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The Role of Green Finance and Research and Development in Economic Resilience

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Abstract. *This study aims to conduct an in-depth analysis of the impact of green finance and research and development (R&D) activities on the level of economic resilience in 24 countries. Economic resilience is defined as a nation's capacity to withstand, adapt to, and recover from various economic pressures or shocks, whether internal or external in nature. The independent variables employed include the Green Growth Index as an indicator of green finance, the number of Research and Development R&D expenditure, Adjusted Net Savings (ANS), and Gross Domestic Product (GDP) per capita. The study utilizes secondary data from 2021 obtained from international institutions such as the World Bank and applies a binary logistic regression approach for analysis. The results reveal that ANS, which accounts for environmental damage caused by carbon emissions, has a positive and statistically significant effect on economic resilience. Conversely, GDP demonstrates a significant negative effect. Meanwhile, the variables representing green finance and R&D do not exert a statistically significant influence in the final model. These findings underscore that environmental sustainability constitutes a key determinant in strengthening economic resilience, whereas traditional economic growth may not necessarily reflect long-term resilience unless accompanied by the principles of inclusivity, resource efficiency, and environmental sustainability.*

Keywords:
Economic Resilience;
Green Finance;
R&D;
Gross Domestic Product

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Introduction

In recent years, countries across different regions of the world have faced increasingly complex and multidimensional challenges. Many economies have experienced recessions or economic slowdowns resulting from pressures arising from multiple sources (Ciptawan & Melina, 2023). These pressures include natural disasters, geopolitical conflicts, energy and food crises, as well as the global COVID-19 pandemic. The COVID-19 pandemic caused a severe shock to the global economy (Arianto, 2022). The economic downturn resulting from restrictions on social and economic activities during the pandemic substantially affected overall economic performance. The tourism sector, which represents an important source of foreign exchange revenue for many countries, was particularly severely affected due to restrictions on travel between cities, islands, and countries (Fazaalloh et al., 2024).

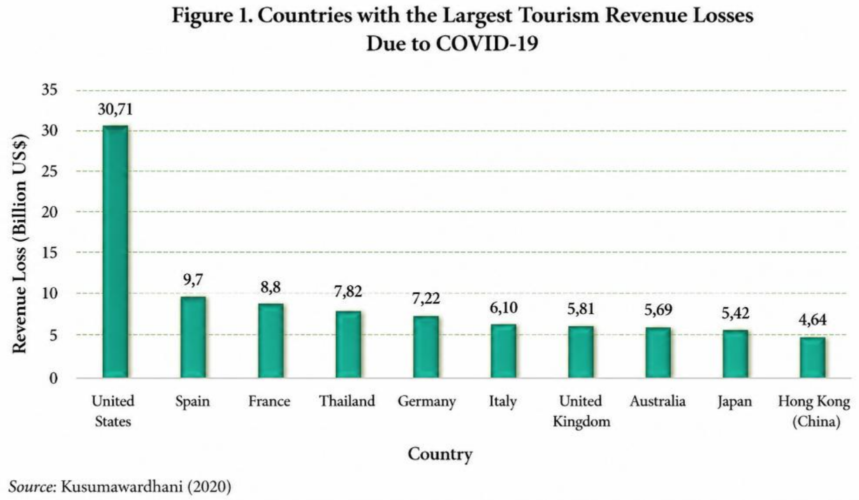

Figure 1. Countries with the Largest Tourism Revenue Losses Due to COVID-19

As illustrated in Figure 1, the COVID-19 pandemic had a substantial impact on the global tourism sector. The United States, which recorded one of the highest numbers of COVID-19 infections, experienced tourism revenue losses amounting to approximately US$30.71 billion (Kusumawardhani, 2020).

During the post-COVID-19 economic recovery period, effective government policies are required to stimulate economic activity (Said, 2025). Governments have implemented various measures to promote economic growth; however, greater attention must also be given to the sustainability of such growth. This is particularly important because governments play a crucial role in facilitating the transition toward a green economy through an integrated approach encompassing economic, social, and environmental dimensions (Azzahra et al., 2025). Environmental sustainability should therefore become an integral component of economic development strategies to ensure sustainable economic performance and strengthen national economic resilience.

