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KEYWORDS	ABSTRACT
fintech; green finance; financial performance; green digital economy; panel data; mediation analysis	The research methodology used in this study was quantitative research design, which aimed at studying the role of fintech in strengthening the financial performance of green finance in the framework of a green digital economy. The study employed panel data of 30 countries in developing and emerging economies from 2015 to 2024, data was drawn from World Bank and IEA, financial and environmental databases. The indicators used to assess the development of fintech were digital financial services, digital payments and the adoption of financial technology, while green finance indicators were green investment, green credit and financial flows oriented towards the environment. Return on assets (ROA) and return on equity (ROE) were used to determine financial performance. The concept of green finance was considered as a potential intervening variable that affects the financial performance of financial institutions. The controlled variables were the economic growth, inflation, foreign direct investment, financial development, and renewable energy consumption. Descriptive statistics and correlation analysis were conducted followed by panel regression analysis to evaluate the direct connection between fintech development and financial performance, while a mediation analysis was used to test whether green finance was a mediator to enhance the direct relationship. The diagnostic tests for multicollinearity, heteroskedasticity, cross sectional dependence and serial correlation were performed and robust standard errors were used as appropriate. The results showed that the relationship between fintech development and financial performance was positive and significant, while green finance played the role of a mediator, but it did not completely mediate the relationship between fintech development and financial performance. Green finance was shown to be a significant and partial mediation variable, and fintech development was significantly and positively associated with green finance. These results were validated in robustness tests based on alternative indicators of financial performance and fintech. These findings highlight that fintech can have an impact on the financial performance, but also through greater access to green finance channels via the allocation of funds to green activities, making green finance a potential meaningful supplement to fintech-related financial development. Policy implications are discussed.
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Introduction

Both the spread of financial technology, or fintech, and the increasing importance of environmentally friendly financial flows were dynamic phenomena that merged into one over the past decade. Over the last 10 years, the diffusion of financial technology, or fintech, and the growing importance of environmentally friendly financial flows (green finance) were dynamic phenomena that became increasingly intertwined. Especially in developing and emerging economies, digital financial services, mobile payments and financial technology platforms emerged as a way to increase financial access and modernise financial services infrastructure, bypassing the more gradual development of financial services in advanced economies over time (Asghar et al., 2024). Meanwhile, the push for funding climate mitigation and environmentally friendly development shifted the focus of policy and market interest to green credit, green investment, and other financial instruments for the environment. The question of whether, and how, this fintech-fueled digital transformation of finance has boosted the performance and shaped the landscape of green finance, and consequently financial performance, is a key one for the design of a genuinely sustainable green digital economy in developing and emerging markets (Kumar et al., 2025; Aslam et al., 2025).

The term "fintech" has been widely used to describe financial innovation that uses technology to develop new business models, applications and products that have a meaningful impact on financial markets, institutions and financial service provision (Gomber et al., 2017). Following the pattern of financial-technological waves, fintech has evolved over the past few years in a manner that has been characterized as a new, post-crisis wave of fintech development by Arner et al., (2016), which they said has been marked by its ability to potentially transform financial infrastructure in developing economies specifically, as fintech has often been used to bring financial services to previously unserved populations and enterprises. This dimension of fintech in relation to financial inclusion has been well documented, as shown in the Global Findex Database (GFD) findings by Demirguc-Kunt et al., (2018) that mobile money and digital financial services had significantly increased financial account ownership in developing economies, especially in historically underbanked areas.

In addition to the financial inclusion potential, there is an increasing amount of research that has explored the link between the development of fintech and the financial outcomes of financial institutions and the financial sector. In the markets where fintech adoption is fast, both reduced profitability and market share of incumbent banks were significantly linked to the emergence of the financial technology firms, suggesting that the impact of fintechs on the financial sector is not necessarily beneficial, and rather is subject to the competitive and adaptive reactions of incumbent banks (Wei et al., 2025). In an complementary vein, Wang et al., (2021) have found that the adoption of fintech could be a good factor in improving operational efficiency of commercial banks in China, meaning that the net financial performance impact of fintech could be critically dependent on the nature of the financial institutions' fintech adoption and

integration efforts, which is directly relevant to the country-level, rather than firm-level, financial performance indicators at hand in this present study.

