome many of the existing asset pricing anomalies. Carhart (1997) proposed a four-factor model adding the momentum factor to FF3FM. Palacios-Huerta (2003) tested the efficiency of conditional CAPM with human capital. Similarly, Zhang (2006) tested human capital in the asset return, and Swathi (2013) stated that human capital has a causal relationship with cross-sectional returns.

Fama and French (2015) extended their FF3FM with two prominent factors, namely investment and profitability, in order to propose a five-factor model (FF5FM). Later on, Fama and French (2018) extended their own FF5FM to a six-factor model by including the momentum factor. The latest development in asset pricing was provided by Roy and Shijin (2018), who proposed a new six factor model (6FMRS) that included human capital as a new factor along with 5FMFF.

In an emerging country such as Pakistan, many researchers put their efforts into providing various studies on asset pricing models and their comparison; e.g., Wahab and Zada (2017) tested short- and long-term usage of CAPM in the cement industry, Hassan and Javed (2011) conducted a study to test 3FMFF, Zada et al. (2018) conducted a study on 5FMFF, and Zada et al. (2019) developed an efficient portfolio for investors to earn maximum profit by undertaking comparatively less risk than others. Younus and Butt (2022) tested the performance of 3FMFF, 5FMFF, and 6FMFF using time-series tests.

Many scholars across the world have recently focused on the development of human capital, including Roy and Shijin (2018), Maiti and Balakrishnan (2018), Tambosi et al. (2022), and Khan et al. (2022), to find a way to include human capital as a risk factor in asset pricing models. According to previous literature, limited studies have been conducted in the context of Pakistan that explore the dynamism of the asset pricing model. Such study is needed to test the efficiency of single-factor and multi-factor asset pricing models. Our study presents novel findings in two areas. First, this study tests the efficiency and validity of the single-factor and FF three-factor models. Second, this study extends the FF three-factor and five-factor models by adding human capital (proxied by payable salaries and wages) in order to propose human capital-augmented four- and six-factor models. Therefore, this study aims to test the validity and applicability of a single factor model (CAPM) and multi-factor asset pricing models that include the Fama–French three-factor model, human capital-based four-factor model, Fama–French five-factor model and human capital-based six-factor model, in the context of Pakistan. This study finds that CAPM significantly explained the market risk premium above the risk-free rate. Similarly, the FF three-factor model was found to be valid for explaining time-series variation in excess portfolio returns. However, the human capital-based four-factor model outperformed the FF three-factor model for explaining variation in asset returns. Later, we tested the FF five-factor model and employed the human capital-augmented six-factor model. Through this test, this study found that the human capital-based six-factor model outperformed the other competing asset pricing models, including CAPM, the FF three-factor model, the human capital four-factor model, and the FF five-factor model.

The rest of the paper is organized as follows. Section 1 contains the introduction to the study, Section 2 explains the review of related literature, Section 3 contains the methodology of the study, and Section 4 discusses the findings and gives conclusions and policy recommendations.

2. Literature Review

Markowitz (1952) empirically examined the relationship between individual security and portfolio, documenting that the risk associated with portfolio has a negligible effect on individual securities. Depending on the connotation and framework, individual security risk is actually the summation of risk incorporated in terms of opportunity cost, weight of the individual security, and variance and covariance of individual security returns. Later, Tobin (1958) explored the optimal utility function of the investor and asset return through a mean variance conceptual framework. Consequently, Sharpe (1964) developed the capital asset pricing model (henceforth CAPM), which is considered a breakthrough in the field of asset pricing. CAPM measures the sensitivity of stock to the market through the beta coefficient (β). The CAPM research by Sharpe (1964), Lintner (1965) and Mossin (1966) attracted the attention of investors for explaining the risk–return relationship. Later, investors used this model for investment decisions. In the recent past, many researchers have criticized the efficiency and validity of CAPM for explaining the risk–return relationship (including Basu 1977, Ross 1976, Banz 1981, and Acaravci and Karaomer 2017). Subsequently, Fama (1970), relying on CAPM, proposed the Efficient Market Hypothesis (EMH). Based on its premise, if component model projections of stock returns are accurate, then security prices accurately reflect all information currently available. This is because it is possible for the stock market to be in equilibrium and for all information to be considered so that investors receive more compensation for taking calculated risks. Equity markets, however, are not always effective at reflecting all information that is available, and investors may be able to take advantage of arbitrage possibilities. This demonstrates CAPM's drawback of not being able to quantify expected returns in relation to a single risk factor. Ross (1976) proposed Arbitrage Pricing Theory (APT). This theory identified some unknown factors that affect stock returns. Later, some identified factors, namely GDP growth, inflation and dividend yield, were strongly questioned by many researchers. Furthermore, it was exceedingly challenging to determine or add the pertinent factors into the model (Susanti 2020). Rosenberg et al. (1985) documented that the assumptions of CAPM faced many critiques, as it only relies on market risk when measuring stock return. Further, it was suggested that stock return is not only dependent on market premium. Some other considered variables (i.e., size, leverage, price-to-earnings, and book-to-market ratio) can also affect stock return. Additionally, it concludes that a single beta (β) is insufficient to explain stock return. Similarly, Debondt and Thaler (1985) documented that there exists a positive relationship between book-to-market ratio and stock return. Later, Fama and French (1992) explored the combined effects of market beta, size, leverage, price-to-earnings (P-E) ratio, and book-to-market ratio for explaining cross-sectional variation in the expected returns of companies listed on the NYSE, AMEX, and NASDAQ. They found that market beta, size, and book-to-market ratio explain the cross-sectional variations in stock returns.

Similarly, Fama and French (1993) extended CAPM model with two prominent factors, namely size (small-minus-big, SMB) and value (high-minus-low) factors. Carhart (1997) extended the Fama–French three factors with a momentum (up-minus-down, UMD) factor. Across the world, many studies have been conducted that empirically test the FF3FM and C4FM. Such studies conclude that these models do not fully capture the variation in expected stock returns. As such, Fama and French (2015) extended their 3FM with two prominent factors, namely profitability (robust-minus-weak, RMW) and investment (conservative-minus-aggressive, CMA). Furthermore, Fama and French (2015) tested the 5FM in developed markets and concluded that 5FM better explains the variation than 3FM. Similarly, Fama and French (2018) extended their 5FM with a momentum (up-minus-down, UMD) factor, introducing the FF6 six-factor model. Later, Fama and French (2018) developed an alternative six-factor model (henceforth $FF6_{cp}$). This model replaces the operating factor with cash profitability. Fama and French tested this alternative six-factor model in the US market and found that the model performs well under all performance metrics.

Martinsa and Eid (2015) tested the performance of FF3FM and FF5FM in the Brazilian stock market. They found that the FF5FM outperforms the FF3FM. Furthermore, the authors documented that MKT (market premium), SMB (size premium), and HML (value premium) explain most variation in excess returns compared to RMW and CMA. Chiah et al. (2016) tested FF3FM and FF5FM in the Australian market. The authors found that profitability and investment premium have positive and significant effects on stock returns. Moreover, the FF5FM outperforms the FF3FM for capturing the variation in asset returns. Contrarily, with the findings of Fama and French (2015), the authors documented that the value factor (HML) remains neutral in the presence of the CMA and RMW factors. Chowdhury (2017) tested the FF3FM in the Bangladesh stock market and found that low market capitalization companies outperform high market capitalization companies. Similarly, companies with high book-to-market ratios report low earnings. Furthermore, the author documented that FF3FM is less explanatory for explaining stock returns in the Bangladesh stock market. Jiao and Lilti (2017) tested the efficiency of FF3FM and FF5FM in the Chinese stock market. The authors documented that FF5FM showed different explanatory power within a set of variant portfolios. In addition to FF3FM, the two factors added in FF5FM (RMW (profitability) and CMA (investment premium)) do not capture more variation than the FF3FM in asset returns. Shaharuddin et al. (2018) tested the FF3FM in the pre- and post-periods of the 2008 financial crisis. They found that FF3FM is valid in both periods of the financial crisis for explaining variation in asset return. Kubota and Takehara (2018) documented that the FF5FM was less explanatory for explaining variation in asset returns. Furthermore, the authors reported that the conclusion drawn from this information is that some anomalies' effects are still unknown. Huynh (2018) tested the performance of FF3FM and FF5FM through the GRS (Gibbons–Ross–Shanken) test. The author argued that the GRS test shows insufficient results for Fama–French models. Furthermore, this study concludes that the quest for developing optimum asset pricing models is still ongoing around the world. Similarly, Dutta (2019) found that FF5FM is inefficient for detecting long-term anomalies.

When the Fama–French three factor model (FF3FM) failed to accommodate a wide range of anomalies, Hou et al. (2017) added an additional factor (q-factor) in to the FF3FM. The q-factor model was found to successfully accommodate some anomalies. Later, Stambaugh and Yuan (2017) tested models to accommodate set anomalies in horse racing by considering the FF3FM, FF5FM, and q-factor model. They found the latter model superior to and better performing than the rest of the models. Fama and French (2018) proposed two models, $FF6_{OP}$ and $FF6_{CP}$. Using the maximum squared Sharpe ratio, they found the alternative six-factor model the best performer of the models. Fletcher (2018) conducted a study in the UK equity market that tested the performance of FF5FM and FF6FM. It found that FF6FM is the foremost model for explaining variation in expected stock return. Racicot et al. (2019a) conducted a study in order to determine time-varying alpha (α) and beta (β) estimates using the recursive/rolling IV GMM technique. The authors documented that market risk premium was the most influential factor for explaining variation. Similarly, Racicot et al. (2019b) asserted that the FF model's static approach might not be sufficient. The authors further concentrated on the Jensen performance measure's time-varying characteristics and the market's sensitivity to systematic risk, because these parameters are fundamentally universal in asset pricing models. Similarly, Chai et al. (2019) tested the FF5FM and $FF6_{CP}$ (alternative six-factor model) in US and Australian markets. This study found that the alternative six-factor model is suitable for both markets. Later, Hou et al. (2019) tested all models, including the q-factor model, mispricing model of Stambaugh and Yuan (2017), and FF five- and six-factor models of 2015, 2018, in the US market. They found the q-factor model more effective than other competing models in terms of the subsuming factor. Similarly, Barillas et al. (2020) conducted a study in the US market and tested eight models including the q-factor model of Hou et al. (2017), two-factor model of He et al. (2017), extended CAPM model of Frazzini and Pedersen (2014); mispricing model of Stambaugh and Yuan (2017), FF5FM 2015, Fama–French alternative and altered models 2015, and regular value factor model of Asness and Frazzini (2013). This study documented that the altered six-factor model was more effective than other models. Haqqani and Aleem (2020) tested the augmented liquidity six-factor model in the Pakistan equity market. The authors documented that the six-factor model performed efficiently in the PSX (Pakistan stock exchange). Furthermore, the liquidity factor has a significant and key role in the asset pricing model. Paliienko et al. (2020) evaluated the efficiency and performance of asset pricing models. The authors found that FF5FM better explained the variation in excess portfolio return compared to other asset pricing models. Sadhwani et al. (2019) evaluated the efficiency of FF3FM and FF5FM in the Pakistani stock market. They demonstrated that the FF5FM outperforms the FF3FM and better explains the variability in stock return. Foye and Valentincic (2020) documented that FF5FM more significantly captured variability in stock return than FF3FM in the Indonesian stock market. Mosoeu and Kodongo (2020) tested the efficiency of FF5FM in emerging equity markets. They found that the profitability is one of the most useful factors in emerging equity markets for explaining cross-section. Furthermore, according to the Gibbons–Ross–Shanken (GRS) test, the FF5FM performs poorly on geographically diversified and country-specific portfolios. Horvath and Wang (2020) examined the efficiency of the Fama–French model during COVID-19 in the U.S. stock market. The authors evaluated the performance of FF models. This study found that the R^2 of the growth model for the dotcom bubble was statistically significant. Furthermore, this study reports a rapid decrease in R^2 for portfolios during 2008 financial crisis. Zaremba et al. (2021) tested the efficiency of seven competing asset models (CAPM, FF3FM, C4FM, q-factor model, FF5FM, $FF6_{OP}$ and Barillas and Shanken model) in frontier markets. This study documented that the Carhart four factor model performs better than other competing models in frontier markets.

