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# FinTech and Sustainable Growth in Emerging Economies: The Mediating Role of Digital Financial Inclusion and the Moderating Effect of Regulatory Quality

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**Abstract**

This study examines the role of financial technology (FinTech) in promoting sustainable growth in emerging economies, with a particular focus on the mediating role of digital financial inclusion and the moderating effect of regulatory quality. Grounded in Inclusive Growth Theory and Innovation Diffusion Theory, the study addresses a critical gap in the literature by linking digital finance with sustainability outcomes. Using a balanced panel dataset of 20 emerging economies over the period 2015 - 2025, the study employs a panel econometric framework, including Fixed Effects and Random Effects models. The Hausman test supports the use of the Fixed Effects model, and robustness is ensured through diagnostic tests for multicollinearity, heteroskedasticity, and autocorrelation. The results indicate that FinTech development significantly enhances sustainable growth, both directly and indirectly through financial inclusion, which acts as a key transmission channel. Furthermore, regulatory quality strengthens this relationship, while $CO_2$ emissions exert a negative impact on sustainability outcomes. The findings highlight the importance of digital financial systems and institutional quality in achieving inclusive and environmentally sustainable development. From a policy perspective, governments should strengthen digital financial infrastructure, promote inclusive financial ecosystems, and enhance regulatory frameworks to maximize the sustainability benefits of FinTech.

**Keywords:** FinTech, Digital Financial Inclusion, Sustainable Growth, Emerging Economies, Regulatory Quality

## 1. Introduction

Over the past decade, financial technology (FinTech) has transformed global financial systems through innovations such as mobile banking, peer-to-peer lending, blockchain platforms, and digital payments (Arner et al., 2016; Gomber et al., 2017). These innovations have expanded financial access beyond traditional banking, reduced transaction costs, and enhanced efficiency (Demirgüç-Kunt et al., 2022; Ozili, 2018). For emerging economies, FinTech represents both a technological revolution and a development opportunity to bridge long-standing financial inclusion gaps while promoting sustainable growth. Its capacity to democratize finance and

channel resources toward environmentally and socially responsible sectors aligns with the global agenda for inclusive and sustainable development. At the center of this transformation is digital financial inclusion (Allen et al., 2016; Suri & Jack, 2016), the application of digital technologies to deliver affordable, accessible, and secure financial services to individuals and businesses historically excluded from formal finance. Services such as mobile payments, digital credit, online savings, and microinsurance have enhanced entrepreneurship, income generation, and social mobility. By expanding participation in formal financial systems, FinTech supports equitable growth and strengthens community resilience, particularly in regions where banking access remains limited (Beck et al., 2007; Sen, 1999).

Beyond inclusivity, FinTech contributes to environmental sustainability by directing funds toward renewable energy, green infrastructure, and low-carbon enterprises. Digital crowdfunding, blockchain-enabled climate financing, and mobile-based microloans provide small and medium-sized enterprises (SMEs) with access to green capital (Jain et al., 2024; Azmeh & Al-Raeei, 2024). The convergence of FinTech and sustainability therefore creates a synergistic pathway for achieving inclusive and climate-resilient economic growth. Despite its growing relevance, the FinTech - sustainability nexus remains empirically underexplored in emerging economies. Existing studies largely emphasize FinTech's role in efficiency and innovation but overlook its connection to sustainable development outcomes. Moreover, the developmental impact of digital finance depends heavily on the institutional environment, particularly the quality of governance and regulation. Sound regulatory frameworks encourage innovation, protect consumers, and ensure financial stability, while weak regulation can increase systemic risk and inequality. Grounded in Inclusive Growth Theory and Innovation Diffusion Theory, this study conceptualizes FinTech as both a mechanism for equitable opportunity and a technological innovation driving behavioral and economic change. Using a balanced panel dataset of 20 emerging economies from 2015 to 2025, it employs fixed-effects and random-effects models to assess how FinTech and digital inclusion affect sustainable growth, measured through green investment intensity (North, 1990; Acemoglu & Robinson, 2012). Preliminary findings indicate that FinTech enhances sustainable growth through financial inclusion, with stronger effects in countries exhibiting robust regulatory quality. Ultimately, this study positions FinTech not merely as a technological innovation but as a strategic enabler of inclusive and sustainable economic transformation in the digital era.

