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Does ESG matter? Investigating the ESG Premium in Pakistan Stock Market. An Asset Pricing Approach

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A B S T R A C T

Purpose—The Fama and French (2015) five-factor model has been extended by adding ESG premium (ESG-based high minus low return spread) as an additional risk factor to examine its impact on excess returns of portfolios in the emerging market of Pakistan.

Study Design/methodology/approach—Monthly stock prices data of 70 non-financial firms have been gathered from June 2015 to July 2023 to construct portfolios. 32 portfolios are created on the basis of size, value, profitability, investment, and ESG premium. Fama & French (1993, 2015) OLS time series regression is run to check the applicability of the model.

Findings—The equities that are traded on the PSX have premiums for MKT, SMB, HML, RMW, CMA, and HML_{ESG} factors. Higher R^2 values of the six-factor model indicate its efficiency in capturing stock return variations. MKT remains the biggest component across all models. SMB regularly has positive coefficients, indicating that small-cap firms beat large-cap equities. RMW and CMA produce inconsistent results, implying that profitability and investment factors are portfolio-dependent. Furthermore, the presence of CMA and RMW factors does not negate the value component.

Practical Implications—The better performance of the HML_{ESG}-based six-factor model emphasizes the significance of ESG-related factors in stock valuation. ESG should be considered as a priced risk factor, enabling investors and asset managers to incorporate it into asset pricing to better capture hidden sustainability risk and improve long-term portfolio performance.

Originality/value—First, this study adds to the current asset pricing models by suggesting an ESG-based six-factor model. Second, this paper highlights the importance of the factor model and provides valuable insight for investors. Third, this study is the first to extend the Fama and French (2015) model by adding an ESG-based risk factor to assess its impact in the Pakistani market.

Keywords: Asset's pricing model, Pakistan stock exchange, ESG-based six-factor model, ESG premium.

JEL Classification Codes: G11, G12, Q01, Q56

1 | INTRODUCTION

1.1 | Background and Context

Investment decision seeks to maximize their return while minimizing risk, a concept established by (Markowitz, 1952), Modern Portfolio Theory, subsequently expanded by Sharpe (1964), Lintner (1965) through the Capital Asset Pricing Model (CAPM). CAPM's dependence on systematic risk resulted in

unexplained anomalies, prompting the development of Ross (1976) Arbitrage Pricing Theory (APT) and Fama and French (1992) three-factor model, which incorporates size (SMB) and value (HML), and was subsequently extended to include profitability and investment (Fama & French, 2015). Multifactor models improve explanatory power (Chahuán-Jiménez et al., 2025; Kan et al., 2024; Thalassinos et al., 2025), yet certain variations persist, highlighting the necessity to investigate additional anomalies (Kan et al., 2024; Khoa & Huynh, 2023; Korenak & Stakic, 2022; Qadeer et al., 2023).

Climate change represents a significant threat to global economies, positioning sustainable investing at the forefront of financial markets (Fan & Gao, 2024). ESG (environmental, social, and governance) factors are extensively incorporated into investment and asset pricing models in developed markets; however, their implementation in emerging economies is still constrained. Pakistan encounters specific sustainability challenges, such as water scarcity, climate vulnerability, wealth inequality, and inadequate corporate governance (SBP, 2021). Despite an increasing amount of local research exploring the relationship between ESG and firm performance, as well as investor behavior, such as Hasan et al. (2025) on ESG disclosure practices, Abbas et al. (2024) on financial performance, and Zaidi and Lakhal (2025) on investment decisions, there remains a lack of systematic integration of ESG into multifactor asset pricing models. Recent studies, including Ullah et al. (2025) and Thalassinos et al. (2025), identify this gap and advocate for the integration of ESG as an additional priced factor in Pakistani markets.

In a similar vein, past studies show that firms with high ESG scores generally surpass those with lower scores, possibly attributable to diminished capital expenses and investor inclinations (Auer & Schuhmacher, 2016; Bello, 2005; Edmans, 2011), whereas alternative perspectives contend that high-ESG equities may yield reduced returns as ESG initiatives could limit short-term profitability (Hong & Kacperczyk, 2009; Pástor et al., 2021, 2022). To harmonize these conflicting perspectives, Pedersen et al. (2021) introduced an ESG-adjusted CAPM, Avramov et al. (2022) highlighted the influence of ESG uncertainty on risk-return dynamics, and Mulialim and Madyan (2023) illustrated that incorporating ESG as a risk factor in Indonesia enhanced explanatory power, albeit frequently resulting in adverse return implications. Likewise, Hasan et al. (2025) discovered in the Indian market that ESG elements adversely affected the majority of portfolios while enhancing the explanatory power of models relative to the Fama-French framework. The findings indicate that ESG variables are becoming increasingly pivotal in investment decisions (Li et al., 2023), although their price influence and performance ramifications remain inadequately examined in developing markets like Pakistan.

1.2 | Problem Statement

Apart from SECP's sustainability rules and PSX's ESG disclosure initiatives, previous research has not empirically examined ESG as a risk factor in asset pricing. This gap hinders comprehension of ESG's influence on stock returns and constrains the ability of investors and regulators to synchronize capital markets with sustainable growth.

1.3 | Research Objectives

The current study aims to address the problem by pursuing the following objectives:

a. To test the explanatory power of the ESG-based sixth factor model for portfolio excess return in the Pakistani stock market.

b. To examine the impact of ESG integration on portfolio efficiency using risk-adjusted performance measures.
c. To evaluate the practical significance of ESG factor pricing for investors' decision making and regulatory policy in the Pakistan capital market.

1.4 | Research Questions

Based on these broad objectives, the current study proposed the following research questions.

RQ1: How does the augmented six-factor affect the explanatory power of Fama and French models in the Pakistan stock market?

RQ2: Does the anticipated six-factor model outperform the traditional models in the Pakistan stock market?

RQ3: What are the practical implications of incorporating ESG into asset pricing for investors, regulators, and asset managers?

RQ4: Does the value factor (HML) remain significant in explaining portfolio excess returns in Pakistan, or does it lose relevance when profitability (RMW) and investment (CMA) are incorporated into the Fama-French five-factor model?

Moreover, our research in this paper offers a fresh angle on the cross-section of stock returns in Pakistani stock markets and delves into the significance of the ESG performance of companies. The Pakistani stock market's non-financial stocks are divided into 32 portfolios according to company size, B/M ratio, investment, profitability, and whether or not the firms operate in environmentally friendly industries. The ESG variable measures the disparity in average returns between the two sets of portfolios. In addition to expanding the current body of knowledge on asset pricing model tests, this paper will incorporate the ESG effect as its contribution. In continuation of Fama and French (1992, 1993, 2015) work, we will present time series data to empirically examine the connection between ESG as a risk factor and excess returns. Lastly, unlike developed markets, we primarily examine the Pakistani stock market to determine the explanatory power of ESG.

The findings of our paper reveal that small-cap stocks beat large-cap stocks, as shown by a positive SMB coefficient, emphasizing the presence of the size effect premium. HML remains a significant predictor of return, signifying that value stock performs better. Investment and profitability show inconsistent results, indicating their effect are portfolio specific. Despite Fama and French (2015) findings, HML is not redundant in the Pakistan stock market, as profitability and investment do not fully capture the value premium. The high adjusted R^2 value indicates that the 6-factor model surpasses the previous models.

The next section of the paper is organized as follows: Section 2 comprises of literature review discussing the relation of risk factors on stock returns in the Pakistan context. Section 3 comprises methodology. Section 4 comprises results and empirical findings. Section 5 comprises of conclusion, limitations, and implications.

1.5 | Insight into Pakistan Stock Market (PSX)

The Pakistan Stock Exchange (PSX) is a frontier market featuring more than 500 listed companies, presenting opportunities for high returns, though it is characterized by volatility and low liquidity. Recently,

there has been an increase in ESG awareness, highlighted by PSX's participation in the UN SSE Initiative and the SECP's release of voluntary ESG disclosure guidelines in 2024. Although the adoption of ESG varies, prominent companies such as Engro and Bestway Cement have achieved significant advancements in sustainability practices. The changing ESG landscape offers a chance to explore if investors have factored in environmental and social responsibility into their pricing decisions. Incorporating an ESG premium into asset pricing models enables us to evaluate the impact of sustainable practices on stock returns in Pakistan, offering fresh perspectives to both local and international asset pricing research.

2 | LITERATURE REVIEW

2.1 | Theoretical Background.

Asset pricing theories seek to explain the relationship between risk and return in financial markets. Markowitz (1952) established diversity as a means for optimal portfolio creation. Capital Asset Pricing Model (Sharpe, 1964) established a connection between expected returns and market risk (beta), predicated on the assumptions of rational investors and efficient markets. Efficient Market Hypothesis Fama (1970) posited that stock prices completely incorporate all accessible information, rendering it impossible to regularly achieve abnormal profits. Nonetheless, the concept of the Efficient Market Hypothesis (EMH) does not entirely apply in Pakistan, as informational efficiency fluctuates over time (Said et al., 2022). To address the shortcomings of the Capital Asset Pricing Model (CAPM), Ross (1976) proposed the Arbitrage Pricing Theory (APT), which permits many macroeconomic factors to explain asset returns without dependence on a singular market portfolio. Subsequently, Fama and French (1993, 2015) introduced multifactor models, incorporating size (SMB), value (HML), profitability (RMW), and investment (CMA) to more accurately reflect return fluctuations. Recently, ESG factors have gain significant importance in asset valuation. In Pakistan, the incorporation of ESG is still evolving; however, initiatives by the SECP and PSX regarding sustainability reporting indicate an increasing interest. Integrating ESG as a sixth element in the asset price model enhances current theories such as EMH and APT by addressing unconventional sources of risk pertinent to modern-day investors.

2.2 | Traditional Risk Factors in Asset Pricing

The Capital Asset Pricing Model (CAPM) proposed by Sharpe (1964) and Lintner (1965), although sophisticated in its connection of risk and return, has faced extensive criticism due to its limiting assumptions and insufficient empirical support. Multiple studies illustrate its failure to account for cross-sectional volatility in returns, especially in the presence of anomalies such as size, value, and momentum (He, 2023; Khoa & Huynh, 2023). This deficiency has prompted the pursuit of more sophisticated models adept at encapsulating the intricacies of actual markets. By adding size and value premiums, Fama and French (1992) three-factor model (FF3) marked a substantial advancement. These characteristics are supported by solid and consistent evidence in developed markets (Brailsford et al., 2012; Cheung et al., 2015), but the findings in emerging economies continue to be incongruous. For instance, in Pakistan, some research supports the function of SMB and HML (Mirza & Shahid, 2008; Rashid et al., 2018), while other research completely disputes their robustness (Ali et al., 2021). Even momentum, when observed, lacks persistence (Mirza & Reddy, 2017). These discrepancies imply that factor payoffs may not generalize across contexts and are extremely sensitive

to market dynamics. The five-factor model (FF5) proposed by Martinsa and Eid Jr (2015) sought to resolve these concerns by incorporating profitability (RMW) and investment (CMA). Nevertheless, the data remains disjointed in this context as well. In markets including the U.S., Brazil, and Australia, the FF5 surpasses the FF3 (Cakici & Zaremba, 2021; Chiah et al., 2016; Martinsa & Eid Jr, 2015). Conversely, research from China and Japan indicates that RMW and CMA contribute minimal explanatory power (Jiao & Lilti, 2017; Kubota & Takehara, 2018). This disparity raises questions about the universality of the expanded model. In Pakistan, empirical research on FF5 is limited, leaving it uncertain if the value factor (HML) still captures independent risk premia or becomes superfluous in the context of profitability and investment.

