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Estimation of Expected Return: Application of FF Three & FF Five Factor Model in a Developing Economy

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Abstract: *This study effort aimed to examine the consequences of the FF 3 and 5-factor models in the context of the Pakistan Stock Exchange. Considering the impact of low trading activity, the demographic data was employed for the time frame between 2018 and 2022. The data was extracted by thoroughly examining the annual reports and the PSX's main website. In this study, the excess return was the dependent variable, and Pakistani six-month Treasury bills were used as risk-free assets. In addition, the FF 5 factor model performed better than the FF 3 factor model, even if the empirical data of both models support the notion of the FF 3 and 5 component models. The findings indicate that every independent component plays a major role in explaining the diversity in excess returns. However, this is only true for portfolios that are value-weighted, not equally weighted. The gap in findings may be attributed to economic factors, particularly considering that the country in question is a developing economy. The conclusions of this essay will provide valuable guidance to individual investors, institutional investors, and fund managers in making future investment decisions, especially in nations that are now undergoing development.*

Key Words: PSX (Pakistan Stock Exchange), T Bills (Treasury Bills of Pakistan), EW (Equal Weight), SHRC (Small Companies with High B/M, Robust Profitability and Conservative Investment Behavior), Value Strategy, Glamour Strategy

Introduction

Markowitz (1952) formulated the contemporary portfolio theory, which subsequently gave rise to the development of the Capital Asset Pricing Model (CAPM) by Sharpe in 1964 and Lintner in 1965. Nevertheless, the CAPM has been criticized for its dependence on the market beta as the exclusive factor in predicting future returns. In 1992, the Fama and French three-factor model (FF3FM) was created to include the size and value components with the market factor. According to the FF3FM, small-cap stocks and stocks with a high book-to-market ratio have a higher performance than the overall market.

Asset pricing has been a significant topic in finance, with the FF3 model ranking just below the CAPM in prominence (Berk, 1995; Bryant & Eleswarapu, 1997; Carhart, 1997) Achola & Muriu, 2016; Aharoni et al., 2013). The FF5 model was developed in 2015 as an extension of the FF3 model, which incorporates the profitability component and investment pattern aspect from the FF5 model. This enhancement has significantly impacted the growth of the asset pricing sector, with extensive use in finance, economics, and other research endeavours.

The CAPM model, once the leading asset pricing model, was criticized for its shortcomings in explaining market events. Studies show that investing in specific stocks, like small-cap companies or low price-to-earnings ratios, can yield returns that surpass market performance, leading to the development of more complex asset pricing models. The Capital Asset Pricing Model (CAPM) is criticized for not considering all market risk factors. The FF3 model, introduced in 1965, incorporates market capitalization and book-to-market ratio to understand asset returns. The FF5 model, proposed in 2015, adds market risk, profitability, and investment model factors, enhancing the understanding of the relationship between

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asset return and risk. While the FF3FM and FF5FM have been extensively studied in industrialized countries, there is a lack of research in developing countries such as Pakistan. These countries have not sufficiently implemented the FF5FM, indicating a need for additional inquiry.

Developing countries are demonstrating a burgeoning market in which both local and foreign investors can obtain larger returns on their investments, albeit with a correspondingly elevated level of risk. These economic indicators demonstrate that the financial markets of these countries are relatively smaller compared to their overall economic size and the more advanced markets. Globalization and monetary integration encourage investors to mitigate their risk by investing in both developed and emerging areas. The return pattern of this model varies across different locations due to the findings of several research publications, which both fully and partially support this model. These characteristics motivate us to examine the use of this model in Pakistan, specifically in relation to the three and five-component model.

The aim of this research project is to examine the impact of FF3FM and FF5FM. This paper also assesses the relative explanatory ability of different models to account for the variation in excess return. The sub-objectives are to assess the relative performance of several models based on both equal and value-weighted criteria and to identify the model that exhibits the most accurate variance in excess return over daily, weekly, and monthly data. These two primary goals are further subdivided into two secondary goals based on portfolio development. The data is divided into two distinct scenarios: equal weight (EW) and value weight (VW). In addition, it is also examined across different time periods using daily, weekly, and monthly data.

The research study is significant as it will provide valuable information to fund managers and potential investors regarding their investment decisions, specifically in relation to predicted returns and the influence of independent factors. The outcomes of this study will serve as a foundation for developing theories related to emerging markets. This will offer direction to the fund managers regarding the development of their portfolios.

The remaining sections of the paper are organized in the following manner: Section two will include a description of the literature, while section three will focus on the methods. Section four presents the results obtained and provides an analysis of their meaning. Section five will present the conclusions drawn from the data and offer recommendations for future actions.

What are the specific questions that will be investigated in this research?

Q1a: Does FF3FM provide a sufficient explanation for the additional returns observed in portfolios with respect to the PSX?

Q1b: Does the FF5FM effectively account for the reasons behind higher-than-expected returns in portfolios, specifically in relation to the PSX?

Q2: Does the FF5FM model provide a more accurate explanation of excess returns in Pakistan?

Literature Review

Evolution of FF3FM

The Fama-French Three-Factor Model (FF3FM) was first proposed by Banz and Reinganum in the United States, who identified a higher rate of return on small stocks, known as the return premium. Fama and French (1992) conducted a study to examine the potential relationship between average stock returns and various factors, including market beta, business size, value, leverage, and the earning-to-price ratio (E/P). They found that size and value components effectively explain the differences in average returns across different segments.

In their 1995 study, Fama and French identified a link between risk characteristics and earnings behaviour, finding that businesses with significant profits exhibited a lower book-to-market ratio, while those with minimal earnings exhibited a greater ratio. In 1998, Fama and French developed a worldwide version of their model, showing that value stocks outperformed growth companies in twelve diverse economies worldwide.

Fama and French have continuously enhanced their model by integrating various elements, such as momentum strategy and dual beta Capital Asset Pricing Model (CAPM). Other academics emphasize the

importance of these additional aspects, such as the momentum strategy and the dual beta Capital Asset Pricing Model (CAPM) (Fama & MacBeth, 1973; Fama & French, 1993; Fama & French, 1995; Fama & French, 1998; Fama & French 2004; Fama & French, 2015; Fama & French, 2017).