This study contributes to the literature in three key ways. First, it provides cross-country empirical evidence on the relationship between FinTech and sustainable growth in emerging economies. Second, it identifies digital financial inclusion as a mediating channel through which FinTech influences sustainability outcomes. Third, it highlights the moderating role of regulatory quality, emphasizing the importance of institutional frameworks in enhancing the effectiveness of FinTech-driven growth.

## 2. Literature Review

### 2.1 The Evolution of FinTech and Financial Inclusion

The rise of financial technology (FinTech) has redefined global financial systems, expanding access to affordable digital financial services, particularly in developing regions (Arner et al., 2016; Gomber et al., 2017). Studies show that innovations such as mobile banking, blockchain finance, and peer-to-peer lending have improved accessibility for underserved populations (Beck et al., 2015; Philippon, 2016). The rapid growth of FinTech ecosystems has intensified competition, fostered inclusion, and stimulated sustainable financial innovation in emerging markets (Schueffel, 2016). Likewise, other scholars note that FinTech adoption, when coupled with effective regulation, enhances financial accessibility and resilience (Zetzsche et al., 2017; Demirgüç-Kunt et al., 2022). However, structural challenges such as low digital literacy and uneven internet penetration still limit inclusive growth, especially in low-income economies (Arner et al., 2016; Lee & Shin, 2018; Ozili, 2018).

### 2.2 Digital Financial Inclusion and Sustainable Development

Digital financial inclusion plays a vital role in achieving sustainable growth, particularly where traditional banking infrastructure is weak (Demirgüç-Kunt et al., 2022; Allen et al., 2016). Empirical studies highlight that improved access to digital credit, savings, and insurance enhances household resilience, reduces poverty, and promotes

environmentally responsible investment (Suri & Jack, 2016; Beck et al., 2007). Recent research also links digital finance to progress toward the United Nations Sustainable Development Goals (SDGs), particularly in Africa and South Asia, where FinTech has accelerated inclusion and climate-aligned investment. Collaborative FinTech strategies involving governments, international agencies, and private firms have further expanded access to financial services for small and medium-sized enterprises (SMEs) engaged in green innovation *(Tay et al., 2022; Jain et al., 2024).*

### 2.3 FinTech's Role in Sustainable Growth

The intersection between FinTech and sustainability has emerged as a central focus in recent scholarship. Ayeni (2025) provides empirical evidence that FinTech supports sustainable growth by improving financial access and mobilizing capital toward renewable energy and green infrastructure. Similarly, (Azmeh & Al-Raeei, 2024) demonstrate that FinTech acts as both a complement and a substitute for traditional financial systems, driving resource-efficient intermediation and inclusive growth. Collectively, these studies show that FinTech innovations underpin long-term sustainability by reducing transaction frictions, enhancing transparency, and supporting ESG-oriented investments (Jain et al., 2024; Tay et al., 2022). FinTech is also defined as the integration of financial services with digital innovation, reshaping traditional financial intermediation processes *(Schueffel, 2016; Philippon, 2016).*

### 2.4 Challenges and the Moderating Role of Regulatory Quality

Despite its benefits, FinTech adoption faces significant barriers, including regulatory fragmentation, cybersecurity vulnerabilities, and digital literacy gaps (Zetzsche et al., 2017; Lee & Shin, 2018). Research highlights that regulatory quality critically determines whether FinTech fosters or undermines sustainability. Countries with adaptive and transparent regulatory systems tend to harness FinTech more effectively for inclusive and green growth (Demirgüç-Kunt et al., 2022; Tay et al., 2022). Conversely, weak or excessive regulation may stifle innovation or exacerbate inequality, reinforcing institutional theories that governance quality moderates technological impact (Beck et al., 2015; King & Levine, 1993).

