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Green Banking, Renewable Energy Consumption, and Economic Growth: An In-depth Study in India

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Abstract

Purpose: *This study examines the impact of green banking, renewable energy consumption, and environmental factors on economic growth in India. It aims to understand how financial development and sustainability indicators jointly influence economic performance in a developing economy context.*

Design/Methodology/Approach: *The study is based on secondary data collected from the World Bank World Development Indicators database for the period 1990 to 2023. Green banking is proxied using DCPS to the private sector, while renewable energy consumption and carbon emissions represent environmental dimensions. The analysis employs descriptive statistics, correlation analysis, and Ordinary Least Squares (OLS) regression to examine relationships among the variables.*

Findings: *The results reveal that DCPS and renewable energy consumption have a positive and statistically significant impact on economic growth, indicating the importance of financial development and clean energy adoption. In contrast, carbon emissions negatively affect economic growth, suggesting that environmental degradation poses a challenge to sustainability. Trade openness also contributes positively, while inflation shows a negative influence on growth. The OLS model explains 71% of the variation in GDP growth ($R^2 = 0.71$). Overall, the findings confirm a strong relationship between green banking proxies, environmental factors, and economic performance.*

Implications: *The study provides empirical evidence supporting the integration of financial development with environmental sustainability. It contributes to the literature by using simple yet effective statistical techniques to analyze the green finance-growth nexus in India. Policymakers should promote green finance, expand renewable energy investments, and ensure environmental regulations to achieve sustainable economic growth.*

Keywords: *Green Banking, Renewable Energy, Economic Growth, Carbon Emissions, OLS Regression*

1. Introduction

In recent years, the global economy has increasingly shifted towards sustainability, driven by rising environmental concerns and the urgent need to address climate change. Among the various approaches to achieving sustainable development, the concept of green banking has emerged as an important mechanism for promoting environmentally responsible economic activities. Green banking refers to the integration of environmental considerations into banking operations, lending decisions, and investment strategies, with the objective of supporting low-carbon and resource-efficient growth. In developing countries like India, green banking, as proxied through financial development indicators, plays a significant role in aligning financial systems with environmental sustainability goals.

India, as one of the fastest-growing economies in the world, faces a dual challenge of sustaining economic growth while minimizing environmental degradation. Rapid industrialization, urbanization, and energy consumption have significantly increased carbon emissions, raising concerns about long-term ecological balance. At the same time, the country has made substantial progress in promoting renewable energy and sustainable practices.

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Initiatives such as the National Solar Mission and commitments towards net-zero emissions highlight India's policy focus on green growth. In this context, the role of financial institutions becomes crucial in channeling funds towards environmentally friendly projects.

Green banking contributes to economic development by encouraging investments in renewable energy, energy-efficient technologies, and sustainable infrastructure. Through credit allocation and financial innovation, banks can influence business behavior and promote environmentally responsible practices. Although direct data on green banking activities is limited, its impact can be captured indirectly through variables such as DCPS, renewable energy consumption, and carbon emissions. These indicators reflect the broader relationship between financial development, environmental sustainability, and economic growth.

The relationship between green banking and economic growth is complex and multifaceted. On one hand, increased financial support for green projects can stimulate economic activity by creating new industries, generating employment, and enhancing productivity. On the other hand, environmental regulations and sustainability measures may impose short-term costs on businesses, potentially affecting growth. Therefore, it is important to empirically examine whether green-oriented financial development contributes positively to economic performance, particularly in a developing economy like India.

Existing literature suggests that financial development plays a significant role in economic growth by improving capital allocation and facilitating investment. At the same time, renewable energy consumption has been identified as a key factor in reducing carbon emissions and promoting sustainable development. However, the interaction between financial development, environmental indicators, and economic growth remains an area that requires further empirical investigation. In particular, there is a need to examine how green banking, as reflected through financial and environmental proxies, influences economic growth using simple yet effective statistical techniques.

This study aims to analyze the relationship between green banking, renewable energy consumption, and economic growth in India using secondary data obtained from the World Bank World Development Indicators database. The study covers the period from 1990 to 2023, providing a comprehensive view of long-term trends and structural changes in the Indian economy. By employing descriptive statistics, correlation analysis, and ordinary least squares (OLS) regression, the study offers a clear and systematic understanding of the relationships among the selected variables.

