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Research Article

Revaluating Sustainability by Integrating ESG into the Fama-French Asset Pricing Model in India

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ABSTRACT

Introduction: This study examines the effects of ESG performance on stock returns in India through incorporation of ESG to the Fama-French five-factor model. It fills the research gap by testing ESG effects in an emerging market environment with econometric models.

Objectives: In order to look at the impact of ESG performance on excess stock returns in the Indian market with the integration of ESG scores in the Fama-French five-factor model and to study the interaction between ESG and size and value factors in shaping the return dynamics.

Methods: Utilizing panel data for 183 Indian companies (2014–2023), the study applies pooled OLS, fixed effects and logit regressions. ESG scores are lagged, integrated with both the traditional Fama-French factors and the interaction terms and quadratic components in order to assess linear and nonlinear pricing effects.

Results: The results from pooled OLS regressions and fixed effects panel regressions show that ESG has a statistically significant positive effect on excess returns. According to the results of a logit regression model, ESG scores create a positive impact on the chances of positive abnormal returns. Research using a two-sample t-test proves that businesses scoring higher on ESG than the median demonstrate superior market performance when compared to firms in the lower-performance category. The value premium receives an enhancement from ESG investments according to interaction models, but the size effect receives a moderation as per these models, and non-linear analysis detects no evidence of reduced ESG returns.

Conclusions: The study enriches existing research by establishing the implementation of ESG effects in a confined econometric framework, which produces fresh expertise on sustainability price effects in emerging markets.

Keywords: ESG Performance, Excess Returns, Five Factor CAPM Model, Market Performance

INTRODUCTION

ESG factors have become increasingly important for financial decision-making, thus reshaping investment analysis and corporate valuation practices during recent times. The Fama-French multifactor framework represents the dominant traditional asset pricing model, which studies cross-sectional stock returns, but the integration of ESG metrics within these models creates both a practical and theoretical requirement (Friede, Busch & Bassen, 2015). Academic researchers disagree about the financial return implications of ESG performance when testing these relationships under rigorous multifactor econometric evaluation.

A study analyses how delayed ESG scoring influences stock market surplus returns when applied to the Fama-French Five-Factor Model. The augmented model integrates ESG performance measurement as another explanatory element, together with SME, HML, RMW, UMD and MRP system variables. The research technique fills a crucial void in prior studies that showed insufficient ESG model integration or uncontrolled firm diversity and time-based factors (Krüger, 2015; Khan, Serafeim & Yoon, 2016).

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The body of work benefits from four major contributions through this research. Among the study's contributions stands the empirical evaluation of ESG performance's relationship with excess stock returns using fixed-effects panel data regression, which resolves problems from unobserved heterogeneity. The study evaluates the probability of positive excess returns through logit regression to determine how high ESG scores influence this outcome. The median-based t-test evaluates the existence of substantial differences in excess return levels between different ESG performance groups. The analysis introduces two interaction terms that reflect advanced conditional relationships between sustainability factors and factor premia in developing sustainable finance research..

OBJECTIVES

The study aims at understanding the ESG scores and excess stock returns, controlling traditional risk factors, with the first hypothesis (H1) testing for the existence of a significant positive relation between the ESG performance and excess returns against the null hypothesis that no such relation exists. Furthermore, the study attempts to determine if any ESG scores interact with other explanatory variables, namely, size (SMB) and value (HML) factors into excess stock returns. The H2 second hypothesis suggests that these interactions have a large impact on returns, unlike the null hypothesis, which has put forward no significant interaction between ESG scores and these factors in explaining excess returns.

METHODS

The analysis makes use of a panel dataset of 183 publicly listed Indian firms from different sectors for the years 2014-2023. Financial and stock market information was sourced from the CMIE Prowess database, and ESG scores were taken from secondary sustainability databases, which were then time-matched for consistency when making predictions on returns. The dependent variable is excess return, which is the difference between stock return and risk-free rate. Independent variables are the Fama-French five factors: SMB (size), HML (value), RMW (profitability), UMD (momentum) and MRP (market risk premium).

In addition, one-year lagged ESG score is an important explanatory variable in this system and two interaction terms (ESG × SMB and ESG × HML), a quadratic term (ESG^2) to measure non-linearity and year dummies to take into account macro-economic or systemic time varying components. The methodological strategy combines various applications of regression techniques, starting with pooled OLS to assess the exodus development rate of the ESG impact, then moving to the fixed effects panel regression confirmed by the Hausman test. A logit regression tests the likelihood of positive excess returns while a two-sample t-test draws comparisons of the mean excess returns for the high- and low-ESG firms. Interaction and non-linear models move further with conditional relationships. All statistical analyses were conducted using Stata 17, with pre-processing in Excel and Python and included diagnostic testing on multicollinearity, heteroskedasticity and model robustness.

