

Business Strategy Innovation and Investment Risk Prevention and Control under Sustainable Development

-- Take the Stock Markets as An Example

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Abstract: This research investigates the relationship between innovation strategies and investment risk, with a particular focus on the moderating effect of Environmental, Social, and Governance (ESG) practices. Utilizing data from Chinese listed companies, we employ multiple regression models to assess the impact of R&D investments on systematic risk (Beta) and explore how ESG scores influence this relationship. Our findings indicate that increased R&D investment is associated with higher investment risk, highlighting the inherent uncertainties and potential volatility of innovation activities. However, strong ESG practices mitigate these risks, suggesting that companies with robust ESG frameworks can reduce the additional risk introduced by high levels of innovation. The study also reveals significant interrelationships among key financial metrics, underscoring the complexity of managing innovation and investment risk. These insights provide valuable implications for companies, investors, and policymakers, emphasizing the need for balanced growth strategies that incorporate effective risk management and sustainable practices. This research contributes to the literature by offering empirical evidence on the interplay between innovation, ESG, and investment risk, ultimately advocating for more resilient and sustainable business practices.

Keywords: Innovation strategies, Investment risk, ESG, Moderating effect, Sustainable development.

1. Introduction & Main Contents

1.1. Background

Recently, the concept of Environmental, Social, and Governance (ESG) criteria has emerged as a pivotal framework in the realms of business and investment, signaling a significant shift from traditional financial metrics to a broader perspective of corporate responsibility and sustainability. ESG encapsulates an array of factors that define a corporation's ethical and sustainable footprint in the world, including environmental, social and governance. The volatility of financing for startups focused on innovation is well-known, with the most innovative firms typically having the greatest real options, this high level of financial uncertainty significantly impacts the innovation efforts of these startups. [1]. In this context, many listed companies believe that innovation is driven by organizational structures and management processes [2], and they will spend a relatively large proportion on R&D, this may lead to some investment risk. According to Cooper and Priestley [3], the investment factor can be understood as an economic risk factor tied to the business cycle, for which investors demand a premium to hold. And we'll use R&D ratio within companies and beta based on CAPM as measurements of innovation strategies and investment risk. For the moderating factor, we'll use comprehensive scores of ESG as our measurement as an interaction term in our model. Therefore, we come up with the research question that whether innovation strategies of companies will increase or decrease the investment risk under the moderating effect of ESG.

1.2. Significance of the Research

This research mainly concentrates on the relationship between innovation strategies and investment risk of companies under the moderating effect of ESG. With the background of ESG disclosures of listed companies nowadays, it's essential to find that if the innovation strategies of companies can be beneficial or do harm to investment risk, which can help those listed companies to making good use of innovation strategies to match with their actual situation and current background.

1.3. Research Objectives & Main Issues to be Solved

By analyzing the relation between innovation and investment risk under ESG perspective, we can find the appropriate proportion of innovation within a company that can reduce the investment risk. Also, our research provides practical implications for trilateral parties --- companies, investors and government. First, ESG disclosure practices can be turned into positive firm performance. Second, according to companies' strategies and their ESG disclosure, investors can choose their preferred stocks to invest. Thirdly, government can supervise companies' operation by noticing their ESG level or scores. Hence, it can provide benefits for three parties.

1.4. Novelties of the Proposed Topic

In the research, we use beta based on CAPM to measure the investment risk for companies in CSI 300 to ensure the comprehensive and completion of the research. Besides, we select ESG disclosure as dummy variables to find that the differences in investment risk when ESG score is disclosed

and when it is not.

2. Literature Review and Hypothesis

2.1. Previous Study Summary & Research Gap

According to Sgurev [4], the implementation of any innovation can be viewed as a manageable multistep process aimed at achieving the innovation with minimal financial costs and minimal risk. And innovation involves utilizing newly acquired knowledge to develop a new product or service [5]. Novelty is central to innovation but this inevitably implies risk. Also, under the background of ESG disclosure in recent years, some researchers have demonstrated that ESG is a reliable indicator for describing SDGs. We explain the mechanisms by which ESG moderates financial constraints, offering new evidence to the recent ESG literature. [6] [7]. In my research, I use ESG as a moderating effect to find whether it may influence the process of innovation strategies to investment risk of listed companies to provide constructive suggestions to them, which complements the gaps in the existing research.

