

## Exploring the Role of Governance in Strengthening FinTech-Driven Financial Inclusion: A Cross-Country Analysis

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### Abstract

This study observes the FinTech Innovations and governance role in promotion of financial inclusion across emergent economies using a longitudinal panel data approach. Grounded in institutional theory, the study argues that while FinTech enhances access to financial services, its effectiveness is contingent upon the quality of governance. Using data spanning over two decades from multiple international sources, composite indices for financial inclusion, governance, and FinTech development are created through principal component analysis. The empirical analysis employs panel unit root tests, cointegration techniques, and an error correction model (ECM) to examine both long-run equilibrium associations and short-run dynamics. The findings reveal a momentous and favorable impact of FinTech Innovations on financial inclusion, confirming its significance in enhancing reach to financial services. Governance quality is also found to exert a strong positive influence, reinforcing the importance of institutional frameworks in enabling inclusive financial systems. Outcomes of cointegration demonstrate a steady long-run association amongst the variables, while the ECM findings suggest that approximately 44% of short-term disequilibrium adjusts annually toward equilibrium. The findings highlight that technological innovation alone is insufficient; effective governance is essential to ensure that FinTech-driven financial inclusion is sustainable, secure, and equitable. Policy implications accentuate the necessity of simultaneous investment in digital financial

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infrastructure and institutional quality to maximize inclusion outcomes in emerging economies.

**Keywords:** financial inclusion; FinTech innovations; governance quality; institutional theory; panel data analysis; digital finance; economic development

### **Introduction**

Financial inclusion (FI) has recently been arisen as a significant determinant of sustainable economic development, particularly across emerging economies. It is “the capacity of people and business enterprises to access and use reasonably priced financial services and products; comprises of saving, expenditures, insurance, and credit; enabling effective management of risk, assets composition, and participation in formal economic systems” (Demirgüç-Kunt et al., 2018). Promoting financial inclusion is imperative both for the social as well as economic development, since it is significantly associated with Sustainable Development Goals (SDGs) of poverty eradication and enhancing inclusive economic growth (Arner et al., 2018). To enable this transformation Financial Technology (FinTech) has evolved and being considered significant component by designing and developing innovative solutions to reach unbanked populations (Demir et al., 2022; Olaoye et al., 2026). FinTech apps like mobile banking, blockchain-based platforms, peer-to-peer lending, and digital identity services, helps in reducing the limitations of traditional banking, lowering cost and enhance the banking accessibility to remote and low-income population (Gupta, 2024; Morgan, 2022). For instance, mobile money platforms like Paytm in India and M-Pesa in Kenya significantly enhance access to digital financial services; signifying importance of FinTech’s democratize financial systems (Ediagbonya & Tioluwani, 2022).

Recent literature has proposed the concept of FinTech Innovations, which can be understood as the implementation of digital financial innovations in a way that would promote inclusion, operational efficiency, and environmental, social and governance (ESG) sustainability goals simultaneously (Arner et al., 2020; Mhlanga & Dzingirai, 2025). However, FinTech’s mere availability doesn’t inevitably result in effective and sustainable financial inclusion. The effectiveness of FinTech is contingent on multiple

factors, chief amongst them the level of governance, broadly defined as the eminence of organizations, regulations, rule of law, and corruption prevention (Rehman et al., 2022). In environments with high governance, the use of digital systems is often trusted, consumers are protected and financial regulations are enforced; all of which is critical for the secure and efficient use of FinTech (Kwenda & Chinoda, 2019; Patel et al., 2024). In contrast, in environments with weak governance, FinTech advancements can result in data abuse, cyber fraud and exclusionary impacts on already disadvantaged populations (Guo, 2024; Koloseni & Mandari, 2024).

While there is an increasing scholarship on financial inclusion and FinTech, few empirical studies explore how governance mediates or moderates the association amid FinTech adoption and financial inclusion, particularly in the emergent economies where both institutional and digital infrastructure are still evolving (Lyons et al., 2021; Mpofu & Maraga, 2023; Yang et al., 2022). The majority of prior research either adopts a case-specific or theoretical lens, or fails to integrate governance as a dynamic factor in the FinTech-inclusion equation. In addition, robust econometric evidence that is based on the longitudinal cross-country research is still considerably lacking (Sethi & Acharya, 2018). This absence of empirical evidence as a unit constitutes a severe knowledge/gap in the scholarly discipline as well as policymaking. In consideration of this gap, the current research examines the dynamic link between FinTech Innovations and Governance and the impact on outcomes of FI in various economies.