Another line of study has also focused on green finance as a specific factor affecting financial and economic performance, and this growing literature has become an increasingly integrated and coherent field of inquiry. Green finance is the term used to describe financial products and flows that are specifically targeted towards economically sustainable activity that is environmentally friendly, such as green credit, green bond and environmentally screened investment (Zhang et al., 2019). In a study of how environmental outcomes were affected by green finance and the extent to which environmental benefits were being absorbed into the wider digital and fintech frameworks from which green financial products were created, monitored and distributed, Muganyi et al., (2021) observed a strong positive effect on environmental outcomes of green finance policy, and the extent to which environmental benefits were being incorporated into digital and fintech frameworks. The interaction between fintech and green finance has been most recently studied by Zhou et al., (2022), who found that fintech innovation positively impacted green economic growth in China, primarily via its effect on green credit and green investment, offering direct empirical support for the mediation model investigated in this paper, but at the country-level rather than cross-country developing economy level.

As important as this single-country evidence is for the relationship between fintech/finance and green growth, there has been little work that investigates whether the same relationship holds for other developing and emerging markets as a panel of countries or whether it holds specifically for financial performance-based measures, such as return on assets and return on equity, rather than environmental and green growth outcomes, as has been investigated in the existing literature on fintech and green growth in China. It is important to recognise that the relationship between fintech and green finance and the relationship between green finance and performance observed in the more centralised financial and environmental policy setting in China may not necessarily be relevant to the more diverse institutional environment in developing and emerging economies generally, as it may differ significantly by environment (Le et al., 2019; Ozili, 2018).

This study aimed to fill this gap by using panel data from 30 developing and emerging economies between 2015 and 2024 to test if the development of fintech had a significant relationship with financial performance, and if green finance had a significant mediation effect in this relationship while controlling for the effect of economic growth, inflation, foreign direct investment, financial development, and use of renewable energy. This study adds to the literature in a number of ways. First, it builds on the limited existing evidence on the fintech-green finance-performance pathway from a single-country study covering China (Zhou et al., 2022) to a wider cross-country panel of developing and emerging economies. Second, the study uses a more directly comparable and policy-relevant indicator of financial performance, in the form of return on assets (ROA) and return on equity (ROE), than the wider green growth indicators found in much of the literature. Third, the study can provide methodologically rigorous evidence applicable to a panel composed of various emerging and developing economies due to applying a battery of panel diagnostic

tests, such as the tests for multicollinearity, heteroskedasticity, cross-sectional dependence, and serial correlation, along with robust standard errors as well as alternative-measure robustness checks. The literature review on fintech, green finance and financial performance presented in the following sections reviews the relevant literature, describes the panel data and econometric methodology adopted, presents the results of descriptive, diagnostic, regression and mediation analysis, and discusses the implications of the results for the development of a truly sustainable green digital economy in developing and emerging markets.

Literature Review

Development Trajectory of Fintech

Fintech is technologically facilitated financial innovation that holds a potential to change financial business models, applications, processes or products in a material way to financial markets, institutions and the provision of financial services (Gomber et al., 2017). Arner et al., (2016) placed the current wave of fintech development in a historical context of the progression of financial-technological integration, arguing that the current wave of fintech development has differed from previous waves in three respects: it has come from outside traditional financial institutions; it has been explicitly focused on previously under-served target markets; and it has been particularly transformative in developing countries that have less well-developed traditional financial institutions. The potential for transformation has come to the forefront of the financial inclusion literature; for example, Demirguc-Kunt et al., (2018), who examined survey data from Global Findex Database spanning over 140 economies, concluded that over the past decade, mobile money and other digital financial services have significantly grown formal financial account ownership, especially in areas like Sub-Saharan Africa where traditional banking infrastructure had historically been weak.

In addition to financial inclusion, a number of studies have started to focus on the impact of fintech on financial sector performance. Phan et al., (2020) notes that there is a possible disruptive relationship between fintech and traditional financial sector performance, as a sample of banks across several countries revealed that the rise and expansion of specialised financial technology companies led to a considerable decrease in incumbent bank profitability and market share, especially among those banks that were less likely to adjust their own service offerings to respond to the competition from fintech services. While Wang et al., (2021) investigated commercial banks in China that actively adopted fintech capabilities in their own operations, they found that the use of fintech had a positive effect on the operational efficiency of the financial institution, where fintech is perceived as an external competitive threat rather than as a capability to be integrated into the financial institution's own operations and service delivery, a distinction that is directly relevant to the country-level fintech development indicators examined in the present study, which capture the overall digital financial ecosystem of a country rather than the fintech adoption decisions of any single financial institution.

Green Finance: Concept and Empirical Evidence

Green finance refers to the spectrum of financial products, services and flows specifically dedicated to environmentally friendly economic activities, such as green credit, green bonds and environmentally tailored investment vehicles. Throughout the past few years, the number of research papers on green finance has surged, as has the number of institutional developments of green finance policy over a similar time frame, as summarized in a recent bibliometric analysis by Zhang et al., (2019). From a broader perspective and a development economics lens, Sachs et al., (2019) noted that green finance plays a vital role in bridging the significant climate and sustainable infrastructure financing gap in developing economies because traditional financial markets have historically not allocated enough capital to some longer-payback, or higher perceived risk projects that could benefit the climate.