Economic resilience refers to a country's capacity to maintain stable economic growth and preserve adequate living standards for its population through high-quality economic development (Putra, 2022). Such resilience can also be reflected in a country's capacity to preserve environmental sustainability while maintaining economic performance. Accordingly, the implementation of *green finance* is increasingly important because it facilitates the transformation of conventional economic systems toward more environmentally friendly and sustainable economic structures (Judijanto & Al-Amin, 2025).

A growing body of research has investigated the role of *green finance* in economic development. Rangkuty et al., (2023) found that *green finance* significantly influences *Gross Domestic Product* (GDP). Studies conducted by Wang & Wang (2020), Purba et al. (2024), and Rosadi et al. (2025) similarly indicate that *green finance* plays a significant role in promoting inclusive economic growth. Shen et al. (2024) further demonstrated that *green finance* contributes to strengthening both environmental and economic resilience during China's post-COVID-19 recovery. Nevertheless, empirical findings remain inconclusive. Wang & Wang (2020), for example, reported that *green finance* is directly and negatively associated with *green growth*. This finding suggests that higher levels of *green finance* implementation or financing may, under certain conditions, be associated with lower levels of *green growth*.

In addition to *green finance*, the development of economic resilience requires environmentally friendly technological innovation supported by *Research and Development* (R&D). Innovations generated through research activities contribute to the development of environmentally sustainable technologies, improvements in energy efficiency, and the establishment of sustainable production systems. These developments can ultimately enhance national economic competitiveness while simultaneously reducing adverse environmental impacts. Investment in R&D has been demonstrated to promote long-term economic growth by facilitating the development of new products and production processes that enable economies to respond adaptively to global challenges (*OECD Science, Technology and Innovation Outlook*, 2023). Therefore, integrating sustainable development strategies with research and innovation policies constitutes a crucial component of national economic development planning. Achieving sustainable development requires sustained support for technological development, research, innovation, and evidence-based policymaking (Maritha, 2021).

Previous studies have extensively examined the relationship between *green finance* and economic performance, including those conducted by Rangkuty et al., (2023), Wang & Wang (2020), Purba et al., (2024), Rosadi et al. (2025), and Shen et al. (2024). However, relatively few studies have specifically investigated the effect of *green finance* on a country's economic resilience. Furthermore, empirical research integrating environmental sustainability indicators and *Research and Development* (R&D) within the context of economic resilience remains limited. This gap highlights the need for a more comprehensive empirical framework that simultaneously considers financial, environmental, technological, and macroeconomic dimensions of economic resilience.

Accordingly, this study aims to examine the effects of *green finance*, proxied by the *Green Growth Index*, *Adjusted Net Savings* (ANS), and *Research and Development* (R&D), on economic resilience across 24 countries worldwide. The study also incorporates *Gross Domestic Product* (GDP) as a macroeconomic variable that is expected to influence economic resilience.

Based on the theoretical framework and findings of previous studies, the following hypotheses are proposed:

H_1: Research and Development (R&D) has a significant effect on economic resilience.
H_2: Green Finance has a significant effect on economic resilience.
H_3: Adjusted Net Savings (ANS) has a significant effect on economic resilience.
H_4: Gross Domestic Product (GDP) has a significant effect on economic resilience.

Research Methods

This study employed a quantitative research approach using secondary data. The units of analysis were countries for which complete data were available for all research variables in 2021. Of all countries included in the relevant international databases, only 24 had complete data for all variables examined in this study. Therefore, these 24 countries were selected as the research sample.

Table 1. Countries Included in the Research Sample

No	Country
1	Austria
2	Belgium
3	Canada
4	Switzerland
5	Chile
6	China
7	Germany
8	Denmark
9	Spain
10	Finland
11	France
12	Greece
13	Hungary
14	Ireland
15	Japan
16	Italy
17	South Korea
18	Mexico
19	Netherlands
20	Norway
21	New Zealand
22	Portugal
23	Russian Federation
24	Sweden

Based on the selected country sample, this study employed several variables consisting of one dependent variable and four independent variables. The dependent variable was economic resilience, whereas the independent variables consisted of *Research and Development* (R&D), *Green Finance*, *Adjusted Net Savings* (ANS), and *Gross Domestic Product* (GDP). The operational definitions of the variables are presented in Table 2.