2.2. Innovation Strategies and Investment Risk

Until now, the importance of innovation in firm management has been broadly recognized, but some argue that its impact extends beyond company growth, also promoting regional and local development [8]. Innovation policies encompass both the contents of innovation strategies and the processes of innovation management. The seminal work from Rothwell [9] provides a comprehensive overview of key factors commonly identified in numerous studies, pertaining to companies that are technically advanced or linked with successful innovation. Besides, the financing available for startups focused on innovation is notoriously volatile, often described as financial constraints. These investment cycles are not only well-documented in venture capital literature [10], but have also been shown in historical work linking financial market activity to radical innovations in manufacturing, communications and transportation going back to the mid-1700s [11]. Also, according to Bowers and Khorakian [12], innovation entails leveraging fresh knowledge to create a new product or service. Novelty is central to innovation but this inevitably implies risk. Risk is inherent in every project, but it is particularly significant in innovation, where a high rate of failure is typical [13]: 35 percent of innovation projects do not achieve commercial success, representing 45 percent of the costs associated with new product development [14]. Based on the abovementioned analysis, this study puts forward the following hypotheses:

H1: Innovation strategies have a positive effect on investment risk.

2.3. ESG to the Process of Innovation Strategies and Investment Risk

According to Zhang et al. [15], ESG performance data offers a superior assessment of a company's strength through soft information, aiding investors in determining the investment worthiness of the enterprise. Earlier research indicated that ESG disclosure practices can enhance a company's value, thereby playing a crucial role in alleviating the negative impacts of a firm's weaknesses [7]. High ESG ratings can enhance investor outcomes in financial portfolios, as firms with superior ESG performance tend to be ethical without compromising returns, and these companies are more

likely to endure crises sustainably [16]. Further, due to additional environmental protection costs [17], firms with strong financial backing tend to excel in environmental protection, thereby gaining easier access to investment capital and reducing financial constraints. [18]. Additionally, the three ESG dimensions enable stakeholders to evaluate a firm's transparency, potential, and risk levels. [19]. The capability to provide non-financial disclosures inherent in ESG, along with growing investor focus, suggests that favorable ESG information likely eases external financial constraints [20]. According to the abovementioned analysis, this study puts forward the following hypotheses:

H2: ESG has a positive moderating impact on the process of innovation strategies and investment risk.

3. Methodology and Feasibility Analysis

3.1. Data and Sample

We examined the hypothesis within the content of Chinese enterprise and used panel data for analysis. After selecting and downloading the Chinese listed companies from CSMAR and RESSET database, the sample size will be determined later.

3.2. Dependent Variables

Beta, estimated by CAPM, represents the systematic risk of an asset relative to the overall market, measuring the asset's price volatility relative to the market portfolio. Within the CAPM framework, risk is quantified by variance, which equally considers both upward and downward fluctuations in returns. [21]. Also, according to Jagannathan & McGrattan [22], the CAPM was developed, in part, to clarify the variations in risk premiums among assets, which stem from the differing levels of return riskiness across those assets. The model asserts that the correct measure of riskiness is its measure—known as beta—and that the risk premium per unit of riskiness is the same across all assets. Thus, in the research, I use CAPM to estimate the beta of all stocks related to Chinese listed companies as the dependent variables.

3.3. Independent Variables

Innovation strategies, the independent variable, is measured by research and development ratio within companies during their operation process. From the perspective of investment theory, R&D has a number of characteristics that make it different from ordinary investment. First and most importantly, in practice fifty per cent or more of R&D spending is the wages and salaries of highly educated scientists and engineers. Their efforts create an intangible asset, the firm's knowledge base, from which profits in future years will be generated. To the extent that this knowledge is "tacit" rather than codified, it is embedded in the human capital of the firm's employees, and is therefore lost if they leave or are fired [23]. Thus, using R&D ratio within companies can be an appropriate measurement for innovation strategies.

3.4. Moderating Variables

ESG, standing for environmental, social, and governance factors, is measured based on three key areas: environmental protection, social responsibility, and corporate governance. These performance scores are typically objective assessments conducted by third-party rating agencies [24]. In the research, I use dummy variables for ESG. When ESG comprehensive

score of a company is disclosed, $ESG = 1$, and when it does not, $ESG = 0$. And I will use ESG comprehensive scores as the measurement of ESG of listed companies.

3.5. Control Variables

This research selects 4 control variables base on the independent and dependent variables, which includes: (1) Size: the natural logarithm of total assets at the end of the period. The use of enterprise size as a control variable can eliminate the problems caused by the size of the enterprise.