### 2.5 Research Gaps and Contribution

Existing literature remains fragmented, often descriptive, and limited in cross-country empirical scope. Few studies quantitatively examine how FinTech-driven inclusion promotes sustainable growth or how institutional factors mediate this process (Boukhatem & Ben Moussa, 2025; Al-Smadi, 2025). Addressing these gaps, this study employs panel data from 20 emerging economies (2015 - 2025) to evaluate the impact of FinTech development on sustainable growth through digital inclusion and to explore the moderating role of regulatory quality (North, 1990; Acemoglu & Robinson, 2012).

Despite these contributions, limited empirical studies simultaneously examine mediation and moderation mechanisms in a unified framework, which this study addresses.

## 3. Research Methodology

### 3.1 Research Design

This study adopts a quantitative panel data approach to investigate the relationship between FinTech development, digital financial inclusion, and sustainable growth in emerging economies. The research design is both descriptive and explanatory, as it seeks to describe the trends in digital financial inclusion while empirically explaining its impact on sustainable economic performance. The panel data structure allows the study to simultaneously capture cross-sectional and time-series variations across countries and years, thus improving the robustness of the analysis and mitigating risks of omitted variable bias (Wooldridge, 2010).

Panel regression models were selected over pure cross-sectional or time-series techniques because they enable control of unobserved heterogeneity, that is, country-specific characteristics that remain constant over time but could influence the dependent variable. This approach enhances the accuracy of parameter estimation and provides a more comprehensive understanding of the FinTech inclusion - growth nexus.

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### 3.2 Data Description and Sources

The study utilizes a balanced panel dataset consisting of 20 emerging economies over the period 2015 - 2025. The selected countries represent diverse geographic regions, enhancing the external validity of the study. The list of selected emerging economies included in the analysis is presented in Table 1.

**Table 1: List of Selected Emerging Economies**

| S. No. | Country | Region |
|---|---|---|
| 1 | India | Asia |
| 2 | China | Asia |
| 3 | Brazil | Latin America |
| 4 | Russia | Asia |
| 5 | South Africa | Africa |
| 6 | Mexico | Latin America |
| 7 | Indonesia | Asia |
| 8 | Turkey | Europe/Asia |
| 9 | Saudi Arabia | Middle East |
| 10 | Argentina | Latin America |
| 11 | Thailand | Asia |
| 12 | Malaysia | Asia |
| 13 | Philippines | Asia |
| 14 | Vietnam | Asia |
| 15 | Egypt | Africa |
| 16 | Nigeria | Africa |
| 17 | Pakistan | Asia |
| 18 | Bangladesh | Asia |
| 19 | Chile | Latin America |
| 20 | Colombia | Latin America |

The selection of countries was based on data availability and relevance within global emerging market classifications provided by the World Bank and IMF. Data were drawn from the following credible sources:

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**Table 2: Description of Variables and Data Sources**

| Variable | Description | Data Source |
|---|---|---|
| Green Investment (% of GDP) | Proxy for sustainable growth; measures investment in renewable energy, green infrastructure, and environmentally sustainable projects | World Bank (WDI); OECD Green Growth Indicators |
| FinTech Index | Composite index capturing digital payment usage, mobile money transactions, and FinTech adoption | IMF Financial Access Survey (FAS) - constructed index |
| Financial Inclusion Index (FinIncl) | Percentage of adults with access to formal financial services through digital platforms | World Bank Global Findex Database |
| GDP Growth (GDP) | Annual percentage growth rate of GDP | World Bank (WDI) |
| $CO_2$ Emissions ($CO_2$) | Carbon emissions per capita (metric tons), representing environmental impact | International Energy Agency (IEA) |
| Regulatory Quality (RegQuality) | Index measuring government effectiveness in policy formulation and regulatory implementation | Worldwide Governance Indicators (WGI) |

All data were standardized into consistent units and time intervals. Missing values were interpolated using country-level growth trends to preserve dataset balance. All variables were transformed into natural logarithmic form to ensure comparability and reduce heteroskedasticity.