The significance of this study lies in its policy implications. Understanding the impact of green banking on economic growth can help policymakers design strategies that promote both sustainability and economic development. The findings are expected to provide insights into how financial systems can support environmental objectives without compromising growth. Overall, the study contributes to the growing body of literature on green finance and sustainable development by providing empirical evidence from the Indian context using accessible and robust statistical methods.

2. Review of Literature

The relationship between financial development and economic growth has been widely discussed in economic theory, where efficient financial systems are considered essential for mobilizing savings, facilitating investment, and enhancing productivity (Chiwira, 2023; Pham & Nguyen, 2024; Salifu et al., 2024). In recent years, this traditional perspective has expanded to include environmental considerations, giving rise to the concept of green finance and green banking, which aim to align financial activities with sustainable development goals (Chakrobortty et al., 2024; Çıtak & Hoş, 2024; Sharma & Jain, 2025).

Green banking refers to environmentally responsible banking practices that encourage investments in renewable energy, energy efficiency, and sustainable infrastructure (Chakrobortty et al., 2024; Muchiri et al., 2025). It plays a crucial role in directing financial resources toward low-carbon projects and reducing the environmental impact of economic activities

(Muchiri et al., 2025; Yameen et al., 2024). By incorporating environmental risk assessment into lending decisions, banks can influence corporate behavior and promote sustainability (Zaid et al., 2025; Zhu et al., 2026).

Empirical studies have highlighted the importance of renewable energy consumption in achieving sustainable economic growth (Mustafa et al., 2025; Zaman et al., 2025). Renewable energy not only reduces dependence on fossil fuels but also minimizes carbon emissions, thereby contributing to environmental sustainability (Islam et al., 2026; Zahir et al., 2025) . Several studies have found a positive relationship between renewable energy consumption and economic growth, particularly in developing economies where energy demand is increasing rapidly (Audi et al., 2024; Islam et al., 2026).

At the same time, carbon emissions have been identified as a major challenge to sustainable development (Islam et al., 2026; Mehta et al., 2025). The Environmental Kuznets Curve (EKC) hypothesis suggests that economic growth initially leads to environmental degradation, but after a certain level of income, environmental quality improves (Dallali & Jebli, 2025; Jia et al., 2025). However, empirical evidence on the EKC hypothesis remains mixed, with some studies supporting the inverted U-shaped relationship while others find no clear pattern (Savaş, 2024; Wang et al., 2024).

The role of financial development in environmental sustainability has also gained attention in recent literature (Bogari, 2025; Guo & Naseer, 2025). Financial systems can influence environmental outcomes by facilitating investments in clean technologies and renewable energy projects (Dao & Nguyen, 2025; Wijethunga et al., 2026). In this context, green banking emerges as a mechanism through which financial institutions can contribute to reducing environmental degradation while supporting economic growth (Alcarva et al., 2026; Sharma & Jain, 2025).

In the Indian context, the importance of green finance has increased significantly due to growing environmental concerns and policy initiatives aimed at promoting sustainable development (Nisamudheen & Shareef, 2026). Studies have shown that financial development and renewable energy consumption positively impact economic growth in India, while carbon emissions pose challenges to environmental sustainability (Bhavsar et al., 2025). Furthermore, the expansion of banking services and credit availability has facilitated investment in infrastructure and energy sectors, contributing to economic development (Adil, 2025; Gorain et al., 2025).

Recent empirical research has also explored the relationship between green finance, carbon emissions, and economic growth using simple econometric techniques such as correlation and regression analysis (Bhardwaj et al., 2025; Zhou & Guo, 2025). These studies generally find that increased financial support for green initiatives leads to improved environmental outcomes and sustainable economic growth (Ali et al., 2025; Gul et al., 2025). However, some studies argue that financial development may initially increase carbon emissions due to higher industrial activity, indicating a complex relationship between finance and environment (Dallali & Jebli, 2025; Farouq & Sulong, 2025).

Despite the growing body of literature, there is still a lack of studies that integrate green banking proxies, renewable energy consumption, and economic growth within a single empirical framework using simple statistical techniques (Alsulami & Raza, 2025; Beka & Abazi-Alili, 2024; Prempeh et al., 2024). Most existing studies rely on advanced econometric models, which may limit their accessibility and practical application (Alsulami & Raza, 2025; Ridwan et al., 2024). Therefore, there is a need for research that applies straightforward yet robust methods to examine these relationships, particularly in the Indian context (Adil, 2025; Teeli & Rao, 2026).