The use of enterprise size as a control variable can eliminate the impact of additional earnings caused by the size of the enterprise. (2) Leverage: The leverage ratio is defined as the ratio of a company's debt to its equity, which can be calculated by dividing the total debt of the company by its shareholder equity. This ratio helps assess the financial health and risk of a company. (3) PE: P/E ratio of company which can measures the performance of company. (4) BM: Book-to-market ratio which can measure the company performance related to market in certain period.

Table 1. Variables

Category	Variable Name	Measurement	Source
Independent Variable	Inno	The amount of investment for enterprise in R&D	CSMAR Database
Dependent Variable	Beta	Beta based on CAPM model	CSMAR Database
Moderating Variable	ESG	Dummy variables for ESG disclosure level; Comprehensive score for ESG disclosure	CSMAR Database
Control Variable	Size		CSMAR Database
Control Variable	Leverage	EBITDA Leverage Ratio = (Net Income + Interest Expense + Tax Expense + Depreciation Expense) / (Net Income + Interest Expense + Tax Expense)	CSMAR Database
Control Variable	P/E Ratio	P/E = (Current Closing Price)/Net profit _{Last year} / Net profit _{This year}	CSMAR Database
Control Variable	Book-to-market ratio	BM = Total Asset / Firm Market Value	CSMAR Database

3.6. Statistical Model

Based on hypothesis 1, we constructed following model to examine the impact of innovation strategies to investment risk:

$$\text{Model 1: } \beta = \alpha_i + \beta_1 \text{Inno} + \beta_2 \text{Size} + \beta_3 \text{LEV} + \beta_4 \text{PE} + \beta_5 \text{BM} + \varepsilon_{it}$$

Based on hypothesis 2, we constructed following models to examine the moderating effect of ESG to the process of innovation strategies:

$$\text{Model 2: } \beta = \alpha_i + \beta_1 \text{Inno} + \beta_2 \text{Size} + \beta_3 \text{LEV} + \beta_4 \text{PE} + \beta_5 \text{BM} + \beta_6 \text{Inno} * \text{ESG} + \varepsilon_{it}$$

3.7. Feasibility Analysis

When it comes to analyze the feasibility of the research, I will discuss it from two perspectives: previous studies and methodology.

According to the literature review above, it's clear that many researchers has already done researches that are strongly correlated to that of mine. For example, Simon [13] has concluded that risk is important for innovation in all projects, and Pedersen [16] has proposed that those ESG-disclosure firms are more likely to grow in a sustainable way.

There are abundant previous papers that can support my topic.

For methodology, all of the data samples are available in some authoritative websites such as CSMAR and RESSET. Besides, the proposed models and hypothesis will be tested firstly using descriptive statistics in order to have an overall understanding of all variables, after that I will use R studio or Python to do the empirical analysis.

Thus, my research is totally feasible that will have relative accurate results with useful details and suggestions.

3.8. Statistical Techniques

The proposed models and hypothesis will be tested firstly using descriptive statistics in order to have an overall understanding of all variables.

3.8.1. Basis Statistical Analysis

This report involves a total over 700 sample data of listed companies with ESG comprehensive scores and beta covering the period from 2012 to 2021. The table below presents the descriptive statistics for the variables Inno (innovation strategies), Beta (investment risk), and ESG (Environmental, Social, and Governance scores).

Table 2. Basic Variables Analysis

Variables Name	Mean	S.D.	Min	Max	Range	Skewness	Kurtosis
IV: Inno	-0.1804	0.1974	-0.2459	1.8116	2.0576	3.5430	19.2116
DV: Beta	1.0895	0.2940	0.1477	2.2711	2.1234	-0.1581	0.6754
MV: ESG	-0.1048	1.0403	-5.3674	2.4771	7.8445	-0.7914	1.3268

According to the table shown above, the range of Inno is 2.0576, indicating a wide spread of data points. The high skewness (3.5430) and kurtosis (19.2116) suggest that the data is heavily skewed to the right with a high peak, which indicates that while most companies have low to moderate R&D investments, there are a few companies with significantly higher R&D investments, impacting the overall distribution. The range of Beta is 2.1234, demonstrating

variability in investment risk among the companies. The skewness is slightly negative (-0.1581), and the kurtosis is close to normal distribution (0.6754), which suggests that the investment risk is fairly normally distributed across companies, with some deviations. The range of ESG is 7.8445, indicating a broad distribution of ESG scores. The negative skewness (-0.7914) and moderate kurtosis (1.3268) indicate that the data is moderately skewed to the left with a relatively

flat distribution, showing that while many companies have moderate ESG scores, there are some with very low scores, affecting the distribution.