Ali et al. (2021) conducted a study testing the performance of CAPM, FF3FM, FF5FM and FF6FM (including the momentum factor) in the Pakistan equity market. This study concluded that FF5FM significantly explained more variation in excess portfolio returns than alternative asset pricing models. Li and Duan (2021) examined the effectiveness and performance of the FF3FM and FF5FM during the COVID-19 outbreak. Despite the authors' observation that the significance level of all independent variables grew over the course of the pandemic, the FF5FM displayed a substantial increase and showed greater efficiency during the epidemic. Kostin et al. (2022) analyzed the performance of FF3FM during crises in the last two decades and the COVID-19 outbreak in emerging and developed markets. They found that the results of FF5FM do not outperform in developed markets. The authors suggest that adding more regression factors would improve the asset pricing models, which could yield more reliable returns. Similarly, Ali (2022) tested the augmented mispricing model of asset pricing in Pakistani stock market. This study examined the performance of the augmented UMO (undervalued-minus-overvalued) factor model, CAPM, C4FM, FF3FM, FF5FM and FF6FM using the factor spinning test, Barillas–Shanken maximum squared Sharpe ratio test, and Gibbons–Ross–Shanken (GRS) test. The author concludes that the UMO factor carries distinctive information from the rest of the factors, and the augmented UMO four-factor model including MKT (market premium), SMB (size premium), and RMW (profitability premium) outperforms other competing asset pricing models. Hua (2022) conducted study and compared the explanatory power of five models, namely the FF3FM, C4FM, Novy–Marx 4FM, FF5FM, and Hou–Xue–Zhang 4F-model, in the Chinese SME board. The author found that FF5FM was insufficient for explaining better variation in asset return for the SME board. Furthermore, this study concludes that C4FM and q-FM are better for capturing better variability in asset returns for the SME board. Akhtar et al. (2022) compared the FF3FM and Daniel and Titman characteristics model (D&T) in the Indian stock market. They found that FF3FM has more favorable characteristics for explaining variation in asset return than the Daniel and Titman

(D&T) characteristics model. Similarly, Nugraha et al. (2022) conclude that FF5FM was efficient for explaining variation in excess portfolio returns.

Review of Human Capital in Asset Pricing Models

Mayers (1972) documented that human capital describes the variation in return predictability. Furthermore, he argues that 75% of consumption is based on the labor income growth rate. Similarly, Fama and Schwert (1977) found a weak relationship between human capital and marketable security returns. However, the most prominent models such as CAPM and Fama–French have ignored the inclusion of human capital in asset pricing models. Campbell (1996) introduced human capital, which was accounted for through wealth. Later, the author included human capital (proxied by LBR) in CAPM and found that the CAPM does not capture most of the variability in asset return. Jagannathan and Wang (1996) found that, in contrast with CAPM specifications, the labor income beta (β) substantially improved the performance of CAPM. According to Jagannathan and Wang (1998), human capital beta (β) is more likely to be positive over business cycle frequencies and negative over monthly frequencies. Similarly, Rosett (2001) used market- and accounting-based risk variables in their study, which documents that human capital has a statistically positive relationship with equity return. Qin (2002) added the non-traded human capital factor to the generalized CAPM and found that the human capital beta (β) captures the variation in asset returns. Similarly, in today's knowledge based-economy, human capital must be considered an investment rather than an expense of a company; moreover, human capital has a greater influence on determining the value of company (Wright et al. 2001; Bontis 2003). According to Palacios-Huerta (2003), investing in human capital can have an impact on asset returns across industries. According to Pantzalis and Park (2009), organizations that invest in their human resources are compensated more, which boosts productivity and raises the market value of the company. Crook et al. (2011) finds that firm characteristics and the uniqueness of human assets are difficult to replicate and copy. A company that invests in its human resources might achieve a lasting competitive advantage over rival businesses. According to Edmans (2011), small-size businesses cannot rely on the market to forecast the accuracy of their human assets. Determining the link between human resources and corporate valuation is also crucial. According to Kim et al. (2011), an asset pricing model that includes human capital together with size and value premiums can forecast changes in stock returns. Human capital and asset returns are causally related. Similarly, human capital plays a significant role in asset pricing models (Shijin et al. 2012; Belo et al. 2017).

Kuehn et al. (2017) found that labor income is an important determinant for explaining cross-section variation in equity returns. Moreover, this study documented that firms with low labor loading outperform firms with high labor loading. Florensia and Susanti (2020) tested the HC6FM in the Indonesia stock market. The authors reveal that market, size, value, profitability, investment and labor income growth rate premiums have significant effects on excess stock returns. Maiti and Vukovic (2020) explored the role of human capital in firm valuation. They find that ignoring the human assets in firm valuation may lead to serious problems. Khan et al. (2022) extended FF5FM with augmented human capital in the context of Pakistan. The authors documented that the HC6FM model statistically captured variability in excess portfolio returns.

3. Research Methodology

This study collected monthly closing share price data for non-financial firms listed on the Pakistan stock exchange (PSX) over the period June 2010–June 2020. This sample period was selected as it was considered to be a normal period after the financial crisis of 2007–2008 and before the recent COVID-19 pandemic of 2020 (Ulbert et al. (2022). The sample contains all available data on stock prices, book value, market capitalization, profitability, investment, and payable salary and wages. This study excludes data from those firms that report a negative book-to-market ratio. Furthermore, for market returns we used the KSE-100 index as a proxy, and the three-month treasury bill rate was used as a proxy for the risk-free rate (Rf). We obtained the data from multiple sources. Company share price data were taken from business recorder websites. Data for market capitalization, firm book equity, profitability and investment were taken from the balance sheet analysis (BSA) report published by the state bank of Pakistan. The salary and wages payable data used as a proxy for human capital were obtained from listed companies' annual reports. The monthly time series of the three-month treasury bill rates (Market treasury bill auction rate) and the daily trading volume of the KSE-100 index were taken from the websites of the Pakistan Stock Exchange and the State Bank of Pakistan, respectively. Similarly, T-bill (3%, 6%, 12%) rates in Pakistan are considered to be a financial tool that helps maintain liquidity in the economy. Therefore, the term liquidity has greater importance for business activity that improves economic growth (Ali et al. 2015).

To compute the factor premium, we sorted the sample into portfolios based on size, book-to-market (BM) ratio, investment, profitability, and labor income growth rate factors.

3.1. Variable Description

The variables, their description, and the related references are as follows:

Variable	Description	References
Size	Market capitalization is used as a proxy for size.	Fama and French (1993)
HML	Book value of equity to market value of equity is used as a proxy for the value factor.	Fama and French (1993)
RMW	Earnings before interest and taxes (EBIT) divided by book value of equity is used as a proxy for the profitability factor.	Fama and French (2015)
CMA	Annual change in total assets is used as a proxy for the investment factor.	Fama and French (2015)
LBR	Annual salaries and wages payable mentioned in the fiscal year annual report, from end of year t_{-1} to end of year t, is used as a proxy for the labor income growth rate factor.	Maiti and Balakrishnan (2018)

3.2. Portfolio Calculation and Formation

This study created 32 portfolios in which companies were divided into categories based on size, value, profitability, investment, and human capital. The term high represents companies with high market capitalization, high or low book-to-market value, robust or weak profitability, conservative or aggressive investment, and low or high labor income growth rate. The term small represents companies with small market capitalization, high or low book-to-market value, robust or weak profitability, conservative or aggressive investment, and low or high labor income growth rate. This study follows Fama and French (1992, 1993, 2015)'s estimation techniques for factor construction. Calculation of factor premiums is given in the Appendix A and the Portfolio Abbreviations and Descriptions in Appendix B.

3.3. *Fama and MacBeth's (1973) Regression*

This study follows Fama and MacBeth's (1973) methodology and regressed a set of thirty-two portfolios for the empirical estimation of excess portfolio return. In the recent past, Fama and MacBeth's (1973) regression was widely followed by many researchers in empirical asset pricing studies. This study follows the factor construction criteria of Fama and French (1992, 1993, 2015) for portfolio stocks as a test to estimate risk premium associated with various factors (in our case, market, size, value, profitability, investment premium and human capital). Fama and MacBeth's (1973) regressions investigate the linear relationship between exposure to (priced) risk variables and predicted returns. The core concept behind the regression approach is to forecast asset returns based on factor exposures or traits that mimic exposure to a risk factor in the cross-section over each period.

Econometrically, the regression can be expressed as

$$R1, t = \alpha 1 + \beta 1, F1F1, t + \beta 1, F2, F2, t + \cdots + \beta 1, FmFm, t + \epsilon 1, t$$

$$R2, t = \alpha 2 + \beta 2, F1F1, t + \beta 2, F2F2, t + \cdots + B2, FmFmt + \epsilon 2, t$$

$$Rn, t = \alpha n + \beta n, F1F1, t + \beta n, F2F2, t + \cdots + Bn, FmFmt + \epsilon n, t$$

3.4. *Econometric Model of the Study*

The following Equations (1)–(5) show the econometric models of the study.

- **CAPM (capital asset pricing model)**

$$R_{it} - R_{ft} = \alpha + b_i(MKT_t) + e_{it} \quad (1)$$

- **FF3 (Fama–French three) factor model**

$$R_{it} - R_{ft} = \alpha + b_i(MKT_t) + s_i(SMB_t) + h_i(HML_t) + e_{it} \quad (2)$$

- **Human capital four-factor model**

$$R_{it} - R_{ft} = \alpha + b_i(MKT_t) + s_i(SMB_t) + h_i(HML_t) + l_i(LoMHi_t) + e_{it} \quad (3)$$

- **FF5 (Fama–French five) factor model**

$$R_{it} - R_{ft} = \alpha + b_i(MKT_t) + s_i(SMB_t) + h_i(HML_t) + r_i(RMW_t) + c_i(CMA_t) + e_{it} \quad (4)$$

- **Augmented human capital six-factor model**

$$R_{it} - R_{ft} = \alpha + b_i(MKT_t) + s_i(SMB_t) + h_i(HML_t) + r_i(RMW_t) + c_i(CMA_t) + l_i(LoMHi_t) + e_{it} \quad (5)$$

In these equations, R_{it} is the excess return of portfolio *i* for the month of *t*, and SMB_t, HML_t, RMW_t, CMA_t and $LoMHi_t$ are constructed factors, namely size, value, profitability, investment, and human capital, for portfolio *i* for the month of *t*.

4. Results and Discussion

Table 1 shows the descriptive summary containing mean, maximum, minimum, standard deviation, skewness, and kurtosis for the set of thirty-two portfolios sorted by size, value, profitability, investment, and labor income growth rate premium. Furthermore, the mean value shows the average return of each portfolio, while the standard deviation shows the associated risk of each portfolio.

