

## Integration of Green Innovation in Default Risk Management with Altman's Z"-Score and ZMIJEWSKI'S Zm-Score

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### ABSTRACT

This study analyzes the effect of green innovation on the default risk of non-financial companies in Indonesia and China during the period 2018–2024. Both countries were selected because they have banking-based financial systems but face different environmental challenges. Default risk is measured using a combined accounting-based approach, namely Altman's Z"-Score, and Zmijewski's ZM-Score. The estimation results using the Fixed Effect Model show that in aggregate, green innovation has no significant relationship with default risk. However, when analyzed per country, the effect of green innovation is proven to be significant and negative on default risk in companies in China, while in Indonesia the relationship is not statistically significant. These findings indicate that the effectiveness of green innovation as a financial risk mitigation strategy is greatly influenced by institutional readiness and national policies. This study provides important insights for policymakers and market players in developing countries regarding the importance of supporting the green innovation ecosystem to strengthen financial stability.

**KEYWORDS** #GreenInnovation #EnviromtentInnovation #DefaultRisk  
#FinancialRiskMitigation



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### INTRODUCTION

The concept of sustainable finance has gained increasing global attention since the signing of the Paris Agreement in 2015, which committed 196 countries to reduce greenhouse gas emissions. The goal is to limit global temperature rise to below two degrees Celsius and strive to keep it within 1.5 degrees Celsius (Change, n.d.). In this context, companies are required to increase transparency and accountability through the application of ESG (Environmental, Social, and Governance) principles, which include environmental, social, and good governance risk management. The application of ESG is not only intended to comply with increasingly stringent climate regulations but is also able to improve the company's reputation, attract investors, and reduce exposure to long-term financial risks (Meles et al., 2023; Zhao, 2025).

In line with this, global investment in the renewable energy sector has increased sharply after the Paris Agreement, projected to exceed USD 2 trillion in 2024 and could reach USD 4.5 trillion per year by 2050 (Forum, 2025). However, the challenges in the global energy transition are quite large, considering that more than 80% of the world's energy still comes from fossil fuels. A balanced strategy is needed, including electrification, energy efficiency, and the development of storage infrastructure and smart grids, which require synergies between policies, technologies, and environmental financing sources. Developing countries, such as Indonesia and China, face greater risks in this transition due to market instability and limited infrastructure, which can increase capital costs and financial risks, including exchange rate and interest rate fluctuations (Forum, 2025).

China, as the world's largest carbon emitter since 2007 with emissions of 8.5 gigatons of CO<sub>2</sub>, plays an important role in the global climate change agenda. However, China's per capita emissions are still lower than those of the United States (Ayuningsih et al., 2023). The East and Southeast Asia region shows complex dynamics in its energy development and policies. Most electricity is still generated from coal, and clean energy investment needs to triple from 2021–2023 levels to achieve decarbonization targets. In this case, sustainable innovation is the key to integrating economic, environmental, and social dimensions in a balanced manner (Xu et al., 2023).

Green innovation includes the development of environmentally friendly technologies, energy efficiency, and waste reduction. Companies that implement it tend to have a lower risk profile, gain better access to funding, and reduce the possibility of default risk. Green innovation also strengthens competitiveness and supports economic growth through long-term value creation and better stakeholder relationships (Khan et al., 2023; Zhang & Chen, 2023). In a financial system dominated by the banking sector, such as in China and Indonesia, green innovation strategies are a relevant risk mitigation instrument. Development and private banks in both countries have an important role in channeling financing to priority sectors that contribute to GDP, such as agriculture and manufacturing (Pulungan & Listiyanto, 2021). In this context, strengthening ESG and green innovation are strategic needs for corporate stability and sustainability.

This study aims to answer two main questions: how does green innovation affect the credit risk of non-financial companies in China and Indonesia, and whether there are significant differences between the two countries. Through an empirical approach, this study aims to fill the gap in previous literature by presenting relevant and up-to-date data for practitioners and academics. The main focus of this study is to analyze the effect of green innovation on credit risk in non-financial companies in China and Indonesia.

In addition, this study also aims to test whether there are significant differences in the impact of green innovation on default risk between non-financial companies in the two countries, so as to provide deeper insights into the role of green innovation in a cross-country context. Based on the identification of the problems described, this study is expected to provide meaningful contributions to various stakeholders, including regulators, practitioners, academics, and researchers. First, this study provides an empirical picture of the effect of green innovation on the credit risk of non-financial companies in China and Indonesia, by utilizing comprehensive and standardized Refinitiv Eikon-based scores. The focus on the real sector is expected to provide sharper insights into the relationship between green innovation and the financial condition of companies.