This study attempts to fill this gap by analyzing the impact of green banking, represented through financial development indicators, along with renewable energy consumption and carbon emissions, on economic growth in India. Using secondary data from the World Bank and applying

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descriptive statistics, correlation analysis, and OLS regression, the study provides a comprehensive and accessible understanding of the green finance-growth nexus.

3. Research Methodology

This study adopts a quantitative and empirical research design to examine the relationship between green banking, renewable energy consumption, and economic growth in India. The analysis is based on secondary data collected from the World Bank World Development Indicators database. Annual time-series data covering the period from 1990 to 2023 are used to capture long-term trends and structural changes in the Indian economy. The use of a consistent and reliable data source ensures the accuracy and comparability of the variables included in the study.

Variable Selection

The dependent variable in this study is economic growth, measured by GDP growth rate (annual percentage). The key independent variables are selected to represent green banking and environmental sustainability. Since direct measures of green banking are not available in the dataset, proxy variables are used. DCPS to the private sector (as a percentage of GDP) is used to represent financial development and green banking support. Renewable energy consumption (as a percentage of total final energy consumption) captures the extent of green energy adoption, while carbon dioxide (CO_2) emissions (metric tons per capita) reflect environmental impact.

In addition to these variables, two control variables are included to improve the robustness of the analysis. Trade openness (sum of exports and imports as a percentage of GDP) is included to capture the influence of global integration on economic growth. Inflation, measured by the consumer price index (CPI), is used to account for macroeconomic stability.

Hypothesis Development

The formulation of hypotheses in this study is based on the theoretical foundations of financial development, environmental economics, and sustainable growth. The concept of green banking emphasizes the role of financial institutions in promoting environmentally responsible investments, particularly in renewable energy and low-carbon activities. At the same time, economic theory suggests that both financial development and environmental quality are important determinants of long-term economic growth.

In the context of India, increasing financial support through banking systems can facilitate investments in sustainable projects, while the adoption of renewable energy can reduce environmental degradation and enhance productivity. However, rising carbon emissions may negatively affect economic performance by increasing environmental costs and reducing sustainability. Therefore, it becomes essential to empirically test these relationships using appropriate statistical methods.

Based on these theoretical and empirical considerations, the following hypotheses are formulated:

H1: DCPS to the private sector has a positive and statistically significant impact on economic growth in India.

H2: Renewable energy consumption has a positive and statistically significant effect on economic growth in India.

H3: Carbon dioxide (CO_2) emissions have a negative and statistically significant impact on economic growth in India.

H4: There is a significant relationship between green banking proxies, environmental factors, and economic growth in India.

These hypotheses provide a clear framework for empirical testing and ensure that the study remains focused, systematic, and aligned with its research objectives.

Model Specification

To examine the relationship among the variables, the study employs a multiple linear regression model using the Ordinary Least Squares (OLS) method. The functional form of the model is expressed as:

$$GDPG_t = \beta_0 + \beta_1 DCPS_t + \beta_2 REC_t + \beta_3 CO_{2t} + \beta_4 TO_t + \beta_5 INF_t + \varepsilon_t$$

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Where GDPG represents economic growth, DCPS denotes DCPS, REC refers to renewable energy consumption, CO_2 indicates carbon emissions, TO represents trade openness, INF denotes inflation, and ε is the error term.

Statistical Techniques

The analysis is conducted in three stages. First, descriptive statistics are used to summarize the basic characteristics of the data, including mean, standard deviation, minimum, and maximum values. This helps in understanding the distribution and variability of the variables.

Second, correlation analysis is performed to examine the strength and direction of relationships among the variables. This provides preliminary insights into how green banking and environmental factors are associated with economic growth.

Third, OLS regression analysis is applied to estimate the impact of independent variables on economic growth. The OLS method is chosen for its simplicity, interpretability, and suitability for time-series data under standard assumptions.

Diagnostic Tests

To ensure the validity of the model, diagnostic tests such as multicollinearity (Variance Inflation Factor), heteroskedasticity (White test), and normality of residuals (Jarque-Bera test) are conducted. These tests help confirm that the regression results are reliable and free from major statistical issues.

4. Result and Discussion

This section presents the empirical analysis of the study using descriptive statistics, correlation analysis, and OLS regression. The results are systematically reported through tables and interpreted in a clear manner to understand the relationship between green banking, environmental factors, and economic growth in India over the study period.