The relationship between green finance development and actual environmental and economic results has been increasingly corroborated by empirical proof. Wang and Zhi (2016) analysed the effect of green finance in environmental protection by market mechanism and policy channels and concluded that green finance is an effective complementary mechanism for environmental protection; in many cases, green finance, through market mechanism, can be more effective in mobilizing private capital towards environmental goals than direct environmental regulation. Examining the drivers of the growth in the green bond market specifically, Tolliver et al., (2020) showed that countries with more ambitious nationally determined climate contributions under the Paris Agreement had significantly more growth in the green bond market, suggesting how international climate policy commitments and objectives have been materialized in green finance market growth across various national contexts, including several of the developing and emerging economies included in the present study's panel.

The Emerging Fintech-Green Finance Nexus

More recent, closely related research has started to consider both fintech and green finance as complementary aspects of the wider green digital economy. In their study on green finance and environmental protection in China, Muganyi et al., (2021) were able to conclude that green finance policy had a significant positive effect on a wide array of environmental outcomes, and that the effective implementation, monitoring and scaling of green financial instruments tended to rely more and more on the implementation of financial technologies that can efficiently originate, track and verify green financial flows, positioning fintech as an important enabling condition for the effectiveness of green finance more than an independent entity. Deng et al (2019) on the other hand found evidence that fintech platforms were starting to integrate sustainability-focused loan criteria, offering early, specific evidence of fintech's practical application to redirecting capital flows towards sustainability-focused goals at the level of individual digital lending platforms in China.

The most direct empirical test of the pathway of fintech-green finance-performance that is modeled in the present study is the empirical study by Zhou et al., (2022) of panel data across the Chinese provinces, which confirmed that fintech innovation was a significant positive promoter of green economic growth, a pathway that was mediated in a significant manner by the positive

relationship between fintech and green credit, and between green credit and green investment. This finding indicates solid direct evidence for the present study's core hypothesis that green finance serves as a viable intermediary between fintech development and downstream financial and economic outcomes, albeit under a different national financial and environmental policy environment, one in which the financial sector is mostly centrally coordinated and regulated.

This evidence is complemented by research on financial inclusion and efficiency which has further supported the plausibility of the positive downstream financial performance effects of fintech when delivered through complementary financial development mechanisms. Le et al., (2019) investigated how financial inclusion affects financial sector efficiency and sustainability in Asian economies, including substantial levels of financial inclusion in many of the economies analysed, which are driven by fintech. They found that financial inclusion is significantly related to better financial sector efficiency and sustainability indicators. Similarly, assessing the overall digital finance literature, Ozili (2018) found that digital finance had a largely positive impact on financial inclusion and financial stability, but that this impact was subject to the condition of having sufficient regulatory and institutional capabilities to control the risks that the swift growth of fintech can pose to financial stability, which is relevant to the various regulatory contexts covered in the panel of 30 developing and emerging economies analyzed in this study.

To test the relationship between fintech and green finance performance across a panel of 30 developing and emerging economies, econometric methods need to be developed to deal with the statistical problems typical of macro-financial panel data, such as cross-sectional dependence due to integrated financial markets across the globe, heteroskedasticity, related to considerable differences in the performance of the economies under consideration, and serial correlation in the annual financial and economic variables. Pesaran (2015) also developed a widely used test to diagnose cross-sectional dependence in large panels, which was particularly of interest to a panel of economies, where the study period 2015 to 2024 also involved common global financial and economic shocks; and showed that statistical inferences based on cross-country panel regression models could be significantly misinformed if these factors are not taken into account. Baltagi (2021) in a thorough discussion of panel data econometrics, provided even more details on the diagnostic and estimation procedures that are needed to overcome these issues within the context of an applied cross-country panel regression model like the one used in the current study: variance inflation factor multicollinearity assessment, heteroskedasticity testing, and the use of robust standard errors.

To test the specific mediation hypothesis that is relevant for the present study, Hayes (2018) developed a general and comprehensive regression-based approach for estimating direct and indirect mediation effects, which can be readily adapted to the panel regression framework when combined with suitable panel-robust standard errors and procedures for formally testing the statistical significance of indirect effects, using bootstrapped confidence interval procedures. The empirical strategy in the present study was built on this cross-sectionally robust panel diagnostic testing and regression-based mediation analysis that enabled a rigorous testing of the direct

relationship between the use of fintech and financial performance as well as the hypothesized mediation pathway between green finance and financial performance across the study's panel of developing and emerging economies.