3.8.2. Normality of numeric variables

Density Plots Analysis:

Beta (Investment Risk):

The density plot for Beta is relatively symmetrical and centered around its mean value of 1.0895, with a slight left skew. This aligns with the skewness and kurtosis values, indicating a distribution close to normal with minor deviations. The peak of the distribution suggests that most companies have an investment risk around the mean value, with fewer companies having significantly higher or lower risk.

ESG (Environment, Society, Governance Scores):

The density plot for ESG shows a left-skewed distribution, consistent with the negative skewness value. The majority of companies have moderate ESG scores, with some having very low scores, contributing to the long-left tail. The peak and spread of the distribution reflect the broad range of ESG practices and disclosures among companies.

Inno (Innovation Strategies):

The density plot for Inno is highly skewed to the right, with a long tail. This is consistent with the high skewness and kurtosis values. Most companies have low to moderate R&D investments, while a few have significantly higher investments. The sharp peak at the lower end of the distribution indicates that a substantial number of companies have minimal R&D investment, which could impact their innovation strategies and associated risks.

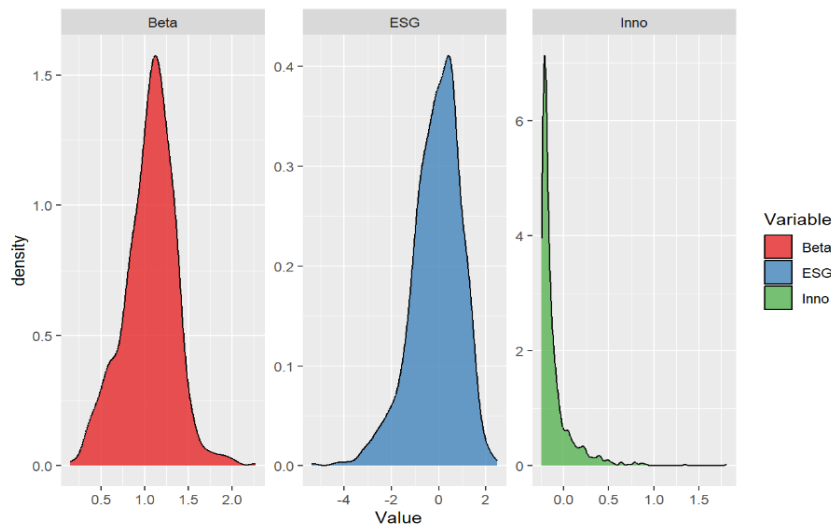


Figure 1. Density Plots

QQ Plots Analysis:

Beta (Investment Risk):

The QQ plot for Beta shows points that mostly follow the 45-degree line, with some deviation at the tail, it's clear that Beta is approximately normally distributed, with minor deviations at the extremes, which supports the earlier observation from the density plot that most companies have investment risks around the mean, with few outliers.

ESG (Environmental, Social, and Governance Scores):

The QQ plot for ESG shows significant deviation from the 45-degree line, especially at the lower end, indicating that the

ESG scores are not normally distributed. The left skewness observed in the density plot is further confirmed here, highlighting that many companies have low ESG scores, affecting the overall distribution.

Inno (Innovation Strategies):

The QQ plot for Inno shows a clear deviation from the 45-degree line, especially at the upper end, confirming that the Inno data is not normally distributed. The high right skewness in the density plot is evident here, indicating that most companies have low to moderate R&D investments, with a few having significantly higher investments.