## RESEARCH METHOD

This study uses secondary data from Refinitiv Eikon for non-financial companies listed on IDX, SHSE, and SZSE during the period 2017–2024. The sample includes companies that have a Green Innovation score. Default risk is analyzed for the period 2018–2024, with some control variables using one-year lag data; therefore, 2017 data is also included.

This study proposes two main hypotheses to test the relationship between green innovation and default risk in firms in Indonesia and China. The selection of these two countries is based on similar characteristics, such as dependence on energy-intensive industries and global emission pressures, but with different policy approaches, where China is more active in encouraging green innovation through various regulations, such as through policies like *Made in China 2025* and environmental courts (Qi et al., 2023; L. Xu, 2022).

H1: Corporate green innovation is negatively related to default risk in Indonesia and China.

H2: The impact of green innovation on default risk is significantly different between firms in Indonesia and China.

The use of a one-year lag in this study is intended to reduce simultaneity bias, namely the potential for mutual influence between independent and dependent variables in the same period. This approach allows for a more accurate analysis of the impact of green innovation on default risk, considering that green investment usually takes time to affect company performance. The year 2018 was chosen as the starting point for observing default risk, in line with the implementation of POJK No. 51/2017 concerning *Sustainable Finance*, which requires public entities to integrate ESG principles into financial reports. Meanwhile, sample selection was carried out using a purposive sampling method on non-financial companies listed on the IDX, SHSE, and SZSE during 2017–2024, provided they have EIScore data from Refinitiv Eikon.

The addition of companies from China was carried out to strengthen the number of samples and expand the scope of the analysis, due to limited green innovation data in Indonesia. In addition, these two countries have similar characteristics in coal use and significant contributions to global CO<sub>2</sub> emissions. This study examines the effect of green innovation on default risk using panel regression with a fixed effect approach. Default risk is measured using Z"-Score and ZM-Score. This study is correlational and does not test for two-way causality or use endogeneity methods such as GMM.

The regression model used in this study refers to the approach adopted by Meles et al. (2023), which explores the relationship between green innovation and corporate default risk. In this study, the basic model used is panel regression with fixed effect specifications, which aims to control unobserved heterogeneity at the firm level. The general regression formula is as follows:

$$\text{Default\_Risk}_{i,t} = \alpha + \beta \text{EnvInnovation}_{i,t-1} + \gamma_1 \text{Income/Assets}_{i,t-1} + \gamma_2 \text{Ln(Equity)}_{i,t-1} + \gamma_3 \text{Ln(Debt)}_{i,t-1} + \gamma_4 1/\sigma E_{i,t-1} + \gamma_5 \text{SalesGrowth}_{i,t-1} + \theta_{\text{firm}} + \varepsilon_{\{i,t\}} \quad [3]$$

where  $\text{Default\_risk}_{i,t}$  is a measure of default risk measured by Z"-score, or ZM-score for firm  $i$  in year  $t$ . Default risk is the dependent variable.  $\alpha$  is a regression constant, the average value of default risk if all other variables are zero. •  $\text{EnvInnovation}_{i,t-1}$  is the green innovation score of firm  $i$  in year  $t-1$  (one-year lag) as an independent variable whose data is taken from Refinitiv Eikon for Environmental Innovation score. The coefficient  $\beta$  is expected to be negative if green innovation reduces default risk.  $\text{Income/Assets}_{i,t-1}$ ,  $\text{Ln(Equity)}_{i,t-1}$ ,  $\text{Ln(Debt)}_{i,t-1}$ ,  $1/\sigma E_{i,t-1}$ , and  $\text{SalesGrowth}_{i,t-1}$  are the firm's financial control variables with a one-year lag. These variables are secondary data from the firm's financial statements available in the Refinitiv Eikon database that are relevant to Indonesian firms and China.  $\gamma_1 \text{Income/Assets}_{i,t-1}$ , a measure of profitability that is higher should reduce the risk of default.  $\gamma_2 \text{Ln(Equity)}_{i,t-1}$  is a measure of the company's capitalization as measured by its market price, greater equity indicates a strong capital structure.  $\gamma_3 \text{Ln(Debt)}_{i,t-1}$  shows a measure of leverage so that the greater the debt, the higher the potential for default.  $\gamma_4 1/\sigma E_{i,t-1}$ , shows the size of the market risk, if  $\sigma$  is high it reflects high risk and its inverse value decreases.  $\gamma_5 \text{SalesGrowth}_{i,t-1}$  is a measure of company growth so that the higher the company growth the lower the default risk will be.  $\theta_{\text{Firm}}$  is a firm fixed effects to control for company characteristics that do not change over time, such as industrial sector, or the impact of country differences.  $\varepsilon_{\{i,t\}}$  is an error term which is a residual component that is not explained in the model.