It is indicated that portfolios sorted by size shows that the risk and return of the ten small portfolios (including small-size companies) are considerably higher than those of corresponding big-size portfolios (i.e., the risk and returns of $S_LL_BC_wC_cLo$, $S_LL_BC_wC_cHo_i$, $S_LL_BC_wC_ALo_i$, $S_LL_BC_wC_AHo_i$, $S_LL_BC_RCcLo_i$, $S_LL_BC_RC_cHo_i$, $S_LL_BC_RC_ALoi$, $S_HH_BC_wC_ALo_i$, $S_HH_BC_RC_cLo_i$, and $S_HH_BC_RC_cHo_i$ report higher than $B_LL_BC_wC_cLo_i$, $B_LL_BC_wC_cHo_i$, $B_LL_BC_wC_ALo_i$, $B_LL_BC_wC_AHo_i$, $B_LL_BC_RC_cLo_i$, $B_LL_BC_RC_cHo_i$, $B_HH_BC_wC_cLo_i$, $B_HH_BC_RC_cLo_i$, and $B_HH_BC_RC_cHo_i$). This means that in Pakistan, on average small portfolios (small-size companies), earn considerably higher returns than big portfolios (large-size companies). The excess portfolio returns are represented by the mean values, while the maximum and minimum values represent the highest percentages of excess portfolio return movement from the mean value. The standard deviation shows the deviation from the mean value of the risk associated with each portfolio. Furthermore, portfolios sorted by size value show that five out of eight small high-value stock portfolios show higher mean values (excess portfolio return) along with standard deviation (risk) than those of the corresponding big low-value stock portfolios (i.e., excess return and risk of $S_HH_BC_wC_cLo_i$, $S_HH_BC_wC_cHo_i$, $S_HH_BC_wC_ALo_i$, $S_HH_BC_RC_cHo_i$, and $S_HH_BC_RC_ALo_i$ are reported to be higher than those of $B_LL_BC_wC_cLo_i$,

$B_LL_BC_wC_cHo_i$, $B_LL_BC_wC_ALo$, $B_LL_BC_RC_cHo_i$, and $B_LL_BC_RC_ALo_i$). This means that, in Pakistan, small high-value stock portfolios earn considerably higher returns than big low-value stock portfolios. The average risk and return of three out of four small high-value robust stock portfolios are much greater than the prevalent values among big low-value weak stock portfolios, due to small high-value profitable stocks (excess return and risk of $S_HH_BC_RC_cHo_i$, $S_HH_BC_RC_ALo_i$, and $S_HH_BC_RC_AHo_i$ are reported to be higher than those of $S_HH_BC_wC_cHo_i$, $S_HH_BC_wC_ALo_i$, and $S_HH_BC_wC_AHo_i$). This indicates that, in Pakistan, robust stocks (stocks with higher profitability) earn considerably higher returns than weak stocks (stocks with lower profitability). In addition, a portfolio comprised of small high-value robust conservative stocks exhibits a significantly higher rate of return and risk than a portfolio comprised of big low-value weak aggressive stocks (i.e., excess return and risk of $S_HH_BC_RC_cHo_i$ is reported to be higher than that of $S_HH_BC_RC_AHo_i$). However, small, high-value, robust, conservative, low labor income growth rate stock portfolios show higher risk and returns than their corresponding large, low-value, weak, aggressive, high labor income growth rate stock portfolios (excess returns of $S_HH_BC_RC_cLo_i$ are reported to be higher than that of $S_HH_BC_RC_AHo_i$). This indicates that when considering size, value, profitability, investment, and labor income growth rate, small-size portfolios are riskier than big-size portfolios, which results in higher returns. These results reported in Table 1, in the context of Pakistan, support the proposition of Richardson (1970) who argued that "*Investors on average earn higher return by taking greater risk, thus, to enjoy broad acceptance throughout the investment community*".

Table 1. Descriptive summary of the thirty-two portfolios.

Excess Portfolio Returns	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis
$S_LL_BC_wC_cLo_i$	0.052	0.007	1.303	−0.246	0.183	−0.418	5.805
$S_LL_BC_wC_cHo_i$	0.028	0.013	0.363	−0.150	0.100	0.903	0.943
$S_LL_BC_wC_ALo_i$	0.021	0.009	0.486	−0.201	0.102	0.945	3.291
$S_LL_BC_wC_AHo_i$	0.023	0.011	0.352	−0.213	0.107	0.788	0.935
$S_LL_BC_RCcLo_i$	0.023	0.008	0.539	−0.229	0.105	1.281	4.326
$S_LL_BC_RC_cHo_i$	0.028	−0.005	1.060	−0.183	0.151	−0.743	5.769
$S_LL_BC_RC_ALoi$	0.017	−0.002	0.492	−0.261	0.115	0.846	1.660
$S_LL_BC_RC_AHo_i$	0.021	0.004	0.405	−0.191	0.098	0.919	1.513
$S_HH_BC_wC_cLo_i$	0.024	0.013	0.442	−0.173	0.109	1.049	2.046
$S_HH_BC_wC_cHo_i$	0.023	0.006	1.060	−0.234	0.147	−0.239	3.578
$S_HH_BC_wC_ALo_i$	0.024	0.008	0.526	−0.206	0.113	1.257	3.137
$S_HH_BC_wC_AHo_i$	0.008	−0.007	0.368	−0.147	0.093	1.036	1.418
$S_HH_BC_RC_cLo_i$	0.026	0.004	0.414	−0.205	0.101	0.845	1.448
$S_HH_BC_RC_cHo_i$	0.037	0.015	1.060	−0.218	0.150	3.545	19.445
$S_HH_BC_RC_ALo_i$	0.025	0.003	0.453	−0.232	0.115	0.843	1.230
$S_HH_BC_RC_AHo_i$	0.015	0.005	0.389	−0.244	0.101	0.597	1.915
$B_LL_BC_wC_cLo_i$	0.015	0.010	0.423	−0.173	0.102	0.904	2.067
$B_LL_BC_wC_cHo_i$	0.015	0.001	0.275	−0.178	0.083	0.467	0.634
$B_LL_BC_wC_ALo_i$	0.018	0.005	0.359	−0.194	0.092	1.128	2.399
$B_LL_BC_wC_AHo_i$	0.021	0.016	0.413	−0.205	0.086	0.956	3.454
$B_LL_BC_RC_cLo_i$	0.022	0.022	0.255	−0.135	0.085	0.508	−0.020
$B_LL_BC_RC_cHo_i$	0.021	0.006	0.389	−0.222	0.094	0.827	2.020
$B_LL_BC_RC_ALo_i$	0.016	0.014	0.413	−0.203	0.091	0.986	3.048
$B_LL_BC_RC_AHo_i$	0.021	0.012	0.341	−0.292	0.100	0.454	1.047
$B_HH_BC_wC_cLo_i$	0.017	0.001	0.468	−0.142	0.094	1.334	3.725
$B_HH_BC_wC_cHo_i$	0.035	0.012	0.601	−0.170	0.110	1.764	5.724
$B_HH_BC_wC_ALo_i$	0.026	0.023	0.446	−0.226	0.112	1.031	2.637
$B_HH_BC_wC_AHo_i$	0.026	0.019	0.330	−0.143	0.086	0.785	0.897
$B_HH_BC_RC_cLo_i$	0.017	0.010	0.398	−0.155	0.086	0.798	2.357
$B_HH_BC_RC_cHo_i$	0.022	0.011	0.443	−0.109	0.089	1.643	4.706
$B_HH_BC_RC_ALo_i$	0.029	0.014	0.413	−0.236	0.104	1.048	1.888
$B_HH_BC_RC_AHo_i$	0.027	0.016	0.471	−0.231	0.111	0.961	2.388

Note: Max = Maximum, Min = Minimum, Std. Dev. = Standard Deviation. Description of each portfolio is given in Appendix A.

Table 2 shows the descriptive statistics containing the mean, median, standard deviation, skewness, and kurtosis of factor premiums for each of the six factors. MKT (market-premium) reported a mean value of −0.018, while its maximum value was 0.129 and minimum value was −0.275. The negative mean value of MKT was found to be like the findings of Sadhwani et al. (2019) that MKT has a higher absolute mean value than other factors and is more volatile. SMB reported a mean value of 0.002 while its maximum value was 0.173 and minimum value was −0.066. RMW had a mean value of −0.008, a maximum value of 0.084 and a minimum value of −0.094. The negative mean value of RMW implies that weak stocks outperform robust stocks. The negative mean value of RMW found was like the findings of Zada et al. (2018). Small-value stocks and companies with low labor income growth outperform big-value stocks and stocks with high labor income growth, according to the positive mean values of SMB, HML, and LoMHi.

Table 2. Descriptive summary of the six factors.

	MKT	**SMB**	**HML**	**RMW**	**CMA**	**LBR**
Mean	−0.018	0.002	0.008	−0.008	0.004	0.038
Median	−0.011	−0.016	0.001	−0.004	0.002	0.003
Max	0.129	0.173	0.064	0.084	0.195	0.081
Std. Dev.	0.059	0.037	0.023	0.028	0.038	0.033
Min	−0.275	−0.066	−0.083	−0.094	−0.122	−0.170
S.E	0.005	0.003	0.002	0.002	0.003	0.003
Skewness	−0.618	1.454	−0.208	−0.065	0.773	−1.195
Kurtosis	2.315	4.060	1.151	1.285	5.800	5.598

Note: Max = Maximum, Min = Minimum, S.E = Standard Error, Std. Dev. = Standard Deviation.

The study's correlation matrix is shown in Table 3. It shows that SMB and MKT (market premium) have a positive correlation. HML (value premium) and CMA (investment premium) show negative correlations with MKT (market premium). LBR and MKT are found to be positively correlated; the VIF test was employed for the multicollinearity issue. The value of the VIF test was below 4. According to Hair et al. (2010), if a VIF value greater than 4 is found, then the multicollinearity problem exists among the explanatory variables. According to Table 3, there is no substantial multicollinearity among the variables that make up the factors.

Table 3. Correlation matrix of the six factors.

	MKT	**SMB**	**HML**	**RMW**	**CMA**	**LBR**	**VIF**
MKT	1						1.017
SMB	0.048	1					1.153
HML	−0.046	0.136	1				1.096
RMW	0.090	−0.025	0.090	1			1.082
CMA	−0.181	0.305	−0.047	0.112	1		1.195
LBR	0.101	−0.168	−0.230	−0.258	−0.226	1	1.202

Table 4 shows a comparison of the econometric models. This study constructed a set of thirty-two portfolios. Subsequently, we regressed the thirty-two portfolios for each model employed in this study. Furthermore, we compared all the competing asset pricing models (CAPM, F3FM, HC4FM, FF5FM, HC6FM) on the basis of the adjusted R^2 of each model regressed against the thirty-two portfolios. CAPM and multifactor models for each portfolio are given in Tables 5–8.

Table 4. Model comparison on the basis of Adj-R^2.

Portfolio Return	CAPM	FF3FM	H4FM	FF5FM	H6FM
$S_L L_B C_w C_c Lo_i$	6.70%	30.82%	36.94%	42.35%	47.95%
$S_L L_B C_w C_c Ho_i$	20.54%	33.14%	32.64%	39.15%	38.62%
$S_L L_B C_w C_A Lo_i$	50.83%	54.30%	59.31%	57.96%	60.75%
$S_L L_B C_w C_A Ho_i$	27.73%	36.68%	36.52%	43.87%	43.45%
$S_L L_B C_R CcLo_i$	22.79%	27.26%	33.82%	33.11%	45.25%
$S_L L_B C_R C_c Ho_i$	6.02%	33.84%	42.01%	49.08%	52.83%
$S_L L_B C_R C_A Loi$	35.01%	42.11%	51.76%	45.01%	53.52%
$S_L L_B C_R C_A Ho_i$	25.43%	30.30%	33.55%	32.26%	36.07%
$S_H H_B C_w C_c Lo_i$	24.45%	35.50%	45.35%	40.49%	48.93%
$S_H H_B C_w C_c Ho_i$	12.08%	44.27%	52.10%	56.20%	61.13%
$S_H H_B C_w C_A Lo_i$	23.06%	33.40%	40.32%	42.11%	45.13%
$S_H H_B C_w C_A Ho_i$	28.87%	41.82%	41.31%	45.54%	45.33%
$S_H H_B C_R C_c Lo_i$	20.27%	27.27%	30.75%	29.41%	36.06%
$S_H H_B C_R C_c Ho_i$	10.76%	38.66%	44.57%	55.60%	57.08%
$S_H H_B C_R C_A Lo_i$	28.72%	34.00%	41.00%	35.23%	40.68%
$S_H H_B C_R C_A Ho_i$	31.30%	44.12%	44.52%	49.12%	48.92%
$B_L L_B C_w C_c Lo_i$	27.04%	29.53%	34.22%	36.45%	39.71%
$B_L L_B C_w C_c Ho_i$	38.98%	38.51%	37.98%	41.07%	40.57%
$B_L L_B C_w C_A Lo_i$	16.61%	15.18%	21.50%	17.77%	21.75%
$B_L L_B C_w C_A Ho_i$	34.25%	33.16%	32.62%	35.99%	35.62%
$B_L L_B C_R C_c Lo_i$	30.67%	33.58%	33.82%	36.57%	38.07%
$B_L L_B C_R C_c Ho_i$	34.18%	33.34%	32.94%	35.60%	35.05%
$B_L L_B C_R C_A Lo_i$	37.91%	37.27%	36.72%	38.57%	38.23%
$B_L L_B C_R C_A Ho_i$	47.47%	46.59%	46.40%	52.91%	52.59%
$B_H H_B C_w C_c Lo_i$	19.23%	18.81%	23.95%	31.23%	38.12%
$B_H H_B C_w C_c Ho_i$	15.78%	14.83%	14.13%	24.49%	24.11%
$B_H H_B C_w C_A Lo_i$	34.55%	34.63%	40.47%	36.93%	40.72%
$B_H H_B C_w C_A Ho_i$	22.95%	22.17%	23.69%	26.68%	29.65%
$B_H H_B C_R C_c Lo_i$	40.51%	39.88%	40.17%	39.48%	39.87%
$B_H H_B C_R C_c Ho_i$	21.27%	20.24%	21.21%	24.55%	26.83%
$B_H H_B C_R C_A Lo_i$	27.78%	30.59%	34.45%	31.20%	37.50%
$B_H H_B C_R C_A Ho_i$	33.99%	34.38%	34.02%	33.65%	36.53%

Note: Description of each portfolio is given in Appendix A.