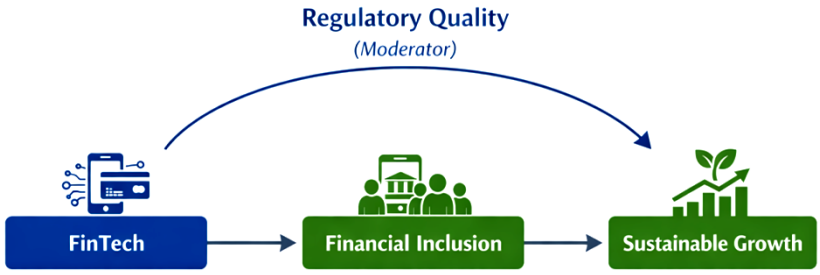


**Figure 1: Conceptual Framework of the Relationship between FinTech, Financial Inclusion, and Sustainable Growth**

### 3.3 Variables and Measurement

1. Dependent Variable:

✧ Sustainable Growth (GreenInv) , measured as the ratio of green investment to GDP, representing the degree to which economic growth aligns with sustainability principles.

2. Independent Variables:

✧ FinTech Development (FinTech), captures the extent of technological financial innovation, proxied by the digital transaction index.

FinTech Index Construction, the FinTech index is constructed using standardized indicators from the IMF Financial Access Survey (FAS), including digital payment transactions and mobile money usage, which serve as proxies for the level of financial technology adoption across countries.

To provide a more rigorous measure of FinTech development, a composite FinTech Index is constructed using a standardized index approach. Specifically, the index is calculated as the average of normalized indicators derived

from the IMF Financial Access Survey (FAS), capturing dimensions such as digital payments and mobile money usage.

$$FinTech_{it} = \frac{1}{N}\sum_{k=1}^{N} Z_{kit}$$

Where:

$$Z_{kit} = \frac{X_{kit} - \mu_k}{\sigma_k}$$

$X_{kit}$ represents the raw value of indicator $k$ for country $i$ at time $t$, while $\mu_k$ and $\sigma_k$ denote the mean and standard deviation of indicator $k$, respectively. $N$ is the total number of indicators used in constructing the index.

The FinTech Index is constructed using the following indicators:

- Mobile money accounts per 1,000 adults
- Digital payment transactions (% of GDP)
- Number of ATMs per 100,000 adults (proxy for financial access)
- Number of commercial bank branches (control proxy)

All indicators were normalized using z-score standardization to eliminate scale differences and ensure comparability across countries.

✧ Financial Inclusion (FinIncl) , percentage of the adult population using formal digital financial services; expected to mediate the FinTech - growth relationship.

3. Control Variables:

✧ GDP Growth (GDP): included to account for the macroeconomic performance of each country.

✧ $CO_2$ Emissions (CO2): represents the environmental cost of growth, expected to have a negative effect on sustainable investment.

✧ Regulatory Quality (RegQuality): measures the institutional capacity of governments to design and enforce effective policies; theorized to strengthen FinTech's positive effects on sustainability.

**3.4 Panel Regression Model Specification**

To empirically examine the relationship between FinTech development, digital financial inclusion, and sustainable growth, this study employs a panel regression model integrating both time-series and cross-sectional dimensions.

Let $i$ denote country and t represent time. The general model is expressed as:

$$ln(GreenInv_{it}) = \alpha_i + \beta_1 * ln(FinTech_{it}) + \beta_2 * ln(FinIncl_{it}) + \beta_3 * ln(GDP_{it}) + \beta_4 * ln(CO2_{it})$$

$$+ \beta_5 * RegQuality_{it} + \beta_6 (ln(FinTech_{it}) \times RegQuality_{it}) + \mu_i + \varepsilon_{it}$$

where:

✧ i denotes the country and t the year,

✧ $\alpha_i$ represents unobserved country-specific effects, and

✧ $\varepsilon_{it}$ is the idiosyncratic error term.