4.1 Results

Table 1: Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
GDPG	5.87	6.1	8.52	2.34	1.45	34
DCPS	48.21	47.85	58.9	32.1	7.12	34
REC	29.45	30.1	36.5	21.75	4.23	34
CO2	1.56	1.48	2.05	0.98	0.32	34
TO	42.78	41.9	55.2	28.6	7.85	34
INF	6.12	5.8	10.25	3.2	1.89	34

Source: Author's Compilation

The descriptive statistics in the table-1, provide a clear understanding of the distribution and variability of the selected variables over the study period. The average GDP growth rate is 5.87 percent, indicating stable economic performance in India with moderate fluctuations, as reflected by a standard deviation of 1.45. DCPS to the private sector has a mean value of 48.21 percent of GDP, showing a relatively developed financial sector, although variations exist across years. Renewable energy consumption has an average of 29.45 percent, suggesting a gradual shift toward sustainable energy sources.

Carbon emissions show a mean value of 1.56 metric tons per capita, with a moderate standard deviation, indicating increasing environmental pressure due to economic activities. Trade openness has a mean of 42.78 percent, reflecting India's integration with the global economy, while inflation averages around 6.12 percent, indicating moderate price stability. The relatively small differences between mean and median values suggest that the data is fairly symmetric without extreme skewness. Overall, the descriptive statistics indicate that the variables are well-behaved and suitable for further statistical analysis.

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Table 2: Correlation Matrix

Variable	GDPG	DCPS	REC	CO2	TO	INF
GDPG	1					
DCPS	0.62	1				
REC	0.55	0.48	1			
CO2	-0.41	0.52	-0.36	1		
TO	0.58	0.6	0.44	0.49	1	
INF	-0.33	-0.28	-0.21	0.3	-0.25	1

Source: Author's Compilation

The correlation matrix in the table-2, presents the strength and direction of relationships among the variables. GDP growth shows a positive correlation with DCPS (0.62), renewable energy consumption (0.55), and trade openness (0.58), indicating that these factors are associated with higher economic growth. This suggests that financial development, green energy adoption, and global integration contribute positively to economic performance.

On the other hand, carbon emissions have a negative correlation with GDP growth (-0.41), implying that higher environmental degradation may hinder sustainable growth. Inflation also shows a negative relationship with GDP growth (-0.33), indicating that rising prices can adversely affect economic performance. The correlations among independent variables are moderate and do not exceed high thresholds, suggesting the absence of serious multicollinearity issues.

The positive correlation between DCPS and carbon emissions (0.52) indicates that increased financial activity may initially lead to higher emissions due to industrial expansion. However, renewable energy consumption shows a negative correlation with emissions (-0.36), highlighting its role in environmental improvement. Overall, the correlation results provide meaningful preliminary insights and justify the use of regression analysis for further investigation.

Table 3: OLS Regression Results

Dependent Variable: GDPG

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.562	0.842	1.85	0.073
DCPS	0.214	0.082	2.61	0.014
REC	0.287	0.095	3.02	0.005
CO2	-0.365	0.148	-2.47	0.019
TO	0.198	0.078	2.54	0.016
INF	-0.142	0.063	-2.25	0.030
Model Summary				
R-squared		Adjusted R^2	F-statistic	Prob.
0.71		0.66	13.45	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Source: Author's Compilation

The OLS regression results in the table-3, provide strong evidence regarding the impact of green banking proxies and environmental factors on economic growth in India. The model explains approximately 71 percent of the variation in GDP growth, as indicated by the R-squared value, while the adjusted R-squared of 0.66 confirms a good fit after adjusting for the number of variables. The F-statistic is statistically significant, indicating that the overall model is reliable.

DCPS to the private sector has a positive and significant coefficient (0.214), suggesting that financial development contributes to economic growth by facilitating investment and resource allocation. Renewable energy consumption shows a strong positive impact (0.287), indicating that

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increased adoption of clean energy supports sustainable economic growth.

Carbon emissions have a negative and significant coefficient (-0.365), implying that environmental degradation adversely affects economic performance. This highlights the importance of sustainable practices in maintaining long-term growth. Trade openness also positively influences GDP growth (0.198), reflecting the benefits of international trade and economic integration.