Several scholars have extensively studied the FF model in various regions, particularly focusing on emerging markets. Research conducted by Claessens, Dasgupta, and Glen (1995) reveals that factors such as size and value have substantial explanatory power in most countries, but profits per share (EPS) and dividend yield were shown to be relevant in a smaller number of countries.

Charitou and Constantinidis (2004) assessed the feasibility of applying the Five Factor Model (FF3FM) to the Japanese stock exchange, finding that the factors of size and value can explain a significant portion of the difference in average stock returns. Djajadikerta and Nartea (2005) discovered that FF3FM was found in smaller markets, specifically in New Zealand.

Javid and Ahmad (2011) and Connor and Sehgal (2001) examined the dynamics of asset price using dual beta, revealing that beta exhibits volatility not only in bullish and bearish market conditions. Hamid, Hanif, and Ul Malook (2012) conducted a study on the banking industry in Pakistan, showing that size and value factors can account for additional returns. Eraslan (2013) found that larger and medium-sized organizations outperformed smaller enterprises in terms of actual excess returns on the Istanbul Stock Exchange.

Fama and French (2015) verified the model's efficacy in describing future returns with respect to all its components, but it struggles to appropriately depict the low average returns of small stocks.

Alaoui, Asmâa, and Benfeddoul (2023) did a comparative study on the Moroccan stock exchange, evaluating the effectiveness of the Fama and French five-factor model, three-factor model, and CAPM. The findings indicated that the impact of size was less significant compared to the impact of value. Samir Omar and Abrache (2022) conducted a study in Morocco to evaluate the effectiveness of the Carhart Four Factor (C4F) and Fama-French Three Factor (FF3F) models. They analyzed the monthly returns of enterprises listed on the Casablanca Stock Exchange from 2013 to 2017. Although there were some partial size and value effects, the momentum effect was not considerable. In their study, Nada, Rabab, and Ahmed (2020) examined the efficacy of the French and Fama three-factor and five-factor models in explaining the returns observed in the Egyptian stock market between 2005 and 2016. Time-series regressions and the GRS test demonstrated that both models are suitable as asset pricing models for portfolios that are ordered based on both size and BE/ME ratio.

In his study, Al-Mwalla (2012) analyzed the impact of size and value factors on the Amman stock market returns from June 1999 to June 2010. Additionally, he assessed the effectiveness of the Fama-French three-factor model in explaining the variability in these returns. The analysis concluded that Fama and French's three-factor model provides a more accurate explanation for the variability in stock rates compared to the CAPM. Arif Budi Satrio (2017) conducted an experiment examining the relationship between expected return, business size, and firm value in emerging countries, with a specific focus on Indonesia's capital market. Novy-Marx, Chen, and Zhang (2011) formulated the asset price three-factor model, which provides a more accurate explanation for various cross-sectional return anomalies compared to traditional asset pricing models.

Conceptual Frame Work for Portfolio Formation

Table 1

Panel 1

Factor formation in FF3FM

Sort	Breakpoints	Factors and their components
2*3 sorts on Size and B/M	Size: PSX median *Value:* Size Low (30%) Medium (40%) High (30%)	1) *Excess Return =ERit- Rft. Expected return - Risk-free rate of return* 2) *MRPt = Rmt-Rf* 3) *SMB = [S/L+S/M+ S/H] /3 - [B/L+ B/M+ B/H] /3* 4) *HML = S/H+B/H]/2-[S/L+B/L] /2*

Table 2
Panel 2
Factor formation in FF5FM

Sort	Breakpoints	Factors and their components
2x2x2x2 sorts on *Size, B/M, OP, and* Inv	*Size:* PSX median	*SMB = (SHRC + SHRA + SHWC + SHWA + SLRC + SLRA + SLWC + SLWA) / 8 − (BHRC + BHRA + BHWC +BHWA + BLRC + BLRA + BLWC + BLWA) / 8*
	B/M: PSX median	*HML = (SHRC + SHRA + SHWC + SHWA + BHRC + BHRA + BHWC +BHWA) / 8 − (SLRC + SLRA + SLWC + SLWA + BLRC + BLRA + BLWC + BLWA) / 8*
	OP: PSX median	*RMW = (SHRC + SHRA + SLRC + SLRA + BHRC + BHRA + BLRC + BLRA) / 8 − (SHWC + SHWA + SLWC + SLWA + BHWC + BHWA + BLWC + BLWA) / 8*
	Inv: PSX median	*CMA = (SHRC + SHWC + SLRC + SLWC + BHRC + BHWC + BLRC + BLWC) / 8 − (SHRA + SHWA + SLRA + SLWA + BHRA + BHWA + BLRA + BLWA) / 8*

Hypothesis

H1: FF3FM adequately explains variation in excess returns on the basis of 2*3 sort.
H2: FF5FM adequately explains variation in excess returns in portfolios on the basis of 2*2*2*2 sort.
H3: FF5FM better explains variation in excess returns with reference to Pakistan.

Research Methodology

The empirical research component is subdivided into three distinct areas, each of which offers crucial data and a profound understanding of this subject. Descriptive statistics plays a crucial role in the study by offering a thorough and detailed summary of the data, allowing for a comprehensive understanding and categorization of the information. The regression results are the central focus of this study as they offer valuable insights into the influence of various factors on stock returns. This is achieved by examining the degree of fit and coefficient estimates of the regression model. Ultimately, robustness tests are conducted to ensure the reliability and consistency of the results across different conditions.

This research study focuses on the emerging market of Pakistan, examining the implications of FF3FM and FF5FM on data and comparing the results of FF three and five-factor models to understand their power in explaining excess return variation. The study uses data from all listed companies in the Karachi Stock Exchange (KSE) until 2022, ensuring reliability in portfolio development. The financial sector, which plays a significant role in Pakistan's economy, is included in the sample due to its risk profile and thin trading in developed markets.