2.3 | ESG Performance as a Risk Factor

In the last twenty years, researchers have enhanced conventional asset pricing models by integrating new risk factors; however, their efficacy in emerging markets is inconsistent. Huang (2019) illustrates that the Fama-French five-factor model shows inconsistent explanatory power in emerging stock markets, underscoring the necessity of identifying context-specific factors. Recent focus has turned to sustainability and green finance as potential influences on asset pricing, in light of the global urgency surrounding environmental degradation (Kumar et al., 2025). ESG (environmental, social, and governance) factors serve as a business rationale for sustainability, positing that effective management of ESG risks can generate long-term value for firms (Signori et al., 2021). The evidence regarding the financial impact of ESG is not consistent. Multiple studies indicate that ESG enhances risk-adjusted performance by reducing downside risk and volatility (Broadstock et al., 2021; Hoepner et al., 2024; Pedersen et al., 2021). Conversely, some research highlights that ESG stocks might yield lower returns due to regulatory exposure or short-term cost pressures (Görgen et al., 2020; Pástor et al., 2021). Albuquerque et al. (2020) and Khan (2019) demonstrate that firms with high ESG ratings achieve superior returns; however, Shanaev and Ghimire (2022) indicate that the effects of ESG ratings are asymmetric. The conflicting evidence indicates that the role of ESG as a priced factor depends on market structures, regulatory environments, and investor preferences. Recent efforts to formally incorporate ESG into asset pricing models have yielded varied results. Hubel and Scholz (2018) and Dobrick et al. (2025) illustrate that ESG-based extensions improve explanatory power, whereas they report that ESG factors adversely impact portfolio returns in India, suggesting that investors require a premium for low-ESG firms. The identified inconsistencies highlight the necessity for market-specific testing of ESG as an additional variable.

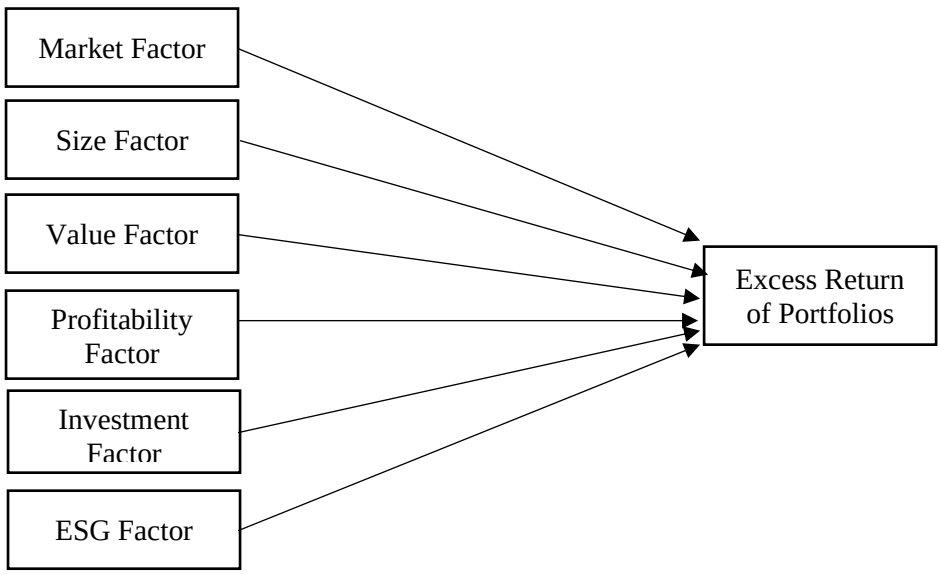
In Pakistan, recent studies have primarily concentrated on outcomes at the firm level. Jan and Zahid (2024) establish a connection between ESG practices and financial success, Awan and Gul (2024) investigate the impact of ESG on corporate investment behavior, and Siddiqui et al. (2024) emphasize its nonlinear effects on firm performance. Majeed et al. (2022) demonstrate that carbon budgeting can facilitate the creation of ESG-compliant portfolios with minimal sacrifice in returns; however, this pertains to portfolio construction rather than pricing mechanisms. Although these studies highlight the increasing significance of ESG within the Pakistani context, none systematically integrate ESG into multi-factor asset pricing models. This study is, to the authors' knowledge, the first to integrate ESG premium into the five-factor model in Pakistan.

2.4 | Theoretical Framework

The incorporation of ESG factors into asset pricing is supported by theoretical models, including the ESG-adjusted CAPM proposed by Pedersen et al. (2021) and stakeholder theory articulated by Freeman (1984). The ESG-adjusted CAPM posits that sustainability influences returns via a risk channel, wherein inadequate ESG practices increase exposure to regulatory, reputational, and litigation risks, and a preference channel, wherein investors are willing to accept lower returns for portfolios aligned with ESG principles. Stakeholder theory suggests that effective ESG practices diminish conflicts, stabilize cash flows, and reduce downside risk. These perspectives indicate that ESG functions as a systematic driver of risk and return, thus constituting a priced factor. Despite the theoretical justifications, no research has empirically examined ESG as a priced factor within the Fama-French framework in the Pakistani stock market, highlighting a significant gap that this study aims to address.

Figure 1

Theoretical Model



3 | METHODOLOGY & DESIGN

Expanding upon the five-factor model of Fama and French (2015) by adding an ESG aspect. In order to be part of the sample, companies must have been trading on PSX for a minimum past twelve months. The data of the combined ESG score has been retrieved from Refinitiv Eikon instead of analyzing E, S, and G aspects separately because it minimizes the likelihood of multicollinearity, captures the interconnectedness of the ESG pillars, and offers a consistent, comparable benchmark across companies and industries. The composite measure is recommended. Furthermore, the composite score is better in line with real market practices because investors generally see ESG as a comprehensive indicator of sustainability success.

Accounting data and market data are analyzed in this quantitative study. Accounting data that are sorted to form portfolios are collected from the unconsolidated financial statements of sampled companies. They include market capitalization (share price multiplied by outstanding shares), B/M ratio (book equity divided

by market equity), investment (change in total assets), and operating profitability (gross profit minus selling, general/other, and administrative expenses, minus interest expense, all divided by book equity) (Fama & French, 2015). To determine monthly stock prices from 2015 to 2020, we gathered data from the Open Door, and from 2020 to 2023, we used PSX. Yahoo Finance had been used for market returns. From 2015 to 2023, the "Balance Sheet Analysis" report was used to gather accounting data for calculating the B/M ratio, investment, and profitability. Twelve-month treasury-bill rate is used to calculate the risk-free rate of return. Monthly statements, and more especially the "Market Treasury Bill Auction Results", provide the data used by the State Bank of Pakistan to calculate treasury-bill rates. For ESG, Thomson Reuters indicators have been used. This study utilizes Fama and French's original portfolio-based methodology to assess risk indicators in the PSX. Survivorship bias is addressed by including all listed firms, omitting only those with negative equity in line with standard practice (Elton et al., 1996). Further, (1) all missing values are also removed in our dataset. (2) The financial sector was not included due to market portfolios. Finally, data had been gathered from 70 non-financial firms listed on PSX from July 2015 to June 2023 with available ESG data on Refinitiv Eikon. Financial organizations were omitted due to their unique accounting and regulatory frameworks, and only firms with comprehensive ESG and financial data were incorporated to guarantee precise and comparable portfolio analysis.

3.1 | Definition of Variables

The Fama and French (2015), which serves as the study's baseline, examines the influence of five factors on portfolio returns: market, size, value, profitability, and investment. The "five-factor model" incorporates ESG performance as a sixth risk factor to analyze its effect on excess returns from the portfolio. To measure these variables, the following proxies are introduced.

Market Factor (MKT)

Market factor is the market portfolio's excess return over the risk-free rate, which captures systematic risk. Diversifying among several equities reduces unsystematic risk, but market risk, which impacts all assets, cannot be eradicated (Sharpe, 1964).

Size Factor (SMB)

SMB represents the differential return between small market capitalization portfolios and large market capitalization portfolios, thereby illustrating the size effect in stock returns (Banz, 1981; Fama & French, 1992, 1993).

Value factor (HML)

The HML factor represents the differential in average returns between portfolios consisting of high book-to-market (value) stocks and those comprising low book-to-market (growth) stocks (Fama & French, 1993).

Profitability factor (RMW)

RMW represents the disparity in returns between enterprises exhibiting strong (high) and weak (low) operating profitability (Fama & French, 2015).

Investment factor (CMA)

CMA represents the disparity in average returns between companies exhibiting conservative and aggressive investing strategies (Fama & French, 2015).

ESG factor (HML_{ESG})

HML_{ESG} is the returns generated from a portfolio consisting of companies with elevated ESG scores subtracted by those with lower ESG scores (Mulialim & Madyan, 2023).

Table 1

Category definition of ESG (Thomson Reuters indicator)

Resource Use Score	Efficiency in the company's supply chain management and its ability to cut down on material, energy, and water consumption while simultaneously finding greener solutions.
Emission Reduction Score	A measure of the company's dedication and success in cutting down on emissions from its operations and production.
Innovation Score	The business may be an industry leader in developing and implementing innovative, environmentally conscious processes, products, and technology. This way, it can find new markets while also lowering environmental costs for customers.
Workforce Score	How well the company takes care of its employees in terms of their happiness on the job, their health and safety, the diversity of its employees, and their opportunities for advancement.
Human Rights Score	The efficiency with which the company complies with basic human rights agreements
Community Score	The company's dedication to upholding corporate ethics, safeguarding public health, and being a good neighbor
Product Responsibility Score	The ability of the business to manufacture high-quality goods and services while simultaneously protecting the privacy, security, and well-being of its customers
Management Score	Commitment and effectiveness of the company in adhering to principles of best practice in corporate governance
Shareholders Score	How well the company treats its shareholders fairly.
CSR Strategy Score	By doing things like publishing thorough sustainability reports, following integrated reporting frameworks, and actively engaging stakeholders, the company effectively communicates its pledge to incorporate economic, social, and environmental factors into its everyday decisions. A commitment to balanced decision-making that encompasses financial, social, and environmental dimensions is further reinforced by leadership commitment, employee training,

The Fama and French (2015) study serves as the study's baseline, examining the influence of five factors on portfolio returns: market size, value, investment, and profitability. The “five-factor model” incorporates ESG as a sixth risk factor to analyze its effect on excess returns from the portfolio. To measure these variables, the following proxies are introduced;

Table 2

Description and measurement of the variable

Variable	Measurement	References
Market factor	R_{mt} = ln [PSX 100_t/PSX 100_{t-1}]	(Sharpe, 1964).
Size factor	Market Capitalization = price of the share × No. of outstanding shares	(Fama & French, 1992, 1993; Banz, 1981).
Value factor	Book-to-market ratio: book value equity / Market value equity	(Fama & French, 1992, 1993)
Profitability	Profitability = $EBIT_{t-1}$/ Book equity of firmt-1	(Fama & French, 2015)
Investment	Asset growth= [Total $Asset_{t-1}$/Total $Asset_{t-2}$] -1	(Fama & French, 2015)
ESG Performance	Measure varying in value from 0 to 1. An all-encompassing word used in the financial markets and by investors to assess the conduct of a company and to forecast its future financial success by evaluating its sustainability. Environmental Score, Social Score, and Governance Score are the three pillars upon which it rests. Companies' annual reports were sifted for data on ESG performance, which was then used to create an ESG index and ultimately yield the ESG Score.	(Ortas, 2015; Cheng et al.,2014)

3.2 | Construction of Portfolios

3.2.1. Fama and French 3-factor model

Portfolios are formed on the basis of market capitalization and the B/M ratio at the end of June of each year. Initially, we divided the stock into 2 sets, “small” and “big” portfolios, while using the median as a breakeven point to form size-based portfolios. Then these 2*2 portfolios generate 4 sub-portfolios on the basis of the B/M ratio. We divide small-cap stocks into two sub-portfolios: one for firms with a B/M ratio below the median SL and the other for firms with a B/M ratio above the median SH. Similarly, big portfolios are divided into two sub-portfolios on the basis of the B/M ratio, and they are classified as BL and BH.