Based on the Sustainability-FinTech-Inclusion (SFI) framework, the study tests the hypothesis that the eminence of governance reinforces the favorable relations that FinTech has on financial inclusion. The theoretical underpinning of the study framework is the institutional theory that maintains that an effective technological innovation is heavily reliant on regulatory and institutional environment where the innovation is implemented (Wang et al., 2024). Through a panel dataset across many years and countries, this paper will create composite indices of FinTech development, the quality of governance, and FI furnishing high-quality cross-national comparisons.

This research has two objectives as follows:

- Evaluating the direct influence of FinTech Innovations on financial inclusion;
- Estimating the role of governance in influencing financial inclusion.

### **Theoretical Framework**

The current study employs the Institutional Theory to explain the individual and complementary functions of FinTech Innovations and Governance in enhancing FI in emerging economies. Institutional theory holds that economic performance including the availability of finance is a result of an institutional arrangement like laws, regulations and governance systems that define the rules of the game of social interaction (North 1990; Anarfo & Abor, 2020). In this context, FinTech can be thought of as a structure innovation that has the potential of bypassing existing roadblocks in traditional banking by use of digital tools like mobile payments and online credit facilities along with blockchain-based financial services. Such innovations make transactions more readily available and cheaper, especially to the unbanked and underbanked population (Finkelstein-Shapiro et al. 2022; Gupta 2024). Nevertheless, the possibility of expanding the access to finance created by FinTech depends on the availability of the conducive institutional environments. Similarly, governance, as the quality of public institutions, regulatory integrity and enforcement, becomes a vital factor of financial inclusion. Good governance enables inclusive financial systems in terms of equal access, protection, and legal redress; good governance discourages corruption, regulatory gaps, and mistrust of financial services, limiting their availability and influence (Abaidoo & Agyapong, 2023). Institutional Theory offers a consistent theoretical lens through which the two phenomena, FinTech and governance, is explained as a structural determinant of financial inclusion.

### **FinTech and Financial Inclusion**

FinTech has become a significant tool that has enabled the concept of financial inclusion, especially in emerging markets where traditional banking system has not been able to reach the socioeconomically marginalized members. With the implementation of digital wallets, mobile-money platforms, other

credit-scoring systems, and distributed-ledger technologies, FinTech overcomes long-running barriers like excessive transaction costs, geographical inaccessibility, and rigorous documentation requirements (Gupta, 2024; Guo, 2024). This positive link between the innovation aspect of FinTech technologies and increased financial access is being supported by an increasing amount of empirical research. Lyons et al. (2021) have shown that the progress of FinTech in 16 key emerging economies was related to quantifiable increases in the level of borrowing, saving, and remittances. In line with these results, Ediagbonya and Tioluwani (2022) uncovered that mobile-money solutions, like Kenya-based M-Pesa and India-based Paytm, have significantly increased the economic and FI of the under-served. The link is not however, necessarily uniformly linear. Finkelstein-Shapiro et al. (2022) argue that, despite the improvement of access barrier that can be seen through the entry of FinTech, it can also increase volatility in the credit markets and lead to unbalanced adoption of services. Noreen et al. (2022) also note that there are still issues of the lack of infrastructure, digital illiteracy, and distrust that still hinders adoption among low-income and rural groups. These findings suggest the importance of investigating access to financial services, as well as the patterns of use and long run consequences-aspects that in comparison are relatively less studied in current quantitative studies.