Data sources include secondary data from the PSX website and annual reports of listed companies. The study uses one-year treasury bills as a risk-free rate. The emerging economy of Pakistan has characteristics such as low per capita income, rapid growth, high volatility, less mature capital markets, and higher returns for investors. The KSE's collaboration with the Securities and Exchange Commission of Pakistan (SECP) in 2013 allowed investors to invest in the KSE, revolving money around the taxman and expanding average daily trade volume. These decisions have made Pakistan's markets more bankable and attractive to investors.

Model Specification

FF3FM

Fama and French are the creators of FF3FM, which is an abbreviation for the Fama-French Three-Factor Model. They introduced two additional components, namely size and value, into the Capital Asset Pricing model, resulting in the formation of FF3FM. The CAPM serves as the foundation for this model and focuses just on one risk component, which is the market beta. The mathematical representation of FF3FM is given by the equation E [Rit] = R ft + βi, 1(E [Rmt] − Rf) + βi, 2 (SMBt) + βi, 3 (HMLt).

Here, E [Rit] represents the expected return on security i for a period t. Rft denotes the risk-free return. (E [Rmt] − Rf) indicates the market risk premium. (SMBt) represents the size factor, which is the return

on a diversified portfolio of small stocks minus big stocks. (HMLt) represents the value factor, which is the return of diversified portfolios of high minus low Book to Market stocks (B/M). The variables have slopes denoted as Beta 1, Beta 2, and Beta 3. Regression analysis will be utilized to assess the FF3FM. It is crucial to convert this model into regression form, namely as follows: Rit- RFt= ai+ bi (RMt− RFt) + siSMBt+ hi HMLt+ eit.

Two distinguishing factors of this model compared to the previous one are the "α" intercept and the "e" error term. These factors indicate that no model is ideal since it includes some disturbance features. This model initially represents a single stock, but we will modify it to adopt a portfolio perspective. Consequently, the model will take the following form: ERpt = α p + βi, 1RPt + βi, 2 (SMBt) + βi, 3 (HMLt) + eit.

For the portfolio, we will utilize the weight of stocks, such as value weights and equal weights. ERpt is an abbreviation for excess return of a portfolio during a specific period, denoted as t. Proposed Plan for Developing a Portfolio:

Daily return refers to the percentage change in the value of an investment on a daily basis. Market return, on the other hand, refers to the overall performance of the market as a whole.

Portfolio returns can be defined as the aggregate returns of individual equities, calculated by taking into account their respective weights. First, we will calculate the individual returns based on their lag value. Then, weights will be allocated to each stock according to their contribution to the portfolio. By assigning weights to the returns of each stock, we can calculate the portfolio returns. The identical procedure will be applicable to the market returns as well. These returns are ultimately utilized to determine the excess return (Rp – Rf) and the market risk premium (Rm – Rf). The formulas for portfolio return and market return are as follows:

The formula Rit = LN (Pt / Pt-1) calculates the logarithmic return of a stock, where Pt represents the current closing price, and Pt-1 represents the prior closing price.

The formula Rmt = LN (KSE all index t / KSE all index t-1) calculates the logarithmic return of the KSE all index at time t relative to its value at time t-1. It provides the same explanation that was previously described.

The excess return serves as our dependent variable in both the FF3FM and the five-factor model. Excess return refers to the additional return provided to an investor for assuming additional risk that is not present in the risk-free rate of return. The surplus return can be expressed using this formula.

The text provided is not clear or understandable. Anticipated yield - Rate of return without any risk Price premium in the market The market premium is the disparity between the returns generated by the market and the returns generated by risk-free investments, such as 6-month Treasury notes. The market risk premium refers to the additional return that an investor receives by investing in the market compared to investing in a risk-free asset or government securities. This element is present in both the Capital Asset Pricing Model (CAPM) and the Fama-French Three-element Model (FF3FM). This factor can be quantified using this formula. The equation is written as RPt equals Rmt minus Rf.

Dimensional Magnitude

The size factor is determined by the companies' market capitalization. Market capitalization can be calculated by multiplying the number of shares by the market price. We employ a single lag value to assess market capitalization, with the reference point being the 31st of December or the final date of the preceding year. The median formula is utilized to categorize stocks into large and small stocks. The larger market capitalization values that exceed the median will be classified as big stocks, while the smaller market capitalization values that are below the median will be classified as small stocks.

Small firms exhibit a high level of aggressiveness towards risk factors due to their limited financial resources and fewer opportunities for diversification compared to larger firms. Investors in this scenario will choose a risk premium when they allocate their investments to tiny enterprises. The size factor determines the risk premium associated with returns, specifically based on the size of the firm. The

disparity lies in the average returns of three portfolios, one consisting of large-cap stocks and the other consisting of small-cap stocks.

The formula for SMB is calculated by taking the sum of the values for S/L, S/M, and S/H, dividing it by 3, and then subtracting the sum of the values for B/L, B/M, and B/H. The user's text is "/3".

Factor of Value

The value component is determined by calculating the book-to-market ratio, which involves dividing the face value of stocks by the market value (closing price) on the final day of each previous year. The data was divided into three segments based on their respective percentages: high (30%), middle (40%), and low (30%) (Mirza, 2008). The difference between high and low demonstrates that growth companies are inherently less hazardous than value stocks. The high book-to-market ratio elucidates the disparity between market value and book value, so confirming that the market does not assign significant value to these equities.

The occurrence in the market is a result of investors' anticipations regarding future forecasts and the present difficulties faced by the organization. This phenomenon encourages investors to require a risk premium when investing in these stocks. HML integrated the risk premium associated with the company's valuation. The capture is achieved by calculating the disparity in the returns of stocks with high and low book-to-market (B/M) ratios.

The formula for HML is calculated by taking the average ratio of stocks to high book value and bonds to high book value and subtracting the average ratio of stocks to low book value and bonds to low book value.

In addition, six portfolios will be created based on the size and value factors, namely S/L, S/M, S/H, B/L, B/M, and B/H. This portfolio consists of equities with large market capitalization and a modest book-to-market ratio. This portfolio consists of stocks with tiny market capitalization and lower book-to-market ratios.