3.2.2. Fama and French 5-factor model

We divide these four-sub portfolios into eight sub-portfolios on the basis of profitability. The first sub-portfolio includes stocks with high profitability, and the second one contains stocks with lower profitability. The small-sized portfolios with a high B/M ratio are again sorted on the basis of profitability. All the stocks above the median with low profitability are known as SHW (Small size-HB/M-Weak P), whereas stocks below the median with high profitability are known as SHR (Small size-HB/M-Robust P). Then again, SL is sorted based on profitability and forms the sub-portfolios SLW (Small-LB/M-Weak P) and SLR (Small-LB/M-Robust P). Similarly, big portfolios with high and low B/M ratios are further sorted on the basis of profitability to form four sub-portfolios. These four sub-portfolios are known as BHW (Big-HB/M-Weak P) and BHR (Big-HB/M-Robust P), and BLW (Big-LB/M-Weak-P), along with BLR (Big-LB/M-Robust P). These eight sub-portfolios, SHW, SHR, SLW, SLR, BHW, BHR, BLW, BLR, are again sorted based on investment to form sixteen sub-portfolios. Above median stocks with small investment are referred to as a conservative

approach (SHWC, SHRC, SLWC, SLRC, BHWC, BHRC, BLWC, and BLRC). However, the stock with high investment is referred to as an aggressive approach: SHWA, SHRA, SLWA, SLRA, BHWA, BHRA, BLWA, and BLRA.

3.2.3. Extended 6-factor model

The previously formed 16 portfolios are again sorted on the basis of ESG performance to form 32 sub-portfolios while using the median as a breakeven point. Sixteen sub-portfolios ("SHWC, SHRC, SLWC, SLRC, BHWC, BHRC, BLWC, BLRC, SHWA, SHRA, SLWA, SLRA, BHWA, BHRA, BLWA, and BLRA are arranged by ESG Performance in ascending order to create a future portfolio. The initial 16 sub-portfolios consist of above-median stocks characterized by low ESG, designated as SHWCL, SHRCL, SLWCL, SLRCL, BHWCL, BHRCL, BLWCL, BLRCL, SHWAL, SHRAL, SLWAL, SLRAL, BHWAL, BHRAL, BLWAL, and BLRAL. The remaining 16 sub-portfolios comprise below-median companies exhibiting high ESG. The 16 sub-portfolios are designated as "SHWCH, SHRCH, SLWCH, SLRCH, BHWCH, BHRCH, BLWCH, BLRCH, SHWAH, SHRAH, SLWAH, SLRAH, BHWAH, BHRAH, BLWAH, and BLRAH.

This study used a median split of composite ESG scores from Refinitiv Eikon to categorize firms into high- and low-ESG portfolios because it prevents overfitting due to arbitrary thresholds and offers a clear, balanced sample division. The median guarantees adequate representation in each group and comparability across emerging economies where ESG disclosure is still developing.

However, collectively 62 portfolios are formed, which include the final 32 sub-portfolios formed based on ESG and all the intermediate sub-groupings formed at an earlier stage of the sorting process. Such as 6 portfolios after sorting by size and B/M ratio, 8 portfolios after sorting by profitability, and 16 after sorting by investment.

Table 3

Construction of Portfolios

Model	Sort	Breakeven point	Factor calculation
FF 3-factor model	2*2 Sort on size and B/M ratio	Size: Median B/M: median	SMB: (SH+SL)/2 – (BH+BL)/2 HML: (SH+BH)/2 – (SL+BL)/2
FF5 factor model	2*2*2*2 Sort on size, B/M, P, INV	Size: median B/M: median P: median INV: median	**SMB**=(SHRC+SHRA+SHWC+SHWA+SLRC+SLRA+SLWC+SLWA)/8-(BHRC+BHRA+BHWC+BHWA+BLRC+BLRA+BLWC+BLWA)/8 **HML**=(SHRC+SHRA+SHWC+SHWA+BHRC+BHRA+BHWC+BHWA/8 – (SLRC+SLRA+SLWC+SLWA+BLRC+BLRA+BLWC+BLWA)/8 **RMW**=(SHRC+SHRA+SLRC+SLRA+BHRC+BHRA+BLRC+BLRA)/8 – (SHWC+SHWA+SLWC+SLWA+BHWC+BHWA+BLWC+BLWA)/8 **CMA**=(SHRC+SHWC+SLRC+SLWC+BHRC+BHWC+BLRC+BLWC)/8 – (SHRA+SHWA+SLRA+SLWA+BHRA+BHWA+BLRA+BLWA)/8
Expanded 6-factor model	2*2*2*2*2*2 Sort on size, B/M, P, INV, ESG	Size: median B/M: median P: median INV: median ESG: median	**SMB**=(SHRCH+SHRCL+SHRAH+SHRAL+SHWCH+SHWCL+SHWAH+SHWAL+SLRCH+SLRCL+SLRAH+SLRAL+SLWCH+SLWCL+SLWAH+SLWAL)/16 – (BHRCH+BHRCL+BHRAH+BHRAL+BHWCH+BHWCL+BHWAH+

			BHWAL+BLRCH+BLRCL+BLRAH+BLRAL+BLWCH+BLWCL+BLWAH+BLWAL)/16 **HML**=(SHRCH+SHRCL+SHRAH+SHRAL+SHWCH+SHWCL+SHWAH+SHWAL+BHRCH+BHRCL+BHRAH+BHRAL+BHWCH+BHWCL+BHWAH+BHWAL)/16 – (SLRCH+SLRCL+SLRAH+SLRAL+SLWCH+SLWCL+SLWAH+SLWAL+BLRCH+BLRCL+BLRAH+BLRAL+BLWCH+BLWCL+BLWAH+BLWAL)/16 **RMW**=(SHRCH+SHRCL+SHRAH+SHRAL+SLRCH+SLRCL+SLRAH+SLRAL+BHRCH+ BHRCL+BHRAH+BHRAL+BLRCH+BLRCL+BLRAH+BLRAL)/16 – (SHWCH+SHWCL+SHWAH+SHWAL+SLWCH+SLWCL+SLWAH+SLWAL+BHWCH+BHWCL+BHWAH+BHWAL+BLWCH+BLWCL+BLWAH+BLWAL)/16 **CMA**=(SHRCH+SHRCL+SLRCH+SLRCL+BHRCH+BHRCL+BLRCH+BLRCL+SHWCH+SHWCL+SLWCH+SLWCL+BHWCH+BHWCL+BLWCH+BLWCL)/16 – (SHRAH+SHRAL+SLRAH+SLRAL+BHRAH+BHRAL+BLRAH+BLRAL+SHWAH+SHWAL+SLWAH+SLWAL+BHWAH+BHWAL+BLWAH+BLWAL)/16 **HML_{EP}**=(SHRCH+SLRCH+BHRCH+BLRCH+SHWCH+SLWCH+BHWCH+BLWCH+SHRAH+SLRAH+BHRAH+BLRAH+SHWAH+SLWAL+BHWAH+BLWAH)/16 – (SHRCL+SLRCL+BHRCL+BLRCL+SHWCL+SLWCL+BHWCL+BLWCL+SHRAL+SLRAL+BHRAL+BLRAL+SHWAL+SLWAL+BHWAL+BLWAL)/16

3.3 | Specification of Model and Regression Equation

We used Fama and French (1992, 1993, 2015) OLS time series regression to determine how firm-specific elements, size, B/M, profitability, investment, and ESG affect different asset pricing models' excess portfolio returns. Beta coefficients help determine the direction as well as the intensity of how these characteristics influence excess portfolio returns. Adjusted R^2 serves as the metric to evaluate the explanatory capabilities between asset pricing models. Model specifications are as follows;

Capital asset pricing model (CAPM)

$$R_{p,t} - R_{f,t} = a + b_i\,(R_{m,t} - R_{f,t}) + e_i$$

Fama and French 3-factor model

$$R_{p,t} - R_{f,t} = a + b_i\,(R_{m,t} - R_{f,t}) + S_i\,(SMB_t) + h_i\,(HML_t) + e_i$$

Fama and French 5-factor model

$$R_{p,t} - R_{f,t} = a + b_i\,(R_{m,t} - R_{f,t}) + s_i\,(SMB_t) + h_i\,(HML_t) + ri\,(RMW_t) + c_i\,(CMA_t) + e_i$$

Proposed 6-factor model

$$R_{p,t} - R_{f,t} = a + b_i\,(R_{m,t} - R_{f,t}) + s_i\,(SMB_t) + h_i\,(HML_t) + r_i\,(RMW_t) + c_i\,(CMA_t) + h_i\,(HML_{ESG,\,t}) + e_i$$

Whereas,

$R_{p,t} - R_{f,t}$ are excess returns of the portfolio for period t. $R_{m,t}$ is the Market return and $R_{f,t}$ is the Risk-free rate. $R_{m,t} - R_{f,t}$ is the market premium, and $SMBt$, HML_t, RMW_t, CMA_t, $HML_{ESG,t}$ are the risk premiums at time t. b_i, s_i, h_i, r_i, c_i, h_i are sensitivities of $R_{p,t} - R_{f,t}$ to a change in market premium ($R_{m,t} - R_{f,t}$), size premium, value premium, Profitability premium, Investment premium, and ESG premium, respectively. For the proxy

of ESG risk premium, we used Fama and French (1993) long and short value-weighted portfolio approach, which captures the return differential between firms with high and low ESG performance (Dobrick et al., 2025; Mulialim & Madyan, 2023).

In this study, summary statistics and correlation analysis have been employed. Although this study incorporated market portfolios, which are based on the construction of the Fama and French model. We followed the recent work of Thalassinos et al. (2025), indicating that the construction of the factor model has been measured by portfolio indices. So, there is no need to do preliminary analysis such as D-W test, heteroscedasticity, multicollinearity, and pre- and post-sensitivity analysis because these market portfolios omit all outliers.

4 | RESULTS AND ANALYSIS

4.1 | Summary Statistics of all Portfolios

The table given below shows that small-sized portfolios produce higher returns than large-sized portfolios, but with higher risk. High B/M ratio outperforms the low B/M ratio stock. Firms with high profitability outperform firms with low profitability without higher risk. However, the aggressive investment approach performs poorly compared to the conservative investment approach. High ESG performance firms perform better than the low-performance firms. The results support the asset pricing aspect and highlight the importance of incorporating ESG factors in the previous model. The negative mean value noted in certain factor portfolios suggests that the respective premiums underperformed during the sample period. This observation aligns with recent literature that highlights the time-varying characteristics of factor returns (Fama & French, 2015; Said et al., 2022). Such outcomes are frequently observed, especially in emerging markets such as Pakistan, where macroeconomic volatility and structural inefficiencies may result in deviations from anticipated risk premiums.