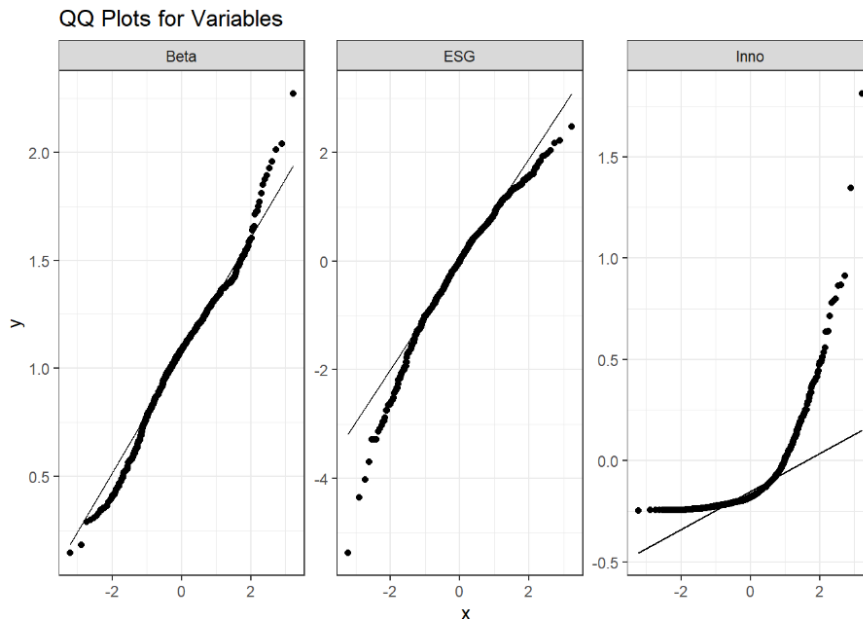


Figure 2. QQ Plots

Correlation Plot Analysis:

Inno and Beta:

The correlation coefficient between Inno and Beta is 0.02, indicating a very weak positive correlation. This suggests that there is almost no linear relationship between innovation strategies and investment risk. However, this does not contradict the regression model results, as the regression analysis considers multiple factors and interactions, while correlation only looks at linear relationships.

Inno and ESG:

The correlation coefficient between Inno and ESG is 0.15, indicating a weak positive correlation, representing that companies with higher R&D investments tend to have slightly higher ESG scores. This relationship might be due to companies that invest in innovation also focusing on sustainable and responsible practices.

Beta and ESG:

The correlation coefficient between Beta and ESG is 0.02, indicating a very weak positive correlation. And there is almost no linear relationship between investment risk and ESG scores. Such a weak correlation might be due to the complex nature of investment risk, which is influenced by various factors beyond ESG scores.

Scatter Plot Analysis

The scatter plots provide additional insights into the relationships between the variables through scatter plots and histograms.

Inno and Beta:

The scatter plot between Inno and Beta reveals a widely dispersed distribution with no discernible pattern, indicating the absence of a strong linear relationship between the two variables. This observation is consistent with the correlation coefficient (0.019), which suggests a very weak linear relationship. The histogram for Inno displays a high concentration of values near zero, accompanied by a long tail extending to higher values, confirming the skewness noted in the descriptive statistics and density plots.

Inno and ESG:

The scatter plot between Innovation (Inno) and Environmental, Social, and Governance (ESG) metrics reveals a weak positive correlation, as evidenced by the majority of data points clustering around the lower to moderate values of both variables. This observation is consistent with the computed correlation coefficient of 0.151, which denotes a weak positive linear relationship. Furthermore, the histogram for ESG displays a left-skewed distribution, corroborating the skewness identified in the density plots and QQ plots.

Beta and ESG:

The scatter plot between Beta and ESG shows a widely scattered distribution with no clear pattern, indicating that there is no strong linear relationship between the two variables. This aligns with the correlation coefficient (0.024), suggesting a very weak linear relationship. The histogram for Beta shows a relatively symmetrical distribution, confirming the observations from the density plots and QQ plots.