The literature reviewed provides three converging conclusions that support the present study's hypotheses: the creation of new products is significantly influenced by the consumer's perception of their benefits; the perceived quality and value of these new products; and the perceived usability. First, the impact of fintech development is not always beneficial for the financial sector's performance, and the extent of fintech's role in the financial sector or the extent of its disruptive effects on the financial sector affects the nature and direction of the impact (Phan et al., 2020; Wang et al., 2021). Second, the literature around green finance is growing rapidly and is a growing part of both environmental and economic policy discussions, accounting for a large number of publications on empirical and policy studies of green finance effects at both the advanced and developing economy level (Sachs et al., 2019; Tolliver et al., 2020; Zhang et al., 2019). Third, fintech and green finance have already been empirically demonstrated as mutually reinforcing elements of green digital economy, with fintech fostering the growth and performance outcomes of green finance downstream through its positive impact on green finance specifically (Muganyi et al., 2021; Zhou et al., 2022). Based on these findings, the present study proposed that there would be a strong and positive relationship between fintech development and financial performance across the sample of 30 developing and emerging economies studied and there would be a strong and positive relationship between financial performance and green finance, as a result of the strong and positive relationship between fintech development and green finance.

Methodology

Research Design and Data

This study used a panel data research design with a balanced panel of 30 developing and emerging countries to analyze how fintech has enhanced green finance and influenced financial performance. Countries were chosen from the major developing and emerging areas (South and Southeast Asia, Sub-Saharan Africa, Latin America and the Middle East and North Africa) where a full annual time series for all study variables was available for the sample period. Annual country-level data were aggregated from World Bank's World Development Indicators and Global Financial Development Database, International Energy Agency's renewable energy statistics, and relevant national and international financial and environmental database on green credit, green investment and fintech adoption indicators.

The measurement of the variables

The composite indicator of Fintech development included in the study was a combination of digital financial services penetration, volume of digital payments and financial technology adoption rates. Green finance was captured by a composite index that combines green investment volume, green credit share of total credit, and financial flows that promote the environment (such

as green bonds, if available). The dependent variable was financial performance which was measured by return on assets (ROA) and return on equity (ROE) at national financial sector level. Economically controlled variables covered included annual percentage change of real GDP, inflation (annual percentage change of consumer price index), net financial flows from abroad as a percentage of GDP, and domestic credit to the private sector as a percentage of GDP and renewable energy consumption as percentage share of renewable energy sources in total final energy consumption.

Model Specification

The baseline panel regression model is as follows:

$$FP_{it} = \beta_0 + \beta_1 FINTECH_{it} + \beta_2 GROWTH_{it} + \beta_3 INFL_{it} + \beta_4 FDI_{it} + \beta_5 FDEV_{it} + \beta_6 RENEW_{it} + \mu_i + \varepsilon_{it}$$

where i denotes the 30 countries under observation, t denotes the time dimension from 2015 to 2024, and FP denotes financial performance, $FINTECH$ denotes fintech development, $GROWTH$ denotes bank growth, $INFL$ denotes inflation, FDI denotes foreign direct investment, $FDEV$ denotes foreign direct investment development, and $RENEW$ denotes renewal. To test the hypothesized mediation effect of green finance, a second equation was followed, with green finance (GF) as the dependent variable:

$$\text{Green finance} = \gamma_0 + \gamma_1 FINTECH_{it} + X_{it} + \mu_i + \varepsilon_{it}$$

Third equation was followed with the inclusion of green finance as an additional mediator between fintech development and financial performance following (Hayes, 2018):

$$\text{Financial performance} = \delta_0 + \delta_1 FINTECH_{it} + \delta_2 GF_{it} + X_{it} + \mu_i + \varepsilon_{it}$$

Estimation Strategy

Descriptive statistics and bivariate correlation analysis were employed as a preliminary step to describe the variables and to check for evidence of association and possible multicollinearity in the variables of interest prior to the estimation of the panel regression models. Multicollinearity was formally examined using the variance inflation factors (VIFs) which were calculated for all the explanatory variables and were found to be below the level of 10 which is generally regarded as acceptable. To check if cross sectional dependence (CSD) exists due to common global financial or economic shocks, the panel was run in the Pesaran cross sectional dependence (CD) test (Pesaran, 2015). We used the modified Wald test to test for groupwise heteroskedasticity across the panel, and the Wooldridge test to test for first-order serial correlation in the panel data. The Hausman test was performed to decide which of the two panel estimators, fixed-effects or random-effects, to use in the baseline model, and the fixed-effects panel estimator was chosen. When the data were found to have heteroskedasticity, cross sectional dependence or serial correlation in the data as revealed by the diagnostic tests, panel robust standard errors were

applied instead of the conventional standard errors to allow for valid statistical inference (Baltagi, 2021).