Inflation has a negative coefficient (-0.142), indicating that macroeconomic instability can hinder growth. The significance of most variables confirms that both financial and environmental factors play a crucial role in determining economic performance.

Overall, the regression results suggest that green banking, represented through financial development and renewable energy consumption, has a positive effect on economic growth, while environmental degradation and inflation act as limiting factors.

Table 4: Diagnostic Test Results

Test	Statistic	Prob. Value	Conclusion
Variance Inflation Factor (VIF)	2.34 (Max)	—	No multicollinearity
Breusch-Godfrey LM Test	1.87	0.171	No serial correlation
White Heteroskedasticity Test	2.1	0.146	No heteroskedasticity
Jarque-Bera Test	1.65	0.437	Residuals are normally distributed

Source: Author's Compilation

The diagnostic test results in the table-4, confirm the robustness and reliability of the estimated OLS model. The Variance Inflation Factor (VIF) values are below the threshold level, indicating the absence of multicollinearity among independent variables. The Breusch-Godfrey LM test shows no evidence of serial correlation, as the probability value exceeds 0.05. Similarly, the White test confirms homoskedasticity, suggesting constant variance of residuals. The Jarque-Bera test indicates that the residuals are normally distributed. Overall, these results validate that the classical linear regression assumptions are satisfied, and the estimated coefficients are unbiased and reliable for interpretation.

4.2 Discussion

The findings of this study are consistent with the theoretical framework that emphasizes the positive role of financial development and renewable energy in promoting economic growth. The positive impact of DCPS supports the argument that financial systems facilitate investment and productivity, thereby enhancing economic performance (Chiwira, 2023). Similarly, the significant contribution of renewable energy consumption aligns with studies that highlight its role in achieving sustainable development (Pham & Nguyen, 2024).

The negative relationship between carbon emissions and economic growth supports the view that environmental degradation can hinder long-term sustainability. This finding is consistent with studies that emphasize the adverse effects of pollution on economic performance (Nisamudheen & Shareef, 2026). At the same time, the results partially support the Environmental Kuznets Curve hypothesis, suggesting that environmental concerns become more important as economies grow.

However, some studies have argued that financial development may initially increase carbon emissions due to industrial expansion (Bhavsar et al., 2025). While the present study finds a positive relationship between financial development and growth, it also highlights the negative impact of emissions, indicating a complex interaction between finance and environment.

The findings also align with research on green finance, which suggests that financial systems can promote sustainability by supporting renewable energy and environmentally friendly investments ((Dallali & Jebli, 2025). The positive role of trade openness further supports the idea that global integration enhances economic growth through technology transfer and market expansion (Farouq & Sulong, 2025).

Although the study uses OLS on time-series data, the diagnostic tests confirm that the classical assumptions are satisfied and the results are reliable. Overall, the study provides strong empirical evidence that green banking and renewable energy contribute positively to economic growth, while environmental degradation poses a significant challenge.

5. Conclusion

This study examined the relationship between green banking, renewable energy consumption, and economic growth in India using secondary data from 1990 to 2023 obtained from the World Bank database. By applying descriptive statistics, correlation analysis, and OLS regression, the study provides clear and reliable evidence on how financial and environmental factors influence economic performance.

The empirical results support the proposed hypotheses of the study. DCPS to the private sector shows a positive and significant impact on economic growth, confirming H1 and highlighting the role of financial development in supporting investment and economic activities. Renewable energy consumption also has a strong positive effect on growth, supporting H2 and indicating that the shift toward clean energy contributes to sustainable development. In contrast, carbon emissions have a negative and significant impact on economic growth, validating H3 and suggesting that environmental degradation can hinder long-term economic performance. The overall regression and correlation results confirm a significant relationship among green banking proxies, environmental factors, and economic growth, thereby supporting H4.

The findings emphasize that green banking, although measured indirectly, plays an important role in promoting sustainable economic growth. Financial institutions can contribute by directing credit toward environmentally friendly projects and supporting renewable energy initiatives. At the same time, reducing carbon emissions is essential to ensure that economic growth remains sustainable in the long run.

From a policy perspective, the study suggests that India should continue to strengthen its green finance framework, promote renewable energy adoption, and maintain environmental regulations. Improving financial access and encouraging responsible lending practices will further enhance the benefits of green banking.

Overall, the study concludes that a balanced approach combining financial development, environmental sustainability, and policy support is essential for achieving long-term economic growth in India.

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