Table 2. Operational Definitions of Research Variables

No	Variable	Operational Definition	Unit	Source
1	Economic Resilience (Y)	Economic resilience is represented by the Economic Resilience Index, which measures a country's capacity to absorb, adapt to, and recover from economic shocks. The index takes into account structural vulnerabilities and the country's response capacity. The variable is coded as 0 for an economic resilience value ≤ 0.5 and 1 for an economic resilience value > 0.5.	Index	*World Bank - Economic Resilience Index Data*
2	*Research and Development (R&D) (X1)*	R&D refers to total current and capital expenditures on research and development activities undertaken by the business sector, government,	Percent (%)	*World Bank – Research and Developmen*

		higher education institutions, and private non-profit organizations, expressed as a percentage of GDP. R&D includes basic research, applied research, and experimental development.		*t Expenditure*
3	*Green Finance* (X_2)	*Green Finance is represented in this study by the Green Growth Index. The variable measures a country's performance in achieving sustainability objectives, including the Sustainable Development Goals (SDGs) and the Paris Climate Agreement, across four principal dimensions. Scores ranging from 1 to 100 indicate the level of achievement, using indicators validated by experts to ensure their policy relevance.*	Index	*World Bank - Green Growth Indicators Data*
4	*Adjusted Net Savings (ANS) (X3)*	*Adjusted Net Savings, represented by Adjusted Savings: Carbon Dioxide Damage, reflects the estimated cost of damage caused by carbon dioxide emissions resulting from fossil fuel use and cement production. The damage is estimated at US$40 per ton of CO_2, based on 2017 US dollar values for CO_2 emissions in 2020, multiplied by the number of tons of CO_2 emitted.*	US$	*World Bank - Adjusted Savings: Carbon Dioxide Damage*
5	*Gross Domestic Product (GDP) (X4)*	GDP is calculated on the basis of the fiscal year and uses an alternative exchange rate (PA.NUS.ATLS) for countries operating multiple exchange-rate systems. This exchange rate is calculated as a weighted average so that GDP more accurately reflects actual economic conditions and facilitates more reliable cross-country comparisons.	US$	*World Bank - GDP*

Data Analysis Technique

To address the research objectives, this study employed binary logistic regression analysis. Binary logistic regression is a statistical method used to examine the relationship between a dichotomous dependent variable, measured on a nominal or ordinal scale with two categories, and one or more continuous or categorical independent variables (Putri et al., 2022). Because the dependent variable consists of only two possible outcomes (0 or 1), the response variable Yfollows a Bernoulli distribution. The binary logistic regression model employed in this study is formulated as follows:

$$g(x) = \ln\left(\frac{\pi(x)}{1-\pi(x)}\right)\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ \beta_4 X_4 + et$$

Keterangan:
X_1: R&D;

X_2: Green Growth Index;
X_3: Adjusted Net Saving;
X_4: GDP
The logit function represents the natural logarithm of the odds ratio

In addition, model goodness-of-fit was assessed using the Hosmer-Lemeshow test and Nagelkerke R^2. The Hosmer-Lemeshow test was employed to determine whether the logistic regression model adequately fitted the observed data. The testing hypotheses were as follows:

H_0: The model is consistent with the observed data.
H_1: The model is not consistent with the observed data.

The Hosmer-Lemeshow test statistic is formulated as follows:

$$\hat{C} = \sum_{k=1}^{g} \frac{(O_k - E_k)^2}{E_k(1-\hat{\pi}_k)}$$

Note:

- O_k= observed frequency in the k-th group
- E_k= expected frequency in the k-th group
- $\hat{\pi}_k$= predicted probability in the k -th group
- g= number of groups.

Furthermore, the Nagelkerke R^2 value was used to assess the extent to which the independent variables explain variation in the dependent variable within the logistic regression model. Nagelkerke R^2 ranges from 0 to 1. A value approaching 1 indicates greater explanatory and predictive ability of the model.