Table 5. Capital Asset Pricing Model (CAPM).

	Intercept	MKT	Adj-R^2	F-Stat
$S_L L_B C_w C_c Lo_i$	0.037	0.85	0.066	9.541 **
	(2.189) **	(3.089) ***		
$S_L L_B C_w C_c Ho_i$	0.012	0.783	0.205	31.763 ***
	(1.421)	(5.635) ***		
$S_L L_B C_w C_A Lo_i$	0.013	1.235	0.508	124.037 ***
	(1.991) *	(11.137) ***		
$S_L L_B C_w C_A Ho_i$	0.01	0.975	0.2773	46.662 ***
	(1.201)	(6.831) ***		
$S_L L_B C_R CcLo_i$	0.009	0.872	0.2279	36.133 ***
	(1.031)	(6.011) ****		
$S_L L_B C_R C_c Ho_i$	0.01	0.666	0.0601	8.619 **
	(0.724)	(2.935) **		
$S_L L_B C_R C_A Loi$	0.008	1.172	0.351	65.098 ***
	(0.981)	(8.068) ***		
$S_L L_B C_R C_A Ho_i$	0.005	0.839	0.254	41.582 ***
	(0.729)	(6.448) ***		
$S_H H_B C_w C_c Lo_i$	0.011	0.925	0.244	39.515 ***
	(1.223)	(6.286) ***		
$S_H H_B C_w C_c Ho_i$	0.009	0.893	0.127	17.348 ***
	(0.699)	(4.165) ***		

Table 5. *Cont.*

	Intercept	MKT	Adj-R^2	F-Stat
$S_HH_BC_wC_ALo_i$	0.017 (1.115)	0.944 (6.054) ***	0.235	36.657 ***
$S_HH_BC_wC_AHo_i$	−0.066 (−0.826)	0.854 (7.021) ***	0.288	49.303 ***
$S_HH_BC_RC_cLo_i$	0.004 (0.523)	0.799 (5.597) ***	0.202	31.256 ***
$S_HH_BC_RC_cHo_i$	0.022 (1.666)	0.859 (3.917)	0.107	15.347 **
$S_HH_BC_RC_ALo_i$	0.0144 (1.545)	1.058 (6.995) ***	0.287	48.937 ***
$S_HH_BC_RC_AHo_i$	−0.002 (−0.318)	0.964 (7.431) ***	0.313	55.221 ***
$B_LL_BC_wC_cLo_i$	0.001 (0.159)	0.913 (6.715) ***	0.271	45.095 ***
$B_LL_BC_wC_cHo_i$	−0.003 (−0.591)	0.898 (8.776) ***	0.389	77.033 ***
$B_LL_BC_wC_ALo_i$	−0.003 (−0.048)	0.649 (4.972) ***	0.165	24.701 ***
$B_LL_BC_wC_AHo_i$	0.006 (0.918)	0.849 (7.937) ***	0.342	62.997 ***
$B_LL_BC_RC_cLo_i$	0.006 (0.983)	0.814 (7.324) ***	0.306	53.641 ***
$B_LL_BC_RC_cHo_i$	0.008 (1.154)	0.943 (7.923) ***	0.341	62.787 ***
$B_LL_BC_RC_ALo_i$	0.003 (0.484)	0.959 (8.583) ***	0.379	73.669 ***
$B_LL_BC_RC_AHo_i$	0.012 (1.771)	1.172 (10.417) ***	0.476	108.528 ***
$B_HH_BC_wC_cLo_i$	0.001 (0.013)	0.722 (5.415) ***	0.192	29.326 ***
$B_HH_BC_wC_cHo_i$	0.018 (1.896)	0.764 (4.826) ***	0.157	23.295 ***
$B_HH_BC_wC_ALo_i$	0.016 (1.919) *	1.127 (7.989) ***	0.345	63.826 ***
$B_HH_BC_wC_AHo_i$	0.008 (1.211)	0.713 (6.036) ***	0.229	36.437 ***
$B_HH_BC_RC_cLo_i$	0.003 (0.557)	0.932 (9.057) ***	0.405	82.037 ***
$B_HH_BC_RC_cHo_i$	0.004 (0.637)	0.702 (5.757) ***	0.212	33.149 ***
$B_HH_BC_RC_ALo_i$	0.015 (1.877) *	0.937 (6.838) ***	0.277	46.768 ***
$B_HH_BC_RC_AHo_i$	0.017 (2.014) ***	1.105 (7.899) ***	0.339	62.266 ***

Note: T-values are shown in parentheses, while 10%, 5%, and 1% significance levels are represented by the symbols *, **, ***, respectively. Description of each portfolio is given in Appendix A.

Table 6. Fama–French Three-Factor Model.

	Intercept	MKT	SMB	HML	Adj-R^2	F-Stat
$S_LL_BC_wC_cLo_i$	0.039 (2.103) **	0.742 (3.123) ***	2.287 (6.001) ***	−2.112 (−3.476) ***	0.308	18.673 **
$S_LL_BC_wC_cHo_i$	0.016 (1.271)	0.738 (5.775) ***	0.831 (4.068) ***	−1.082 (−3.309) ***	0.331	20.666 ***
$S_LL_BC_wC_ALo_i$	0.012 (1.889) *	1.213 (11.283) ***	0.443 (2.588)**	−0.658 (−2.401)**	0.543	48.135 ***

Table 6. *Cont.*

	Intercept	MKT	SMB	HML	Adj-R^2	F-Stat
$S_LL_BC_wC_AHo_i$	0.008	0.935	0.844	−0.794	0.366	23.984 ***
	(0.995)	(6.979) ***	(3.939) ***	(−2.306) **		
$S_LL_BC_RCcLo_i$	0.007	0.853	0.684	−0.071	0.272	15.862 **
	(0.816)	(6.019) ***	(3.031) ***	(−0.198)		
$S_LL_BC_RC_cHo_i$	0.003	0.605	2.149	0.227	0.338	21.291 ***
	(0.265)	(3.168) ***	(7.036) ***	(0.465)		
$S_LL_BC_RC_ALoi$	0.006	1.133	0.774	−0.874	0.421	29.854 ***
	(0.792)	(8.239) ***	(3.522) ***	(−2.486) **		
$S_LL_BC_RC_AHo_i$	0.004	0.812	0.625	−0.393	0.303	18.246 **
	(0.518)	(6.444)***	(3.106)**	(−1.222)		
$S_HH_BC_wC_cLo_i$	0.007	0.908	0.977	0.285	0.355	22.832 ***
	(0.929)	(6.604) ***	(4.482) ***	(0.819)		
$S_HH_BC_wC_cHo_i$	0.002	0.858	1.978	1.397	0.442	32.514 ***
	(0.198)	(5.013) ***	(7.227) ***	(3.191) ***		
$S_HH_BC_wC_ALo_i$	0.007	0.932	0.797	0.892	0.334	20.894 ***
	(0.859)	(6.435) ***	(3.441) ***	(2.408) **		
$S_HH_BC_wC_AHo_i$	−0.008	0.846	0.748	0.731	0.418	29.507 ***
	(−1.316)	(7.656) ***	(4.238) ***	(2.588) **		
$S_HH_BC_RC_cLo_i$	0.002	0.773	0.797	−0.078	0.272	15.876 **
	(0.247)	(5.651) ***	(3.644) **	(−0.223)		
$S_HH_BC_RC_cHo_i$	0.015	0.827	1.869	1.347	0.386	25.996 ***
	(1.411)	(4.534) ***	(6.411) ***	(2.889) **		
$S_HH_BC_RC_ALo_i$	0.012	1.047	0.665	0.525	0.339	21.433 ***
	(1.334)	(7.177) ***	(2.853) **	(1.409)		
$S_HH_BC_RC_AHo_i$	−0.005	0.951	0.865	0.638	0.441	32.316 ***
	(−0.779)	(8.091) ***	(4.612) ***	(2.125) **		
$B_LL_BC_wC_cLo_i$	0.007	0.899	0.296	−0.767	0.295	17.622 **
	(0.092)	(6.643) ***	(1.382)	(−2.236) **		
$B_LL_BC_wC_cHo_i$	−0.003	0.899	0.102	−0.246	0.385	25.839 ***
	(−0.626)	(8.647) ***	(0.625)	(−0.913)		
$B_LL_BC_wC_ALo_i$	−0.004	0.649	0.012	0.024	0.151	8.098 **
	(−0.054)	(4.915)**	(0.066)	(0.073)		
$B_LL_BC_wC_AHo_i$	0.005	0.847	0.041	−0.043	0.331	20.683 **
	(0.891)	(7.835) ***	(0.237)	(−0.158)		
$B_LL_BC_RC_cLo_i$	0.006	0.794	0.228	−0.695	0.335	21.053 ***
	(0.942)	(7.283) ***	(1.309)	(−2.494) **		
$B_LL_BC_RC_cHo_i$	0.008	0.939	0.019	−0.221	0.333	20.839 ***
	(1.149)	(7.815) ***	(0.099)	(−0.721)		
$B_LL_BC_RC_ALo_i$	0.003	0.955	−0.022	−0.244	0.372	24.562 **
	(0.508)	(8.483) ***	(−0.126)	(−0.848)		
$B_LL_BC_RC_AHo_i$	0.012	1.168	0.023	−0.071	0.465	35.607 ***
	(1.745)	(10.287) ***	(0.127)	(−0.245)		
$B_HH_BC_wC_cLo_i$	−0.001	0.728	0.025	0.393	0.188	10.192 **
	(−0.019)	(5.435) ***	(0.117)	(1.149)		
$B_HH_BC_wC_cHo_i$	0.018	0.771	−0.032	0.338	0.148	7.907 **
	(1.873)*	(4.831) ***	(−0.127)	(0.828)		
$B_HH_BC_wC_ALo_i$	0.015	1.131	0.177	0.495	0.346	22.009 **
	(1.827)*	(7.988) ***	(0.754)	(1.132)		
$B_HH_BC_wC_AHo_i$	0.008	0.715	0.085	0.217	0.221	12.296 **
	(1.147)	(6.006) ***	(0.455)	(0.714)		
$B_HH_BC_RC_cLo_i$	0.003	0.937	−0.037	−0.213	0.398	27.312 ***
	(0.589)	(8.964) ***	(−0.225)	(−0.803)		
$B_HH_BC_RC_cHo_i$	0.005	0.708	−0.119	0.148	0.202	11.065 **
	(0.668)	(5.754) ***	(−0.563)	(0.471)		
$B_HH_BC_RC_ALo_i$	0.014	0.945	0.197	0.786	0.305	18.479 **
	(1.786)*	(7.019) ***	(0.919)	(2.284) **		
$B_HH_BC_RC_AHo_i$	0.016	1.098	0.336	0.161	0.343	21.779 ***
	(1.879)*	(7.841) ***	(1.502)	(0.458)		

Note: T-values are shown in parentheses, while 10%, 5%, and 1% significance levels are represented by the symbols *, **, ***, respectively. Description of each portfolio is given in Appendix A.