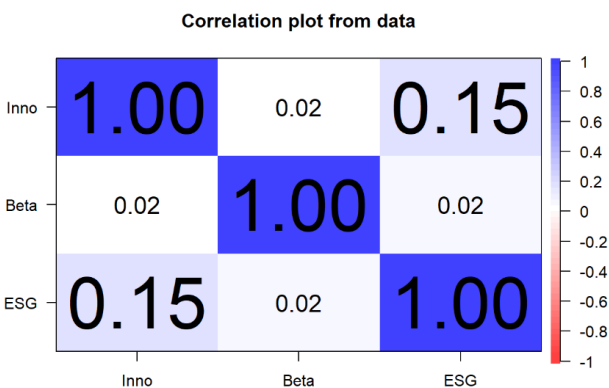


Figure 3. Correlation

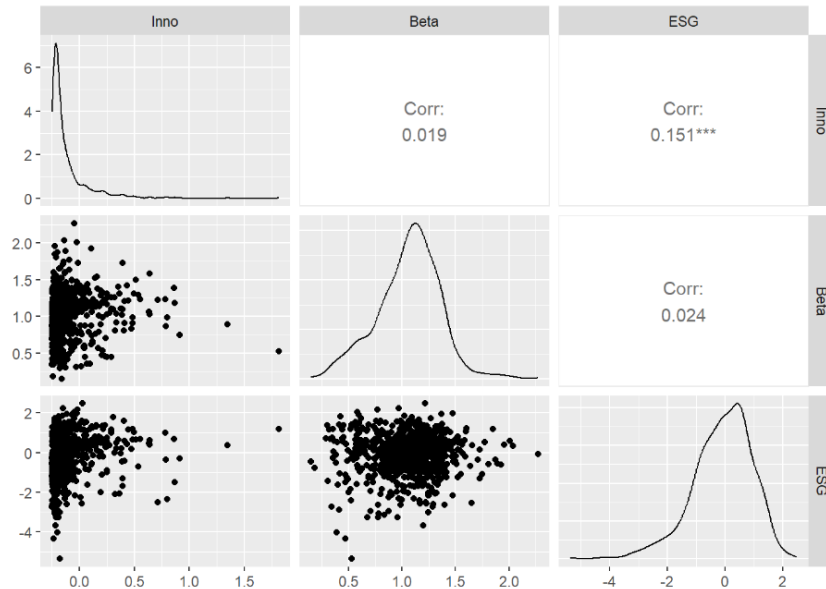


Figure 4. Scatter Plots

4. Empirical Analysis

4.1. Methodology Explanation

The significant result of Bartlett's test for sphericity (p-value = 0) implies that the variables in the dataset (Inno, Beta, ESG, ROE, ROA, Lev, Size) are not independent of each other. Instead, they exhibit significant interrelationships. This is a crucial finding for several reasons:

Table 3. Bartley sphericity test

Bartley sphericity test	Approximate Chi-Square	1825.765
	Degree Freedom	21
	P-Value	0.000

(1) Appropriateness for Factor Analysis

The significant correlation among variables suggests that factor analysis or principal component analysis is appropriate. These techniques can be used to reduce the dimensionality of the data, identifying underlying factors that explain the correlations among the observed variables. Nevertheless, due to the limit of data sample, I do not include principal component analysis in this case.

(2) Multicollinearity Consideration

In regression analysis, multicollinearity can be a concern when independent variables are highly correlated. The significant result from Bartlett's test indicates the presence of multicollinearity, which might inflate the standard errors of the coefficients and make it difficult to assess the individual contribution of each predictor. And in the additional analysis section, I have proved the multicollinearity between MV and IV.

(3) Model Implications

For the regression models analyzed earlier, the presence of multicollinearity means that the coefficients of the variables should be interpreted with caution. The interaction effects and the combined impact of correlated variables need careful consideration to draw accurate conclusions. The conclusions will be discussed in detail in the following sections.

4.2. Pool OLS Analysis

This section provides a detailed empirical analysis of the relationship between innovation strategies (Inno), investment risk (Beta), and the moderating effect of Environmental,

Social, and Governance (ESG) factors. We will analyze the results from two pooled Ordinary Least Squares (OLS) regression models to draw meaningful conclusions for each variable and discuss their impact on the models.

Model 1: $Beta = \alpha_i + \beta_1 Inno + \beta_2 Size + \beta_3 Lev + \beta_4 PE + \beta_5 BM + \epsilon_{it}$

Table 4. Model 1

Coefficients	Estimate	Std. Error	T-value	Pr (> t)
(Intercept)	1.0474	0.0128	82.095	<2e-16***
Inno	0.1977	0.0598	3.308	0.000983***
ROE	0.00039	0.017934	0.021	0.982868
ROA	-0.02595	0.02046	-1.268	0.205150
Lev	-0.02090	0.01218	-1.716	0.086495
Size	-0.36358	0.07875	-4.617	4.553-06***

Note: Residual standard error: 0.2883 on 786 degrees of freedom

Multiple R-squared: 0.04474, Adjusted R-squared: 0.03866

F-statistic: 7.362 on 5 and 786 DF, p-value: 9.313e-07

Model 1 is designed to investigate how various financial factors, specifically innovation strategies, affect a firm's investment risk as measured by Beta. I will conduct the analysis based on the variables in the model.

Innovation Strategies (Inno):

The coefficient for Inno is positive and highly significant, indicating that increased R&D investment is associated with higher investment risk. While R&D activities are essential for growth and competitiveness, they also introduce greater uncertainty and potential volatility, impacting the firm's systematic risk, which aligns with the general understanding that innovation, while beneficial, carries inherent risks.

Control Variables:

Firm Size (Size): The coefficient for Size is negative and highly significant, suggesting that larger firms typically have lower investment risk. This can be attributed to the diversification benefits and more stable revenue streams that larger firms enjoy, reducing their overall risk profile.