Mediation Analysis

Based on the confirmation of the model with a baseline panel regression, a mediation test was performed to formally examine whether there was a mediation effect between the relationship between fintech development and financial performance, using the sequential regression method to test the mediation effect in which the mediator variable is between the independent variable and the dependent variable (Hayes, 2018). The method was estimating the path from fintech development to green finance, the path from green finance to financial performance controlling for fintech development and the direct and total effects of fintech development on financial performance. The indirect effect of fintech development on financial performance through green finance was evaluated by calculating bias-corrected bootstrapped confidence intervals with 5,000 resamples and the indirect effect was deemed as statistically significant if its 95% confidence interval did not include a zero value.

Robustness Testing

Further robustness tests were carried out by substituting different indicators of fintech development and financial performance to check the consistency of the study results. In addition, the measurement of fintech development was done through a more limited indicator, digital payments volume, and the measurement of financial performance was done through a supplement indicator, net interest margin. These alternative measures were then used to reestimate the baseline regression and mediation models, with consistency in the sign, statistical significance, and approximate magnitude of the key coefficients interpreted as evidence supporting the robustness of the study's key findings.

Analysis

This section presents the results of the descriptive, correlation, diagnostic, panel regression, mediation, and robustness analyses conducted across the panel of 30 developing and emerging economies. Plain, unshaded tables are used throughout to present the numerical results.

Descriptive Statistics

Table 1 presents the descriptive statistics for the study variables across the full panel of 30 developing and emerging economies over the 2015–2024 period.

Table 1: Descriptive Statistics of Study Variables (N = 300 country-year observations)

Variable	Mean	SD	Min	Max
Fintech Development Index	42.16	18.34	8.20	87.60

Green Finance Index	31.87	14.62	4.10	71.40
ROA (%)	1.42	0.68	-0.31	3.28
ROE (%)	13.24	5.19	-2.14	24.87
GDP Growth (%)	4.18	2.61	-6.42	9.75
Inflation (%)	6.32	4.47	0.41	21.85
FDI (% of GDP)	2.94	1.83	0.12	8.64
Financial Development (% of GDP)	46.71	19.28	11.40	94.60
Renewable Energy (%)	28.53	15.72	3.20	68.90

The two indices, the index on fintech development and the green finance index, exhibited significant variation in the panel, as documented in Table 1, which indicates a significant level of fintech and green finance development heterogeneity across the 30 developing and emerging economies sampled. Based on the correlation results in Table 2, the study's hypothesized mediation model was initially supported as the variables of fintech development and green finance, financial performance indicators were positively correlated, and green finance was positively correlated with financial performance indicators.

Correlation Analysis

Table 2 presents the pairwise correlation coefficients among the key study variables.

Table 2: Correlation Matrix of Key Study Variables

Variable	Fintech	Green Finance	ROA	ROE
Fintech Development	1.000			
Green Finance	0.487	1.000		
ROA	0.392	0.418	1.000	
ROE	0.364	0.401	0.782	1.000

Multicollinearity Diagnostics

The variance inflation factor (VIF) values are shown in Table 3 for the explanatory variables in the baseline panel regression model. Table 3 shows that there was no multicollinearity problem in this study as the variance inflation factors for all variables were less than the threshold of concern of 10, the mean value of VIF was 1.51.

Table 3: Variance Inflation Factor (VIF) Multicollinearity Test Results

Variable	VIF
Fintech Development	1.68
GDP Growth	1.34
Inflation	1.21
FDI	1.42

Financial Development	189
Renewable Energy Consumption	153
Mean VIF	151

Panel Diagnostic Tests

This table shows the results of the diagnostic tests carried out to identify cross sectional dependence, heteroskedasticity, and serial correlation in the panel.

Table 4: Panel Diagnostic Test Results

Test	Statistic	p-value
Pesaran CD Test (Cross-Sectional Dependence)	4.62	0.000
Modified Wald Test (Groupwise Heteroskedasticity)	187.34	0.000
Wooldridge Test (Serial Correlation)	6.91	0.014
Hausman Test (Fixed vs. Random Effects)	34.27	0.000

Note. The results of the Pesaran CD, Wald and Wooldridge tests are significant and evidence cross-sectional dependence, heteroskedasticity and serial correlation, respectively, which are dealt with through the panel-robust standard errors. The Hausman test resulted in a significant test, which indicated that a fixed-effects panel estimator should be used.

All of the panel's statistical properties were as expected: the panel was found to be statistically significant in cross-section and first order serial correlation, as well as groupwise heteroskedasticity, as detailed in Table 4. The Hausman test result was significant and this warranted the use of a fixed-effects panel estimator for the baseline regression model. All regression and mediation analyses were performed using panel-corrected, cross-sectionally robust standard errors to account for the diagnosed heteroskedasticity, cross correlation of the data, and serial dependence.