Table 4

Summary Statistics for all Portfolios

Portfolios	Mean	Std.dev	kurtosis	Skew	Min	Max
P	-0.0067	0.0666	1.8210	0.1036	-0.2404	0.2072
S	-0.0037	0.0777	1.2187	0.3146	-0.2342	0.2386
SH	0.0011	0.0824	1.7213	0.5261	-0.2093	0.2840
SL	-0.0088	0.0766	1.1309	-0.1328	-0.2888	0.1806
SHR	-0.0001	0.0797	0.2476	0.3809	-0.1836	0.2182
SHW	0.0022	0.0967	2.1767	0.6371	-0.2349	0.3733
SLR	-0.0037	0.0747	2.1426	0.2042	-0.2729	0.2358
SLW	-0.0138	0.0876	0.5259	-0.1467	-0.3047	0.1920
SHRA	-0.0113	0.0822	0.9396	0.7159	-0.1517	0.2560
SHRC	0.0113	0.0934	0.6583	0.2142	-0.2652	0.2404
SHWA	0.0050	0.1111	4.4057	0.9901	-0.3159	0.5039
SHWC	-0.0006	0.1016	0.7667	0.4059	-0.2419	0.2761
SLRA	-0.0027	0.0788	1.4024	-0.3736	-0.2838	0.1910

SLRC	-0.0046	0.0883	1.5644	0.4585	-0.2622	0.2946
SLWA	-0.0162	0.0975	1.8258	-0.4798	-0.3927	0.2053
SLWC	-0.0115	0.1043	-0.1586	0.2951	-0.2298	0.2734
SHRAH	-0.0164	0.0871	0.8676	0.4489	-0.2113	0.2639
SHRAL	-0.0062	0.1001	0.5484	0.6375	-0.2286	0.2718
SHRCH	0.0043	0.1037	0.1490	0.1118	-0.2374	0.2831
SHRCL	0.0183	0.1137	2.7115	0.6276	-0.3343	0.4506
SHWAH	0.0095	0.1083	3.8335	0.9911	-0.2252	0.5100
SHWAL	0.0006	0.1389	3.6899	0.8373	-0.4788	0.4979
SHWCH	-0.0067	0.1192	3.0604	1.1460	-0.2292	0.4510
SHWCL	0.0054	0.1197	2.1799	0.6813	-0.3145	0.4490
SLRAH	-0.0094	0.0982	4.5359	-0.3568	-0.4464	0.3129
SLRAL	0.0041	0.0940	1.4482	-0.2811	-0.3297	0.2752
SLRCH	-0.0028	0.0947	1.6889	0.6874	-0.2678	0.3161
SLRCL	-0.0065	0.1096	1.2084	0.1097	-0.3671	0.2731
SLWAH	-0.0167	0.1107	2.2627	-0.6161	-0.4561	0.2682
SLWAL	-0.0157	0.1177	0.3194	-0.0043	-0.3472	0.2631
SLWCH	-0.0131	0.1096	0.4423	0.5365	-0.2325	0.3115
SLWCL	-0.0099	0.13037	0.9664	0.3671	-0.4078	0.3644
Part B: All big portfolios						
B	-0.0098	0.0587	2.7898	-0.1708	-0.2465	0.1758
BH	-0.0105	0.0660	3.2408	-0.2083	-0.2856	0.2035
BL	-0.0093	0.0547	1.5713	-0.1577	-0.2064	0.1537
BHR	-0.0077	0.0614	1.4321	-0.0236	-0.2216	0.1919
BHW	-0.0134	0.0775	3.4962	-0.3868	-0.3497	0.2149
BLR	-0.0063	0.0519	0.4502	-0.0518	-0.1453	0.1568
BLW	-0.0123	0.0685	2.0191	-0.2820	-0.2676	0.1802
BHRA	-0.0102	0.0667	2.8723	-0.7475	-0.3002	0.1643
BHRC	-0.0051	0.0685	1.4977	0.7295	-0.1432	0.2276
BHWA	-0.0101	0.0744	1.5667	-0.1348	-0.2906	0.1954
BHWC	-0.0166	0.0883	4.0209	-0.5491	-0.4088	0.2697
BLRA	-0.0027	0.0618	0.1375	0.1934	-0.1287	0.1729
BLRC	-0.0098	0.0627	1.4828	-0.3075	-0.2083	0.1617
BLWA	-0.0105	0.0797	3.6937	-0.0932	-0.3404	0.2335
BLWC	-0.0141	0.0695	0.7790	-0.1202	-0.2007	0.1774
BHRAH	-0.0096	0.0674	-0.0946	0.1518	-0.1713	0.1737
BHRAL	-0.0108	0.0882	5.3567	-1.0056	-0.4291	0.2771
BHRCH	-0.0052	0.0902	3.2919	1.1705	-0.1826	0.3852
BHRCL	-0.0051	0.0652	1.2333	0.4853	-0.1638	0.2222
BHWAH	0.0007	0.0862	0.0579	0.1395	-0.2468	0.2148
BHWAL	-0.0210	0.0937	2.0697	-0.1223	-0.3344	0.3070
BHWCH	-0.0155	0.0922	1.0262	0.1599	-0.2445	0.3099
BHWCL	-0.0177	0.1071	7.5642	-1.2903	-0.5874	0.2294
BLRAH	0.0077	0.0797	1.2063	0.6287	-0.1699	0.2751
BLRAL	-0.0132	0.0695	0.5054	0.1402	-0.1763	0.1975
BLRCH	-0.0074	0.0633	3.9045	-1.0684	-0.3046	0.1265
BLRCL	-0.0123	0.0887	1.8477	0.0133	-0.2739	0.26969
BLWAH	-0.0158	0.0852	0.6513	-0.1509	-0.2499	0.2209
BLWAL	-0.0053	0.0954	5.6958	-0.1372	-0.4439	0.3165
BLWCH	-0.0158	0.0735	3.7739	-1.0458	-0.3546	0.1260
BLWCL	-0.0124	0.0920	1.1305	0.3651	-0.2267	0.2920

**Note: Note: Table reports summary statistics for Size–B/M–Inv–P–ESG sorted portfolios (July 2015–June 2023; monthly returns). Panel A presents returns, SD, kurtosis, skewness, and min–max values for small-size portfolios; Panel B provides the same statistics for large-size portfolios.*

4.2 | Capital Asset Pricing Model

Regression Result

The table given below shows that most portfolios have significant market beta, demonstrating the strong relation between market premium and beta. Portfolios such as SHWAL (β = 1.47), SHWA (β = 1.34), and BHWCH (β = 1.28) demonstrate high sensitivity to market fluctuations, whereas BLR (β = 0.71) and BLRA (β = 0.70) show lower sensitivity. The negative sign of the intercept shows the underperformance relative to CAPM expectations. Adjusted R^2 values are generally higher for large-cap portfolios (e.g., B = 0.89, P = 0.81), indicating strong explanatory power of the model, whereas small-cap portfolios (e.g., SHRAH = 0.30, SLWCH = 0.24) show lower explanatory power. These findings are consistent with Fama and French (1993, 2015), who noted that CAPM alone does not fully capture return variations, particularly for small firms. This underscores the necessity of multi-factor models that incorporate additional dimensions of risk. However, the model explains that large portfolios produce higher returns compared to the small-cap portfolios.

Table 5

Regression Results of CAPM

Dep. variable	Intercept	MKT	Adj. R^2
P	-0.0084**	1.0541***	0.8130
S	-0.0049	1.1354***	0.6947
B	-0.0119***	0.9728***	0.8911
SH	0.0001	1.1673***	0.6503
SL	-0.0102*	1.0994***	0.6683
BH	-0.0121***	1.0603***	0.8402
BL	-0.0120***	0.8580***	0.7907
SHR	-0.0016	1.0637***	0.5734
SHW	0.0017	1.2709***	0.5624
SLR	-0.0054	1.0510***	0.6448
SLW	-0.0150*	1.1478***	0.5553
BHR	-0.0099**	0.9441***	0.7661
BHW	-0.0142***	1.1766***	0.7514
BLR	-0.0098**	0.7124***	0.6039
BLW	-0.0142***	1.0035***	0.6932
SHRC	0.0098	1.0821***	0.4292
SHRA	-0.0130*	1.0454***	0.5247
SHWC	-0.0015	1.2017***	0.4531
SHWA	0.0049	1.3402***	0.4728
SLRC	-0.0062	1.0834***	0.4877
SLRA	-0.0046	1.0186***	0.5436
SLWC	-0.0133	1.0397***	0.3201
SLWA	-0.0167*	1.2559***	0.5346
SHRCH	0.0028	1.0916***	0.3532
SHRCL	0.0167	1.0725***	0.2827
SHRAH	-0.0192*	0.8499	0.3029
SHRAL	-0.0069	1.2409***	0.5031
SHWCH	-0.0072	1.2644***	0.3629

SHWCL	0.0042	1.1390***	0.2906
SHWAH	0.0086	1.2031***	0.3986
SHWAL	0.0012	1.4772***	0.3658
SLRCH	-0.0055	0.8702***	0.2687
SLRCL	-0.0068	1.2966***	0.4542
SLRAH	-0.0109	1.0882***	0.3959
SLRAL	0.0018	0.9498***	0.3309
SLWCH	-0.0153	0.9596***	0.2441
SLWCL	-0.0112	1.1199***	0.2353
SLWAH	-0.0174	1.2337***	0.4012
SLWAL	-0.0161	1.2782***	0.3777
BHRC	-0.0075	0.9284***	0.5972
BHRA	-0.0124**	0.9598***	0.6674
BHWC	-0.0171***	1.2679***	0.6721
BHWA	-0.0116***	1.0852***	0.6925
BLRC	-0.0133**	0.7243***	0.4223
BLRA	-0.0063	0.7006***	0.4183
BLWC	-0.0163***	0.9523***	0.6063
BLWA	-0.0122*	1.0548***	0.5672
BHRCH	-0.0067	1.0643***	0.4531
BHRCL	-0.0082	0.7925***	0.4765
BHRAH	-0.0127*	0.7737***	0.4233
BHRAL	-0.0119	1.1459***	0.5452
BHWCH	-0.0159**	1.2824***	0.6300
BHWCL	-0.0183*	1.2534***	0.4444
BHWAH	-0.0016	0.9208***	0.3666
BHWAL	-0.0216***	1.2496***	0.5819
BLRCH	-0.0121*	0.5017***	0.1954
BLRCL	-0.0146*	0.9468***	0.3622
BLRAH	0.0037	0.6068***	0.1826
BLRAL	-0.0163**	0.7943***	0.4251
BLWCH	-0.0190**	0.7689***	0.3488
BLWCL	-0.0136*	1.1356***	0.4927
BLWAH	-0.0182*	0.9059**	0.3625
BLWAL	-0.0061	1.2037***	0.5160

Note*: Table shows CAPM regression results. MKT factor explains portfolio returns and denotes the value-weighted return on market portfolio. Significance level $p \leq 0.05$*, or $p \leq 0.1$,

4.3 | Fama and French 3-factor model

4.3.1. Correlation matrix

The correlation matrix given below shows that there is a positive correlation between MKT-SMB (0.29) and MKT-HML (0.29), demonstrating that small-cap stocks and value stocks perform better when the market return increases. However, the weak relation among SMB-HML (0.13) shows that the size and value stocks are mostly independent. Generally, the weak correlation supports the 3-factor as a unique aspect of stock returns in asset pricing.