Leverage (Lev): The leverage coefficient is marginally

significant and negative, indicating a potential but weak inverse relationship with investment risk. This could imply that higher leverage, within reasonable limits, might be associated with disciplined financial management practices that could help mitigate risk.

ROE and ROA: Neither ROE nor ROA are significant in this model, implying that these profitability metrics do not substantially impact investment risk within the context of this analysis.

Model Fit:

The R-squared value indicates that approximately 4.47% of the variability in Beta is explained by the model. While this might seem low, it is not uncommon in financial modeling where numerous external factors influence investment risk.

The F-statistic is significant, affirming that the model collectively provides a meaningful explanation of the variability in Beta despite individual coefficients being less informative.

Therefore, we do not reject H1, which means innovation strategies implemented within companies will increase the investment risk.

$$\text{Model 2: } \beta = \alpha_i + \beta_1 \text{Inno} + \beta_2 \text{Size} + \beta_3 \text{LEV} + \beta_4 \text{PE} + \beta_5 \text{BM} + \beta_6 \text{Inno} * \text{ESG} + \varepsilon_{it}$$

Table 2. Model 2

Coefficients	Estimate	Std. Error	T-value	Pr (> t)
(Intercept)	1.05136	0.0132	79.551	<2e-16 ***
Inno	0.1926	0.0596	3.233	0.00128 **
ROE	-0.001785	0.017885	-0.100	0.92954
ROA	-0.03036	0.02045	-1.484	0.13812
Lev	-0.018024	0.012296	-1.446	0.14309
Size	-0.3693	0.0835	-4.424	1.11e-15 ***
Inno: ESG	-0.0856	0.0512	-1.672	0.09501

Note:

Residual standard error: 0.2872 on 784 degrees of freedom
Multiple R-squared: 0.05437, Adjusted R-squared: 0.04592

F-statistic: 6.439 on 7 and 784 DF, p-value: 2.172e-07

Model 2 builds on the findings of Model 1 by introducing the interaction term between innovation strategies and ESG scores. This model aims to investigate how ESG practices influence the relationship between R&D investment and investment risk. The analysis of Model 2 provides the following indications.

(1) Impact of Innovation Strategies

The coefficient for innovation strategies (Inno) remains positive and highly significant, similar to Model 1. This consistency indicates that increasing R&D investment continues to be associated with higher investment risk. This reinforces the understanding that innovation, while critical for growth and competitiveness, inherently carries more uncertainty and potential for volatility.

(2) Moderating Effect of ESG

The interaction term (Inno) is negative and marginally significant (p = 0.09501). This suggests that ESG practices mitigate the positive impact of innovation strategies on investment risk. In other words, companies with strong ESG practices can reduce the additional risk associated with high R&D investments. It highlights the importance of sustainable and responsible business practices in managing the risks

associated with innovation.

(3) Control Variables

The coefficients for the control variables (ROE, ROA, Lev, Size) show similar patterns to those in Model 1. Specifically, firm size (Size) remains a significant and negative predictor of investment risk, indicating that larger firms tend to have lower risk profiles. The non-significant coefficients for ROE and ROA suggest that profitability metrics do not substantially influence investment risk within the context of this model.

Model Fit

The residual standard error is slightly lower in Model 2 (0.2872) compared to Model 1 (0.2883), indicating a marginally better fit. The Multiple R-squared and Adjusted R-squared values are slightly higher in Model 2, suggesting that the inclusion of ESG and the interaction term provides a better explanation of the variance in investment risk. The F-statistic for Model 2 is significant, indicating that the model as a whole is statistically significant and provides a meaningful explanation of the variability in Beta.

Therefore, we reject H2, which means ESG has a negative effect to the process of innovation strategies and investment risk.

4.3. Additional Analysis

4.3.1. Prove that MV and IV have Multicollinearity

Model 2 aims to deepen our understanding of how innovation strategies affect investment risk by considering the moderating role of ESG practices. The analysis of the model yields several key insights:

(1) Impact of Innovation Strategies and ESG

The coefficient for innovation strategies (Inno) is positive and highly significant, which suggests that an increase in R&D investment is associated with an increase in investment risk. This finding remains robust, and it confirms that higher innovation activities introduce greater uncertainty and potential volatility. Additionally, the interaction term (Inno*ESG) is negative and marginally significant (p = 0.0949), indicating that ESG practices mitigate the positive impact of innovation strategies on investment risk. In other words, companies with strong ESG practices can reduce the additional risk associated with high R&D investments. Therefore, this highlights the importance of integrating sustainability and responsible business practices into innovation strategies.