We use descriptive statistical analysis models and panel data regression. Descriptive statistics are used to describe data characteristics numerically, including measures of central tendency, dispersion, and distribution, in order to understand the data structure and detect outliers before further analysis. This study uses panel data regression because it is able to capture time dynamics and

differences between entities, and reduce multicollinearity and bias due to unobserved fixed variables.

The main model used is the Fixed Effect Model (FEM), because it accommodates differences in fixed characteristics between entities through differences in intercept. The selection of FEM over Pool Least Square (PLS) is done using the Chow test, and compared with the Random Effect Model (REM) through the Hausman test. If the Chow and Hausman results are significant ( $p < 0.05$ ), then FEM is more appropriate. In addition, the Lagrange Multiplier (LM) test is used to assess whether REM is better than PLS. If the random effect is significant, REM is selected; otherwise, PLS is considered sufficient. This evaluation ensures that the model used is consistent and appropriate to the data structure.

## RESULT AND DISCUSSION

Table 1 and Table 2 show a summary of descriptive statistics for 32 companies from Indonesia and 62 companies from China based on purposive sampling method.

**Table 1. Descriptive Statistics for Indonesia Sample**

| Variable       | N   | Mean     | Min      | p50      | Max      | SD       | Skewness | Kurtosis |
|----------------|-----|----------|----------|----------|----------|----------|----------|----------|
| EIScore        | 224 | 21.23803 | 0.0      | 0.0      | 94.73684 | 29.79061 | 0.977274 | 2.45258  |
| INCOMETOTA     | 224 | 0.075475 | -0.18581 | 0.057398 | 0.454267 | 0.086097 | 1.365074 | 6.980889 |
| LNEQUITY       | 224 | 21.56012 | 19.0387  | 21.56319 | 24.06445 | 1.107578 | 0.022134 | 2.757543 |
| LNDEBT         | 224 | 20.77556 | 17.97408 | 20.75524 | 23.06525 | 1.096905 | -0.11282 | 2.300382 |
| PER $\sigma$   | 223 | 10.52972 | 2.386336 | 9.688475 | 33.87564 | 4.637642 | 1.290015 | 6.21775  |
| YOYSSALE       | 224 | 0.337572 | -0.73645 | 0.03234  | 63.02037 | 4.213576 | 14.79575 | 220.6118 |
| z score        | 224 | 4.750608 | -5.76514 | 4.06166  | 17.33034 | 3.804753 | 0.402187 | 3.465088 |
| zm score       | 224 | -2.04171 | -4.88911 | -2.20809 | 1.630255 | 1.352447 | 0.473594 | 2.515276 |
| GRIReportScore | 182 | 55.84771 | 0.0      | 59.63855 | 75.64103 | 22.0106  | -1.95422 | 5.392754 |
| ENPILLARSCORE  | 224 | 43.9052  | 0.0      | 42.01157 | 88.59094 | 25.1122  | -0.0755  | 1.888245 |