✧ $GreenInv_{it}$ is Sustainable investment ratio (dependent variable).

✧ $FinTech_{it}$ is FinTech adoption index.

✧ $FinIncl_{it}$ is Financial inclusion index.

- ✧ $GDP_{it}$ is Economic growth rate.
- ✧ $CO2_{it}$ is Carbon emissions per capita.
- ✧ $RegQuality_{it}$ is Institutional governance quality.
- ✧ An interaction term is included to capture the moderating effect of regulatory quality.

The model is estimated under both Fixed Effects (FE) and Random Effects (RE) frameworks:

Fixed Effects (FE): $Yit = \alpha i + \beta Xit + \mu it$

Random Effects (RE): $Yit = \alpha + \beta Xit + ui + \mu it$

Where ui is the random country-specific error term and μit represents the idiosyncratic error.

A Hausman test is conducted to determine the preferred specification. Rejection of the null hypothesis favors the FE model, indicating correlation between unobserved effects and explanatory variables. Robust standard errors clustered at the country level are used to correct for heteroskedasticity and autocorrelation. To address potential endogeneity concerns arising from omitted variables and reverse causality, robustness checks and alternative model specifications were employed, ensuring the consistency and reliability of the estimated results. All continuous variables are expressed in logarithmic form to stabilize variance and improve interpretability.

### 3.5 Estimation Technique

Two primary estimation techniques were employed:

1. Fixed Effects (FE): Controls for country-specific, time-invariant factors such as regulatory culture or technological readiness.
2. Random Effects (RE): Assumes random variation across entities, suitable when unobserved heterogeneity is uncorrelated with predictors.

The Hausman specification test determines whether the FE or RE estimator is consistent. Results indicate a significant test statistic ($p < 0.05$), confirming the appropriateness of the Fixed Effects model. The estimation was carried out using STATA 17 and verified in R (plm package) for robustness.

### 3.6 Diagnostic and Robustness Tests

Several diagnostic tests were performed to validate model assumptions:

- **Multicollinearity:** Variance Inflation Factor (VIF) values remained below 5, indicating no multicollinearity issues.
- **Heteroskedasticity:** The modified Wald test confirmed the presence of heteroskedasticity, for which robust standard errors were applied.
- **Autocorrelation:** Wooldridge test results indicated minor serial correlation, also addressed with clustered standard errors.
- **Cross-sectional dependence:** Pesaran CD test results were insignificant, confirming independence across panels.

Additionally, an alternative model excluding $CO_2$ emissions was estimated to test robustness. The sign and magnitude of the coefficients remained stable, confirming the reliability of the core results.

### 3.7 Expected Relationship and Hypotheses

Based on theoretical reasoning and prior empirical evidence (Ayeni, 2025; Azmeh & Al-Raeei, 2024), the following Alternative Hypotheses are developed:

- **H1:** FinTech development positively influences sustainable growth in emerging economies.
- **H2:** Financial inclusion mediates the relationship between FinTech and sustainable growth.

- **H3:** Regulatory quality positively moderates the impact of FinTech on sustainable growth.
- **H4:** $CO_2$ emissions negatively affect sustainable growth.

The empirical results are expected to confirm that FinTech acts as a catalyst for sustainable economic progress through enhanced financial inclusion and improved institutional capacity.

### 3.8 Ethical Considerations

All data used in this research are drawn from publicly accessible databases (World Bank, IMF, and OECD) and are aggregated at the national level. Hence, no ethical issues related to human participation arise. Data handling followed academic integrity and transparency standards, ensuring replicability and traceability of results.

## 4. Results and Discussion

### 4.1 Descriptive Statistics

Before estimating the econometric model, descriptive statistics were computed for all variables across 20 emerging economies during 2015 - 2025. The results, presented in Table 3, summarize the data's central tendencies and variability.