*Hypothesis 1: FinTech Innovations development positively influences financial inclusion in cross-country analysis.*

### **Governance and Financial Inclusion**

Literature has supported governance as a crucial institutional enabler of financial inclusion. Good governance, which is comprised of rule of law, regulatory quality, political steadiness and institutional transparency, forms an enabling framework that promotes the development of inclusive financial systems (Arner et al., 2020; Rehman et al., 2022). In these environments, financial rules will be more self-consistent, consumer rights will be more effectively defended, and digital financial services will have a greater chance of gaining the trust of citizens and large adoption. In contrast, weak governance has been found to adversely effects on the dynamics of financial inclusion. Specifically, it results in

incoherent regulatory systems, increases the danger of data privacy violations, and promotes online frauds. Koloseni and Mandari (2024) illustrate this in the case of Tanzania: even when the technical aspect of FinTech platforms is widely available, regulatory enforcement falls short of the capabilities of these platforms to behave inclusively. Patel et al. (2024) go further and note that without clear financial regulation, the innovation of the privately-owned sector is restricted, and the social value of digital financial services is reduced.

This positive link is supported by empirical data. In their study, Rehman et al. (2022) establish the fact that there is a strong correlation between the voice and accountability, regulatory effectiveness, and public integrity governance indicators and FI rate among emerging economies. Similarly, Patel et al. (2024) assert that a resilient institutional governance fosters innovation in digital financial services thus enhancing equitable access and safeguarding the vulnerable users. However, not every study provides consistent findings; some comment on the limitation of the study on context. In particular, Lyons et al. (2021) identified that, even in some developing nations, the improvement in governance indicators yielded incomplete outcomes in FI due to the presence of structural barriers, such as income inequality, gender, and digital illiteracy. Koloseni and Mandari (2024) also demonstrated how even with such widespread reforms of governance, Tanzania suffered regulatory inertia to the detriment of its FinTech inclusion to illustrate a case of governance disconnect with on-the-ground results. A significant gap in the body of knowledge also exists the lack of studies with large-scale, cross-national samples, which support governance as an explanatory variable, and not a control variable. This gap hinders a thorough knowledge of the direct effect of governance in promotion of financial inclusion.

*Hypothesis 2: Governance quality positively influences the financial inclusion in cross-country analysis.*

### **Governance as a Moderating Mechanism: FinTech and Financial Inclusion**

Although the independent effect of Sustainable FinTech, and the independent effect of governance on financial inclusion have been documented in previous research (Hussain et al. 2021; Huang,

et al. 2025), the conditional nature of the FinTech–inclusion relationship under governance has not been rigorously theorized or empirically examined. This study fills this gap by introducing a moderating variable between these two factors: the quality of governance, which can either strengthen or weaken the FinTech innovation’s role in augmenting inclusion.

From a theoretical perspective, this moderating function stems from two theories: Institutional Theory (North, 1990) and the Technology–Institution–Inclusion (TII) framework (Arner et al., 2020), both of which suggest that the social and economic outcomes of technological innovation depend on the quality of the institutional environment within which the technology is used. While the growth of FinTech platforms increases the accessibility of digital financial services, their ability to deliver on inclusion, as evidenced by account ownership, usage and access, is very much linked to the institutional environment in which they operate, as this must provide contract enforcement, consumer data protection, fraud prevention and clarity around regulations. In high-governance settings, citizens are more inclined to believe in electronic financial platforms, and firms have reduced compliance uncertainty and regulators can better promote responsible innovation (Adam et al., 2025). On the other hand, in less robust institutional settings, even high-tech FinTech infrastructures are hard hit by regulatory arbitrage, enforcement failures, and systemic distrust by the unbanked masses (Huang et al., 2025).

Empirical support for this moderation logic is nascent but growing. Hussain et al. (2021) find that governance factors can influence the rate of digital financial services’ reach into underserved populaces, and Lotto (2024) prove that regulatory inaction in the case of Tanzania was a barrier to DfS inclusion outcomes even though platforms were very widely available, which aligns with the moderating hypothesis proposed here. Moreover, cross-national evidence from Latif et al. (2026) shows that structural and institutional barriers role is that of mediators in the association amid digital infrastructure and inclusive outcomes, further supporting the need for an interactive model of governance over digital infrastructure and inclusive outcomes (Adam et al., 2025). All this evidence indicates that governance quality does not simply accompany inclusion via FinTech, it is a precondition of it and the

FinTech–inclusion relationship is thus heterogeneous across institutional contexts. Based on this theory and empirical support, the following hypothesis is advanced:

*Hypothesis 3: Governance quality positively moderates the association amid FinTech and financial inclusion, where the role of FinTech in enhancing financial inclusion is greater in nations with more robust governance quality.*