Table 6

Correlation Matrix of 3FF Model.

	MKT	SMB	HML
MKT	1		
SMB	0.2927	1	
HML	0.2936	0.1275	1

**Note: Correlation results of Fama-French three-factors, with MKT, SMB, and SML demonstrating market premium, size premium, and value premium.*

4.3.2. Regression Result

The results show that all 3-factor significantly affect returns, though their effect vary across portfolios. The results are consistent with Fama and French (1992, 1993). MKT coefficients are positive and highly significant across all portfolios, confirming the dominant influence of market movement on return. SMB is positive and significant among some portfolios, supporting the notion that small-cap stock outperforms large-cap stocks. However, HML shows mixed results, indicating that value stock contributes positively to return in several portfolios but not uniformly across all portfolios. Negative sign of the intercept represents EMH, suggesting no abnormal returns after accounting for the factors. High R^2 values show that the model explains most return variations. Similarly, a lower R^2 value in some portfolios suggests the potential relevance of additional risk factors.

Table 7

Regression Results of 3FF Model.

Dep. Variable	Intercept	MKT	SMB	HML	Adj.R^2
P	-0.0133***	0.9326***	0.6478***	0.0647	0.9132
S	-0.0134***	0.9233***	1.1404***	0.0991	0.9260
B	-0.0131***	0.9416***	0.1552*	0.0304	0.8966
SH	-0.0116***	0.8717***	1.2137***	0.6225***	0.9248
SL	-0.0148***	*0.9903***	*1.0672***	-0.5685***	0.9007
BH	-0.0148***	0.9903***	0.0672	0.4315***	0.8662
BL	-0.0116***	0.8717***	0.2137**	-0.3774***	0.8312
SHR	-0.0115**	0.8122***	1.0533***	0.5036**	0.7859
SHW	-0.0116**	0.9313***	1.3740***	0.7414***	0.8214
SLR	-0.0102**	0.9348***	0.9127***	-0.3171*	0.8085
SLW	-0.0194***	1.0458***	1.2217***	-0.8234***	0.8049
BHR	-0.0109***	0.9168***	0.0013	0.2005	0.7679
BHW	-0.0186***	1.0638***	0.1331	0.6624***	0.7981
BLR	-0.0087**	0.7437***	0.1714	-0.4526***	0.6539
BLW	-0.0145***	0.9998***	0.2559*	-0.3023*	0.7131
SHRC	-0.0016	0.7932***	1.1059***	0.7119**	0.6133
SHRA	-0.0215***	0.8312***	1.0007***	0.2953	0.6885
SHWC	-0.0146*	0.8696***	1.4576***	0.5779*	0.6945
SHWA	-0.0087	0.9931***	1.2904***	0.9049***	0.6605
SLRC	-0.0115*	0.9531***	1.0173***	-0.3477	0.6287

SLRA	-0.0088	0.9166***	0.8082***	-0.2865	0.6549
SLWC	-0.0172*	0.9550***	1.5487***	-1.3695***	0.6465
SLWA	-0.0217***	1.1366***	0.8946***	-0.2705	0.6191
SHRCH	-0.0093	0.7805***	1.03220***	0.9709**	0.5108
SHRCL	0.0062	0.8058***	1.1797***	0.4528	0.3981
SHRAH	-0.0276***	0.6365***	0.9292***	0.3816	0.4278
SHRAL	-0.0155*	1.0258***	1.0723***	0.2091	0.6238
SHWCH	-0.0200*	0.9398***	1.3083***	0.7147*	0.5102
SHWCL	-0.0092	0.7994***	1.6068***	0.4411	0.4863
SHWAH	-0.0042	0.8764***	1.5621***	0.4039	0.6271
SHWAL	-0.0130	1.1097***	1.0187***	1.4059***	0.4844
SLRCH	-0.0109	0.7388***	1.0187***	-0.3409	0.3849
SLRCL	-0.0121	1.1675***	1.0158***	-0.3544	0.5413
SLRAH	-0.0147	0.9964***	0.8432***	-0.4081	0.4721
SLRAL	-0.0028	0.8367***	0.7733**	-0.1648	0.3923
SLWCH	-0.0188*	0.8841***	1.4109***	-1.2607***	0.4854
SLWCL	-0.0155	1.0259***	1.6866***	-1.4783***	0.4767
SLWAH	-0.0212*	1.1525***	1.1127***	-0.8340**	0.5304
SLWAL	-0.0223*	1.1207***	0.6766*	0.2930	0.4053
BHRC	-0.0106*	0.8471***	0.1273	0.4378*	0.6199
BHRA	-0.0113**	0.9865***	-0.1246	-0.0367	0.6642
BHWC	-0.0225***	1.1257***	0.2072	0.7852***	0.7243
BHWA	-0.0147***	1.0020***	0.0591	0.5396**	0.7213
BLRC	-0.0131*	0.7328***	0.1937	-0.3136	0.4348
BLRA	-0.0044	0.7545***	0.1491	-0.5916**	0.4708
BLWC	-0.0159***	0.9623***	0.1124	-0.2192	0.6066
BLWA	-0.0130*	1.0373***	0.3994*	-0.3855	0.5986
BHRCH	-0.0104	0.9686***	0.0895	0.5925*	0.4712
BHRCL	-0.0108*	0.7255***	0.1650	0.2831	0.4853
BHRAH	-0.0115*	0.8045***	-0.0634	-0.1461	0.4149
BHRAL	-0.0110	1.1685***	-0.1859	0.0726	0.5405
BHWCH	-0.0203***	1.1680***	0.1586	0.6420***	0.6579
BHWCL	-0.0248**	1.0833***	0.2558	0.9284**	0.4895
BHWAH	-0.0068	0.7843***	0.1256	0.8485**	0.4196
BHWAL	-0.0227***	1.2198***	-0.0075	0.2307	0.5768
BLRCH	-0.0087	0.5911***	0.0069	-0.6702**	0.2505
BLRCL	-0.0174*	0.8747***	0.3805	0.0431	0.3685
BLRAH	0.0059	0.6688***	0.1784	-0.6886*	0.2181
BLRAL	-0.0146***	0.8403***	0.1198	-0.4946*	0.4483
BLWCH	-0.0203***	0.7399***	0.3076	-0.1823	0.3569
BLWCL	-0.0117	1.1846***	-0.0828	-0.2560	0.4878
BLWAH	-0.0182*	0.9117***	0.4221*	-0.5872*	0.4039
BLWAL	-0.0078	1.1628***	0.3768	-0.1837	0.5244

**Note: Table reports Fama–French three-factor regressions. MKT, SMB, and HML represent market, size, and value return spreads. Modified R^2 values appear on the right. Significance: ***p≤0.01,* *p<0.05, p≤0.1.

4.4 | Fama and French 5-factor model

4.4.1. Correlation matrix

The correlation matrix indicates that MKT has a weak positive relation with SMB (0.2927) and HML (0.2936) and a slight negative correlation with RMW (-0.3830), which shows that the profitability of the firm

decreases in a strong market period. MKT and CMA have a relatively modest relation (-0.0554), indicating that investing methods are mainly independent of overall market performance. SMB and CMA have a weak positive correlation (0.1998), indicating that small-cap stocks are connected with enterprises that use conservative investing techniques, though the relationship is not very significant. HML and RMW show a weak negative correlation (-0.1897), implying that high book-to-market (value) stocks have lower profitability, which supports the notion that growth stocks are frequently more profitable. Interestingly, HML and CMA have nearly no correlation (0.0056), implying that value and investment considerations function independently of one another. The correlation between RMW and CMA is weakly positive (0.0645), indicating that enterprises with better profitability have a minor tendency to choose conservative investment strategies. Generally, the results confirm that the 5-factor model represents different directions of asset pricing consistent with the findings of Fama and French (2015).

Table 8

Correlation Matrix of Fama-French Five Factor Model

	MKT	SMB	HML	RMW	CMA
MKT	1				
SMB	0.2927	1			
HML	0.2936	0.1275	1		
RMW	-0.3830	-0.3282	-0.1897	1	
CMA	-0.0554	0.1998	0.0056	0.064545	1

**Note*: *Table reports correlations among the Fama–French five factors: MKT (market premium), SMB (size), HML (value), RMW (profitability), and CMA (investment).*

4.4.2. Regression Result

The findings show that across all portfolios, MKT is the most constant and substantial factor of excessive return. SMB and RMW factors demonstrate the substantial significance in some portfolios, confirming their relevance in capturing systematic variations in returns. While HML and CMA produce inconsistent results, indicating that their impact is market or portfolio-specific. The negative sign of the intercept supports EMH, suggesting that abnormal return is absorbed by these risk factors. The efficiency of the model is confirmed by high adjusted R^2 values, and results are consistent with those of the Fama and French (2015) model, indicating that five five-factor model is better than the three-factor model, though some factors may be conditionally redundant.

Table 9

Regression Results of 5FF Model.