(2) Control Variables

Firm Size (Size): The coefficient for firm size is negative and highly significant, suggesting that larger firms typically have lower investment risk. This relationship is consistent with the idea that larger firms benefit from diversification and more stable revenue streams, reducing their overall risk profile.

Leverage (Lev): The leverage coefficient is negative and marginally significant, indicating a potential inverse relationship with investment risk. This suggests that higher leverage might be associated with disciplined financial management practices, although the effect is not strong.

(3) Model Fit and Diagnostics

Based on the results, the residual standard error of 0.2873 indicates the average distance that the observed values deviate from the regression line. A lower residual standard error implies a better fit of the model to the data. The Multiple R-squared value of 0.05442 and the Adjusted R-squared value of 0.04597 indicate that the model accounts for approximately

5.44% of the variance in investment risk. Although this value is relatively low, it is typical in financial modeling due to the numerous external factors influencing the outcome variable. The significance of the F-statistic confirms that the overall model is statistically significant and that the predictors collectively explain a portion of the variance in Beta.

(4) Multicollinearity

The note regarding multicollinearity between the moderating variable (ESG) and the independent variable (Inno) suggests potential issues with the interaction term. Multicollinearity can inflate the standard errors of the coefficients, making it harder to detect significant effects. Nevertheless, the significance levels of the key variables indicate that the model still provides meaningful insights despite this potential issue.

5. Discussion and Recommendation

5.1. Contributions

According to the previous analysis, this research report can contribute a lot for both company directors and policy makers.

First of all, it gives an insight into the Impact of Innovation Strategies on Investment Risk. The study demonstrates that increased R&D investment is associated with higher investment risk, which is significant as it provides empirical evidence to support the commonly held belief that while innovation drives growth and competitiveness, it also introduces greater uncertainty and potential volatility.

More importantly, it offers implications for companies in risk management and strategic planning. The findings suggest that firms need to balance their innovation efforts with robust risk management practices. The identification of firm size as a significant factor in reducing investment risk highlights the benefits of diversification and stable revenue streams. Companies can use these insights to develop more effective strategies that balance growth and risk.

Lastly, for the policy makers, the research provides evidence-based recommendations for policymakers to promote ESG disclosures and support sustainable business practice, encouraging companies to adopt and report on ESG practices can help them manage the risks associated with innovation more effectively, contributing to overall market stability.

5.2. Recommendation

Based on the findings from the empirical analysis, the following recommendations can be proposed for both companies and policy makers.

(1) Enhance R&D Investments with Caution

While increasing R&D investments is crucial for innovation and long-term growth, companies should be aware of the associated higher investment risk. Implementing robust risk management strategies to mitigate these risks is essential.

(2) Integrate ESG Practices

Companies should integrate strong ESG practices into their operations. The findings suggest that ESG practices can mitigate the additional risk associated with high R&D investments. By focusing on sustainable and responsible business practices, companies can reduce their overall risk profile and attract more conscientious investors.

(3) Leverage and Financial Management

Maintain a balanced leverage ratio. While higher leverage might imply disciplined financial management practices, it is essential to ensure that leverage levels are within reasonable

limits to avoid excessive risk.

(4) ESG Reporting and Transparency

Companies should improve their ESG reporting and transparency. The study indicates that firms with better ESG disclosures have a positive impact on their risk profiles. Transparent ESG practices can enhance investor confidence and potentially lower the cost of capital.

(5) Regulatory Support

Regulators and policymakers should encourage ESG disclosures and provide frameworks that support sustainable business practices. This can help companies integrate ESG considerations into their strategies more effectively and contribute to overall market stability. By adopting these recommendations, companies can better manage the risks associated with innovation strategies and leverage ESG practices to enhance their overall risk profiles and sustainable growth.

5.3. Conclusions

Based on the results of the empirical analysis, several key conclusions can be drawn regarding the impact of innovation strategies on investment risk and the moderating effect of ESG practices. It is found that innovation strategies will increase the risk of companies, and ESG is not beneficial to this process.

The research advances the understanding of how innovation strategies and ESG practices interact to influence investment risk. It provides valuable insights for companies, investors, and policymakers on managing and mitigating risks associated with innovation, ultimately contributing to more sustainable and resilient business practices.

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