### Conceptual Model

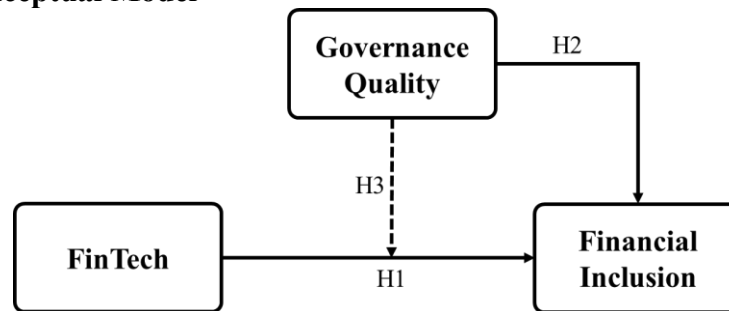


Figure 1: Conceptual Mode (Source: Authors)

### Data and Sources

This study adopts a quantitative longitudinal panel-data design to explore the influence of FinTech and governance quality on financial inclusion. The investigation is carried on the secondary data compiled from the internationally recognized databases around approximate 23-24 years, depending on the availability of data of the individual reporting entity. By combining the cross-sectional heterogeneity across economies and the time-varying nature of financial inclusion and governance and FinTech development, a longitudinal panel framework would be suitable as it would also facilitate the estimation of the effects in a more effective manner and avoid omitted-variable errors (Baltagi, 2008; Hsiao, 2022).

The first dataset is from the World Development Indicators (WDI) and include a total of 266 entities reported across several years. These entities are sovereign countries, territories and other internationally recognized reporting units as per the World Bank reporting framework. In this study, the unit of analysis is the country-year (reporting entity-year) observation, namely, each



panel is one reporting entity observed over time. Following the integration of information from several databases in various countries and the elimination of observations that lacked required information on the variables of the empirical model, the sample used for estimation included **\*\*6,384 panel observations\*\***. The resulting data set is thus an unbalanced panel, which means that there are differences in data availability between reporting entities and years. International databases do not provide complete data for each economy and each year so the use of an unbalanced panel is suitable in cross-country empirical research. Instead of discarding over half of the reporting entities that only have partial observations, the unbalanced panel keeps all of the information and with it, statistical efficiency, minimalization of sample-selection bias, and improvement of analysis representativeness (Baltagi, 2008; Wooldridge, 2010). This is a common way of conducting macro-panel studies using secondary data from comparable sources throughout the world.

Secondary data were collected from trusted and publicly cited sources to enhance transparency, uniformity and reproducibility. The data on macroeconomic and financial indicators came from the World Development Indicators (WDI); governance indicators are adopted from the Worldwide Governance Indicators (WGI); indicators related to FinTech are used from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Bank for International Settlements (BIS), and the World Development Indicators; and indicators of financial inclusion are derived from the IMF's Financial Access Survey (FAS). The panel database for empirical estimation was built by merging all data sets with common identifiers for reporting entities and a common year.

### **Sample Selection**

A broad reporting-entity sample based upon internationally comparable databases. Reporting entities included were those where enough data existed to build Financial Inclusion Index, Governance Index, FinTech Index, Financial Development and GDP per capita variables. The observations for which any of the variables appearing in the estimation were missing were omitted (listwise deletion). This means that the number of observations is different across the

reporting entities and across years, which means that it is an unbalanced panel. This sampling strategy ensures consistency in the empirical analysis, retains the largest information possible, and is consistent with cross-country panel-data research practice.

### Variable Description and Measurement

To operationalize multidimensional concepts like Financial Inclusion, Governance and FinTech, the study adopts the composite index construction method commonly used in institutional and financial inclusion studies.