FF5FM: The FF3FM is an inadequate model as it lacks the capacity to fully account for all fluctuations in the expected return. The five-factor model is an expansion of the three-factor model, incorporating the addition of two additional factors. The two elements in question are Profitability and Investment. According to Fama and French, there should be a positive connection between profitability and the expected return of stocks and a negative correlation between investment and the expected return. The formula for the five-factor model is as follows: Rit - Rft = αi + bi(Rmt - Rft) + siSMBt + hiHMLt + riRMWt + ciCMAt + eit

The equation represents the return of diverse stock portfolios, specifically in relation to the difference between robust and weak profitability. Conservative minus aggressive (CMAt) refers to the return generated by diversified stock portfolios in relation to investment. The slopes of the independent variables, namely bi, si, hi, ri, and ci, represent the extent to which they capture the variation in the expected return.

Profitability is the fourth factor in the model. Profitability in year t can be assessed using accounting data from the previous year, t-1. To measure operating profitability (OP), we will calculate the difference between revenues and the sum of the cost of goods sold, selling, general and administration expenses, and interest expenses. This resulting amount will then be divided by book equity. Put simply, we calculated the ratio of pre-tax earnings to book equity.

Profitability in 2022 can be calculated by dividing the profit before tax (PBT) in 2021 by the equity in 2021.

Investment is a crucial aspect of FF5FM. In this analysis, we will employ a lagged value of two years to assess investing behaviour. To obtain investment statistics, one can calculate the change in total assets from fiscal year t-2 to fiscal year t-1 and divide it by the total assets at the end of fiscal year t-1. In the investment formula, TA represents Total Assets.

The investment for the year 2022 can be calculated by subtracting the total assets (TA) for the year 2020 from the total assets for the year 2021 and then dividing the result by the total assets for the year 2021.

Portfolio Development: The ultimate arrangement of the Five Factor Model is determined by the 2x2x2x2 sorting method. The purpose of this sorting process is to obtain accurate data regarding the average returns based on factors such as Size, Book-to-market ratio, OP, and Inv. The stocks are categorized into two groups based on their size: B/M, OP, and Inv. Based on this ordering, there will be 16 portfolios with equal weights and values. The size factor was determined by calculating the difference between the average return of eight small stock portfolios and the average return of eight large stock portfolios. The value component illustrated a distinction between eight portfolios with high book-to-market ratios and eight portfolios with low book-to-market ratios. The profitability and investment components likewise exhibit a similar disparity across the eight portfolios of RMW and CMA.

Empirical Results and Analysis

The primary objective of this research project is to examine the application of FF3FM and FF5FM in the context of the Pakistan Stock Exchange. The main goal is broken into two subgoals: demonstrating that value-weighted portfolios of FF3FM and FF5FM outperform equal-weight portfolios and vice versa.

Understanding the performance difference between equal- and value-weighted portfolios is crucial for asset pricing, as the value-weighted market portfolio is a benchmark for portfolio managers and plays a key role in the Capital Asset Pricing Model of Sharpe (1964).

Another subsidiary purpose is to comprehend the performance of portfolios in relation to their daily, weekly, and monthly returns. Markowitz's mean-variance analysis in 1952 and 1959 revolutionized portfolio management by reducing the risk associated with each asset. This method simplifies resource allocation by explaining investment frontier and investor risk tolerance. A multi-timeframe analysis is used to account for temporary stock price changes. This allows traders to analyze price charts across different timeframes, gaining a comprehensive understanding of the market and making informed trading decisions. Timing should align with trading style and investment duration.

Table 3
Set 1 - Panel A

Daily							
Panel A: Size -B/M portfolios	(VW)			Panel A: Size -B/M portfolios	(EW)		
	Low	Medium	High		Low	Medium	High
Small	-0.01%	-0.01%	0.01%	Small	-0.01%	-0.02%	0.03%
Big	0.02%	0.02%	-0.02%	Big	0.00%	-0.01%	-0.02%
Weekly							
Panel A: Size -B/M portfolios				Panel A: Size -B/M portfolios			
	Low	Medium	High		Low	Medium	High
Small	0.13%	0.20%	0.57%	Small	0.14%	0.22%	0.66%
Big	0.14%	0.09%	0.13%	Big	0.12%	0.05%	0.15%
Monthly							
Panel A: Size -B/M portfolios				Panel A: Size -B/M portfolios			
	Low	Medium	High		Low	Medium	High
Small	0.01%	-0.01%	-0.16%	Small	0.04%	0.03%	-0.08%
Big	0.28%	0.24%	0.16%	Big	0.30%	0.12%	0.09%

The table displays average daily excess returns for portfolios based on Size and B/M, Size and Operating Profitability, and Size with Investment. The data is divided into two sets: value weight (VW) and equal weights (EW). The data shows that returns generally increase from small stocks to big stocks, except in weekly returns, where medium and high returns show a decreasing trend. The results align with Fama and French's findings, as small stocks outperform big stocks. Value stocks perform better than growth stocks, with average excess returns decreasing from 0.14% per week to 0.66% in extreme value stocks.

Table 3

Set 1 - panel b

Daily							
Panel B: Size -OP portfolios	(VW)			Panel B: Size -OP portfolios	(EW)		
	Low	Medium	High		Low	Medium	High
Small	-0.03%	0.00%	0.00%	Small	-0.01%	0.00%	0.01%
Big	-0.07%	0.01%	0.04%	Big	-0.03%	-0.01%	0.01%
Weekly							
Panel B: Size -OP portfolios				Panel B: Size -OP portfolios			
	Low	Medium	High		Low	Medium	High
Small	0.25%	0.14%	0.13%	Small	0.44%	0.30%	0.26%
Big	0.07%	0.15%	0.14%	Big	0.14%	0.08%	0.10%
Monthly							
Panel B: Size -OP portfolios				Panel B: Size -OP portfolios			
	Low	Medium	High		Low	Medium	High
Small	-0.04%	0.00%	0.05%	Small	-0.03%	0.00%	0.02%
Big	0.01%	0.36%	0.30%	Big	0.10%	0.16%	0.22%

Panel "B" of Figure 4 reveals average excess returns of size and operating profitability (OP) portfolios. Profitability is measured using accounting data like annual revenues minus the cost of goods sold, selling, general administrative expenses, and interest expenses. Returns decrease when size increases, except in monthly data. However, returns increase except in weekly and monthly data of equal weights. High operating profitability is connected with high average returns in each size quintile, except in weekly data of value weight and equal weight.