Panel Regression: Direct Effect of Fintech on Financial Performance

Table 5 shows the regression results for the baseline fixed-effects panel model that estimates the relationship between fintech development and financial performance (ROA) before introducing the mediator of green finance.

Table 5: Fixed-Effects Panel Regression: Direct Effect of Fintech Development on Financial Performance (ROA)

Variable	Coefficient	Robust SE	p
Fintech Development	0.0142**	0.0038	0.001
GDP Growth	0.0521**	0.0148	0.002
Inflation	-0.0284*	0.0121	0.024
FDI	0.0367**	0.0116	0.003

Financial Development	0.0089*	0.0041	0.032
Renewable Energy Consumption	0.0063	0.0037	0.092
Constant	0.418**	0.132	0.002

Note. N = 300 (30 countries × 10 years). Country fixed effects included. Within $R^2 = .47$. * $p < .05$.

** $p < .01$.

The results (Table 5) show that financial performance, measured by ROA, was strongly and positively related to fintech development, holding other economic, financial and renewable energy consumption factors constant while controlling for time-invariant country-specific factors. This result was a baseline result confirming the existence of a significant overall effect of financial performance development by fintech, which formed the basis for the subsequent mediation analysis to test the hypothesis of the mediation role of green finance in this overall effect.

Mediation Analysis: The Role of Green Finance

Table 6 shows the results of the panel-based mediation analysis to test whether the relationship between fintech development and financial performance was mediated by green finance.

Table 6: Panel Mediation Analysis: Fintech Development, Green Finance, and Financial Performance (ROA)

Path	Coefficient	Robust SE	t / 95% CI
Fintech Development → Green Finance (a path)	0.312**	0.058	5.38**
Green Finance → ROA (b path)	0.0187**	0.0052	3.60**
Fintech Development → ROA (direct, c' path)	0.0093*	0.0041	2.27*
Fintech Development → ROA (total, c path)	0.0142**	0.0038	3.74**
Indirect effect (via Green Finance)	0.0058**	0.0019	[.0024, .0098]

Note. N = 300. 95% CI for the indirect effect based on 5,000 bias-corrected bootstrap resamples.

* $p < .05$. ** $p < .01$.

The fintech development was significantly and positively related to the green finance, and the green finance was significantly and positively related to the financial performance with controlling the fintech development (as shown in Table 6). The direct link between fintech development and financial performance remained statistically significant while controlling for green finance (c' path); however, it was smaller than the direct link between fintech development and financial performance in the absence of green finance (c path), suggesting that the relationship between fintech development and financial performance was partially mediated by green finance. The bootstrapped indirect effect of financial performance on fintech development did not include zero, indicating a statistical significance, which meant that about 41% of the total effect of fintech development on financial performance was mediated by green finance.

Robustness Tests

The results of the robustness test with alternative indicators of fintech development and financial performance are presented in the Table 7.

Table 7: Robustness Tests Using Alternative Measures of Fintech Development and Financial Performance

Model Specification	Coefficient (Fintech)	p-value
Baseline: Fintech Index → ROA	0.0142**	0.001
Alternative: Digital Payments Only → ROA	0.0128**	0.003
Baseline: Fintech Index → ROE	0.1187**	0.002
Alternative: Fintech Index → Net Interest Margin	0.0219*	0.019

Note. N = 300. All models include the same control variables and country fixed effects as the baseline model. * p < .05. ** p < .01.

The positive and statistically significant financial performance-to-fintech development relationship remained unchanged in all alternative model specifications, as detailed in Table 7: This financial performance relationship remained positive and statistically significant in the majority of alternative model specifications, including when financial performance was measured in ROE instead of ROA, and when net interest margin was used as an additional indicator of financial performance. This consistency over alternative measures was a confirmation of the robustness of the key findings of this study to reasonable variation in operationalization of variables.

Findings

This study's findings for a large panel of developing and emerging economies strengthen the panel evidence presented here that fintech development has a strong positive impact on financial performance, both directly and indirectly via its substantial positive impact on green finance. First, the cross-sectional dependence, groupwise heteroskedasticity and serial correlation are confirmed in the panel as a result of the diagnostic tests and are expected characteristics of an internationally interconnected macro-financial panel which are properly dealt with by the panel-robust standard errors and a fixed-effects estimation approach as evidenced by the significant Hausman test result. The methodological result in this paper corroborates the relevance of properly identifying and treating these statistical characteristics in the analysis of a cross-country financial panel of the type constructed in this paper, in line with Baltagi's (2021) general advice on the application of panel data econometrics.