Results and Discussion

Binary logistic regression was employed to examine the effects of *Research and Development* (R&D), *Green Finance*, *Adjusted Net Savings* (ANS), and *Gross Domestic Product* (GDP) on economic resilience. Binary logistic regression is appropriate when the dependent variable consists of two categories and the explanatory variables may be continuous or categorical (Putri et al., 2022).

The analysis adopted a significance level of 10% ($\alpha = 0.10$). Given the relatively small cross-country sample, findings with p-values between 0.05 and 0.10 are interpreted as marginally significant and should therefore be interpreted cautiously rather than as strong statistical evidence.

Table 3. Logistic Regression Estimation Results for the Full Model

							95% CI for EXP(B)	
	B	**S.E.**	**Wald**	**df**	**Sig**	**Exp(B)**	**Lower**	**Upper**
R&D (*X_1*)	-0,314	0,992	0,100	1	0,751	0,730	0,104	5,108
Green Finance (*X*	1,226	1,033	1,409	1	0,235	3,408	0,450	25,824
Adjusted Net Saving (*X_3*)	28,783	17,104	2,832	1	0,092	3,164E+12	0,009	1,147E+27
GDP (*X_4*)	-29,946	17,404	2,961	1	0,085	0,000	0,000	64,402
Constant	-2,161	1,415	2,334	1	0,127	0,115		

Source: Data processed by the authors (2025)

Based on the full logistic regression model presented in Table 3, R&D (X1) produced a coefficient of -0.314 with a p-value of 0.751, whereas *Green Finance* (X2) generated a positive coefficient of 1.226 with a p-value of 0.235. Neither variable was statistically significant. In contrast, *Adjusted Net Savings* (X3) exhibited a positive coefficient of 28.783 with a p-value of 0.092, while GDP (X4) showed a negative coefficient of -29.946 with a p-value of 0.085. The latter two variables therefore demonstrated marginal statistical significance at the 10% level. Based on Table 3, the initial logistic regression model (*full model*) was obtained as follows:

$$\hat{\pi}(X) = \frac{\exp\left(-2{,}161 - 0{,}314X_{1(1)} + 1{,}226X_{2(1)} + 28{,}783X_{3(1)} - 29{,}946X_{4(1)}\right)}{1 + \exp\left(-2{,}161 - 0{,}314X_{1(1)} + 1{,}226X_{2(1)} + 28{,}783X_{3(1)} - 29{,}946X_{4(1)}\right)}$$

In logit form:

$$\log\left(\frac{\hat{\pi}(X)}{1-\hat{\pi}(X)}\right) = -2{,}161 - 0{,}314X_{1(1)} + 1{,}226X_{2(1)} + 28{,}783X_{3(1)} - 29{,}946X_{4(1)}$$

At the initial stage (Step 1), all four independent variables—*Research and Development* (R&D) (X1), *Green Finance* (X2), *Adjusted Net Savings* (X3), and GDP (X4)—were entered into the regression model. Subsequently, the backward stepwise procedure was employed to eliminate statistically insignificant variables. The final and best-fitting model was obtained at Step 3, in which only two variables remained: *Adjusted Net Savings* (X3) and GDP (X4).

Table 4. Backward Stepwise Elimination Results

		B	S.E.	Wald	df	Sig	Exp(B)	95% CI for EXP(B) Lower	Upper
Step 1[a]	R&D (X_1)	-0,314	0,992	0,100	1	0,751	0,730	0,104	5,108
	Green Finance (X_2)	1,226	1,033	1,409	1	0,235	3,408	0,450	25,824
	Adjusted Net Savings (X_3)	28,783	17,104	2,832	1	0,092	3,164E+12	0,009	1,147E+27
	GDP (X_4)	-29,946	17,404	2,961	1	0,085	0,000	0,000	64,402
	Constant	-2,161	1,415	2,334	1	0,127	0,115		
Step 2[a]	*Green Finance* (X_2)	1,122	0,942	1,417	1	0,234	3,070	0,484	19,450
	Adjusted Net Savings (X_3)	26,232	14,471	3,286	1	0,070	2,468E+11	0,119	5,129E+23
	GDP (X_4)	-27,242	14,533	3,514	1	0,061	0,000	0,000	3,462
	Constant	-1,981	1,254	2,494	1	0,114	0,138		
Step 3[a]	*Adjusted*	22,196	12,891	2,965	1	0,085	4361997040	0,046	4,101E+20