**Table 1:**  
*Variables operationalization*

| Variable Name             | Definition / Formula                                                                          | Source                          | Citation                                                         |
|---------------------------|-----------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------|
| Financial Inclusion Index | PCA of bank branches per 100,000 adults, ATM density, % of adults with accounts               | WDI / IMF FAS                   | Demirgüç-Kunt et al. (2018); Sarma (2008); Park & Mercado (2018) |
| Governance Index          | PCA of regulatory quality, rule of law, and control of corruption                             | World Bank WGI                  | Kaufmann et al. (2010)                                           |
| FinTech Index             | PCA of mobile money accounts per capita, FinTech firm density, and digital transaction volume | BIS (2021), UNESCAP (2020), WDI | BIS (2021); UNESCAP (2020)                                       |
| Financial Development     | Domestic credit to                                                                            | WDI                             | Svirydzenka (2016)                                               |

|                             | private sector<br>(% of GDP)                 |     |                       |
|-----------------------------|----------------------------------------------|-----|-----------------------|
| GDP per capita<br>(Control) | Log of GDP per capita<br>(constant 2010 USD) | WDI | Beck et al.<br>(2007) |

PCA was employed to create three composite indices to explain the complexity of the major constructs being studied. The Index Financial Inclusion (FI) included three proxies: the density of ATMs, the density of bank branches per 100,000 adults, and the proportion of adults with accounts in financial institutions. This methodology is consistent with Park and Mercado (2018) and Sarma (2008) that propose a multidimensional conceptualization of inclusion by incorporating availability, accessibility, as well as usage.

The Governance Index (GI) included three pointers about institutional quality-, rule of law, corruption control and quality of regulation, and applied the framework that Kaufmann et al. (2010) had described. These dimensions expound on the institutional setting that supports credibility, responsibility and good financial regulation.

Lastly, FinTech Innovations Index (SFI) was compiled as a combination of digital transaction volume, mobile-money-account density per capita and internal credit to the private sector (GDP percentage). These indicators reflect the scope, deepness and access of digital financial services according to the latest definitions and measurement initiatives developed by the Bank for International Settlements (BIS, 2021) and the United Nations ESCAP (2020).

### Descriptive Analysis

Descriptive statistics were used to describe the nature and features of the study variables. It gives an overview of country differences and within country variation in financial access, digital finance and governance quality.

### Panel Unit Root Tests

Panel unit root analysis is conducted to assess whether a variable is stationary, or has a unit root (i.e., non-stationary). In panel data with both cross-sectional and time series components, such tests are essential for the validity of regression analysis. Spurious regression and inefficient statistical inference can be caused by non-stationary variables (Baltagi, 2008). In our own research, we have used Levin, Lin, and Chu (2002), which requires a common unit root process across cross-sections, and Im, Pesaran, and Shin (2003), which does not require a common unit root process. Finally, Fisher-ADF and Fisher-PP tests pool individual test statistics using Fisher's approach (Maddala & Wu, 1999). These tests are essential for measuring the variables' order of integration and subsequent selection of cointegration and error correction models. Unit root tests are important tests in financial and institutional studies as economic time series are often non-stationary. The general panel unit root equation:

$$\Delta y_{it} = \alpha_i + \rho_i y_i + \sum_{j=1}^p \phi_{ij} \Delta y_{i,t-j} + \varepsilon_{it}$$

Most variables were I (1), becoming stationary after first differencing.

### Panel Cointegration Tests

Following unit root analysis and measuring variables' order of integration with same order (typically I (1)), panel cointegration analysis was conducted for determining long-run relationship amongst variables. Cointegration suggest that even with non-stationary nature of the variables, there exist a stationary and linear association, suggesting a meaningful long-term association (Pedroni, 1999; Kao, 1999). In this study, cointegration analysis is necessary to determine whether FinTech Innovations and Governance jointly influence FI in a stable, long-run manner. Pedroni's test allows for heterogeneous intercepts and slope coefficients, making it suitable for diverse country contexts, while Kao's test assumes homogeneity and is based on residual stationarity.

Residual-based cointegration model:

$$FI_{it} = \alpha_i + \beta_1 FinTech_{it} + \beta_2 GI_{it} + \varepsilon_{it}$$

Both tests confirmed cointegration amongst the three key indices.