Dep. Variable	Intercept	MKT	SMB	HML	RMW	CMA	Adj. R^2
P	-0.0121***	0.9004***	0.6051***	0.0472	-0.2024*	-0.0007	0.9187
S	-0.0123***	0.8926***	1.0969***	0.0818	-0.1976*	0.0104	0.9295
B	-0.0119***	0.9082***	0.1133	0.0125	- 0.2071**	-0.0117	0.9044
SH	-0.0106***	0.8450***	1.1796***	0.6082***	-0.1667*	-0.0071	0.9264
SL	-0.0132***	0.9466***	1.0106***	-0.5922***	- 0.2737**	-0.0081	0.9087
BH	-0.0132***	0.9465***	0.0106	0.4078***	- 0.2737**	-0.0081	0.8770
BL	-0.0106***	0.8450***	0.1795*	-0.3918***	-0.1667*	-0.0071	0.8348
SHR	-0.0144***	0.8820***	1.1825***	0.5481***	0.4924***	-0.1548	0.8119
SHW	-0.0068	0.8079***	1.1766***	0.6681***	-0.8257***	0.1406	0.8755
SLR	-0.0113***	0.9726***	0.9454***	-0.2995*	0.2134	0.0772	0.8118
SLW	-0.0151***	0.9204***	1.0759***	-0.8849***	-0.7607***	-0.0933	0.8629
BHR	-0.0107***	0.9188***	-0.0199	0.1975	-0.0213	0.1035	0.7643
BHW	-0.0156***	0.9743***	0.0412	0.6182***	-0.5262***	-0.1196	0.8334
BLR	-0.0112***	0.8096***	0.2724**	- 0.4142**	0.4347***	-0.0562	0.7012
BLW	-0.0101**	0.8804***	0.0867	- 0.3695**	-0.7680***	0.0419	0.8061
SHRC	-0.0053	0.8972***	1.2399***	0.7681***	0.6501**	0.0217	0.6436
SHRA	-0.0236***	0.8668***	1.1251***	0.3283	0.3349*	-0.3313	0.7014
SHWC	-0.0101*	0.8169***	1.1187***	0.5022*	-0.7163***	1.1591***	0.7871
SHWA	-0.0037	0.7990***	1.2345***	0.8341***	-0.9353***	-0.8779***	0.7541
SLRC	-0.0113*	0.9924***	0.9015***	-0.3555	0.0076	0.7261**	0.6574
SLRA	-0.0114*	0.9529***	0.9893***	-0.2434	0.4191*	-0.5718**	0.6932
SLWC	-0.0104	0.8009***	1.2190***	-1.4756***	-1.1512***	0.5356*	0.7432
SLWA	-0.0198***	1.0399***	0.9328***	-0.2943	-0.3716	- 0.7223**	0.6560
SHRCH	-0.0104	0.8001***	1.0924***	0.9876**	0.1721	-0.1469	0.5028
SHRCL	-0.0002	0.9944***	1.3874***	0.5485	1.1279***	0.1903	0.4675
SHRAH	-0.0294***	0.6749***	1.0208***	0.4096	0.3001	-0.1740	0.4257
SHRAL	-0.0178**	1.0587***	1.2295***	0.2469	0.3697	-0.4886	0.6370
SHWCH	-0.0156	0.8772***	1.0029***	0.6417*	-0.7124*	0.9570**	0.5564
SHWCL	-0.0046	0.7567***	1.2345***	0.3627	-0.7202*	1.3612***	0.5650
SHWAH	-0.0021	0.7550***	1.6208***	0.3760	-0.4512	-0.9535***	0.6805
SHWAL	-0.0052	0.8431***	0.8483**	1.2922***	-1.4193***	-0.8022	0.5843
SLRCH	-0.0127	0.8301***	0.9819***	-0.3186	0.3501	0.6858*	0.4147
SLRCL	-0.0099	1.1546***	0.8211**	-0.3925	-0.3349	0.7665*	0.5623
SLRAH	-0.0181*	1.0594***	1.0358***	-0.3546	0.5527*	-0.4688	0.4944
SLRAL	-0.0046	0.8466***	0.9427***	-0.1322	0.2855	-0.6748*	0.4115
SLWCH	-0.0117	0.7309***	1.0471***	-1.3724***	-1.1949***	0.6872*	0.5815
SLWCL	-0.0091	0.8711***	1.3908***	-1.5787***	- 1.1050**	0.3841	0.5244
SLWAH	-0.0189*	1.0750***	1.0837***	-0.8634**	-0.3829	-0.3215	0.5357
SLWAL	-0.0207	1.0049***	0.7820**	0.2749	-0.3602	-1.1230**	0.4532
BHRC	-0.0121**	0.9100***	0.1311	0.4583**	0.2830	0.3464	0.6421
BHRA	-0.0095*	0.9277***	-0.1709	-0.0634	-0.3255*	-0.1395	0.6796
BHWC	-0.0192***	1.0342***	0.0838	0.7349	-0.5794***	0.0057	0.7528
BHWA	-0.0122**	0.9143***	-0.0013	0.5014**	-0.4729***	-0.2449	0.7565
BLRC	-0.0155***	0.8462***	0.1778	-0.2807	0.4770**	0.7226***	0.5514
BLRA	-0.0069	0.7729***	0.3670*	- 0.5477**	0.3924*	-0.8348***	0.5795

BLWC	-0.0116**	0.8683***	-0.1109	-0.2878	-0.7334***	0.4220*	0.6975
BLWA	-0.0086	0.8925***	0.2843	-0.4512*	-0.8026***	-0.3381	0.6869
BHRCH	-0.0119	1.0534***	0.0457	0.6115*	0.3109	0.6778*	0.5038
BHRCL	-0.0122*	0.7667***	0.2165	0.3051	0.2550	0.0151	0.4863
BHRAH	-0.0095	0.7297***	-0.0987	-0.1758	-0.3801*	-0.2786	0.4400
BHRAL	-0.0095	1.1256***	-0.2431	0.0491	-0.2709	-0.0005	0.5378
BHWCH	-0.0177**	1.0902***	0.08207	0.6042**	-0.4522*	-0.1183	0.6715
BHWCL	-0.0207*	0.9783***	0.0854	0.8656**	-0.7066*	0.1296	0.5129
BHWAH	-0.0054	0.7260***	0.1165	0.82869**	-0.2698	-0.2966	0.4226
BHWAL	-0.0189**	1.1026***	-0.1192	0.1743	-0.6760* *	-0.1932	0.6141
BLRCH	-0.0106	0.6665***	0.0264	-0.6431**	0.3602	0.3511	0.2808
BLRCL	-0.0204**	1.0260***	0.3292	0.0817	0.5939*	1.0940***	0.4842
BLRAH	0.0016	0.7204***	0.4969*	-0.6167*	0.6824**	-1.0776***	0.3435
BLRAL	-0.0154**	0.8255***	0.2371	-0.4788*	0.1024	-0.5921*	0.4758
BLWCH	-0.0164**	0.6524***	0.1184	-0.2429	-0.6563**	0.3120	0.4106
BLWCL	-0.0069	1.0842***	-0.3402	-0.3326	-0.8105***	0.5321	0.5496
BLWAH	-0.0142*	0.7729***	0.3329	-0.6465*	- 0.7395* *	-0.4160	0.4702
BLWAL	-0.0029	1.0122***	0.2358	-0.2558	-0.8658***	-0.2601	0.5877

**Note: Table reports regression results for the Fama–French five-factor model. Monthly excess returns are regressed on MKT, SMB, HML, RMW, and CMA. Modified R^2 values appear on the right. Significance levels: ***$p \leq 0.01$, *$p<0.05$, $p \leq 0.1$.*

4.5 | HML: Fama and French 5-Factor Model Redundancy

This research validates Fama and French (2015) five-factor model but refutes their assertion that the value component (HML) is superfluous. Time-series regressions demonstrate that HML's effects are not entirely captured by profitability (RMW) or investment (CMA), and it still plays an important role in explaining stock returns. Despite HML's lower explanatory power in this dataset, it improves the model's performance, especially in the setting of the Pakistani stock market.

Table 10

Testing Value Factor Redundancy: Four-Factor Regressions Explaining the Fifth Factor.

	Intercept	MKT	SMB	HML	RMW	CMA	Adj. R^2
MKT	-0.0067 (-1.2118)		0.3198 (1.8944)	0.4729* (2.3165)	-0.5071** (-2.7521)	-0.1884 (-0.8108)	0.195
SMB	0.0077* (2.3259)	0.1186 (1.8944)		0.0230 (0.1798)	-0.2899* (-2.5680)	0.3319* (2.4102)	0.157
HML	0.0052 (1.8972)	0.1177* (2.3165)	0.0154 (0.1798)		-0.0737 (-0.7725)	0.0241 (0.2073)	0.054
RMW	0.0058 (1.9206)	-0.1513** (-2.7520)	-0.2330* (-2.5680)	-0.0883 (-0.7724)		0.1332 (1.0531)	0.177
CMA	-0.0009 (-0.3518)	-0.0381 (-0.8108)	0.1808* (2.4102)	0.0196 (0.2073)	0.0903 (0.2073)		0.024

**Note: able reports time-series regressions (June 2015–July 2023) of each factor on the remaining four. MKT is the market excess return; SMB is the size premium; HML is the value premium; RMW is the profitability premium; CMA is the investment premium. Portfolios follow a 2×2×2×2 design. T-statistics are in brackets*

4.6 | Fama-French Six Factor Model Based on ESG Performance.

4.6.1. Correlation matrix

The correlation matrix investigates the links between six main risk factors: MKT, SMB, HML, RMW, CMA, and HML_{ESG}. The data show that MKT has a weak positive correlation with SMB (0.2927) and HML (0.2936), implying that small-cap and value companies are sensitive to general market fluctuations, while the association is not significant. However, MKT has a moderate negative correlation with RMW (-0.3830) and HML_{ESG} (-0.3713), implying that enterprises with good profitability and high ESG performance behave differently than broader market trends. The connection between MKT and CMA is relatively modest (-0.0554), indicating that investing methods are mainly independent of overall market performance. The SMB factor exhibits a poor connection with HML (0.1275), implying that the size and value effects are largely independent. A moderate negative suggestion among SMB and RMW (-0.3282) indicates that smaller businesses are often less profitable. Furthermore, SMB and CMA have a weak positive correlation (0.1998), indicating that small-cap stocks are slightly related to enterprises that use conservative investing techniques, while the relationship is not very strong. Similarly, HML and RMW show a weak negative correlation (-0.1897), implying that high B/M stocks have lower profit, which supports the notion that growth stocks are frequently more profitable. Interestingly, HML and CMA show a near-zero correlation (0.0056), demonstrating that value and investment aspects function separately. RMW and CMA exhibit a very modest positive association (0.0645), implying that organizations with higher profitability are just slightly more likely to pursue conservative investment strategies. The ESG Premium (HML_{ESG}) has a small positive connection with HML (0.2225) and RMW (0.2595), implying that companies with strong ESG performance may have somewhat better book-to-market ratios and profits. However, $HML_{ESG's}$ association with SMB (-0.0848) is relatively modest, indicating that environmental performance is not much related to business size. Furthermore, HMLESG and CMA exhibit an almost zero correlation (0.0097), indicating that ESG performance and investment methods are independent. Overall, the correlation matrix shows that, while MKT, SMB, and HML have some degree of correlation, RMW, CMA, and HMLESG have relatively lower correlations with the other factors, implying that profitability, investment, and ESG performance each contribute unique dimensions to explaining stock returns. The moderate negative correlation between MKT and HML_{ESG} (-0.3713) indicates that enterprises with strong ESG performance behave differently from the overall market. The limited correlations between HML_{ESG} and other variables demonstrate that ESG performance reflects a unique component of asset pricing, emphasising its importance as an independent factor in the six-factor model.

Table 11

Correlation Matrix of ESG-Based Six-Factor Model.

	MKT	SMB	HML	RMW	CMA	HML_{ESG}
MKT	1					
SMB	0.2927	1				
HML	0.2936	0.1275	1			
RMW	-0.3829	-0.3282	-0.1897	1		
CMA	-0.0554	0.1998	0.0056	0.0645	1	
HML_{ESG}	-0.3713	-0.0848	0.2225	0.2595	0.0097	1

***Note**: Note: Table reports correlations among six factors: MKT (market), SMB (size), HML (value), RMW (profitability), CMA (investment), and HMLESG (ESG premium)*

4.6.2. Regression Result

After taking into consideration the six factors, the majority of portfolios show statistically significant negative intercept (α) values, which means that there are no recurring abnormal returns. This lends credence to the Efficient Market Hypothesis (EMH), which states that systemic risk factors, not mispricing, are the most likely explanations for any excess returns. MKT coefficients are positive and highly significant ($p < 0.01$) across all portfolios, indicating that market volatility is still the primary driver of excess returns. The SMB coefficients differ between portfolios, with some demonstrating considerable SMB sensitivity (e.g., SHR = 1.1731*, SHW = 1.1732*, SLW 1.0718*), implying that these portfolios favour small-cap stocks, which tend to yield larger excess returns. However, a few portfolios have lower or insignificant SMB coefficients, demonstrating that size effects do not apply consistently across all portfolios. The HML coefficients show conflicting results, with certain portfolios having positive and considerable HML values (e.g., BH = 0.4205*, SH = 0.6201*), indicating a preference for value stocks. However, several portfolios have negative and large HML values (SLW = -0.8773*, SL = -0.5795*), showing a preference for growth stocks. These mixed results imply that the value factor's influence varies by portfolio and does not always contribute to excess returns. RMW coefficients exhibit a variety of consequences. RMW is positive and significant in various portfolios (e.g., SHR= 0.4728*, SHRC = 0.6500*), indicating that stocks with good profitability create higher excess returns. However, in some portfolios, RMW is negative (e.g., SLW = -0.7693*, BLW = -0.7853*), demonstrating that weak profitability companies can outperform high profitability stocks. The data shows that applying the profitability factor remains inconsistent across different economic situations or market problems. CMA coefficients show significant dual behavior because they demonstrate how careful versus risky investment methods influence stock performance. Portfolio data reveal that enterprises employing a conservative investment approach achieve higher excess returns because of positive and significant CMA coefficients in BLRC = 0.7226* and BLRCL = 1.0940*. Research findings show that aggressive investing companies generate superior returns when compared against their conservative counterparts (SHWA = -0.8763* and SLWA = -0.7088*)**. The market forces applied to this investment factor have reduced its overall applicability. Asset prices within specific investment portfolios are heavily influenced by the environmental performance of companies based on the HML_{ESG} coefficients. Better ESG performance of companies corresponds to higher excess returns according to the positive and statistically significant HML_{ESG}

values found in SHWC = 1.1640* and SHRAH = 0.7221*. The HML_{ESG} demonstrates negative substantial values (e.g., SLWCL -1.0554*, BLRAH = -1.0521*) within certain portfolios since businesses with inferior environmental performance can still produce positive returns periodically. The mixed results show that ESG performance does not have a uniform influence across portfolios, but rather serves as an additional explanatory element in stock returns.