Table 7. Human Capital Four-Factor Model.

	Intercept	MKT	SMB	HML	LBR	Adj-R^2	F-Stat
$S_LL_BC_wC_cLo_i$	0.028	0.663	2.476	−1.679	1.456	0.369	18.427 **
	(1.994) *	(2.894) ***	(6.734) ***	(−2.837) **	(3.508) ***		
$S_LL_BC_wC_cHo_i$	0.009	0.733	0.843	−1.056	0.087	0.326	15.414 **
	(1.243)	(5.685) ***	(4.063)***	(−3.147)***	(0.369)		
$S_LL_BC_wC_ALo_i$	0.011	1.169	0.538	−0.442	0.725	0.593	44.366 ***
	(1.778) *	(11.494) ***	(3.291) ***	(−1.673)	(3.909) ***		
$S_LL_BC_wC_AHo_i$	0.007	0.923	0.871	−0.728	0.207	0.365	18.117 **
	(0.943)	(6.847) ***	(4.016) ***	(−2.077) **	(0.841)		
$S_LL_BC_RCcLo_i$	0.005	0.801	0.798	0.188	0.873	0.338	16.209 **
	(0.641)	(5.914) ***	(3.665) ***	(0.533)	(3.535) ***		
$S_LL_BC_RC_cHo_i$	0.005	0.682	1.971	−0.179	−1.365	0.428	22.552 ***
	(0.526)	(3.793) ***	(6.817) ***	(−0.382)	(−4.163) ***		
$S_LL_BC_RC_ALoi$	0.004	1.069	0.922	−0.537	1.132	0.517	32.915 ***
	(0.578)	(8.473) ***	(4.543) ***	(−1.637)	(4.919) ***		
$S_LL_BC_RC_AHo_i$	0.005	0.845	0.549	−0.566	−0.582	0.335	16.018 **
	(0.688)	(6.829) ***	(2.758) **	(−1.766) *	(−2.589) **		
$S_HH_BC_wC_cLo_i$	0.005	0.842	1.117	0.606	1.076	0.453	25.683 ***
	(0.734)	(6.657)***	(5.508)***	(1.846)*	(4.679)***		
$S_HH_BC_wC_cHo_i$	0.004	0.931	1.809	1.011	−1.299	0.521	33.359 ***
	(0.474)	(5.837)***	(7.049)***	(2.434)**	(−4.467)***		
$S_HH_BC_wC_ALo_i$	0.005	0.878	0.921	1.176	0.955	0.403	21.096 ***
	(0.683)	(6.371) ***	(4.156) ***	(3.281) ***	(3.801) ***		
$S_HH_BC_wC_AHo_i$	−0.009	0.845	0.757	0.735	0.013	0.413	21.941 ***
	(−1.312)	(7.576) ***	(4.183) ***	(2.534) **	(0.067)		
$S_HH_BC_RC_cLo_i$	0.008	0.737	0.881	0.112	0.639	0.307	14.211 **
	(0.099)	(5.491) ***	(4.081) ***	(0.321)	(2.612) **		
$S_HH_BC_RC_cHo_i$	0.018	0.892	1.718	1.001	−1.162	0.445	24.919 ***
	(1.694)	(5.123) ***	(6.129) ***	(2.212) **	(−3.656) ***		
$S_HH_BC_RC_ALo_i$	0.011	0.992	0.791	0.815	0.971	0.409	21.669 ***
	(1.184)	(7.157) ***	(3.549) ***	(2.259) **	(3.841) ***		
$S_HH_BC_RC_AHo_i$	−0.006	0.933	0.903	0.724	0.293	0.445	24.869 ***
	(−0.859)	(7.938) ***	(4.777) ***	(2.368) **	(1.353)		
$B_LL_BC_wC_cLo_i$	−0.006	0.852	0.396	−0.551	0.723	0.342	16.476 **
	(−0.082)	(6.527) ***	(1.865) *	(−1.629)	(3.044) **		
$B_LL_BC_wC_cHo_i$	−0.003	0.891	0.104	−0.236	0.014	0.379	19.214 **
	(−0.621)	(8.556) ***	(0.622)	(−0.873)	(0.074)		
$B_LL_BC_wC_ALo_i$	−0.001	0.607	0.115	0.247	0.749	0.215	9.152 **
	(−0.244)	(4.752) ***	(0.538)	(0.745)	(3.216) ***		
$B_LL_BC_wC_AHo_i$	0.005	0.844	0.047	−0.028	0.051	0.326	15.401 **
	(0.871)	(7.733) ***	(0.272)	(−0.101)	(0.257)		
$B_LL_BC_RC_cLo_i$	0.005	0.789	0.259	−0.624	0.238	0.338	16.203 **
	(0.872)	(7.135) ***	(1.473)	(−2.195) **	(1.192)		
$B_LL_BC_RC_cHo_i$	0.008;	0.946	0.003	−0.257	−0.121	0.329	15.611 **
	(1.175)	(7.806) ***	(0.016)	(−0.816)	(−0.553)		
$B_LL_BC_RC_ALo_i$	0.003	0.956	−0.023	−0.247	−0.009	0.367	18.264 **
	(0.507)	(8.406) ***	(−0.138)	(−0.835)	(−0.044)		
$B_LL_BC_RC_AHo_i$	0.012	1.177	0.002	−0.118	−0.159	0.464	26.752 ***
	(1.784) *	(10.293) ***	(0.012)	(−0.399)	(−0.766)		
$B_HH_BC_wC_cLo_i$	−0.001	0.688	0.117	0.604	0.707	0.239	10.369 ***
	(−0.194)	(5.281) ***	(0.559)	(1.781) *	(2.972) ***		
$B_HH_BC_wC_cHo_i$	0.018	0.775	−0.041	0.318	−0.068	0.141	5.895 **
	(1.875) *	(4.816) ***	(−0.159)	(0.;758)	(−0.231)		
$B_HH_BC_wC_ALo_i$	0.014	1.081	0.284	0.668	0.871	0.404	21.226 ***
	(1.706) *	(7.966) ***	(1.303)	(1.894) *	(3.525) ***		
$B_HH_BC_wC_AHo_i$	0.009	0.737	0.034	0.104	−0.393	0.236	10.235 **
	(1.263)	(6.216) ***	(0.187)	(0.325)	(−1.829) *		
$B_HH_BC_RC_cLo_i$	0.003	0.916	−0.006	−0.142	0.237	0.401	20.976 ***
	(0.508)	(8.806) ***	(−0.038)	(−0.526)	(1.251)		
$B_HH_BC_RC_cHo_i$	0.004	0.689	−0.065	0.252	0.349	0.212	9.006 **
	(0.586)	(5.599) ***	(−0.333)	(0.789)	(1.556)		
$B_HH_BC_RC_ALo_i$	0.013	0.907	0.285	0.986	0.671	0.344	16.632 **
	(1.671)	(6.897) ***	(1.349)	(2.882) **	(2.798) **		
$B_HH_BC_RC_AHo_i$	0.015	1.089	0.357	0.208	0.158	0.342	16.341 **
	(1.834) *	(7.715) ***	(1.573)	(0.568)	(0.615)		

Note: T-values are shown in parentheses, while 10%, 5%, and 1% significance levels are represented by the symbols *, **, ***, respectively. Description of each portfolio is given in Appendix A.

Table 8. Fama–French Five-Factor Model.

	Intercept	MKT	SMB	HML	RMW	CMA	Adj-R^2	F-Stat
$S_LL_BC_wC_cLo_i$	0.03	1.002	1.773	−1.662	−1.862	1.311	0.423	18.486 ***
	(2.243) **	(4.474) ***	(4.799) ***	(−2.958) ***	(−4.036) ***	(3.598) ***		
$S_LL_BC_wC_cHo_i$	0.009	0.835	0.658	−0.904	−0.861	0.425	0.391	16.314 ***
	(1.299)	(6.629) ***	(3.169) ***	(−2.861) **	(−3.329) ***	(2.077) **		
$S_LL_BC_wC_ALo_i$	0.012	1.196	0.537	−0.639	−0.576	−0.312	0.579	33.807 ***
	(2.005) **	(11.262) ***	(3.029) ***	(−2.405) **	(−2.635) **	(−1.809) *		
$S_LL_BC_wC_AHo_i$	0.008	0.921	0.955	−0.752	−0.879	−0.414	0.438	19.608 **
	(1.096)	(7.075) ***	(4.448) ***	(−2.301) **	(−3.245) ***	(−1.957) *		
$S_LL_BC_RCcLo_i$	0.006	0.933	0.452	0.011	0.291	0.711	0.331	12.782 **
	(0.787)	(6.651) ***	(1.963) *	(0.032)	(1.012)	(3.128) ***		
$S_LL_BC_RC_cHo_i$	0.002	0.784	1.646	0.412	0.593	1.542	0.498	23.944 **
	(0.205)	(4.509) ***	(5.766) ***	(0.952)	(1.664)	(5.486) ***		
$S_LL_BC_RC_ALoi$	0.007	1.046	0.992	−0.987	0.049	−0.637	0.458	20.479 **
	(0.864)	(7.565) ***	(4.349) ***	(−2.843) **	(0.172)	(−2.833) **		
$S_LL_BC_RC_AHo_i$	0.004	0.739	0.782	−0.511	0.373	−0.424	0.322	12.332 **
	(0.561)	(5.759) ***	(3.693) ***	(−1.586)	(1.412)	(−2.034) **		
$S_HH_BC_wC_cLo_i$	0.007	0.989	0.828	0.456	−0.905	0.348	0.404	17.195 **
	(0.942)	(7.314) ***	(3.714) **	(1.344)	(−3.252) ***	(1.586)		
$S_HH_BC_wC_cHo_i$	0.001	1.049	1.484	1.639	0.014	1.455	0.562	31.541 ***
	(0.119)	(6.695) ***	(5.744) ***	(4.169) ***	(0.043)	(5.712) ***		
$S_HH_BC_wC_ALo_i$	0.008	0.916	0.926	0.935	−0.998	−0.479	0.421	18.309 **
	(0.963)	(6.568) ***	(4.026) ***	(2.672) **	(−3.475) ***	(−2.114) **		
$S_HH_BC_wC_AHo_i$	−0.008	0.786	0.919	0.666	−0.176	−0.518	0.455	20.901 ***
	(−1.306)	(7.122) ***	(5.047) ***	(2.405) **	(−0.774)	(−2.888) **		
$S_HH_BC_RC_cLo_i$	0.001	0.816	0.661	−0.043	0.305	0.436	0.294	10.914 **
	(0.214)	(5.861) ***	(2.888) **	(−0.123)	(1.048)	(1.901) *		
$S_HH_BC_RC_cHo_i$	0.015	0.937	1.474	1.408	1.254	1.289	0.556	30.804 ***
	(1.562)	(5.853) ***	(5.578) ***	(3.504) ***	(3.802 ***)	(4.949) ***		
$S_HH_BC_RC_ALo_i$	0.012	1.009	0.789	0.495	−0.294	−0.396	0.352	13.946 **
	(1.377)	(6.769) ***	(3.209) ***	(1.323)	(−0.957)	(−1.635)		
$S_HH_BC_RC_AHo_i$	−0.005	0.859	1.097	0.522	0.012	−0.689	0.491	23.974 ***
	(−0.756)	(7.434) ***	(5.752) ***	(1.799) *	(0.052)	(−3.621) ***		
$B_LL_BC_wC_cLo_i$	0.005	0.987	0.132	−0.581	−0.981	0.384	0.364	14.652 **
	(0.068)	(7.511) ***	(0.612)	(−1.762) *	(−3.622) ***	(1.799) *		
$B_LL_BC_wC_cHo_i$	−0.004	0.952	−0.013	−0.131	−0.486	0.293	0.417	17.587 **
	(−0.662)	(9.145) ***	(−0.079)	(−0.502)	(−2.266) **	(1.737) *		
$B_LL_BC_wC_ALo_i$	−0.003	0.651	0.057	0.063	−0.566	−0.188	0.177	6.144 **
	(−0.037)	(4.848) ***	(0.261)	(0.187)	(−2.047) **	(−0.864)		
$B_LL_BC_wC_AHo_i$	0.006	0.834	0.112	−0.031	−0.448	−0.254	0.359	14.383 **
	(0.938)	(7.638) ***	(0.623)	(−0.113)	(−1.992) *	(−1.432)		
$B_LL_BC_RC_cLo_i$	0.006	0.853	0.075	−0.624	0.066	0.471	0.365	14.722 **
	(0.916)	(7.754) ***	(0.388)	(−2.263) **	(0.294)	(2.634) **		
$B_LL_BC_RC_cHo_i$	0.008	0.967	−0.085	−0.208	0.364	0.342	0.356	14.156 **
	(1.135)	(7.939) ***	(−0.422)	(−0.682)	(1.452)	(1.728) *		
$B_LL_BC_RC_ALo_i$	0.003	0.949	−0.046	−0.284	0.448	0.115	0.385	15.942 **
	(0.502)	(8.252) ***	(−0.246)	(−0.971)	(1.893) *	(0.617)		
$B_LL_BC_RC_AHo_i$	0.012	1.167	−0.046	−0.123	0.808	0.284	0.529	27.738 ***
	(1.825) *	(10.607) ***	(−0.255)	(−0.447)	(3.566) ***	(1.591)		
$B_HH_BC_wC_cLo_i$	−0.007	0.884	−0.309	0.628	−0.653	0.919	0.312	11.807 ***
	(−0.099)	(6.919) ***	(−1.471)	(1.967) **	(−2.489) ***	(4.441) ***		
$B_HH_BC_wC_cHo_i$	0.018	0.915	−0.305	0.591	−1.103	0.694	0.244	8.718
	(1.942)	95.892)	(−1.192)	(1.517)	(−3.449)	(2.756)		
$B_HH_BC_wC_ALo_i$	0.016	1.107	0.272	0.413	−0.509	−0.356	0.369	14.934 **
	(1.889) *	(7.723) ***	(1.152)	(1.1494)	(−1.724) *	(−1.503)		
$B_HH_BC_wC_AHo_i$	0.008	0.798	−0.056	0.356	−0.676	0.335	0.266	9.659 **
	(1.154)	(6.622) ***	(−0.257)	(1.197) *	(−2.726) **	(1.728) *		
$B_HH_BC_RC_cLo_i$	0.003	0.959	−0.099	−0.165	−0.154	0.168	0.394	16.524 ***
	(0.562)	(8.923) ***	(−0.563)	(−0.615)	(−0.695)	(0.965)		
$B_HH_BC_RC_cHo_i$	0.004	0.794	−0.316	0.267	−0.163	0.589	0.245	8.742 **
	(0.634)	(6.421) ***	(−1.551)	(0.862)	(−0.642)	(2.939) ***		
$B_HH_BC_RC_ALo_i$	0.014	0.924	0.209	0.729	0.487	0.014	0.312	11.794 **
	(1.799) *	(6.677) ***	(0.917)	(2.098) **	(1.709) *	(0.063)		
$B_HH_BC_RC_AHo_i$	0.016	1.081	0.391	0.144	−0.096	−0.171	0.336	13.069 **
	(1.881) *	(7.429) ***	(1.632)	(0.396)	(−0.322)	(−0.725)		