### Panel Error Correction Model (ECM)

Following cointegration amongst the variables, the panel ECM is applied to measure the short-run volatility and the long-run equilibrium dynamics with error correction term (ECT) (Engle & Granger, 1987). The ECT records the amount of past disequilibrium which is destroyed during period. A large and negative ECT therefore shows a convergence on the long-run relationship on economics. In cross-country financial analysis, the ECM will always be vital in evaluating sensitivity of FI to both governance and FinTech shocks. It offers an effective model that can record both short run effects and institutional path dependency. Isolating short-run and long-run effects allow the ECM to improve the explanatory power and policy relevance of the model, so that policy-makers are in a position to not only craft policies aimed to intervene in the short-run, but also structural changes.

$$\begin{aligned} \Delta FI_{it} = & \gamma_i (FI_{i,t-1} - \beta_1 FinTech_{i,t-1} - \beta_2 GI_{i,t-1}) \\ & - \beta_3 (FinTech \times GI) - (i, t - 1) \\ & + \sum_{j=1}^p \delta_j \Delta X_{i,t-j} + \varepsilon_{it} \end{aligned}$$

The model has been estimated with the Pooled Mean Group (PMG) estimator (Pesaran, et al., 1999), that enforces homogeneity of long-run slope coefficients across panels, while allows for heterogeneity of short-run dynamics and error variances by country. The Hausman specification test supported the long-run slope homogeneity assumption ( $\chi^2(3) = 2.47$ ,  $p = 0.481$ ) which justified the choice of the PMG estimator over the Mean Group (MG) estimator.

The Pesaran (2015) CD test was used to detect cross-sectional dependence which was common across country-level panels due to the global shocks and this was dealt with by using

bootstrap standard errors with 500 replications. The interaction term ( $FI \times GI$ ) was mean centered before being added to the model to avoid multicollinearity, and variance inflation values ( $VIF < 2.5$ ) indicated that there was no multicollinearity concern. The coefficient of disequilibrium (ECT,  $\gamma_i$ ) was negative and significant, meaning that some 44% of the disequilibrium is adjusted in a year.

**Table 2:**  
*Descriptive Stats*

| Variable  | Obs  | Mean      | Std. Dev. | Min    | Max       |
|-----------|------|-----------|-----------|--------|-----------|
| COMBANK   | 6650 | 11.152    | 18.243    | 0      | 285.379   |
| Atm       | 6650 | 27.287    | 41.138    | 0      | 314.769   |
| Aof       | 6650 | 5.656     | 19.422    | 0      | 100       |
| Cce       | 6650 | -.018     | .834      | -1.97  | 2.459     |
| Ruleoflaw | 6650 | -.018     | .836      | -2.591 | 2.125     |
| Rqe       | 6650 | -.02      | .828      | -2.548 | 2.309     |
| Dcp       | 6650 | 39.69     | 40.278    | 0      | 304.575   |
| Gdpc      | 6650 | 13691.348 | 20985.776 | 0      | 224582.45 |

## Results

Table 2 presents the descriptive statistics, summarizing the study variables. The mean of the commercial bank branches per 10,000 adults (COMBANK) is around 11.15, with standard deviation 18.24, indicating a high level of heterogeneity in the financial infrastructure of countries. Similarly, the density of ATM has a mean of 27.29 per 100,000 adults that highlights the high level of variability (standard deviation = 41.14). Account ownership at financial institutions (AOF) has a mean of 5.66% with a high standard deviation, suggesting significant inequality in FI (Beck et al., 2007).

Governance indicators such as control of corruption (CCE), rule of law, and regulatory quality (RQE) are centered around zero, reflecting standardized indexes, with both negative and positive extremes, indicating variation in governance quality (Kaufmann et al., 2010). The mean domestic credit to the private sector (DCP) is approximately 39.69% of GDP, suggesting moderate credit market

development, while GDP per capita (GDPC) averages around \$13,691, reflecting high income disparities amongst countries.