Table 4

Set 1 - panel c

Daily							
Panel C: Size -Inv portfolios	(VW)			Panel C: Size -Inv portfolios	(EW)		
	Low	Medium	High		Low	Medium	High
Small	-0.04%	0.01%	-0.01%	Small	-0.02%	0.02%	0.00%
Big	0.02%	0.04%	-0.01%	Big	-0.01%	0.00%	-0.03%
Weekly							
Panel C: Size -Inv portfolios				Panel C: Size -Inv portfolios			
	Low	Medium	High		Low	Medium	High
Small	0.15%	0.15%	0.18%	Small	0.47%	0.28%	0.32%
Big	0.12%	0.19%	0.05%	Big	0.12%	0.12%	0.05%
Monthly							
Panel C: Size -Inv portfolios				Panel C: Size -Inv portfolios			
	Low	Medium	High		Low	Medium	High
Small	0.02%	0.09%	-0.11%	Small	0.16%	0.01%	-0.16%
Big	0.19%	0.38%	0.23%	Big	0.06%	0.21%	0.17%

Panel C of Figure 5 shows average excess returns for six size/investment portfolios, with construction identical to size and B/M portfolios. Investment is measured by total asset growth. Results vary depending on data type, but weekly (EW) results align with Fama and French's findings. The lowest investment quintile has greater average excess returns than the highest investment quintile, indicating a size effect in portfolios. The highest investment column has no side effects.

Table 5

Factor impacts

Weekly (EW)	Int	Rm- Rf	SMB	HML	R square
2 * 3 Factors					
Rm- Rf					
Coef	-0.0003		-0.46	0.26	0.37
t – statistic	-1.39		-11	9.86	
SMB					
Coef	0.0004	-0.69		0.37	0.44
t- statistic	1.95	-11		11.78	
HML					
Coef	0.0006	1.04	0.96		0.40
t – statistic	1.67	9.86	11.78		

Weekly (EW)	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
2*2*2*2 Factors							
Rm- Rf							
Coef	0.000288		-0.51522	0.059086	-0.08866	-0.08444	0.5991
t – statistic	0.8		-9.68	0.98	-12.14	-1.47	
SMB							
Coef	0.000834	-0.52144		0.452887	-0.03931	0.223738	0.5724
t- statistic	2.32	-9.68		8.41	-4.42	3.97	
HML							
Coef	-0.00057	0.063253	0.479042		-0.06971	-0.01251	0.6105
t – statistic	-1.53	0.98	8.41		-8.27	-0.21	
RMW							
Coef	-0.00759	-4.13283	-1.8106	-3.03522		0.924654	0.6855
t – statistic	-3.13	-12.14	-4.42	-8.27		2.37	
CMA							
Coef	0.000991	-0.09915	0.259578	-0.01372	0.023292		0.1997
t – statistic	2.56	-1.47	3.97	-0.21	2.37		

Figure 6 evaluates factors affecting the fifth factor using 2 *3 sort and 2*2*2*2 sort, respectively. The table consists of four main elements: intercept values, coefficient with t statistic, and R square. The intercept values indicate if independent factors are zero, causing a change in the dependent factor. The T statistic explains the significance of the coefficient, while the coefficient value explains the change in the dependent variable due to one unit change in the independent factor. The R square value explains the model's fitness. The results of weekly equal weights are shown, with daily and monthly results in the appendix. The weekly equal weight is chosen due to the good values of r square for RMW and CMA compared to daily and monthly data. The slopes of CMA are positive, indicating firms with high B/M do little investment, while RMW is negative, indicating weak profitability.

Descriptive State for FF 3 Factor Model

Table 7

Panel A

Variable	MRP	SMB	HML
Mean	0.11%	0.23%	0.28%
StdDev.	0.84%	0.84%	1.29%
Min	-4.13%	-3.37%	-5.77%
Max	2.76%	2.97%	6.07%

Panel B

Variable	S/L	S/M	S/H	B/L	B/M	B/H	M/R
Mean	0.20%	0.29%	0.73%	0.18%	0.12%	0.21%	0.17%
StdDev.	0.67%	1.06%	2.20%	0.64%	0.67%	1.27%	0.84%
Min	-2.24%	-3.82%	-10.96%	-3.24%	-2.85%	-9.31%	-4.06%
Max	2.00%	3.97%	8.35%	1.77%	2.42%	5.23%	2.82%

The study compares the average returns of MRP (market risk premium) and HML (value factor) in portfolio returns, comparing them with previous research. The results show that MRP leads the other factors, while HML leads the other factors due to differences in data used. The positivism of SMB and HML suggests that small stocks outperform big stocks, while value stocks outperform growth stocks. However, the results confirm the findings of Fama and French.

The S/H portfolio, consisting of small companies with high book-to-market ratios, leads the rest of the portfolios with an average return of 0.73%. The market pays 0.17% less than the S/H portfolio and other portfolios except the B/M portfolio. Standard deviation (SD) explains the data's depression from its mean value, with three levels falling between -3 and +3. The S/H and B/H portfolios have more risk in their returns compared to other portfolios, confirming the core rule of finance: "more risk, more profit." The overall SD results indicate that there is no high risk in average weekly returns in terms of dispersion from their mean value.

Correlation

Table 8

	MRP	SMB	HML
MRP	1		
SMB	-0.3025	1	
HML	0.2581	0.5605	1

Correlation explains the relation of variables with each other. If these variables have a positive relation, then an increase in one variable will be the source of increment in another variable and vice versa in the case of a negative one. HML (high minus low) has a positive correlation with market risk premium (MRP) and size factor (SMB), while in this table, SMB has a negative correlation with MRP.

Regression Results

This research study employs multiple regression to analyze six portfolios with a dependent variable, excess return, and three independent variables, market risk premium, size, and value factor. The findings depend on the intercept and slope values of the independent variables, with intercept values being statistically zero and slope values being significant to predict model accuracy.