Net Savings (X_3)								
GDP (X_4)	-23,281	12,786	3,316	1	0,069	0,000	0,000	5,918
Constant	-1,677	1,121	2,238	1	0,135	0,187		

Source: Data processed by the authors (2025)

In addition to parameter estimation, a goodness-of-fit assessment was conducted to evaluate the ability of the logistic regression model to explain the dependent variable. Model fit was evaluated using the Nagelkerke R^2 and Hosmer-Lemeshow test. Nagelkerke R^2 was used to assess the proportion of variation in economic resilience explained by the independent variables included in the model. A value closer to 1 indicates greater predictive ability. Meanwhile, the Hosmer-Lemeshow test was applied to assess the correspondence between model predictions and the observed data. The model is considered to have an adequate fit when the significance value exceeds 0.05.

Table 5. Goodness-of-Fit Tests for the Logistic Regression Model

Test	Value
Cox & Snell R^2	0,516
Nagelkerke R^2	0,688
Hosmer-Lemeshow Sig.	0,425

Based on Table 5, the Hosmer-Lemeshow significance value of 0.425 is greater than 0.05, indicating that the logistic regression model adequately fits the observed data. Furthermore, the Nagelkerke R^2 value of 0.688 indicates that the independent variables included in the model explain approximately 68.8% of the variation in economic resilience, while the remaining 31.2% is attributable to other variables outside the research model. The Cox and Snell R^2 value of 0.516 further indicates that the model has a reasonably strong ability to explain the relationship between the independent variables and economic resilience.

Based on the estimation results and goodness-of-fit tests, the best-fitting binary logistic regression model was obtained as follows:

$$\hat{\pi}(X) = \frac{\exp\left(-1{,}677 + 22{,}196X_{3(1)} \pm 23{,}281X_{4(1)}\right)}{1 + \exp\left(-1{,}677 + 22{,}196X_{3(1)} \pm 23{,}281X_{4(1)}\right)}$$

In logit form:

$$\log\left(\frac{\hat{\pi}(X)}{1 - \hat{\pi}(X)}\right) = -1{,}677 + 22{,}196X_{3(1)} \pm 23{,}281X_{4(1)}$$

Effect of Adjusted Net Savings on Economic Resilience

Based on the logistic regression model presented in Table 4, *Adjusted Net Savings* (X3), adjusted for environmental damage caused by carbon emissions, has a positive and statistically significant effect on economic resilience (Y). The coefficient of 22.196, with a significance level of 0.085, indicates that the variable is statistically significant at the 10% level.

This result suggests that a higher level of *Adjusted Net Savings* (ANS) is associated with a greater probability that a country will exhibit a high level of economic resilience. ANS reflects a country's capacity to maintain the accumulation of net wealth while accounting for the depreciation of natural resources and environmental damage resulting from carbon emissions. Consequently, countries with higher ANS values tend to exhibit more sustainable resource management and development practices, which may contribute to stronger long-term economic resilience.

This finding is consistent with the concept of sustainable development, which emphasizes the importance of maintaining a balance between economic growth and environmental sustainability. Although previous studies, including Rangkuty et al. (2023), Wang & Wang (2020), Purba et al., (2024), and Rosadi et al. (2025) have predominantly examined the effect of *green finance* on economic growth, the findings of the present study suggest that environmental sustainability indicators such as ANS also play an important role in shaping a country's economic resilience. Furthermore, the World Bank recognizes *Adjusted Net Savings* as an important indicator for assessing long-term development sustainability because it reflects a country's capacity to preserve economic and environmental assets for future generations. Countries with low or negative ANS values tend to be more vulnerable to economic and environmental crises, whereas countries with higher ANS values are more likely to maintain economic stability in a sustainable manner.