Dependent Variables- Excess Return = Monthly Returns of Stock (i,t)- Scaled down monthly Risk-free Rate(t)

Independent Variable- 3 Month Lagged ESG Score

Fama-French Five Factor (Control Variables)

- SMB = Avg. return of all small companies – Avg. return of all big companies
- HML = Avg. return of high B/M companies – Avg. return of low B/M companies
- UMD = Avg. return of winners – Avg. return of losers
- RMW = Avg. return of high OP companies – Avg. return of low OP companies
- MRP = Monthly NIFTY 50 Return- Scaled Down Monthly Risk-Free Rate

Note: Scaled Down Monthly Risk-Free Rate = (1+Annual Risk-free Rate)1/12 – 1

RESULTS

Pooled OLS Regression

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Excess_Return(i,t) = -0.30 + 0.02ESG(i,t-3) + 0.55SMB(i,t) + 0.52HML(i,t) - 0.13RMW(i,t) - 0.09UMD(i,t) - 0.03MRP(i,t)

Fixed Effects Regression

Excess_Return(i,t) = -2.58 + 0.07ESG(i,t-3) + 0.56SMB(i,t) + 0.51HML(i,t) – 0.11RMW(i,t) - 0.09UMD(i,t) – 0.04MRP(i,t).

Logit Regression (Excess Return > 0)

probability (Excess_Return(i, t) > 0) = – 0.12 + 0.00ESG (i,t-3) + 0.07SMB(i,t) + 0.08HML(i. t) – 0.02RMW(i, t) – 0.01UMD(i, t) – 0.00MRP(i, t).

Fixed Effects with Interaction Terms

Excess_Return(i,t) = -3.13+0.08ESG(i,t-3) + 1.45SMB(i,t) + 0.20 HML(i,t)- 0.14RMW(i,t) - 0.10UMD(i,t) - 0.03MRP(i,t)- 0.02 × (ESG × SMB)(i,t) + 0.0077 × (ESG × HML)(i,t).

Fixed Effects with ESG² (Non-linearity)

Excess_Return(i,t) = -3.78+ 0.1389ESG(i,t-3) – 0.0008ESG²(i,t-1)+0.56SMB(i,t) +0.52HML(i,t)-0.11RMW(i,t)-0.10UMD(i,t)-0.04*MRP (i,t)

Fixed Effects with Year Dummies

Excess_Return(i,t) = -2.96 + 0.37ESG(i,t-3) + 0.56SMB(i,t) + 0.51HML(i,t) - 0.11RMW(i,t) - 0.09UMD(i,t) - 0.04MRP(i,t) **5.06Year_2015 + 4.37Year_2016 + 3.23Year_2017 + 1.96Year_2018 + 12.47*Year_2019 + 7.32Year_2020 + 35Year_2021 + 7.86Year_2022 + 5.44Year_2023**

Coefficients for most years (except 2021) are statistically significant at conventional levels ($p < 0.05$ or lower)

Table- p-values of independent variables across pooled and fixed/random effect models

Independent Variable	Pooled OLS	Fixed Effects	Logit Model	Interaction Model	Non-Linear Model
ESG Score	0.0052 **	0.0000 ***	0.03 **	0.0000 ***	0.0019 ***
ESG²	–	–	–	–	0.1349 *
SMB	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
HML	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
RMW	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
UMD	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
MRP	0.0500 **	0.0150 **	0.6100 *	0.0200 **	0.0100 ***
ESG × SMB	–	–	–	0.0000 ***	–
ESG × HML	–	–	–	0.0000 ***	–

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

DISCUSSION

The results validate a statistically significant positive relationship between ESG performance and excess stock returns in the Indian equity market. Higher lagged ESG scores are associated with slight improvement of excess returns as indicated by the pooled OLS regression, with fixed effects regression bolstering this relationship by controlling for firm-specific unobserved heterogeneity. This underlines the robustness of ESG as a financial concern over and above conventional Fama-French indicators.

The logit regression results support this result further, finding that the higher the ESG score a firm had, then the higher the probability that the firm generates positive abnormal returns, further confirming ESG's role in reducing

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downside risk and increasing financial stability. The two-sample t-test further supports this insight, that is, a firm which has delivered above median ESG score has outperformed the lower scoring firm in terms of excess returns.

Crucially, interaction models demonstrate that high ESG firms drive the value premium (HML), meaning that high ESG firms have better long-term value. However negative interaction with size factor (SMB) indicates that there is not much room for ESG benefits among small-cap firms perhaps because of gaps in disclosure, resource constraints and investor scepticism in the case of emerging markets. The non-linear model built on ESG^2 has the potential to identify a diminishing return of such ESG investment, but this potential lack of statistical significance still warrants linear treatment of ESG in the current scenario of India..

Year dummies incorporated into the fixed effects model accommodate time-dependent macroeconomic events and folder-wide effects during the 10-year study duration. The additional inclusion of year dummies in this specification makes the ESG variable statistically insignificant ($t = 0.3765$, $p = 0.7065$) while retaining high significance ($t > 2$) for Fama-French factors SMB, HML, UMD and MRP. The earlier detected positive ESG relationship in performance may be explained by variable systemic elements such as regulatory modifications and ESG reporting standards changes, and capital movement patterns during the analysed period (Krüger, 2015; Broadstock et al., 2021). ESG scores exhibit decreased significance when considering the large model statistical strength (F-stat = 160.29, $R^2 = 0.0995$), thus indicating the necessity for interaction terms and non-linear features to explore ESG's conditional effects or structural relationships in addition to its isolated linear interpretation.

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