**Table 2. Descriptive Statistics for China Sample**

| Variable       | N   | Mean   | Min    | Median | Max    | SD     | Skewness | Kurtosis |
|----------------|-----|--------|--------|--------|--------|--------|----------|----------|
| EIScore        | 427 | 38.462 | 0.0    | 43.631 | 96.61  | 33.488 | 0.176    | 1.631    |
| INCOMETOTA     | 427 | 0.038  | -0.153 | 0.036  | 0.257  | 0.041  | 0.574    | 9.275    |
| LNEQUITY       | 411 | 23.22  | 20.367 | 23.175 | 26.57  | 1.12   | 0.218    | 3.174    |
| LNDEBT         | 427 | 23.273 | 19.563 | 23.439 | 26.139 | 1.331  | -0.23    | 2.996    |
| PER $\sigma$   | 407 | 11.934 | 2.608  | 11.231 | 46.379 | 4.918  | 1.564    | 9.05     |
| YOYSSALE       | 421 | 0.127  | -0.564 | 0.089  | 2.755  | 0.278  | 3.074    | 25.145   |
| z score        | 424 | 2.434  | -3.542 | 2.155  | 11.739 | 2.287  | 1.04     | 5.575    |
| zm score       | 427 | -1.302 | -4.211 | -1.234 | 1.614  | 1.004  | -0.319   | 2.868    |
| GRIReportScore | 345 | 70.362 | 0.0    | 79.141 | 84.124 | 23.925 | -2.447   | 7.452    |
| ENPILLARSCORE  | 427 | 55.933 | 0.0    | 57.491 | 95.596 | 21.199 | -0.504   | 2.915    |

### Descriptive analysis

As shown in Table 2, it is obtained that companies in China have an average environmental innovation score (EIScore) of 38.46, much higher than Indonesia which only reached 21.24 refer to Table 1. The median value in China (43.63) shows that most companies have implemented green innovation significantly, while in Indonesia the median is 0, indicating low adoption of green innovation. Although both countries have high maximum values, the minimum value of zero and positive

skewness indicate a right-skewed data distribution, where most companies are at the low score level with a few companies recording very high scores. This inequality is more pronounced in Indonesia. In terms of profitability (INCOMETOTA), companies in Indonesia recorded a profit to total asset ratio twice as high as China (0.075 vs 0.038), indicating better financial efficiency, although fluctuations between companies in the two countries are quite large.

In terms of financial structure, companies in China have an average equity size (LNEQUITY) of 23.22, higher than Indonesia (21.56), reflecting a larger business scale or market capitalization. The distribution pattern for this variable tends to be symmetrical in both countries. Likewise, the average and median debt values (LNDEBT) in China (23.27) indicate higher leverage than Indonesia (20.77), which means that companies in China are more dependent on external funding. For market volatility as measured by  $PER\sigma$ , China also recorded a higher average value (11.93) than Indonesia (10.53), with a very spread distribution and outliers, indicating stock price instability in some companies.

The Z" score used to measure bankruptcy risk shows that the average Z" value in Indonesia (4.75) is much higher than China (2.43), reflecting that companies in Indonesia are generally in a healthier financial condition. Skewness and kurtosis also indicate that the distribution of scores in Indonesia is more balanced compared to China, which tends to have more high-risk companies. The ZM-Score model using a probabilistic approach shows consistent results, with companies in Indonesia having an average ZM-Score of -2.04 compared to China's -1.30. A larger negative value indicates a lower default risk. The negative skewness score in China indicates that the majority are in a safe position, but there are companies with scores close to or above zero that are at high risk. In contrast, Indonesia has a more symmetrical distribution, but still indicates that the majority of companies are relatively financially secure.

In terms of sustainability reporting, the GRI Report scores for companies in China indicate high compliance with the GRI international standard, with an average of 70.36 and a median of 79.14. The GRI Report Score reflects the extent to which a company complies with the sustainability reporting guidelines set by the Global Reporting Initiative (GRI). GRI itself is a global framework that is widely used to prepare ESG (Environmental, Social, and Governance) reports, which include reporting on the impact of a company's activities on economic, environmental, and social aspects. A higher GRI Report Score indicates that the company is increasingly transparent and comprehensive in disclosing sustainability information in accordance with applicable international standards. The very negative skewness indicates that almost all companies have comprehensively reported sustainability aspects. In contrast, companies in Indonesia have a lower average score (55.85) and a wider distribution, reflecting uneven compliance.

Meanwhile, in terms of environmental performance measured through ENPillarScore which is part of the ESG composite score that focuses on the environmental aspects of a company. It assesses the extent to which a company manages environmental risks and opportunities, including emissions, energy efficiency, water and waste, and environmental policies and compliance. Chinese companies again showed a higher score (average 55.93), while Indonesia only recorded an average score of 43.90. The higher the ENPillar score, the better the company's environmental performance and governance, this shows that in general, companies in China have better environmental management.

Companies in Indonesia show a more solid financial position based on Z" and ZM-Score, with a lower default risk in general compared to companies in China. This advantage can be attributed to a relatively more stable financial structure and profitability. In contrast, companies in China excel in aspects of sustainability reporting and environmental management, both in terms of compliance with GRI standards and environmental pillar scores. This may indicate a stronger institutional and regulatory push in China in promoting the ESG agenda, which is likely to drive the effectiveness of green innovation in reducing default risk, as reflected in the previous regression estimation results.