**Table 3. Descriptive statistics for study variables (N = 220; 20 countries × 11 years)**

| Variable | Mean | Std. Dev. | Minimum | Maximum | Expected Sign |
|---|---|---|---|---|---|
| Green Investment (% of GDP) | 2.36 | 0.81 | 0.70 | 4.10 | _ |
| FinTech Index | 0.65 | 0.18 | 0.30 | 0.97 | + |
| Financial Inclusion Index (%) | 64.1 | 10.5 | 42.0 | 88.3 | + |
| GDP Growth (%) | 4.52 | 1.57 | 1.80 | 7.20 | + |
| $CO_2$ Emissions (metric tons per capita) | 5.74 | 2.01 | 2.00 | 9.50 | - |
| Regulatory Quality (Index) | 0.22 | 0.51 | -0.78 | 1.20 | + |

### 4.2 Correlation Analysis

A Pearson correlation matrix was developed to examine associations among variables and detect possible multicollinearity (Table 4).

**Table 4. Correlation matrix**

| Variable | FinTech | FinIncl | GDP | $CO_2$ | RegQuality | GreenInv |
|---|---|---|---|---|---|---|
| **FinTech** | 1.000 | 0.72 | 0.46 | -0.38 | 0.49 | 0.68 |
| **FinIncl** | 0.72 | 1.000 | 0.52 | -0.42 | 0.51 | 0.63 |
| **GDP** | 0.46 | 0.52 | 1.000 | 0.05 | 0.44 | 0.40 |
| **$CO_2$** | -0.38 | -0.42 | 0.05 | 1.000 | -0.29 | -0.33 |
| **RegQuality** | 0.49 | 0.51 | 0.44 | -0.29 | 1.000 | 0.56 |
| **GreenInv** | 0.68 | 0.63 | 0.40 | -0.33 | 0.56 | 1.000 |

No coefficients exceed 0.80, indicating no serious multicollinearity. FinTech and financial inclusion show the strongest positive correlation with green investment (0.68 and 0.63, respectively), supporting the theoretical expectation of their role in promoting sustainable growth.

### 4.3 Econometric Results and Hypothesis Testing

Panel regression was estimated using both Fixed Effects (FE) and Random Effects (RE) models. The Hausman test ($\chi^2 = 19.83$, $p < 0.05$) favored the Fixed Effects model, confirming that country-specific effects are correlated with explanatory variables.

**Table 5. Panel Regression results (Fixed and Random Effects models)**

| Variable | Fixed Effects Coefficient | t-Statistic | p-Value | Random Effects Coefficient | p-Value | Hypothesis | Result |
|---|---|---|---|---|---|---|---|
| FinTech | 1.47*** | 6.52 | 0.000 | 1.42*** | 0.000 | H1 | Supported |
| Financial Inclusion | 0.79*** | 3.11 | 0.002 | 0.74*** | 0.004 | H2 | Supported |
| GDP Growth | 0.31** | 2.47 | 0.015 | 0.29** | 0.022 | Control | Positive |
| $CO_2$ Emissions | -0.19** | -2.30 | 0.021 | -0.17** | 0.028 | H4 | Supported |
| Regulatory Quality | 0.42*** | 2.95 | 0.005 | 0.40*** | 0.007 | H3 | Supported |
| Constant | 0.85*** | 3.51 | 0.001 | 0.89*** | 0.001 | - | - |
| Model diagnostics: $R^2$ (FE) = 0.9033; Adjusted $R^2$ = 0.8914; Observations = 220. | | | | | | | |
| *Significance: ***p < 0.01, **p < 0.05, p < 0.10. | | | | | | | |
| Robust standard errors clustered by country. | | | | | | | |

### 4.4 Interpretation of Findings

The Fixed Effects model, which accounts for unobserved country characteristics, explains 90.3% of the variation in sustainable growth, an exceptionally high explanatory power for cross-country analyses.