## 2.1.Principal Component Analysis

**Table 3:**  
*Principal Component Analysis*

| Index                     | Component | Eigenvalue | Proportion | Cumulative | Key Loadings (Comp1)                           | Variance Explained (Comp1) |
|---------------------------|-----------|------------|------------|------------|------------------------------------------------|----------------------------|
| Governance Index          | Comp1     | 2.800      | 0.933      | 0.933      | Rule of Law (0.584),                           | 93.3%                      |
|                           | Comp2     | 0.139      | 0.046      | 0.979      | Regulatory                                     |                            |
|                           | Comp3     | 0.062      | 0.021      | 1.000      | Quality (0.570), Control of Corruption (0.578) |                            |
| Financial Inclusion Index | Comp1     | 1.631      | 0.543      | 0.543      | Bank Branches (0.635), ATM Density (0.672),    | 54.3%                      |
|                           | Comp2     | 0.907      | 0.302      | 0.846      | Account                                        |                            |
|                           | Comp3     | 0.462      | 0.154      | 1.000      | Ownership (0.381)                              |                            |
| FinTech Index             | Comp1     | 1.303      | 0.652      | 0.652      | Mobile money accounts per capita (0.707),      | 65.2%                      |
|                           | Comp2     | 0.697      | 0.348      | 1.000      | and digital transaction volume (0.707)         |                            |

*Note.* Comp1 was retained for all indices based on eigenvalue > 1 and interpretability. Values in parentheses represent component loadings (eigenvectors). Data Source: WDI, IMF FAS, and WGI (2000–2024). PCA performed in Stata

The results of the PCA on governance indicate that the first principal component (Comp1) accounts for 93.3% of the variance in three indicators: rule of law, regulatory quality and control of corruption. The large eigenvalue (2.800) and equal loadings on Comp1 (between 0.570 and 0.584) for each of the indicators suggest

that one latent factor explains governance. This justifies the creation of a composite index of governance (Comp1) to represent governance (Filmer & Pritchett, 2001).

In the case of financial inclusion, the PCA results show that Comp1 accounts for 54.3% of the variance. The measures ATM and COMBANK have strong loadings on Comp1 (0.672 and 0.635, respectively) and account ownership (AOF) has the strongest loading on Comp2 (0.910). This indicates that infrastructure-based measures (bank branches and ATMs) and usage-based measures (account ownership) are perhaps somewhat different aspects of FI but that Comp1 is a useful index.

The FinTech PCA includes mobile money accounts per capita, and digital transaction volume. Comp1 accounts for 65.2% of the variance, with equal weights (0.707) for the two variables. This indicates that we can consider Comp1 as a good index of FinTech, as also found by Beck, Levine, & Loayza (2000).

**Table 4:**  
*Unit Root Analysis*

| Variable   | Test                  | Transformation | Test Stats                  | Adjusted/Other Stats   | p       |
|------------|-----------------------|----------------|-----------------------------|------------------------|---------|
| Governance | Levin-Lin-Chu (LLC)   | Level          | Adj t* = 13.1000            | -                      | 1.000   |
|            | LLC                   | 1st Diff (D.)  | Adj t* = 63.2634            | -                      | 1.000   |
|            | Im-Pesaran-Shin (IPS) | Level          | unbalanced                  | -                      | -       |
|            | Fisher (ADF)          | Level          | P = 1394.27                 | Z = -22.49, Pm = 26.43 | 0.000** |
|            | Fisher (PP)           | Level          | P = 1394.27                 | Z = -22.49, Pm = 26.43 | 0.000** |
| Inclusion  | LLC                   | Level          | Adj t* = -1.1271            | -                      | 0.129   |
|            | LLC                   | 1st Diff (D.)  | Adj t* = -25.8454           | -                      | 0.000*  |
|            | IPS                   | Level          | Not calculated (unbalanced) | -                      | -       |
|            | Fisher (ADF)          | Level          | P = 1441.17                 | Z = -20.72, Pm = 27.87 | 0.000*  |



|         |             |               |                 |                        |        |
|---------|-------------|---------------|-----------------|------------------------|--------|
|         | Fisher (PP) | Level         | P = 1441.17     | Z = -20.72, Pm = 27.87 | 0.000* |
| FinTech | LLC         | Level         | Adj t* = -0.175 | -                      | 0.431  |
|         | LLC         | 1st Diff (D.) | Adj t* = 0.923  | -                      | 0.823  |

### Unit Root Test Results

The unit root analysis shows mixed evidence on the stationarity of the constructed indices. For governance, Levin-Lin-Chu (LLC) does not reject the null of unit root both at level and first difference ( $p = 1.0000$ ), suggesting non-stationarity. But the Fisher-ADF and Fisher-PP tests reject the null ( $p = 0.0000$ ) very strongly, implying stationarity (Baltagi, 2005). For inclusion, LLC suggests non-stationarity ( $p = 0.1298$ ) at level but stationarity ( $p = 0.0000$ ) at first difference. However, the Fisher tests at level also reject the null. This implies that inclusion is integrated of order one,  $I(1)$ . The FinTech index shows weaker stationarity. LLC tests reject stationarity at both level and first difference, but the Fisher tests confirm weak stationarity at level. So, the development index is probably not stationary but marginally acceptable with Fisher tests.