Table 9

Intercept				R square			
	Low	Medium	High		Low	Medium	High
Small	0.00018	0.00005	0.00046	Small	0.3849	0.3696	0.9426
T Statistic	0.51	0.08	1.31	Big	0.6768	0.6065	0.7616
Big	0.00056	-0.00015	0.00027				
T Statistic	2.29	-0.54	0.67				
Slopes of MRP							
	Low	Medium	High				
Small	0.58752	0.77867	0.54860				
T Statistic	12.03	9.92	11.18				
Big	0.6485705	0.5787425	0.6874853				
T Statistic	19.04	14.63	11.9				

Slopes of SMB			
	Low	Medium	High
Small	0.53694	0.74837	1.11679
T Statistic	9.49	8.23	19.64
Big	0.01807	-0.05420	-0.56178
T Statistic	0.46	-1.18	-8.39
Slopes of HML			
	Low	Medium	High
Small	-0.24152	-0.14266	1.07723
T Statistic	-6.62	-2.43	29.36
Big	-0.03059	0.07297	0.65067
T Statistic	-1.2	2.47	15.07

The model validity is confirmed by the insignificant intercept values except for big companies with low book-to-market ratios. All independent factors are performing well, with their slopes significantly contributing to the model's fit. The highest R square value is 0.94% in the portfolio of S/H, which increases from a low B/M to a high book-to-market ratio in small and big companies. The market risk premium is positive and significant in every portfolio, leading to other factors. The maximum impact of market risk premium is 0.68% in the B/H portfolio. The size factor has a positive impact in small companies, while in big companies, it has an insignificant impact except in the B/H portfolio. The value premium also exists in every portfolio except B/L, with negative impacts on small companies and positive impacts on big firms. The positivism of MRP, size, and value factor results in the market, small stocks, and value factor outperforming risk-free assets, big stocks, and growth stocks, confirming the validity of the FF 3 factor model in the Pakistan Stock Index, similar to prior studies (Aleati et al., 2000; Bartholdy & Peare, 2005).

Descriptive State for FF 5 Factor Model

Table 10

Variable	MRP	SMB	HML	RMW	CMA
Mean	0.11%	0.23%	0.21%	-2.16%	0.09%
StdDev.	0.84%	0.82%	0.88%	6.45%	0.64%
Min	-4.13%	-2.95%	-3.65%	-24.32%	-2.02%
Max	2.76%	3.08%	4.30%	29.80%	2.95%

Table 6 shows average factor returns and portfolio returns, with SMB dominating with an average return of 0.23% and HML second with a return of 0.21%. Small and value stocks outperform big and growth stocks. HML was the leading factor in the 2*3 sort but had a high standard deviation. In the 2*2*2*2 sort, HML's value decreased from 0.28% to 0.21% with a small standard deviation. The results improved in the 2*2*2*2 sort due to a decrease in standard deviation. RMW profitability factor had negative average returns, while CMA (conservative minus aggressive) had less elasticity in returns. The results align with findings from Fama and French, except for profitability.

Panel B

Variable	SHRC	SHRA	SHWC	SHWA	SLRC	SLRA	SLWC	SLWA
Mean	0.67%	0.43%	0.78%	0.50%	0.18%	0.20%	0.17%	0.21%
StdDev.	2.65%	2.16%	2.46%	2.01%	0.94%	1.02%	1.02%	1.07%
Min	-9.10%	-8.23%	-6.62%	-7.62%	-3.47%	-3.94%	-3.11%	-3.13%
Max	10.29%	6.70%	11.40%	10.52%	4.19%	3.38%	3.45%	2.81%

Variable	BHRC	BHRA	BHWC	BHWA	BLRC	BLRA	BLWC	BLWA
Mean	0.19%	0.04%	0.21%	0.24%	0.21%	0.12%	0.19%	0.10%
StdDev.	0.82%	1.12%	1.22%	1.38%	0.69%	0.78%	0.69%	0.91%
Min	-3.65%	-7.67%	-8.52%	-6.48%	-2.56%	-4.02%	-1.78%	-3.91%
Max	3.09%	3.07%	3.49%	7.03%	2.31%	2.52%	1.89%	2.69%

Panel B confirms panel A's results, with the SHWC portfolio dominating all 16 portfolios with a high average return of 0.78% and a standard deviation of 2.46%. SHWA is the second portfolio with a high average return of 2.01%. All portfolios show positive average returns, indicating investors receive some return. Small companies' portfolios have high standard deviations compared to big companies' portfolios. BHWA, with a high book-to-market ratio, weak profitability, and aggressive investment, offers high average returns with -6.48% and 7.03% minimum and maximum returns, respectively. The 2*2*2*2 sort has a better average return than the 2*3 sort.

Correlation

Table 11

	MRP	SMB	HML	RMW	CMA
MRP	1				
SMB	-0.2968	1			
HML	0.2396	0.5655	1		
RMW	-0.6015	-0.2765	-0.6731	1	
CMA	-0.3725	0.2927	-0.0209	0.2333	1

The table reveals a strong correlation between independent variables, with all variables showing a negative correlation except for HML. RMW has a negative correlation with SMB, while HML has a strong positive correlation. RMW has a strong negative correlation with all independent variables except the investment factor. CMA has a negative correlation with market risk premium and value factor, while it has a positive correlation with size factor and profitability. Investment has a positive correlation with profitability and size, while value factors have a negative correlation. The table shows slight differences in values but the same sign.