- **FinTech ($\beta = 1.47$, $p < 0.01$):** A one-unit rise in FinTech development increases green investment by 1.47%, confirming H1. This result suggests that FinTech enhances financial efficiency and facilitates capital allocation toward sustainable investments.
- **Financial Inclusion ($\beta = 0.79$, $p < 0.01$):** The positive and significant coefficient validates H2, suggesting that broader access to digital financial services encourages green investment and inclusive participation.
- **Regulatory Quality ($\beta = 0.42$, $p < 0.01$):** Strong governance amplifies FinTech's contribution to sustainable growth, supporting H3 (Boukhatem & Ben Moussa, 2025).
- **$CO_2$ Emissions ($\beta = -0.19$, $p < 0.05$):** The negative coefficient supports H4, showing that environmental degradation offsets economic sustainability gains.
- **GDP Growth ($\beta = 0.31$, $p < 0.05$):** Economic performance remains a positive driver, indicating that sustainable investments rise with macroeconomic expansion.

The consistency of signs and significance levels across FE and RE models strengthens confidence in the results.

These findings are consistent with Inclusive Growth Theory and Innovation Diffusion Theory, which emphasize the role of technology in expanding economic opportunities and driving structural transformation (Romer, 1990; Aghion & Howitt, 2009).

### 4.5 Model Diagnostics

Diagnostic tests confirm the reliability of the estimation:

- **Multicollinearity:** VIF values < 5.

- **Heteroskedasticity:** Breusch-Pagan test is significant; addressed via robust SEs.
- **Autocorrelation:** The Wooldridge test is significant at 5%; corrected using clustered SEs.
- **Cross-sectional dependence:** The Pesaran CD test is insignificant, indicating country independence.

Collectively, these diagnostics confirm the statistical validity of the model.

## 5. Conclusion

This study examined the relationship between FinTech development, digital financial inclusion, and sustainable growth across 20 emerging economies from 2015 to 2025 using a panel regression framework. Grounded in the principles of Inclusive Growth Theory, Innovation Diffusion Theory, and Institutional Theory, the research aimed to evaluate how FinTech can drive environmentally responsible and inclusive economic progress. Through rigorous empirical analysis, the study found that FinTech development significantly enhances sustainable growth, both directly and indirectly through its effect on financial inclusion. The results indicate that economies with more advanced digital financial systems experience greater investment in sustainable projects such as renewable energy, green infrastructure, and eco-efficient enterprises. Furthermore, regulatory quality amplifies this relationship, while $CO_2$ emissions exert a negative influence on sustainable growth. The findings confirm that digital finance, when properly regulated and inclusively designed, can serve as a powerful engine for achieving the sustainable development goals (SDGs) in emerging markets.

**Key Conclusions**

- FinTech as a Driver of Sustainability: The analysis confirms that FinTech development substantially contributes to sustainable growth ($\beta = 1.47$, $p < 0.01$). Digital finance platforms reduce transaction costs, broaden access to capital, and mobilize resources toward environmentally responsible sectors.
- Financial Inclusion as a Mediating Channel: Financial inclusion mediates the relationship between FinTech and sustainable growth. Expanded access to mobile banking, e-wallets, and digital lending platforms promotes small-scale entrepreneurship and energy-efficient investments.
- The Role of Institutional Quality: The positive and significant impact of regulatory quality ($\beta = 0.42$, $p < 0.01$) highlights that robust governance and sound digital regulations are prerequisites for leveraging FinTech's full potential. Countries with clear FinTech guidelines, cybersecurity frameworks, and innovation sandboxes tend to achieve stronger sustainability outcomes.
- Environmental Constraints: The negative effect of $CO_2$ emissions ($\beta = -0.19$, $p < 0.05$) demonstrates that environmental degradation counteracts FinTech's benefits. This underlines the urgency of integrating green finance policies within the broader digitalization agenda.
- Model Performance: The Fixed Effects model explained approximately 90% of the variation in sustainable growth, underscoring the consistency and robustness of the empirical framework.

Overall, the study concludes that FinTech and digital financial inclusion are not merely technological phenomena, they are structural catalysts for sustainable, inclusive development in emerging economies. From a policy perspective, governments should integrate FinTech development with green finance strategies, strengthen digital infrastructure, and enhance regulatory frameworks to maximize sustainability outcomes in emerging economies.

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