Taking all indicators into account, companies in China tend to be more progressive in adopting and reporting sustainability initiatives, have larger business scale and leverage, but their profitability is relatively lower compared to companies in Indonesia. In contrast, although Indonesian companies are more profitable and have a lower default risk, the adoption of green innovation is still very limited and uneven. The inequality in the distribution of innovation scores and stock price volatility shows that differences in institutional capacity and pressure.

### Sample Test

The selection of the panel regression model was carried out with three stages of testing: Chow, LM, and Hausman (see appendix 1). The Chow test shows that for Z-Score and ZM-Score, the F values are 30.74 and 22.48 respectively with a p-value of 0.00, so that the Pooled Least Squares model is rejected and the Fixed Effect Model (FEM) is declared more appropriate. Furthermore, the Lagrange Multiplier test shows a  $\chi^2$  value of 1101.80 (Z-Score) and 906.43 (ZM-Score), with a p-value of 0.00, indicating that Random Effect (RE) is better than PLS. However, the Hausman test proves that RE is inconsistent because the  $\chi^2$  values of 33.03 and 44.76 for each model are also significant at the 1% level, so FEM remains the main choice. The classical assumption test revealed heteroscedasticity based on the Modified Wald test, with  $\chi^2$  values of 440,494.57 (Z-Score) and 111,982.91 (ZM-Score), both significant. Therefore, robust standard error is used to maintain the validity of the estimate.



In the multicollinearity test (appendix 2), two variables, namely LNEQUITY and LNDEBT, showed very high VIF values of 594.19 and 571.72, respectively, but were retained due to their theoretical relevance. Thus, FEM was chosen as the best model because it provides consistent estimates and can capture differences in characteristics between companies..

### Analysis of Hypothesis Test Results

Hypothesis testing in this study aims to evaluate the effect of green innovation implementation, as measured by the Environmental Innovation Score (EIScore), on the default risk of public companies in Indonesia and China. Default risk is analyzed using three indicators, namely Z"-Score and ZM-Score, each of which is used as a dependent variable in panel data regression. The model used is the Fixed Effect Model (FEM), according to the results of the Chow, LM, and Hausman tests which indicate that FEM is most capable of capturing variations in characteristics between companies. The regression estimates shown in Table 3 present the relationship between EIScore and other control variables on default risk in both countries.

**Table 3. Multivariate Regression Results for Sample Companies in Indonesia and China**

| Variable             | z score coef | z score se | zm score coef | zm score se |
|----------------------|--------------|------------|---------------|-------------|
| EIScore Lag1         | 0.00233      | 0.00317    | -0.00154      | 0.00133     |
| INCOMETOTA Lag1      | 8.935        | 2.297      | -2.919        | 0.919       |
| LNEQUITY Lag1        | 0.393        | 0.185      | -0.206        | 0.0856      |
| LNDEBT Lag1          | -1.433       | 0.347      | 0.44          | 0.0978      |
| PERO Lag1            | 0.00499      | 0.00861    | -0.00212      | 0.00351     |
| YOYSSALE Lag1        | -0.00932     | 0.00353    | 0.0371        | 0.00126     |
| 2.COUNTRY            |              |            |               |             |
| Constant             | 25.69        | 9.131      | -6.474        | 2.666       |
| Metric               | Value        |            |               |             |
| Observations         | 625.0        |            |               |             |
| R-squared (z score)  | 0.257        |            |               |             |
| R-squared (zm score) | 0.219        |            |               |             |
| Number of IDCOMPANY  | 93.0         |            |               |             |

The regression results presented in Table 3 show that the regression table presents the estimated results of the effect of the Environmental Innovation Score (EI Score) and several control variables on the default risk of public companies in Indonesia and China. Default risk measurement is carried out through three approaches: Z"-Score FEM, and ZM-Score FEM. The coefficient values for the main variable EI Score (EIScore\_Lag1) are 0.00233 for the Z"-Score model, and -0.00154 for the ZM-Score. Both coefficient values indicate that in this estimation, there is insufficient statistical evidence that green innovation one year earlier directly affects the risk of corporate default as measured by the accounting approach.