Effect of Gross Domestic Product on Economic Resilience

GDP (X4) has a negative and statistically significant effect on economic resilience (Y). The estimated coefficient is -23.281, with a significance value of 0.069, indicating that GDP is statistically significant at the 10% level, although the direction of its effect is negative. This finding differs from the conventional expectation that countries with greater economic output should possess stronger capacity to withstand economic shocks. Economic resilience, however, represents a broader concept than the size of economic output alone. Putra (2022) describes economic resilience in terms of a country's capacity to maintain economic stability and sustain the living standards of its population. From this perspective, the magnitude of GDP alone may not fully represent the quality, sustainability, and adaptability of an economic system

The result may therefore reflect a distinction between economic size and economic resilience. A country may generate substantial economic output while remaining exposed to structural vulnerabilities, environmental degradation, external shocks, unequal distribution of economic benefits, or dependence on specific sectors. Azzahra et al. (2025) similarly emphasize that sustainable economic development requires an integrated consideration of economic, social, and environmental dimensions. Consequently, high economic output that is not supported by environmental sustainability and structural adaptability may not necessarily translate into stronger economic resilience.

Nevertheless, the result indicates that higher GDP does not necessarily reflect stronger economic resilience. One possible explanation is that GDP measures the total value of goods and services produced within a country over a given period but does not directly account for the distribution of welfare, social inequality, or environmental consequences associated with economic activity. Therefore, substantial increases in GDP may not necessarily represent inclusive and sustainable economic development.

Countries experiencing GDP growth accompanied by natural resource exploitation, environmental degradation, and income inequality may remain vulnerable to long-term economic risks. Within a sustainable development framework, a country's economic strength is therefore determined not merely by the magnitude of its economic output or growth rate, but also by the quality and resilience of its economic structure. This includes its capacity to respond effectively to various risks, including climate change, fluctuations in global markets, and potential public health crises.

Effect of Research and Development on Economic Resilience

The R&D variable does not exhibit a statistically significant effect on economic resilience. In the full model, R&D produced a coefficient of -0.314 with a p-value of 0.751 and was subsequently eliminated through the backward stepwise procedure. Thus, H1 is not supported by the empirical results.

The absence of a significant short-term relationship does not necessarily imply that R&D is economically unimportant. The contribution of R&D is generally realized through technological development, innovation, productivity improvements, and the creation of new products and production processes. According to the (*OECD Science, Technology and Innovation Outlook*, 2023), investment in R&D contributes to long-term economic growth by facilitating innovation and enhancing the capacity of economies to respond to emerging global challenges.

Similarly, Maritha, (2021) emphasizes the role of technological development, research, and innovation in supporting sustainable development. The benefits of R&D may therefore require considerable time before they are reflected in broader measures of economic resilience. This provides one possible explanation for the insignificant finding in the present study, which relies exclusively on cross-sectional observations for 2021.

The effectiveness of R&D may also depend on factors beyond the volume of expenditure itself, including national innovation capacity, institutional quality, research productivity, commercialization capacity, technological absorption, and the effectiveness with which research outputs are translated into economically productive activities. Consequently, a high level of R&D expenditure may not automatically result in greater economic resilience within the same period.

The insignificant result may therefore be attributable partly to the temporal characteristics of the data. The long-term effects emphasized by OECD (2023) are difficult to capture using a single-year cross-sectional design. Future studies using panel data and lagged R&D variables would be better positioned to evaluate whether research and innovation exert delayed effects on national economic resilience.

Effect of Green Finance on Economic Resilience

Green Finance (X2), proxied in this study by the *Green Growth Index*, has a positive coefficient in both Step 1 and Step 2 but does not achieve statistical significance. In the full model, its coefficient is 1.226 with a p-value of 0.235. Therefore, H2 is not supported by the empirical evidence.

This result differs from several previous studies reporting favorable economic effects of green financial development. Rangkuty et al. (2023) found that *green finance* significantly influences economic performance, while Purba et al. (2024), and Rosadi et al. (2025) similarly emphasize the contribution of environmentally oriented economic and financial policies to sustainable economic growth. Shen et al. (2024) also found that green finance contributes to strengthening environmental and economic resilience in the context of China's post-COVID-19 recovery.