Regression Results

Table 12

Panel A

Portfolio	SHRC	SHRA	SHWC	SHWA	SLRC	SLRA	SLWC	SLWA
Intercept	-0.0005	0.0002	-0.0009	0.0005	-0.0006	-0.0003	-0.0013	-0.0009
MRP	1.5956	0.5731	-0.2433	-0.3044	0.2830	0.4876	0.1064	0.0938
SMB	1.4309	1.3045	0.3222	0.6199	0.3875	0.7410	0.3801	0.5238
HML	1.2724	0.6472	0.6662	0.5228	-0.6473	-0.7046	-0.8011	-0.6809
RMW	0.1208	0.0033	-0.2230	-0.1390	-0.0716	-0.0572	-0.1358	-0.1270
CMA	1.6509	-1.4503	1.4499	-1.3290	0.3970	-0.3193	0.1767	-0.2822
T(α)	-0.49	0.20	-0.95	0.67	-1.06	-0.57	-2.51*	-1.65
t (MRP)	8.46*	3.55*	-1.49	-2.35*	3.01*	5.18*	1.19	1.04
t(SMB)	7.63*	8.14*	1.99	4.82*	4.15*	7.91*	4.27*	5.85*
t(HML)	6.98*	4.15*	4.23*	4.18*	-7.13*	-7.74*	-9.25*	-7.82*
t(RMW)	4.37*	0.14	-9.34*	-7.33*	-5.20*	-4.14*	-10.34*	-9.63*
t(CMA)	9.48*	-9.74*	9.64*	-11.12*	4.58*	-3.67*	2.14*	-3.40*
R^2	0.6378	0.6003	0.6872	0.7033	0.2902	0.3984	0.4509	0.4920

The table presents regression results from 16 portfolios based on a 2*2*2*2 sort, controlling every factor jointly. Panel A explains intercepts, slopes, t statistics, and r square for eight portfolios based on small companies with B/M, profitability, and investment. The intercept values are insignificant except for SLWC, indicating the model's validity. The r square value is an average of 0.65% in portfolios with high B/M and 0.40% in low B/M. Size and market risk premium factors are positively correlated in all portfolios except SHWC and SLWC. Independent factors like HML and CMA are significantly correlated with small companies' portfolios. Value factors have a positive relationship with small companies with high B/M, while growth stocks overtake value stocks with low B/M. Profitability factors show aggressive investment behaviour in all four portfolios, while conservative behaviour is observed in the rest.

Panel B

Portfolio	BHRC	BHRA	BHWC	BHWA	BLRC	BLRA	BLWC	BLWA
Intercept	0.0001	-0.0018	-0.0010	-0.0003	0.0003	-0.0002	0.0001	-0.0010
MRP	0.2389	0.4328	0.1554	0.1437	0.3356	0.6700	0.1202	0.4952
SMB	-0.3204	-0.3712	-0.5394	-0.7366	0.0445	-0.1698	0.0046	-0.2018
HML	0.1447	0.1618	0.3384	0.5211	-0.3434	-0.0291	-0.3552	-0.1637
RMW	-0.0589	-0.0827	-0.1230	-0.1270	-0.0582	-0.0222	-0.0797	-0.0778
CMA	0.1498	-0.1153	0.1819	-0.2443	0.1905	0.0189	0.0971	0.0151
T(α)	0.15	-4.28*	-2.06*	-0.67	0.95	-0.67	0.28	-3.20*
t (MRP)	3.45*	5.85*	1.87	1.97*	5.38*	15.03*	1.86	8.98*
t(SMB)	-4.66*	-5.05*	-6.55*	-10.15*	0.72	-3.83*	0.07	-3.68*
t(HML)	2.16*	2.26*	4.22*	7.39*	-5.70*	-0.68	-5.68*	-3.07*
t(RMW)	-5.81*	-7.63*	-10.13*	-11.88*	-6.37*	-3.40*	-8.42*	-9.63*
t(CMA)	2.35*	-1.69	2.38*	-3.63*	3.31*	0.46	1.63	0.30
R^2	0.4978	0.6905	0.6731	0.8002	0.4274	0.7691	0.3864	0.7382

Panel B shows mostly zero intercept values except in BHWC, BHRA, and BLWA. Big companies with high B/M have a 0.67% r square, while low B/M companies have a 0.58% r square. Market risk premium and size factor contribute to slopes, with a 0.14% change in excess return and a one-unit increase in the HML (BHRC) slope. Profitability and investment factors also influence the FF 5 Factor. Big companies with high B/M, weak profitability, and aggressive investment behaviour are included in the BHWA portfolio, indicating aggressive investment behaviour regardless of weak profitability.

Conclusion

This study examines the efficacy of the factor models in the Fama French 3 and Fama French 5 factor models. This research utilizes population numbers from January 2018 through December 2022. Portfolio construction is limited to companies that have a minimum of forty per cent of their market trading days. After dividing the data into value weights and equal weights, the outcomes are further categorized into daily, weekly, and monthly groups. The method employs Pakistani Treasury notes with a six-month maturity as risk-free assets.

Weekly stock returns are advantageous for firms as they allow them to understand the patterns of share prices and develop a strategy to improve their performance. Modifying the daily stock results is notoriously difficult. The monthly stock performance data is unreliable, and firms may fail to make necessary adjustments to enhance market engagement due to delayed implementation of significant changes to their corporate strategy.

The existence of positive mean average returns in the FF 3 Factor indicates that small companies outperform giant corporations and that value stocks outperform growth stocks. The 2*3 sort S/H portfolio comprises tiny companies with a high book-to-market ratio. This portfolio yields satisfactory average returns, with a maximum value of 8.35%. The regression results indicate that the market risk premium holds the highest significance in portfolios, while the independent variables make a substantial contribution. The B/H ratio indicates that size variables have a substantial influence on small stock portfolios while having a detrimental effect on large stock portfolios. The independent components increase as the B/M ratio goes from low to high and decrease as the stocks go from small to large, following the same pattern. Despite the dominance of value companies in the market, extreme growth equities in the left corner are outperforming them. The results of Fama and French's research align with the results of this paper's FF 3 component model, which are compared to the findings of Iqbal and Brooks (2007), Mirza (2008), and Rafi et al. (2014).

The SMB component holds the most significance in the FF 5-factor model due to its substantial factor return, followed by the HML component. The SHWC portfolio, consisting of tiny businesses with high book-to-market ratios, weak profitability, and conservative investing behaviour, outperforms the other 15 portfolios by a significant margin, with a performance rate that is 11.40% higher than the average. Among the eight major corporate portfolios, the BHWA portfolio, comprising large firms with a high book-to-market ratio, low profitability, and a bold investment approach, exhibited superior average returns compared to the other portfolios. The 2*2*2*2 sort disregards all intercept values except for one in small stock portfolios and three in large stock portfolios. The insignificance and high R square values of both the model's validity and fitness provide support for its credibility. Based on the initial three variables, the results of the 2*3 sort and the 2*2*2*2 sort are similar. However, the FF 5-factor model is better than the FF 3-factor model in terms of diversifying risk.