The constant value (intercept) of each model is recorded at 25.69\*\*\* in the Z"-Score FEM model, and -6.474\*\*\* in the ZM-Score FEM. Both intercept values



are statistically significant indicating that the average value of the risk of default when all independent variables are zero has a statistical significance. Meanwhile, the R-squared value of both models shows the magnitude of the variation in default risk that can be explained by the model. The FEM Z"-Score model explains about 25.7% of the variation in the data and the ZM-Score explains 21.9%. This difference indicates that there is variation in the predictive ability of each approach in explaining default risk based on the variables used.

The insignificance of the green innovation score in both models also suggests that the effect of green innovation on corporate financial risk may be indirect or take longer to appear, and may be influenced by differences in the institutional context between Indonesia and China that cannot be fully captured by the current model. Considering these results, hypothesis H1 cannot be statistically accepted because there is no significant relationship between corporate green innovation scores and default risk based on the panel data of the years analyzed.

In the Z"-Score model, the control variable Income to Total Asset (lag 1) shows a positive coefficient of 8.935\*\*\* with a significance level of 1%, indicating that the higher the profitability of the company, the greater the Z"-Score value, so the lower the risk of default. This is in line with the bankruptcy theory that profitability is a signal of the financial strength of the company that can reduce the probability of business failure. which also shows the influence of the Income to Total Asset control variable (lag 1) on the risk of default as measured by the ZM-Score which shows a coefficient of -2.919\*\*\*.

Meanwhile, the equity logarithm also shows a positive and significant coefficient of 0.393\*\* in the model that the risk of default with the Z"-Score method. This strengthens the argument that a strong capital structure through increased equity can increase the company's financial resilience to the risk of default. On the other hand, the debt logarithm shows a significant negative coefficient of -1.433\*\*\*, indicating that debt accumulation actually increases the potential for bankruptcy. The coefficient  $1/\sigma$  as a proxy for volatility is insignificant, indicating that stock price volatility does not play a major role in explaining the variation of Z"-Score. On the other hand, Sales Growth actually provides surprising results with a significant negative coefficient of -0.00932\*\*\*, indicating that high sales growth can be associated with an increase in default risk, possibly due to expansion that is not accompanied by adequate operational risk control.

In the ZM-Score default risk approach, the control variable LN\_Equity shows a significant negative effect (-0.206\*\*) on the ZM-Score, which may reflect the model's sensitivity to high structural leverage, while LN\_Debt shows a positive and significant coefficient (0.440\*\*\*), in contrast to the Z"-Score model. These results indicate that in the ZM model, debt is not always associated with increased

risk, possibly due to adjustments to liquidity or asset efficiency.  $1/\sigma$  remains insignificant in this model, and Sales Growth shows a significant positive coefficient (0.0371\*\*\*), indicating that in this model sales growth is associated with improved financial position.

**Table 4. Multivariate Regression Results for Sample Companies in Indonesia and China Separately**

| Variable                 | coef z ID | se z ID | coef zm ID | se zm ID | coef z CN | se z CN | coef zm CN | se zm CN |
|--------------------------|-----------|---------|------------|----------|-----------|---------|------------|----------|
| EIScore Lag1             | 0.00324   | 0.00952 | -0.00156   | 0.00357  | 0.00295   | 0.0021  | -0.00203   | 0.00118  |
| INCOMETOTA Lag1          | 5.176     | 3.411   | -1.484     | 1.329    | 15.16     | 1.453   | -5.041     | 0.706    |
| LNEQUITY Lag1            | 0.46      | 0.435   | -0.28      | 0.175    | 0.212     | 0.123   | -0.138     | 0.0729   |
| LNDEBT Lag1              | -1.945    | 0.756   | 0.429      | 0.146    | -1.028    | 0.252   | 0.435      | 0.112    |
| PERO Lag1                | 0.0345    | 0.0224  | -0.0126    | 0.00657  | -0.0073   | 0.00651 | 0.00266    | 0.00339  |
| YOYSSALE Lag1            | -0.00955  | 0.00446 | 0.0373     | 0.00188  | -0.108    | 0.0846  | 0.0606     | 0.0674   |
| Constant                 | 34.33     | 20.96   | -4.625     | 4.232    | 20.68     | 5.918   | -7.902     | 3.063    |
| Metric                   | Value     |         |            |          |           |         |            |          |
| Observations (ID)        | 224.0     |         |            |          |           |         |            |          |
| R-squared (z ID)         | 0.208     |         |            |          |           |         |            |          |
| R-squared (zm ID)        | 0.205     |         |            |          |           |         |            |          |
| Number of IDCOMPANY (ID) | 32.0      |         |            |          |           |         |            |          |
| Observations (CN)        | 401.0     |         |            |          |           |         |            |          |
| R-squared (z CN)         | 0.496     |         |            |          |           |         |            |          |
| R-squared (zm CN)        | 0.3       |         |            |          |           |         |            |          |
| Number of IDCOMPANY (CN) | 61.0      |         |            |          |           |         |            |          |