However, the absence of statistical significance in the present study is not entirely inconsistent with the existing literature because previous empirical findings have not been uniform. Wang & Wang (2020), for example, identified circumstances in which *green finance* was negatively associated with *green growth*. This mixed evidence suggests that the effects of green financial development may be conditional on differences in institutional structures, stages of economic development, financial-market maturity, regulatory quality, and national environmental policies.

Judijanto & Al-Amin (2025) further emphasize that the transition toward a green economy requires broader structural transformation rather than the implementation of isolated financial initiatives. This suggests that financial mechanisms alone may be insufficient to generate measurable improvements in economic resilience unless they are accompanied by effective environmental regulation, technological development, institutional capacity, and sustainable investment.

Another possible explanation concerns the measurement of the variable. In the present study, *Green Finance* is represented by the *Green Growth Index*. While this indicator captures important dimensions of environmental sustainability and green-growth performance, it may not fully reflect the volume, depth, and effectiveness of specific green financial instruments such as green bonds, green credit, sustainable investment, or environmentally oriented bank lending. Consequently, the absence of statistical significance may partly reflect the proxy used rather than the complete absence of an underlying relationship between green financial development and economic resilience.

Overall, the results indicate that environmental sustainability, represented by the ANS-related indicator used in this study, exhibits a stronger statistical relationship with economic resilience than either R&D or the *Green Growth Index*. At the same time, the negative GDP coefficient demonstrates that the magnitude of economic output alone may not adequately characterize a country's capacity to withstand and recover from shocks. These findings reinforce the argument that economic resilience should be understood as a multidimensional phenomenon involving economic capacity, environmental sustainability, structural adaptability, and innovation (Putra, 2022; Azzahra et al. (2025); Shen et al. (2024).

Nevertheless, the findings should be interpreted within the limitations of the research design. The analysis is based on only 24 countries observed in a single year. Moreover, the very large coefficient estimates and wide confidence intervals in the final model indicate considerable statistical uncertainty. Future research employing larger cross-country samples, panel data, alternative measures of green finance, and lagged R&D indicators would therefore provide a stronger basis for evaluating the determinants of economic resilience.

Conclusions and Recommendations

Based on the binary logistic regression analysis, the variables found to have statistically significant effects on economic resilience are *Adjusted Net Savings* (X3) and GDP (X4). *Adjusted Net Savings*, adjusted for environmental damage caused by carbon emissions, has a positive and statistically significant effect on economic resilience. This finding supports the proposition that countries with higher levels of net savings after accounting for environmental degradation are more likely to achieve sustainable economic resilience. By contrast, GDP exhibits a negative and statistically significant effect on economic resilience. Although this finding appears inconsistent with conventional expectations, it indicates that economic performance reflected solely by an increase in *Gross Domestic Product* does not necessarily represent genuine economic resilience, particularly when economic expansion is not supported by inclusive, equitable, and environmentally sustainable growth. Meanwhile, the other variables, namely *Research and Development* (X1) and *Green Finance* (X2), do not exhibit statistically significant effects in the final logistic regression model. These findings suggest that, within the context of the model employed in this study, the contributions of R&D and *green finance* to economic resilience remain relatively weak or have not yet demonstrated sufficiently strong statistical relationships.

Based on these findings, future research should employ panel data covering a longer period to provide a more comprehensive assessment of the effects of *green finance* and R&D on economic resilience. The use of more specific indicators of *green finance* is also recommended to better capture the actual implementation of green financing practices across individual countries. Future studies should additionally consider a broader sample of countries and employ more systematically structured sample-selection criteria to improve the generalizability of the findings.

Research Limitations

This study is subject to several limitations. First, it relies on cross-sectional data for a single year, namely 2021, which limits its ability to capture the long-term dynamics of the relationships among the variables. Second, the study is limited to a sample of 24 countries because of incomplete data availability across the research variables. This relatively small sample may restrict the generalizability of the empirical findings. Accordingly, future studies are recommended to employ panel datasets covering longer time periods, thereby enabling a more comprehensive analysis of the dynamic effects of *green finance* and *Research and Development* on economic resilience.

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