The Six-Factor Model efficiently explains a significant percentage of the diversity in portfolio returns, as evidenced by the very high Adjusted R^2 values across portfolios (most above 0.80). HML_{ESG} boosts explanatory power in some portfolios (e.g., SHWC = 0.7851, SHWCH =0.6090), but has a modest influence in others. The regression results support the Six-Factor Model's ability to explain excess returns, with MKT maintaining the greatest predictor across all portfolios. The SMB and RMW components are prominent in many portfolios, demonstrating that size and profitability effects are important in asset pricing. However, the HML and CMA variables produce conflicting results, implying that value and investment effects do not consistently explain excess returns across all portfolios. The introduction of the ESG Performance Premium (HML_{ESG}) brings a new dimension to asset pricing, with major positive or negative consequences depending on the portfolio. The overall performance of the model demonstrates success through its high values of adjusted R^2.

Table 12

Regression Results of ESG-Based Six-Factor Model.

Dep. Variable	Intercept	MKT	SMB	HML	RMW	CMA	HML_{ESG}	Adj. R^2
P	-0.0119***	0.9216***	0.5960***	0.0643	-0.2215**	0.0080	0.1512	0.9208
S	-0.0120***	0.9190***	1.0855***	0.1031	-0.2215**	0.0212	0.1886*	0.9323
B	-0.0118***	0.9242***	0.1064	0.0254	-0.2215**	-0.0052	0.1138	0.9055
SH	-0.0105***	0.8598**	1.1732**	0.6201**	-0.1800*	-0.0010	0.1058	0.9266
SL	-0.0131***	0.9623***	1.0038***	-0.5795***	-0.2879**	-0.0016	0.1127	0.9091
BH	-0.0131***	0.9623***	0.0038	0.4205***	-0.2879**	-0.0016	0.1127	0.8775
BL	-0.0105***	0.8598***	0.1732*	-0.3799***	-0.1800*	-0.0010	0.1058	0.8352
SHR	-0.0142***	0.9037***	1.1731***	0.5656***	0.4728***	-0.1459	0.1552	0.8121
SHW	-0.0068	0.8159***	1.1732***	0.6745***	- 0.8329***	0.1439	0.0564	0.8744
SLR	-0.0111**	0.9947***	0.9359***	-0.2817*	0.1934	0.0862	0.1578	0.8124
SLW	-0.0150***	0.9299***	1.0718***	-0.8773***	-0.7693***	-0.0894	0.0675	0.8617
BHR	-0.0107**	0.9256***	-0.0229	0.2029	-0.0274	0.1062	0.0484	0.7621
BHW	-0.0154***	0.9990***	0.0305	0.6381***	- 0.5485***	-0.1095	0.1769	0.8347
BLR	-0.0111***	0.8202**	0.2679**	-0.4057***	0.4252***	-0.0518	0.0755	0.6991
BLW	-0.0099**	0.8994***	0.07847	- 0.3541**	- 0.7852***	-0.7852***	0.0498	0.1360
SHRC	-0.0054	0.8799***	1.2474***	0.7541**	0.6656**	0.0146	-0.1234	0.6406
SHRA	-0.0229***	0.9275***	1.0989***	0.3772*	0.2800	-0.3064	0.4337*	0.7148
SHWC	-0.0099	0.8289***	1.1135***	0.5118**	- 0.7271***	1.1640***	0.0855	0.7851
SHWA	-0.0036	0.8029***	1.2329***	0.8372***	-0.9387***	-0.8763***	0.0273	0.7514
SLRC	-0.0112	0.9996***	0.8984***	-0.3497	0.0010	0.7291**	0.0520	0.6538
SLRA	-0.0109*	0.9898***	0.9733***	-0.2137	0.3857*	-0.5567**	0.2636	0.6966
SLWC	-0.0106	0.7871***	1.2250***	-1.4868***	-1.1374***	0.5298*	-0.0996	0.7409
SLWA	-0.0195**	1.0728***	0.9186***	-0.2678	-0.4013	-0.7088**	0.2347	0.6557

SHRCH	-0.0094	0.8901***	1.0534***	1.0603***	0.0906	-0.1099	0.6440	0.5204
SHRCL	-0.0015	0.8698***	1.4413***	0.4479	1.2406***	0.1391	-0.8909*	0.4984
SHRAH	-0.0283***	0.7758***	0.9771***	0.4911	0.2088	-0.1325	0.7221*	0.4605
SHRAL	-0.0175*	1.0791***	1.2207***	0.2633	0.3513	-0.4802	0.1454	0.6342
SHWCH	-0.0139	1.0398***	0.9326***	0.7730*	-0.8596**	1.0239**	1.1636***	0.6090
SHWCL	-0.0061	0.6179***	1.2945***	0.2507	-0.5946*	1.3042***	-0.9926**	0.6018
SHWAH	-0.0011	0.8495***	1.5799***	0.4522	-0.5368*	-0.9147**	0.6758**	0.7005
SHWAL	-0.0061	0.7562***	0.8858**	1.2221**	-1.3407***	-0.8379*	-0.6212	0.5918
SLRCH	-0.0119	0.9080***	0.9482***	-0.2558	0.2797	0.7178*	0.5571	0.4291
SLRCL	-0.0106	1.0912***	0.8485***	-0.4436	-0.2776	0.7404*	-0.4531	0.5677
SLRAH	-0.0172*	1.1455***	0.9986***	-0.2851	0.4748	-0.4334	0.6161*	0.5124
SLRAL	-0.0048	0.8342***	0.9481***	-0.1422	0.2967	-0.6799*	-0.0889	0.4054
SLWCH	-0.0105	0.8506***	0.9953***	-1.2759***	- 1.3033***	0.7364*	0.8561**	0.6138
SLWCL	-0.0107	0.7235***	1.4546***	-1.6978***	-0.9715**	0.3234	- 1.0554**	0.5588
SLWAH	-0.0189*	1.0792***	1.0819***	- 0.8601**	-0.3868	-0.3198	0.0298	0.5305
SLWAL	-0.0200*	1.0663***	0.7554*	0.3245	-0.4158	-1.0977**	0.4396	0.4554
BHRC	-0.0117*	0.9440	0.1164	0.4857**	0.2523	0.3604	0.2426	0.6457
BHRA	-0.0097*	0.9073***	-0.1621	-0.0798	-0.3071*	-0.1479	-0.1458	0.6788
BHWC	-0.0188***	1.0682***	0.0691	0.7623***	-0.6102***	0.0197	0.2431	0.7546
BHWA	- 0.0120**	0.9298***	-0.0080	0.5139**	- 0.4869***	-0.2386	0.1107	0.7551
BLRC	-0.0153**	0.8671**	0.1688	-0.2639	0.4582**	0.7311***	0.1491	0.5497
BLRA	-0.0069	0.7732***	0.3669**	- 0.5475**	0.3922**	-0.8348***	0.0020	0.5748
BLWC	-0.0112**	0.9136***	-0.1306	-0.2511	-0.7745***	0.4407*	0.3245*	0.7072
BLWA	-0.0086	0.8852***	0.2875	-0.4571*	-0.7960***	-0.3411	-0.0525	0.6837
BHRCH	-0.0109	1.1440***	0.0065	0.6846**	0.2289	0.7151*	0.6479*	0.5295
BHRCL	-0.0125*	0.7440***	0.2263	0.2867	0.2756	0.0057	-0.1626	0.4843
BHRAH	-0.0089	0.7870***	-0.1235	-0.1296	-0.4320*	-0.2551	0.4095	0.4559
BHRAL	-0.0105	1.0276***	-0.2007	-0.0300	-0.1822	-0.0408	-0.7011**	BHRAL
BHWCH	-0.0168**	1.1732***	0.0462	0.6711**	-0.5272**	-0.0842	0.5932*	0.6927
BHWCL	-0.0208*	0.9633***	0.0919	0.8535**	-0.6931*	0.1235	-0.1070	0.5081
BHWAH	-0.00433	0.8245***	0.0739	0.9081***	-0.3590	-0.2561	0.7048*	0.4564
BHWAL	-0.0196**	1.0351***	-0.0899	0.1198	-0.6149**	-0.2210	-0.4833*	0.6259
BLRCH	-0.0096	0.7409***	-0.0059	-0.5831**	0.2929	0.3817	0.5321*	0.3149
BLRCL	-0.0208**	0.9933***	0.3434	0.0553	0.6235*	1.0806***	-0.2339	0.4823
BLRAH	0.0023	0.7824***	0.4701*	- 0.5666*	0.6263*	-1.0521***	0.4438	0.3550
BLRAL	-0.0161**	0.7640***	0.2638	-0.5284*	0.15802	-0.6174**	-0.4399*	0.4943
BLWCH	-0.0154*	0.7438***	0.0788	-0.1692	- 0.7390***	0.3496	0.6536**	0.4512
BLWCL	-0.0069	1.0835***	-0.3399	-0.3331	-0.8099***	0.5318	-0.0046	0.5445
BLWAH	-0.0134*	0.8425***	0.3028	- 0.5903*	-0.8026***	-0.3874	0.4979	0.4848
BLWAL	-0.0038	0.9279***	0.2722	-0.3239	- 0.7895***	-0.2948	-0.6029*	0.6071

***Note**: Table reports monthly excess-return regressions using the six-factor ESG model (MKT, SMB, HML, RMW, CMA, HMLESG). Factors are constructed from size–B/M–P–Inv–ESG–sorted portfolios. Modified R^2 values are shown on the right. Significance levels: ***p≤0.01,* *p≤0.05, p≤0.1.

4.6.3. Comparison of adjusted R^2 values for CAPM, 3FF, 5FF & 6FF regression

The study indicates that the inclusion of ESG as a sixth component improves the explanatory capacity of asset pricing in Pakistan; however, the findings exhibit subtle differences among portfolios that warrant further examination. The steady rise in adjusted R^2 from CAPM to the three-, five-, and six-factor models underscores the additional value of incorporating size, value, profitability, investment, and ESG factors; nonetheless, the limited enhancements in specific portfolios (e.g., P and S) indicate that the influence of ESG is contingent

upon context and portfolio characteristics. The varied sensitivity shown in specific portfolios, including SHW, SLW, BHWC, and BLWC, indicates that superior ESG performance does not consistently result in elevated returns, demonstrating diverse investor preferences, sectoral disparities, and possible constraints in ESG scoring methodologies. Moreover, the sporadic lower adjusted R^2 in certain five-factor portfolios suggests that conventional factors such as RMW and CMA may not reliably encapsulate risk-return dynamics in emerging markets. The analysis highlights that although the six-factor model provides enhanced explanatory power, it is not universally definitive, and ESG should be viewed as a supplementary rather than an independent driver of returns, underscoring the necessity for a nuanced approach in investment decision-making.