Note: T-values are shown in parentheses, while 10%, 5%, and 1% significance levels are represented by the symbols *, **, ***, respectively. Description of each portfolio is given in Appendix A.

The adjusted R^2 of CAPM ranges from 6.02–50.83%. This indicates that 6.02–50.83% is explained by the market premium above the risk-free rate. Similarly, the adjusted R^2 of

FF3FM for small portfolios (small-size companies) is 14.83% and for big portfolios (large-size companies) 54.30%. This indicates that 14.83–54.30% of variation is explained by the market, size and excess portfolio return value. The adjusted R^2 of the human capital-based four-factor model for small portfolios (small-size companies) was 14.13% and for big size portfolios 59.31%. This indicates that 14.13–59.31% of variation is explained by the market, size, value and labor income growth premium in asset returns. The adjusted R^2 of FF5FM for small portfolios (small-size companies) was 17.77% and for big portfolios (large-size companies) 57.96%. This indicates that 17.77–57.96% of variation is explained by the market, size, value, profitability and investment premium in excess portfolio returns. However, the adjusted R^2 of the human capital-based six-factor model for small portfolios (small-size companies) was 21.75% and for big portfolios 61.13%. This indicates that 21.75–61.13% of variation is explained by the market, size, value, profitability, investment and labor income growth premium in excess portfolio returns.

Table 4 represents the explanatory summary of these five models, namely CAPM, FF3FM, HC4FM, FF5FM and HC6FM. These five asset pricing models are found to be statistically valid and appropriate for explaining variation in excess portfolio returns. Comparing these models on the basis of adjusted R^2 indicated that the human capital-based six-factor model is more appropriate than and superior to other competing asset pricing models for explaining variability in excess portfolio returns in the context of Pakistan.

Results Interpretation for Human Capital Six-Factor Model

Table 9 (see Appendix B) shows the regression output for HC6FM. In the six-factor model, MKT (market premium), SMB (size premium), HML (value premium) RMW (profitability premium), CMA (investment premium), and LBR (labor income growth rate) are regressed on thirty-two portfolios. It is shown in Table 9 that all coefficients of MKT (market-premium) are positive and statistically significant for the market premium above the risk-free rate. However, the SMB (size premium) co-efficient for small portfolios (small-size companies) is positive and statistically significant for all sixteen small-size portfolios, and the association is found to be statistically significant at the 1% or 5% levels. By contrast, the coefficient of SMB for big-size portfolios is positive and statistically insignificant for all of the sixteen big-size portfolios. The significance of SMB for all of the sixteen small portfolios (small-size companies) and insignificance of SMB for the big portfolios shows that, in Pakistan, small portfolios (small-size companies) outperform big portfolios (large-size companies) on the basis of risk-adjusted returns. For HML (value premium factor), the co-efficient of seven out of sixteen high B/M stock portfolios is positive and statistically significant at the 5% level.

Table 9. Human-Capital Six-Factor Model.

	Intercept	**MKT**	**SMB**	**HML**	**RMW**	**CMA**	**LBR**	**Adj-R^2**	**F-Stat**
$S_LL_BC_wC_cLo_i$	0.026	0.919	1.809	−1.267	−1.646	1.615	1.544	0.477	19.268 **
	(2.121) ***	(4.346) ***	(5.397) ***	(−2.283) **	(−3.241) ***	(4.324) ***	(3.639) ***		
$S_LL_BC_wC_cHo_i$	0.009	0.836	0.656	−0.911	−0.867	0.422	−0.022	0.386	13.478 **
	(1.296)	(6.584) ***	(3.128) ***	(-2.806) **	(-3.231) ***	(2.025) **	(-0.096)		
$S_LL_BC_wC_ALo_i$	0.011	1.167	0.583	−0.473	−0.417	−0.231	0.578	0.607	31.697 ***
	(1.876) *	(11.322) ***	(3.428) ***	(−1.798) *	(−1.916) *	(−1.361)	(3.019) ***		
$S_LL_BC_wC_AHo_i$	0.008	0.926	0.947	−0.779	−0.896	−0.428	−0.094	0.434	16.242 **
	(1.115)	(7.053) ***	(4.368) ***	(−2.322) **	(−3.238) ***	(−1.987) *	(−0.386)		
$S_LL_BC_RCcLo_i$	0.004	0.869	0.563	0.359	0.624	0.883	1.212	0.452	17.392 **
	(0.536)	(6.839) ***	(2.685) **	(1.107)	(2.325) **	(4.239) ***	(5.125) ***		
$S_LL_BC_RC_cHo_i$	0.004	0.832	1.556	0.129	0.322	1.402	−0.985	0.528	23.214 ***
	(0.413)	(4.961) ***	(5.633) ***	(0.302)	(0.911)	(5.108) ***	(−3.171) ***		
$S_LL_BC_RC_ALoi$	0.004	0.991	1.094	−0.668	0.354	−0.479	1.111	0.535	23.833 ***
	(0.635)	(7.753) ***	(5.186) ***	(−2.047) **	(1.313)	(−2.287) **	(4.675) ***		
$S_LL_BC_RC_AHo_i$	0.005	0.772	0.722	−0.697	0.194	−0.517	−0.649	0.366	12.189 **
	(0.756)	(6.164) ***	(3.494) ***	(−2.183) **	(0.735)	(−2.517) **	(−2.792) **		
$S_HH_BC_wC_cLo_i$	0.005	0.936	0.923	0.755	−0.619	0.497	1.049	0.489	19.999 **
	(0.727)	(7.442) ***	(4.445) ***	(2.349) **	(−2.329) **	(2.408) **	(4.4522) ***		

Table 9. *Cont.*

	Intercept	MKT	SMB	HML	RMW	CMA	LBR	Adj-R^2	F-Stat
$S_HH_BC_wC_cHo_i$	0.003	1.103	1.385	1.328	−0.283	1.301	−1.082	0.611	32.191 ***
	(0.389)	(7.444) ***	(5.661) ***	(3.506) ***	(−0.905)	(5.351) ***	(−3.931) ***		
$S_HH_BC_wC_ALo_i$	0.006	0.881	0.988	1.131	−0.811	−0.382	0.684	0.451	17.315 **
	(0.813)	(6.464) ***	(4.392) ***	(3.249) ***	(−2.811) **	(−1.707) *	(2.705) **		
$S_HH_BC_wC_AHo_i$	−0.008	0.794	0.904	0.621	−0.218	−0.541	−0.154	0.453	17.443 **
	(−1.253)	(7.147) ***	(4.934) ***	(2.191) **	(−0.931)	(−2.966) **	(−0.748)		
$S_HH_BC_RC_cLo_i$	−0.005	0.771	0.742	0.211	0.544	0.556	0.887	0.366	12.187 **
	(−0.006)	(5.794) ***	(3.379) ***	(0.623)	(1.936) *	(2.551) **	(3.587) ***		
$S_HH_BC_RC_cHo_i$	0.016	0.971	1.414	1.221	1.075	1.196	−0.652	0.571	27.375 ***
	(1.729) *	(6.135) ***	(5.415) ***	(3.021) ***	(3.216) ***	(4.611) ***	(−2.219) **		
$S_HH_BC_RC_ALo_i$	0.011	0.963	0.872	0.755	−0.046	−0.268	0.902	0.406	14.599 **
	(1.217)	(6.715) ***	(3.683) ***	(2.063) **	(−0.151)	(−1.141)	(3.385) ***		
$S_HH_BC_RC_AHo_i$	−0.005	0.851	1.112	0.568	0.056	−0.658	0.164	0.489	19.991 **
	(−0.795)	(7.317) ***	(5.786) ***	(1.911) *	(0.229)	(−3.446) ***	(0.741)		
$B_LL_BC_wC_cLo_i$	−0.007	0.955	0.191	−0.397	−0.805	0.475	0.639	0.397	14.063 **
	(−0.103)	(7.427) ***	(0.902)	(−1.209)	(−2.961) **	(2.254) **	(2.676) **		
$B_LL_BC_wC_cHo_i$	−0.004	0.954	−0.017	−0.142	−0.496	0.287	−0.038	0.405	14.539 **
	(−0.645)	(9.085) ***	(−0.098)	(−0.531)	(−2.237) **	(1.668) *	(−0.197)		
$B_LL_BC_wC_ALo_i$	−0.001	0.618	0.116	0.246	−0.399	−0.098	0.637	0.217	6.5135 **
	(−0.206)	(4.704) ***	(0.534)	(0.732)	(−1.406)	(−0.454)	(2.606) **		
$B_LL_BC_wC_AHo_i$	0.006	0.844	0.101	−0.065	−0.481	−0.271	−0.119	0.356	11.974 **
	(0.972)	(7.637) ***	(0.558)	(−0.233)	(−2.068) **	(−1.504)	(−0.584)		
$B_LL_BC_RC_cLo_i$	0.005	0.833	0.106	−0.511	0.175	0.527	0.393	0.386	13.191 **
	(0.799)	(7.631) ***	(0.591)	(−1.834) *	(0.758)	(2.943) **	(1.938) *		
$B_LL_BC_RC_cHo_i$	0.008	0.965	−0.081	−0.196	0.376	0.348	0.041	0.354	11.702 **
	(1.116)	(7.845) ***	(−0.402)	(−0.626)	(1.447)	(1.728)	(0.181)		
$B_LL_BC_RC_ALo_i$	0.003	0.943	−0.034	−0.242	0.485	0.134	0.132	0.382	13.276 **
	(0.457)	(8.136) ***	(−0.181)	(−0.818)	(1.981) *	(0.706)	(0.615)		
$B_LL_BC_RC_AHo_i$	0.011	1.162	−0.037	−0.094	0.836	0.299	0.099	0.526	22.998 ***
	(1.784) *	(10.479) ***	(−0.203)	(−0.335)	(3.565) ***	(1.643)	(0.482)		
$B_HH_BC_wC_cLo_i$	−0.002	0.838	−0.232	0.868	−0.423	1.038	0.834	0.381	13.217 **
	(−0.343)	(6.906) **	(−1.162)	(2.802) **	(−1.651)	(5.217) ***	(3.701) **		
$B_HH_BC_wC_cHo_i$	0.018	0.924	−0.323	0.536	−1.156	0.667	−0.191	0.241	7.301 **
	(1.976) *	(5.913) ***	(−1.251)	(1.342)	(−3.498) ***	(2.601) **	(−0.659)		
$B_HH_BC_wC_ALo_i$	0.014	1.071	0.341	0.628	−0.303	−0.244	0.747	0.407	14.624 **
	(1.758) *	(7.661) ***	(1.478)	(1.761) *	(−1.029)	(−1.065)	(2.889) **		
$B_HH_BC_wC_AHo_i$	0.009	0.817	−0.098	0.205	−0.815	0.266	−0.526	0.296	9.359 **
	(1.331)	(6.957) ***	(−0.509)	(0.684)	(−3.284) ***	(1.352)	(−2.412) **		
$B_HH_BC_RC_cLo_i$	0.003	0.946	−0.075	−0.091	−0.081	0.206	0.263	0.398	14.148 **
	(0.477)	(8.789) ***	(−0.427)	(−0.327)	(−0.358)	(1.168)	(1.317)		
$B_HH_BC_RC_cHo_i$	0.003	0.769	−0.272	0.407	−0.032	0.658	0.485	0.268	8.272 **
	(0.504)	(6.299) ***	(−1.348)	(1.303)	(−0.117)	(3.281) ***	(2.135) **		
$B_HH_BC_RC_ALo_i$	0.013	0.888	0.288	0.979	0.726	0.138	0.873	0.375	12.967 **
	(1.646)	(6.643) ***	(1.326)	(2.891) **	(2.594) **	(0.635)	(3.533) ***		
$B_HH_BC_RC_AHo_i$	0.017	1.074	0.401	0.175	−0.066	−0.155	0.109	0.365	10.837 **
	(1.845) *	(7.339) ***	(1.659)	(0.469)	(−0.214)	(−0.648)	(0.404)		