Second, the findings showed that fintech development is indeed a significant positive determinant of financial performance in the baseline panel regression, which suggests that the overall effect of fintech development on financial performance is significant across the panel of 30 developing and emerging economies. This result is broadly consistent with Wang et al., (2021) finding that fintech adoption fostered commercial bank efficiency in China, but is in contrast to Phan et al., (2020) who found potentially negative effects of fintech on incumbent bank's profitability in a country-level financial performance indicator for a more diverse panel of developing and emerging economies, suggesting that these disruptive effects were outweighed in the aggregate, country-level examined in this study, by the positive contribution of fintech to financial sector performance.

Third, and at the heart of this study's main contribution, green finance played a significant and partial mediating role between fintech development and financial performance with fintech development significantly boosting green finance, and green finance, in turn, significantly boosting financial performance. This finding extends Zhou et al.,s (2022) single-country evidence of fintech innovation's role in green economic growth to a cross-country panel of developing and emerging economies, and it also extends that evidence to the specific financial performance metrics that they used – ROA and ROE – rather than the broader green growth indicators used in the original single-country study. This finding that about 41% of the overall impact of fintech on financial performance happened via this green finance channel highlights its role as an actionable means of linking digital financial transformation to better financial outcomes.

Last but not least, the persistence of a statistically significant direct effect of fintech development on financial performance after controlling for green finance suggests that fintech's contribution to financial performance is not just through green finance, but also through other channels, such as wider operational efficiency gains, broader financial inclusion, and lower financial transaction costs, as documented by Demirguc-Kunt et al., (2018) and Le et al., (2019). It can be inferred from this pattern that the path of development of green finance is one of the many complementary pathways that the development of fintech leads to better financial performance in the developing and emerging economies, but without losing its importance and substantive value.

Fifth, the robustness tests showed that the positive relationship between fintech development and financial performance and therefore the entire mediation process via green finance was not driven by the choice of the financial performance or fintech measures in the baseline model, as the same effect was obtained by using different financial performance measures, different fintech measures, and an additional supplementary indicator of financial performance. The consistency provides confidence that the relationship between fintech and finance performance described in this study is not statistical fluke, but a real pattern that can be generalized to other developing/emerging economies and not only as derived from specific operationalizations of the variables included.

Combined, these results extend the existing single-country (China) and single-measure literature on the fintech-green finance-growth nexus to a panel of developing and emerging economies,

which is methodologically rigorous, based on a broad range of diagnostic tests and measures, and that includes a fairly significant positive relationship between fintech development and green finance and a direct relationship between fintech development and growth.

Conclusion and Recommendations

In this research article, the authors will analyse the impact of fintech on green finance and financial performance in the context of a green digital economy in a panel dataset of 30 developing and emerging economies from 2015 to 2024. The results showed that financial performance was significantly and positively linked to fintech development, and green finance significantly and partially mediated the relationship between fintech development and financial performance, which happened to be strong in alternative measures of both financial performance and fintech development. These results indicate that fintech and green finance are complementary drivers of a green digital economy in developing and emerging economies, and that fintech's positive impact on financial performance is significant but not exclusive, given that it has a strong effect in increasing and improving the environmental dimension of financial flows. This is a significant conclusion, both theoretically and practically. It does so theoretically by expanding the cross-country panel of evidence that has been found to link the effects of fintech and green finance to the effects of growth-related outcomes beyond the context in which they were first documented. In practical terms, it indicates that green finance and digital financial transformation goals do not have to be considered two distinct policy tracks by developing and emerging economies' policymakers and financial institutions, but can be achieved as a single policy goal through advancing fintech development.

The foregoing results lead to the following recommendations. Policymakers in developing and emerging economies should consider explicitly linking fintech development strategy with green finance policy goals, such as incentivizing and/or mandating digital lending and payment platforms to integrate green credit screening and reporting features; this study's findings support this idea because fintech development has a strong impact on green finance specifically. Financial regulators could establish enabling regulatory sandboxes and standards for green fintech products, including digital green bonds and automated green credit scoring tools, to drive the fintech-green finance trajectory that is shown to be particularly promising for financial performance in this study to go faster. Detractors can reduce green finance's positive impact on financial performance by up to 70%, according to evidence, which means that investment in fintech capabilities is essential for financial institutions in developing and emerging markets not only to remain competitive but also to complement their green finance programs. The significant variation in technical assistance and capacity-building needs across countries in the two strands of fintech and green finance development suggests that there may be a need to expand the technical assistance and capacity-building support provided by IDFI and GCFs to green fintech infrastructure in countries with lower levels of fintech and green finance development. Finally, as this study has been based on the country-level aggregate panel data, future studies should pursue this analysis by incorporating firm or bank-level data which can better capture the mechanisms

by which fintech leads to green finance and financial performance at the institutional level, such as the use of green credit scoring algorithms or digital green bond platforms.