Table 13

Comparison of Adjusted R2 value of CAPM, 3FF,5FF,6FF.

Dep. Variable	CAPM Adj.R^2	3FF Adj. R^2	5FF Adj. R^2	6FF Adj. R^2
P	0.8130	0.9132	0.9187	0.9209
S	0.6947	0.9210	0.9295	0.9323
B	0.8911	0.8966	0.9044	0.9056
SH	0.6503	0.9248	0.9264	0.9266
SL	0.6683	0.9007	0.9088	0.9090
BH	0.8402	0.8662	0.8771	0.8775
BL	0.7907	0.8312	0.8349	0.8352
SHR	0.5734	0.7859	0.8119	0.8121
SHW	0.5624	0.8214	0.8756	0.8744
SLR	0.6448	0.8085	0.8118	0.8124
SLW	0.5553	0.8049	0.8629	0.8617
BHR	0.7661	0.7679	0.7643	0.7621
BHW	0.7514	0.7981	0.8335	0.8347
BLR	0.6039	0.6540	0.7012	0.6991
BLW	0.6932	0.7131	0.8061	0.1360
SHRC	0.4292	0.6133	0.6436	0.6406
SHRA	0.5247	0.6885	0.7014	0.7148
SHWC	0.4531	0.6945	0.7871	0.7851
SHWA	0.4728	0.6606	0.7541	0.7514
SLRC	0.4878	0.6287	0.6574	0.6538
SLRA	0.5437	0.6550	0.6932	0.6966
SLWC	0.3201	0.6466	0.7432	0.7409
SLWA	0.5346	0.6191	0.6560	0.6556
SHRCH	0.3532	0.5108	0.5029	0.5204
SHRCL	0.2827	0.3981	0.4675	0.4984
SHRAH	0.3029	0.4278	0.4257	0.4605
SHRAL	0.5031	0.6238	0.6370	0.6342
SHWCH	0.3630	0.5102	0.5564	0.6090
SHWCL	0.2906	0.4863	0.5650	0.6018
SHWAH	0.3987	0.6271	0.6805	0.7005
SHWAL	0.3658	0.4844	0.5843	0.5918
SLRCH	0.2687	0.3850	0.4147	0.4291
SLRCL	0.4542	0.5413	0.5623	0.5676

SLRAH	0.3959	0.4721	0.4944	0.5124
SLRAL	0.3309	0.3923	0.4115	0.4054
SLWCH	0.2441	0.4854	0.5815	0.6137
SLWCL	0.2353	0.4767	0.5244	0.5588
SLWAH	0.4012	0.5304	0.5357	0.5305
SLWAL	0.3777	0.4053	0.4532	0.4554
BHRC	0.5972	0.6199	0.6421	0.6456
BHRA	0.6674	0.6642	0.6796	0.6788
BHWC	0.6721	0.7244	0.7528	0.7546
BHWA	0.6925	0.7213	0.7565	0.7551
BLRC	0.4223	0.4349	0.5514	0.5497
BLRA	0.4183	0.4708	0.5795	0.5748
BLWC	0.6063	0.6066	0.6975	0.7072
BLWA	0.5672	0.5986	0.6870	0.6837
BHRCH	0.4531	0.4712	0.5038	0.5295
BHRCL	0.4765	0.4853	0.4863	0.4843
BHRAH	0.4233	0.4149	0.4400	0.4559
BHRAL	0.5453	0.5405	0.5378	0.5705
BHWCH	0.6300	0.6579	0.6715	0.6927
BHWCL	0.4444	0.4895	0.5130	0.5081
BHWAH	0.3666	0.4197	0.4226	0.4564
BHWAL	0.5819	0.5768	0.6141	0.6259
BLRCH	0.1954	0.2505	0.2808	0.3149
BLRCL	0.3622	0.3686	0.4841	0.4823
BLRAH	0.1826	0.2181	0.3435	0.3550
BLRAL	0.4251	0.4483	0.4758	0.4943
BLWCH	0.3489	0.3569	0.4106	0.4512
BLWCL	0.4928	0.4879	0.5496	0.5446
BLWAH	0.3626	0.4039	0.4702	0.4848
BLWAL	0.5160	0.5244	0.5877	0.6071

***Note**: Table reports adjusted R^2 values for the CAPM, three-factor, five-factor, and six-factor models across portfolios sorted by size, B/M, profitability, investment, and ESG.*

5 | DISCUSSION

This research examines portfolio performance in relation to Size, Value, Profitability, Investment, and ESG premiums, utilizing CAPM, three-factor, five-factor, and a proposed six-factor models. In alignment with previous studies (Fama & French, 1992, 1993, 2015; Maiti, 2021), small-cap portfolios generated superior returns compared to large-cap portfolios, thereby affirming the existence of a size premium. Portfolios with high book-to-market ratios typically outperformed those with low ratios; however, certain portfolios favored growth stocks. This suggests that value effects are context-dependent and shaped by investor preferences and market conditions (Paredes, 2025). Profitability (RMW) and investment (CMA) factors demonstrated inconsistent outcomes: RMW showed positive significance in several portfolios, whereas it was negative in others, and CMA effects differed between conservative and aggressive strategies. This inconsistency indicates that these factors may be influenced by economic cycles, firm-specific strategies, and market conditions, thereby restricting their universal applicability in the Pakistani market (Hou et al., 2020; Qadeer & Ahmad, 2021). ESG premiums exhibited portfolio-specific effects, with high-ESG firms typically outperforming their

low-ESG counterparts, aligning with the findings of Hasnaoui (2025), Albuquerque et al. (2020), and Broadstock et al. (2021). ESG influence varied across portfolios; those with low ESG scores still achieved positive returns, suggesting that ESG's explanatory power depends on sector characteristics, firm behavior, and investor preferences. Potential factors contributing to this variation encompass diverse market demand for sustainability, discrepancies in the quality of ESG disclosures, and the differing sensitivity of portfolios to environmental and governance risks.

5.1 | ESG Impacts Market Portfolios

The variation in ESG impacts across portfolios can be attributed to several interconnected reasons. First, sectoral differences play a critical role, as industries such as energy, manufacturing, and materials are more sensitive to ESG issues (emissions, resource usage, labor practices) compared to sectors like technology or financial services, which may derive less direct impact from ESG metrics. Second, firm size and visibility matter; larger and more visible firms often face greater stakeholder pressure to adopt ESG practices, leading to stronger ESG effects compared to smaller firms with limited disclosure. Third, data quality and reporting standards vary across firms and sectors in emerging markets like Pakistan, where inconsistent ESG disclosures can weaken comparability and create uneven impacts on portfolio returns. Fourth, investor preferences and awareness influence demand for ESG-compliant firms; portfolios dominated by investor segments more inclined toward sustainable investing will show stronger ESG return effects. Fifth, macroeconomic and regulatory factors can alter the strength of ESG impacts across time and industries, as evolving sustainability policies, disclosure requirements, and global market linkages differently affect portfolios. Finally, interaction with traditional risk factors (such as size, value, or profitability) may amplify or dilute the ESG premium depending on portfolio characteristics, making ESG impacts more pronounced in some portfolios than others.

The underperformance of the RMW and CMA factors in specific portfolios highlights the contextual characteristics of profitability and investment effects within emerging markets. The factors that elucidate excess returns in developed markets exhibit diminished explanatory power in Pakistan, attributable to market inefficiencies, firm-level heterogeneity, and macroeconomic volatility. This supports earlier findings that multi-factor models may need enhancement to maintain their effectiveness in emerging contexts (Huang, 2019; Maiti, 2021).

For a theoretical contribution, the research indicates that ESG functions as a priced risk factor in the Pakistani stock market, offering empirical validation for ESG-adjusted asset pricing theories. Incorporating ESG into the Fama-French framework corresponds with the risk and preference mechanisms suggested by Pedersen et al. (2021), emphasizing that ESG factors consistently affect the risk-return trade-off.

The findings indicate that ESG integration improves portfolio optimization for investors and asset managers, offering an extra perspective for evaluating risk-adjusted returns. Regulators and policymakers can utilize these findings to enhance ESG transparency and sustainable investment practices, hence fostering the establishment of a more resilient and sustainable financial sector in Pakistan.

6 | CONCLUSION

Many theories have been put out by academics in the field of finance to study the connection between risk and the predicted return on investments, from MPT to CAPM to the multi-factor model. New models and

improvements to existing ones are created in response to flaws in the models found during empirical study. This drives the ever-changing asset pricing literature, which employs a wide range of theories and models in its pursuit of the optimal risk-reward trade-off. Various asset pricing models have been either supported or criticized in prior research, suggesting that their applicability and implementation vary between developed and developing nations. Therefore, this research examines the relevance of an ESG-based Six-Factor Model in the Pakistani stock market, utilizing stock returns from 2015 to 2023. In accordance with previous studies, market risk (MKT) continues to be the principal determinant of returns, while small-cap stocks (SMB) routinely surpass large-cap shares in performance. In contrast to the original Fama-French five-factor model, the value component (HML) remains significant despite the inclusion of profitability (RMW) and investment (CMA), indicating market dynamics peculiar to Pakistan. The inclusion of ESG performance (HML_{ESG}) significantly improves the model's explanatory power, indicating that sustainability factors are progressively valued in emerging markets.

6.1 | Theoretical and Practical Implications

The findings of this study demonstrate significant theoretical and practical implications. Theoretically, the results extend the asset pricing literature by showing that ESG-based factors significantly improve the explanatory power of traditional models, confirming that the HML premium remains relevant in Pakistan. This highlights that factor significance is market-specific; profitability and investment factors do not fully capture the value effect in emerging economies. The study also reinforces the evolving nature of asset pricing theory, where non-financial indicators such as ESG performance are increasingly integrated into return prediction models.

Practically, the results suggest that investors and portfolio managers can enhance diversification, predictive accuracy, and risk management by incorporating ESG metrics alongside traditional financial indicators. Small-cap and ESG-compliant firms present attractive opportunities, while regulators may use these insights to strengthen ESG reporting standards and improve market efficiency. Moreover, firms listed on PSX can boost their valuations and investor appeal by improving ESG performance, and analysts are encouraged to embed ESG considerations into their valuation models for more reliable forecasts. Together, these implications emphasize the growing role of sustainability in financial decision-making and the need for both market participants and policymakers to adapt accordingly.

6.2 | Limitations and Future Research Directions

Future research should examine model stability over multiple time periods to account for structural market changes. While the analysis concludes that HML is not completely redundant, its impact varies between portfolios, consistent with mixed findings in previous research. Further research might test the model under various market conditions (bullish vs. bearish phases) to see if HML's role changes over time. The addition of ESG premium is a relatively recent concept in asset pricing. Investor knowledge and regulatory policies in Pakistan may not be completely established, resulting in inconsistencies in factor loading across portfolios. Future studies should look into how sustainability policies, ESG disclosures, and global green investment trends affect stock returns over time.

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