Note: T-values are shown in parentheses, while 10%, 5%, and 1% significance levels are represented by the symbols *, **, ***, respectively. Description of each portfolio is given in Appendix A.

By comparison, the coefficient of six out of sixteen low B/M portfolios is found to be negative and statistically significant and insignificant at the 1 and 5% levels, respectively. The significant and positive relationship of HML to excess portfolio returns in value stock portfolios and significant and negative relationship of HML to excess portfolio returns in growth stock portfolios shows that, in Pakistan, portfolios of value stock (high B/M value stocks) outperform portfolios of growth stocks (low B/M value stocks) based on risk-adjusted returns. In the case of RMW (profitability premium), it is observed that the coefficients for small portfolios (small-size companies) with weak profitability are negative and statistically significant, while those for small portfolios (small-size companies) with robust profitability are positive and statistically significant or insignificant. In the case of RMW for big portfolios, the coefficients are found to be negative and statistically significant for big portfolios (large-size companies) with weak profitability, while the coefficients for big portfolios (large-size companies) with robust profitability are found to be positive and statistically significant or insignificant. The significance and positive relationship of RMW to portfolio returns for robust profitable stock portfolios, and significance and negative relationship of RMW to portfolio returns for weak stock portfolios, shows that portfolio stocks with robust profitability earn higher risk-adjusted returns compared to portfolio stocks with weak profitability. Similarly, investment premium (CMA) coefficients for small portfolios (small-size companies) with conservative investment are found to be positive and statistically significant for thirteen out of sixteen small portfolios. By comparison, for big portfolios (large-size companies) the coefficients are found to be negative and statistically significant for five out of sixteen stocks with aggressive investment. The significance and positive relationship of CMA to portfolio returns of conservative stock and significant and negative relation of CMA with portfolio returns of aggressive stock show that in Pakistan, conservative stocks outperform aggressive stocks on the basis of risk-adjusted returns. In the case of LBR (human capital), it is seen that for fourteen of the sixteen low labor income growth rate portfolios, the coefficients for low labor income growth rate stock are found to be positive and statistically significant, whereas for six out of sixteen portfolios with high labor income growth rates, the coefficients for large stocks are found to be positive or negative, and statistically significant. According to this interpretation, stock portfolios with low labor income growth outperform those with high labor income growth. Out of 32 portfolios, the estimated LBR or human capital component is determined to be statistically significant for 20 portfolios (small and big portfolios sorted from low to high labor income growth rate). This suggests that human capital is an important factor in determining the variation in excess portfolio returns. The adjusted R^2 of the HC6FM (human capital six factor model) ranges from 21.75% to 61.13% and represents the variation in excess portfolio returns by market, size, value, profitability, investment, and labor income growth rate premium in the Pakistani stock market. The model is statistically significant overall, and F-statistics and its probability values are shown to be significant at the 5% level for all portfolios.

5. Discussion

The findings of this study are like the following studies and support the previous literature. Acaravci and Karaomer (2017) concluded that FF5FM was valid in the BIST (Borsa Istanbul stock exchange) for capturing variability in asset returns. According to Fama and French (1993), market risk has a significant role in explaining returns above the risk-free rate but does not account for variation in excess stock return. Additionally, they find that small portfolios (small-size companies) have a larger slope for the SMB factor, which measures the effect of size on stock returns, than large stocks. Similarly, Rosett (2001) used two risk variables (namely market and accounting base) and documented that human capital has a statistically positive relationship with equity returns. Wright et al. (2001) and Bontis (2003) documented that human capital must be considered an investment rather than an expense of the company. Furthermore, the authors argue that human capital has a greater influence on determining the value of a company. Shijin et al. (2012) conducted a study on the NIFTY−50 index and found a causal relationship between labor income and asset returns. Iqbal et al. (2013) found that portfolio managers and investors are encouraged to look for modified and multiple variables models instead of relying on CAPM (capital asset pricing model). According to Abbas et al. (2014), in terms of stock returns, small market capitalization companies outperform large market capitalization companies. Similarly, stocks with high BVR (book-to-market-ratio) report higher returns than stocks with low BVR (book-to-market-ratio).

Chowdhury (2017) tested the FF3FM in the Bangladesh stock market. The study found that FF3FM was less explanatory for explaining stock returns in Bangladesh. Zada et al. (2017) compared CAPM, the three-factor model, and the five-factor model, highlighting that FF5FM outperformed other competing asset pricing models. Rashid et al. (2018) found that MKT (market premium), SMB (size premium), and HML (value premium) are significant factors in the Pakistan equity market and concluded that small-size portfolios offer higher returns when compared to big-size portfolio returns. Fletcher (2018) investigated the UK stock market. The effectiveness of the FF5FM and six-factor model was tested in this study. The six-factor model was found to be the most effective in explaining variation in expected stock returns. Chai et al. (2019) tested the FF5FM and Fama–French alternative six-factor model ($FF6_{CP}$). This study found that the alternative six-factor was superior to FF5FM for explaining the variability in asset returns. Ali et al. (2021) found that, in Pakistan, the profitability factor improves the description of stock returns. However, the authors found that for small portfolios (small-size companies) with negative RMW and CMA (indicating stock behavior of firms that are non-profitable and invest aggressively) and stock with positive RMW and CMA (indicating stock behavior of firms that are profitable and invest conservatively), FF5FM was less explanatory in Pakistan to capture these effects. Khan et al. (2022) tested HC6FM in Pakistan. The authors found that an augmented HC6FM statistically explained the variability in excess portfolio returns.

6. Conclusions

In recent years, the rapid and significant development of emerging markets has globally led to insight from potential investors and academicians seeking to assess these markets in terms of risk inheritance. Such rapid growth and development in emerging markets raises questions regarding unidentified factors that may be different from developed capital markets. Therefore, this study aims to choose the best model for accurately explaining variation in excess portfolio returns. This study collects data on 173 non-financial firms for the period 2010–2020 listed on the Pakistan stock exchange. In order to find an efficient asset pricing model, this study constructs a set of thirty-two portfolios sorted by size, value, profitability, investment, and human capital; these five factors are denoted SMB, HML, RMW, CMA, and LBR and examined along with market risk premium. Furthermore, this study follows Fama and MacBeth's (1973) regression methodology and regresses the thirty-two portfolios. Descriptive summaries of the portfolios show that, in Pakistan, on average small portfolios (small-size companies) earn considerably higher returns than big portfolios (large-size companies). Ultimately, the risk associated with portfolio returns is higher for small portfolios than for big portfolios, which supports the proposition of Richardson (1970), who argues that "*Investors on average earn higher return by taking greater risk, thus, to enjoy broad acceptance throughout the investment community*". According to empirical estimation, CAPM is found to be valid for explaining the variability of market risk premiums above the risk-free rate. FF3FM is also found to be valid for explaining variation in excess portfolio returns. In order to find the most suitable model, we added human capital to FF3FM. The estimated result shows that the human capital-based four-factor model outperforms FF3FM in better explaining the variability in asset returns. We then employed FF5FM and found it to be better for capturing variation on the basis of the adjusted R-square in excess portfolio return than CAPM, FF3FM and the human capital-based four-factor model. Then, we added human capital to FF5FM and proposed the augmented HC6FM. After estimation we found that the human capital-based six-factor model outperformed all the other competing asset pricing models (CAPM, FF3FM, HC4FM, FF5FM) on the basis of the adjusted R-square for explaining variation in excess portfolio return. According to the study findings, small portfolios (small-size companies) earn higher returns than big portfolios (large-size companies) and thus reward investors for taking extra risk. Similarly, excess portfolio returns of high book-to-market ratio stocks are higher than those of low book-to-market ratio stocks. This study encourages future researchers to include human capital in asset pricing models, and encourage investors to consider the human capital factor along with other factors in rational decisions. Furthermore, it is inferred that in the realm of asset pricing, human capital seems to be a vital factor. Therefore, investors are encouraged to take the firm's investment in human capital into account in addition to other aspects such as size, value, profitability, and investment premium.

7. Limitations and Direction for Future Research

First, this study collected data from 2010–2020. Second, the sample size of the study was not enough to construct traditional portfolios (25 size–value, 25 size–value–profitability, and 25 size–value–profitability–investment portfolios) as specified by Fama and French (1992, 1993, 2015). Third, the scope of this study is limited to Pakistan, which represents one of the emerging Asian economies. Therefore, the result may not be applicable to comparison with developed countries. This study encourages future researchers to test the efficiency and applicability of these competing asset pricing models in developed countries. In addition, study can be conducted on extended sample periods. Moreover, future researchers should consider liquidity and value at risk factor as premiums along with other risk factors.