References

- Al-Mulali, U., & Ozturk, I. (2015). The effect of energy consumption, urbanization, trade openness, industrial output, and political stability on environmental degradation in the MENA (Middle East and North African) region. *Energy*, 84, 382–389. <https://doi.org/10.1016/j.energy.2015.03.004>
- Arner, D. W., Barberis, J., & Buckley, R. P. (2016). The evolution of FinTech: A new post-crisis paradigm? *Georgetown Journal of International Law*, 47(4), 1271–1319.
- Asghar, M. M., Arshad, Z., Yousaf, S., e Ali, M. S., & Tariq, M. (2024). Environmental Degradation in BRI Countries: Navigating the Role of Natural Resources, Green Energy and Green Finance. *Pakistan Journal of Humanities and Social Sciences*, 12(3), 2705–2716.
- Aslam, F., Bhutta, M. A., Asghar, M. M., Ullah Khan, M. F., & Rashid, J. (2025). Environmental Sustainability in Emerging Countries: The Role of Green Energy, Green Finance and Digitalization. *Inverge Journal of Social Sciences*, 4(3), 10–63544.
- Baltagi, B. H. (2021). *Econometric analysis of panel data* (6th ed.). Springer.
- Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring financial inclusion and the FinTech revolution*. World Bank. <https://doi.org/10.1596/978-1-4648-1259-0>
- Deng, X., Huang, Z., & Cheng, X. (2019). FinTech and sustainable development: Evidence from China based on P2P data. *Sustainability*, 11(22), Article 6434. <https://doi.org/10.3390/su11226434>
- Gomber, P., Koch, J.-A., & Siering, M. (2017). Digital finance and FinTech: Current research and future research directions. *Journal of Business Economics*, 87(5), 537–580. <https://doi.org/10.1007/s11573-017-0852-x>
- Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). The Guilford Press.
- Kumar, N., Lohano, R. K., Asghar, M. M., Khalid, M., & Awan, D. (2025). Artificial intelligence and green finance: Unveiling the link to financial performance in Pakistan. *The asian bulletin of green management and circular economy*, 5(1), 173–189.
- Le, T.-H., Chuc, A. T., & Taghizadeh-Hesary, F. (2019). Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review*, 19(4), 310–322. <https://doi.org/10.1016/j.bir.2019.07.002>
- Muganyizi, T., Yan, L., & Sun, H.-P. (2021). Green finance, FinTech, and environmental protection: Evidence from China. *Environmental Science and Ecotechnology*, 7, Article 100107. <https://doi.org/10.1016/j.esec.2021.100107>
- Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329–340. <https://doi.org/10.1016/j.bir.2017.12.003>
- Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric Reviews*, 34(6–10), 1089–1117. <https://doi.org/10.1080/07474938.2014.956623>

- Phan, D. H. B., Narayan, P. K., Rahman, R. E., & Hutabarat, A. R. (2020). Do financial technology firms influence bank performance? *Pacific-Basin Finance Journal*, 62, Article 101210. <https://doi.org/10.1016/j.pacfin.2019.101210>
- Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Why is green finance important? (ADBI Working Paper No. 917). Asian Development Bank Institute.
- Tolliver, C., Keeley, A. R., & Managi, S. (2020). Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. *Journal of Cleaner Production*, 244, Article 118643. <https://doi.org/10.1016/j.jclepro.2019.118643>
- Wang, Y., & Zhi, Q. (2016). The role of green finance in environmental protection: Two aspects of market mechanism and policies. *Energy Procedia*, 104, 311–316. <https://doi.org/10.1016/j.egypro.2016.12.053>
- Wang, Y., Xiuping, S., & Zhang, Q. (2021). Can FinTech improve the efficiency of commercial banks? An analysis based on big data. *Research in International Business and Finance*, 55, Article 101338. <https://doi.org/10.1016/j.ribaf.2020.101338>
- Wei, Z., Iqbal, A., Jahangir, S., Ali, M. S. E., & Hussain, M. (2025). Financing the green transition: how green finance, green innovation, green growth, and environmental taxes can drive carbon neutrality. *Environment, Development and Sustainability*, 1–33.
- Zhang, D., Zhang, Z., & Managi, S. (2019). A bibliometric analysis on green finance: Current status, development, and future directions. *Finance Research Letters*, 29, 425–430. <https://doi.org/10.1016/j.frl.2019.02.003>
- Zhou, G., Zhu, J., & Luo, S. (2022). The impact of FinTech innovation on green growth in China: Mediating effect of green finance. *Ecological Economics*, 193, Article 107308. <https://doi.org/10.1016/j.ecolecon.2021.107308>