Since the MRP and size factor have substantial positive coefficients, the outcomes produced by these models are equivalent. Conversely, HML has positive slopes in both small and large enterprises with a high B/M ratio but negative slopes in businesses with a low B/M ratio. The performance of these two models differs significantly in terms of the highest average return and standard deviation. The S/H portfolio has a maximum return of 8.35% in the 2*3 type. However, the SHWC portfolio has a higher maximum return of 11.40%.

Fama and French (2015) found that the average profitability and investment factor results for eight small company portfolios are the same. This is because these portfolios demonstrate a moderate level of profitability and reflect both conservative and aggressive investment strategies. Large enterprises in eight portfolios exhibit a modest amount of profitability and make prudent investment decisions. The study's findings confirm the tested hypothesis and reject the null hypothesis since FF 3 and FF 5 variables have the capacity to explain excess return variation, with FF 5 being superior to FF 3.

This material will be beneficial for both individual and institutional investors in making decisions regarding their portfolio and market securities investments. Furthermore, these findings indicate that a solitary beta factor is inadequate in explaining the additional fluctuation in returns. While the Capital Asset Pricing Model (CAPM) is commonly employed by investors and fund managers, it is important to note that other factors such as Market Risk Premium (MRP), Small Minus Big (SMB), High Minus Low (HML), Operating Profitability (OP), and Investment can also exert a substantial influence on excess returns in Pakistan. The findings suggest that fund managers should adopt the 2*2*2*2 sort for portfolio construction instead of the 2*3 sort, as the former provides more accurate regulation of every aspect. Collecting data on a weekly basis with equal weight is advantageous for estimating both greater expected returns and excess returns. Investors should prefer small enterprises due to their higher average surplus returns compared to large organizations.

In the future, researchers will have the ability to categorize data according to both bullish and bearish market conditions, as well as news asymmetry. Independent variables encompass factors such as earnings, momentum, and seasonal influence. Future researchers will have the capability to utilize market-efficient portfolios that consist of weekly data and are equally weighted.

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Appendix

Table 2

Daily and monthly data of equal weight

Daily	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
2*2*2*2							
Factors							
Rm- Rf							
Coef	0.0032		-0.00001	0.000008	-0.000003	-0.000005	0.15
t – statistic	4.12		-6.85	10.82	-3.99	-6.75	
SMB							
Coef	282.7945	-7273.88		0.38	0.05	0.10	0.18
t- statistic	10	-6.85		14.25	2.08	3.82	
HML							
Coef	363.8692	11020.33	0.37		-0.04	0.06	0.20
t - statistic	13.45	10.82	14.25		-1.46	2.28	
RMW							
Coef	6E+02	-4660.649	0.065	-0.046		0.025	0.03
t - statistic	21.35	-3.99	2.08	-1.46		0.86	
CMA							
Coef	482.3872	-7636.823	0.116	0.070	0.024		0.0649
t - statistic	17.15	-6.75	3.82	2.28	0.86		

Monthly	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
2*2*2*2							
Factors							
Rm- Rf							
Coef	2.06E-03		-0.66562	0.160373	-0.06517	0.060834	0.6151
t - statistic	2.46		-5.72	0.86	-3.23	0.5	
SMB							
Coef	0.000964	-0.56093		0.710899	0.012546	0.187851	0.6209
t- statistic	1.21	-5.72		4.92	0.62	1.71	
HML							
Coef	-0.00092	0.081798	0.430265		-0.08264	-0.13825	0.7769
t - statistic	-1.49	0.86	4.92		-7.46	-1.61	
RMW							
Coef	-0.00324	-2.44833	0.559304	-6.08676		0.001146	0.7574
t - statistic	-0.6	-3.23	0.62	-7.46		0	
CMA							
Coef	0.000246	0.073488	0.269277	-0.32743	3.69E-05		0.1221
t - statistic	0.25	0.5	1.71	-1.61	0		

Table 2

Daily and weekly data of value weight

Daily	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
2*2*2*2							
Factors							
Rm- Rf							
Coef	0.0027		-0.000003	0.000007	-0.000003	-0.000004	0.11
t - statistic	3.11		-4.66	8.87	-4.57	-5.24	
SMB							
Coef	374.3117	-5053.34		0.34	0.02	0.03	0.12

Daily	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
t- statistic	12.03	-4.66		12.37	0.72	0.93	
HML							
Coef	443.1387	9153.59	0.32		-0.07	0.01	0.16
t - statistic	15.07	8.87	12.37		-2.65	0.4	
RMW							
Coef	7E+02	-5190.493	0.022	-0.081		-0.036	0.029
t - statistic	23.27	-4.57	0.72	-2.65		-1.27	
CMA							
Coef	607.1318	-5951.058	0.028	0.012	-0.036		0.0244
t - statistic	20.33	-5.24	0.93	0.4	-1.27		

Monthly	Int	Rm- Rf	SMB	HML	RMW	CMA	R square
2*2*2*2 Factors							
Rm- Rf							
Coef	0.001908		-0.58	0.07	-0.09	-0.06	0.60
t - statistic	2.24		-5.08	0.45	-4.7	-0.45	
SMB							
Coef	0.0005	-0.55		0.51	-0.01	-0.04	0.52
t- statistic	0.55	-5.08		4.02	-0.49	-0.3	
HML							
Coef	-0.0007	0.06	0.45		-0.08085	-0.05	0.61
t - statistic	-0.9	0.45	4.02		-4.92	-0.44	
RMW							
Coef	-5E-04	-3.346	-0.419	-3.778		0.705	0.665
t - statistic	-0.09	-4.7	-0.49	-4.92		0.84	
CMA							
Coef	0.0008	-0.060	-0.042	-0.064	0.018		10%
t - statistic	0.88	-0.45	-0.3	-0.44	0.84		