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Appendix A

1. *Factor Construction*

Size Premium (SMB) = $1/16 *[(S_L L_B C_w C_C Lo_i - B_H L_B C_w C_c Lo_i) + (S_L L_B C_w C_C Hi_i - B_H L_B C_w C_C Hi_i) + (S_L L_B C_w C_A Lo_i - B_H L_B C_w C_A Lo_i) + (S_L L_B C_w C_A Hi_i - B_H L_B C_w C_A Hi_i) + (S_L L_B C_R C_C Lo_i) - (B_H L_B C_R C_C Lo_i) + (S_L L_B C_R C_C Hi_i) - (B_H L_B C_R C_C Hi_i) + (S_L L_B C_R C_A Lo_i - B_H L_B C_R C_A Lo_i) + (S_L L_B C_R C_A Lo_i - B_H L_B C_R C_A Hi_i) + (S_L H_B C_W C_C Lo_i - B_H L_B C_W C_C Lo_i) + (S_L H_B C_W C_C Hi_i - B_H H_B C_W C_C Hi_i) + (S_L H_B C_w C_A Lo_i - B_H H_B C_w C_A Lo_i) + (S_L H_B C_w C_A Hi_i - B_H H_B C_w C_A Hi_i) + (S_L H_B C_R C_c Lo_i - B_H H_B C_R C_c Lo_i) + (S_L H_B C_R C_c Hi_i - B_H H_B C_R C_c Hi_i) + (S_L H_B C_R C_A Lo_i - B_H H_B C_R C_A Lo_i) + (S_L H_B C_R C_A Hi_i - B_H H_B C_R C_A Hi_i)]$

Value Premium (HML) = $1/16 *[(S_L H_B C_W C_C Lo_i S_L L_B C_w C_A Lo_i) + (S_L H_B C_W C_C Hi_i - S_L L_B C_w C_C Hi_i) + (S_L H_B C_w C_A Lo_i - S_L L_B C_w C_A Lo_i) + (S_L H_B C_w C_A Hi_i - S_L L_B C_w C_A Hi_i) + (S_L H_B C_R C_C Lo_i - S_L L_B C_R C_C Lo_i) + (S_L H_B C_R C_C Hi_i - S_L L_B C_R C_C Hi_i) + (S_L H_B C_R C_A Lo_i - S_L L_B C_R C_A Lo_i) + (S_L H_B C_R C_A Hi_i - S_L L_B C_R C_A Hi_i) + (B_L H_B C_w C_C Lo_i - B_L L_B C_w C_c Lo_i) + (B_H H_B W_C C_C H_i - B_H L_B C_w C_c Hi_i) + (B_H H_B C_w C_A Lo_i - B_H L_B C_w C_A Lo_i) + (B_H H_B C_w C_A Hi_i - B_H L_B C_w C_A Hi_i) + (B_H H_B C_R C_c Lo_i - B_H L_B C_R C_c Lo_i) + (B_H H_B C_R C_c Hi_i - B_H L_B C_R CcHi_i) + (B_H H_B C_R C_A Lo_i - B_H L_B C_R C_A Lo_i) + (B_H H_B C_R C_A Hi_i - B_H L_B C_R C_A Hi_i)]$

Profitability Premium (RMW) = $1/16 *[(S_L L_B C_R C_c Lo_i - S_L L_B C_w C_c Lo_i) + (S_L L_B C_R C_c Hi_i - S_L L_B C_w C_c Hi_i) + (S_L L_B C_R C_A Lo_i - S_L L_B C_w C_A Lo_i) + (S_L L_B C_R C_A Hi_i - S_L L_B C_w C_A Hi_i) + (S_L H_B C_R C_c Lo_i - S_L H_B C_w C_c Lo_i) + (S_L H_B C_R C_c Hi_i - S_L H_B C_w C_c Hi_i) + (S_L H_B C_R C_A Lo_i - S_L H_B C_w C_A Lo_i) + (S_L H_B C_R C_A Hi_i - S_L H_B C_w C_A Hi_i) + (B_H L_B C_R C_c Lo_i - B_H L_B C_w C_c Lo_i) + (B_H L_B C_R C_c Hi_i - B_H L_B C_w C_c Hi_i) + (B_H L_B C_R C_A Lo_i - B_H L_B C_w C_A Lo_i) + (B_H L_B C_R C_A Hi_i - B_H L_B C_w C_A Hi_i) + (B_H H_B C_R C_c Lo_i - B_H H_B C_w C_c Lo_i) + (B_H H_B C_R C_c Hi_i - B_H H_B C_w C_c Hi_i) + (B_H H_B C_R C_A Lo_i - B_H H_B C_w C_A Lo_i) + (B_H H_B C_R C_A Hi_i - B_H H_B C_w C_A Hi_i)]$

Investment Premium (CMA) = $1/16 *[(S_L L_B C_w C_c Lo_i - S_L L_B C_w C_A Lo_i) + (S_L L_B C_w C_c Hi_i - S_L L_B C_w C_A Hi_i) + (S_L L_B C_R C_c Lo_i - S_L L_B C_R C_A Lo_i) + (S_L L_B C_R C_c Hi_i - S_L L_B C_R C_A Hi_i) + (S_L H_B C_w C_c Lo_i - S_L H_B C_w C_A Lo_i) + (S_L H_B C_w C_c Hi_i - S_L H_B C_w C_A Hi_i) + (S_L H_B C_R C_c Lo_i - S_L H_B C_R C_A Hi_i) + (S_L H_B C_R C_c Hi_i - S_L H_B C_R C_A Hi_i) + (B_H L_B C_w C_c Lo_i - B_H L_B C_w C_A Lo_i) + (B_H L_B C_w C_c Hi_i - B_H L_B C_w C_A Hi_i) + (B_H L_B C_R C_c Lo_i - B_H L_B C_w C_A Lo_i) + (B_H L_B C_R C_c Hi_i - B_H L_B C_w C_A Hi_i) + (B_H H_B C_w C_c Lo_i -$

$B_H H_B C_w C_A Lo_i) + (B_H H_B C_w C_c Hi_i\text{-}B_H H_B C_w C_A Hi_i) + (B_H H_B C_R C_c Lo_i\text{-}B_H H_B C_R C_A Lo_i) + (B_H H_B C_R C_c Hi_i\text{-}B_H H_B C_R C_A Hi_i)]$

Labor Income Growth Premium (LoMHi) = $1/16 *[(S_L L_B C_w C_c Lo_i)\text{-}S_L L_B C_w C_c Hi_i) + (S_L L_B C_w C_A Lo_i)\text{-}S_L L_B C_w C_A Hi_i) + (S_L L_B C_R C_c Lo_i\text{-}S_L L_B C_R C_c Hi_i) + (S_L L_B C_R C_A Lo_i\text{-}S_L L_B C_R C_A Hi_i) + (S_L H_B C_w C_c Lo_i\text{-}S_L H_B C_w C_c Hi_i) + (S_L H_B C_w C_A Lo_i\text{-}S_L H_B C_w C_A Hi_i) + (S_L H_B C_R C_c Lo_i\text{-}S_L H_B C_R C_c Hi_i) + (S_L H_B C_R C_A Lo_i\text{-}S_H H_B C_R C_A Hi_i) + (B_H L_B C_w C_c Lo_i\text{-}B_H L_B C_w C_c Hi_i) + (B_H L_B C_w C_A Lo_i\text{-}B_H L_B C_w C_A Hi_i) + (B_H L_B C_R C_c Lo_i\text{-}B_H L_B C_R C_c Hi_i) + (B_H L_B C_R C_A Lo_i\text{-}B_H L_B C_R C_A Hi_i) + (B_H H_B C_w C_c Lo_i\text{-}B_H H_B C_w C_c Hi_i) + (B_H H_B C_w C_A Lo_i\text{-}B_H H_B C_w C_A Hi_i) + (B_H H_B C_R C_c Lo_i\text{-}B_H H_B R_C C_c Hi_i) + (B_H H_B C_R C_A Lo_i\text{-}B_H H_B C_R C_A Hi_i)]$

Appendix B

Portofolio Abbreviations and Descriptions

Portfolio	Portfolio Abbreviations/Descriptions
$S_L L_B C_w C_c Lo_i$	Company with small market capitalization, low BVR, weak profitability, conservative investment and paying low salaries.
$S_L L_B C_w C_c Ho_i$	Company with small market capitalization, low BVR, weak profitability, conservative investment and paying high salaries.
$S_L L_B C_w C_A Lo_i$	Company with small market capitalization, low BVR, weak profitability, aggressive investment and paying low salaries.
$S_L L_B C_w C_A Ho_i$	Company with small market capitalization, low BVR, weak profitability, aggressive investment and paying high salaries.
$S_L L_B C_R CcLo_i$	Company with small market capitalization, low BVR, robust profitability, conservative investment and paying low salaries.
$S_L L_B C_R C_c Ho_i$	Company with small market capitalization, low BVR, robust profitability, conservative investment and paying high salaries.
$S_L L_B C_R C_A Loi$	Company with small market capitalization, low BVR, robust profitability, aggressive investment and paying low salaries.
$S_L L_B C_R C_A Ho_i$	Company with small market capitalization, low BVR, robust profitability, aggressive investment and paying high salaries.
$S_H H_B C_w C_c Lo_i$	Company with big market capitalization, high BVR, weak profitability, conservative investment and paying low salaries.
$S_H H_B C_w C_c Ho_i$	Company with big market capitalization, high BVR, weak profitability, conservative investment and paying high salaries.
$S_H H_B C_w C_A Lo_i$	Company with big market capitalization, high BVR, weak profitability, aggressive investment and paying low salaries.
$S_H H_B C_w C_A Ho_i$	Company with big market capitalization, high BVR, weak profitability, aggressive investment and paying high salaries.
$S_H H_B C_R C_c Lo_i$	Company with big market capitalization, high BVR, robust profitability, conservative investment and paying low salaries.
$S_H H_B C_R C_c Ho_i$	Company with big market capitalization, high BVR, robust profitability, conservative investment and paying high salaries.
$S_H H_B C_R C_A Lo_i$	Company with big market capitalization, high BVR, robust profitability, aggressive investment and paying low salaries.
$S_H H_B C_R C_A Ho_i$	Company with big market capitalization, high BVR, robust profitability, aggressive investment and paying high salaries.
$B_L L_B C_w C_c Lo_i$	Big company with small market capitalization, low BVR, weak profitability, conservative investment and paying low salaries.
$B_L L_B C_w C_c Ho_i$	Big company with small market capitalization, low BVR, weak profitability, conservative investment and paying high salaries.
$B_L L_B C_w C_A Lo_i$	Big company with small market capitalization, low BVR, weak profitability, aggressive investment and paying low salaries.
$B_L L_B C_w C_A Ho_i$	Big company with small market capitalization, low BVR, weak profitability, aggressive investment and paying high salaries.
$B_L L_B C_R C_c Lo_i$	Big company with small market capitalization, low BVR, robust profitability, conservative investment and paying low salaries.
$B_L L_B C_R C_c Ho_i$	Big company with small market capitalization, low BVR, robust profitability, conservative investment and paying high salaries.
$B_L L_B C_R C_A Lo_i$	Big company with small market capitalization, low BVR, robust profitability, aggressive investment and paying low salaries.
$B_L L_B C_R C_A Ho_i$	Big company with small market capitalization, low BVR, robust profitability, aggressive investment and paying high salaries.
$B_H H_B C_w C_c Lo_i$	Big company with big market capitalization, low BVR, weak profitability, conservative investment and paying low salaries.
$B_H H_B C_w C_c Ho_i$	Big company with big market capitalization, high BVR, weak profitability, conservative investment and paying high salaries.
$B_H H_B C_w C_A Lo_i$	Big company with big market capitalization, high BVR, weak profitability, aggressive investment and paying low salaries.
$B_H H_B C_w C_A Ho_i$	Big company with big market capitalization, high BVR, weak profitability, aggressive investment and paying high salaries.
$B_H H_B C_R C_c Lo_i$	Big company with big market capitalization, high BVR, robust profitability, conservative investment and paying low salaries.
$B_H H_B C_R C_c Ho_i$	Big company with big market capitalization, high BVR, robust profitability, conservative investment and paying high salaries.
$B_H H_B C_R C_A Lo_i$	Big company with big market capitalization, high BVR, robust profitability, aggressive investment and paying low salaries.
$B_H H_B C_R C_A Ho_i$	Big company with big market capitalization, high BVR, robust profitability, aggressive investment and paying high salaries.

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