Notes: Robust standard errors in parentheses in original tables. Significance: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 4. explains the estimated effect of Environmental Innovation Score (EI Score) and control variables on the risk of default of companies separately between Indonesia (columns 1–2) and China (columns 3–4). This is intended to answer Hypothesis H2, namely that the impact of green innovation on the risk of default differs significantly between companies in Indonesia and China. In general, the effect of EI Score on the risk of default in Indonesia is not significant in all regression models. For companies in Indonesia that are the objects of observation, the EI Score coefficient for Z-score is 0.00324, and ZM-score is negative 0.00156, without any significance indicator, thus indicating that for public companies in Indonesia, there is no statistically strong relationship between the level of environmental innovation and the risk of default from the accounting approaches.

In contrast, in China, EI Score shows a significant effect on the risk of default in two of the three models. In the ZM-score model, the coefficient is -0.00203\* which is significant at the 10% level, indicating that increasing green innovation is associated with decreasing default risk. Meanwhile, in the China Z-score model, the EI Score is also insignificant (0.00295), although the direction of the relationship remains positive. This means that only the ZM model in China shows statistical evidence of a negative and significant relationship between green innovation and default risk. Comparing the results between the two countries, it appears that the effect of green innovation on default risk tends to be stronger and more significant in China than in Indonesia. This difference empirically supports hypothesis H2, namely that the effect of green innovation is not homogeneous

across countries, possibly due to differences in environmental regulations, policy incentives, ESG readiness levels, and capital market pressures on sustainability. In addition, the R-squared value in the China model also tends to be higher, for example 0.496 for the Z-score, compared to only 0.208 in the same model in Indonesia, indicating that the prediction model in China is better at explaining variations in default risk based on observed variables.

## Discussion

To understand the indirect pathway of how green innovation can reduce default risk through the role of intermediary variables such as financial ratios and risk management practices, further studies are needed to identify which financial indicators function as mediating mechanisms. These indicators include improving financial performance and strengthening capital structures that ultimately strengthen the company's resilience to external pressures.

The results of this study provide implications that companies—especially in Indonesia—need to start adopting green innovation in a more integrated manner in their business strategies and risk management systems. The approach to green innovation should no longer be symbolic or merely to comply with regulations, but should be positioned as a strategic component in strengthening long-term financial resilience. Strengthening the financial structure, for example through increasing retained earnings and prudent debt management, can be an effective channel in reducing default risk, and green innovation has the potential to accelerate this process.

From a policy perspective, strengthening the regulatory framework is needed to expand the adoption of sustainability practices systematically. This includes providing fiscal incentives, strengthening ESG reporting obligations, and developing a credible green performance rating system or index. These steps are expected to increase market response to companies' environmental performance and encourage the integration of green innovation as part of a financial risk mitigation strategy.

## CONCLUSION

The estimation results show that when all samples are combined, there is no significant relationship between green innovation scores and default risk. However, the direction of the coefficient in the ZM model shows a negative tendency, indicating that theoretically, green innovation does have the potential to reduce default risk, although this has not been statistically reflected at a significant level. This influence presents a different picture in each country. In China, the effect of green innovation on default risk is proven to be stronger and statistically significant,

especially in the ZM-Score model. The negative effect of green innovation on default risk in China indicates that companies with higher environmental scores tend to have a safer financial position. In contrast, in Indonesian companies, green innovation scores do not show a significant effect on default risk in the three estimation models. This finding also emphasizes the importance of strengthening the financial performance channel as a mechanism to optimize the strategic benefits of green innovation. By considering the significant differences between Indonesia and China, this study provides empirical and policy contributions that can be used by stakeholders, both in the business world and regulators, to formulate policies that support the green transition that are not only environmentally friendly but also strengthen the long-term financial stability of companies.

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