### Cointegration

**Table 5:**

*Panel Cointegration: Kao and Pedroni*

| Test                                                                          | Stats   | p     | Interpretation                                  |
|-------------------------------------------------------------------------------|---------|-------|-------------------------------------------------|
| <i>Kao (1999) Test Null hypothesis: No cointegration (homogeneous panels)</i> |         |       |                                                 |
| Modified Dickey-Fuller t                                                      | -15.785 | 0.000 | Reject $H_0$ – Cointegration exists             |
| Dickey-Fuller t                                                               | -17.624 | 0.000 | Reject $H_0$ – Cointegration exists             |
| Unadjusted Modified DF t                                                      | -43.837 | 0.000 | Reject $H_0$ – Strong evidence of cointegration |

|                            |         |       |                                                          |
|----------------------------|---------|-------|----------------------------------------------------------|
| Unadjusted Dickey-Fuller t | -27.642 | 0.000 | Reject H <sub>0</sub> – Strong evidence of cointegration |
|----------------------------|---------|-------|----------------------------------------------------------|

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*Pedroni (1999-2004) Test Null hypothesis: No cointegration (heterogeneous panels)*

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|                            |         |       |                                              |
|----------------------------|---------|-------|----------------------------------------------|
| Modified Phillips-Perron t | -18.690 | 0.000 | Reject H <sub>0</sub> – Cointegration exists |
| Phillips-Perron t          | -42.939 | 0.000 | Reject H <sub>0</sub> – Cointegration exists |
| Augmented Dickey-Fuller t  | -42.905 | 0.000 | Reject H <sub>0</sub> – Cointegration exists |

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*Note.* Both Kao (1999) and Pedroni (1999, 2004) tests reject the null hypothesis of no cointegration at the 1% significance level. Tests were conducted using the Bartlett kernel with Newey-West bandwidth selection. Data include 266 panels over 23–24 years.

The Kao test findings confirm the presence of cointegration in the panel data. The test statistics of all versions of the ADF test are highly significant ( $p = 0.0000$ ) and reject the null hypothesis of no cointegration. This implies a long run equilibrium exists between the variables. The Pedroni test, which accounts for panel heterogeneity, also shows cointegration. The Modified Phillips-Perron t, Phillips-Perron t, and SDF t tests reject the null at the 1% level, confirming cointegration (Pedroni, 1999).

**Table 6:**  
*ECM MODEL*

| Variable                                                                                   | Coef. | S.E. | t-stat | P-value | CI Lower | CI Upper | Sig. |
|--------------------------------------------------------------------------------------------|-------|------|--------|---------|----------|----------|------|
| <i>Panel A: Short-Run Dynamics — FinTech and Governance Effects on Financial Inclusion</i> |       |      |        |         |          |          |      |
| D. FinTech Index (SFI)                                                                     | .146  | .034 | 4.37   | .000    | .081     | .212     | ***  |
| D. Governance Index (GI)                                                                   | .098  | .013 | 7.52   | .000    | .072     | .124     | ***  |
| D. SFI x GI (Moderation)                                                                   | .071  | .021 | 3.38   | .001    | .030     | .112     | ***  |
| Constant                                                                                   | .015  | .008 | 1.79   | .073    | .001     | .031     | *    |
| <i>Panel B: Error Correction Term — Confirming Long-Run Equilibrium</i>                    |       |      |        |         |          |          |      |
| ECT <sub>(t-1)</sub>                                                                       | -.446 | .011 | -41.58 | .000    | -.467    | -.425    | ***  |

| <i>Panel C: Moderation — Marginal Effect of FinTech at Governance Levels (Short-Run)</i> |         |              |       |           |            |          |            |
|------------------------------------------------------------------------------------------|---------|--------------|-------|-----------|------------|----------|------------|
| GI = -1 SD (low governance)                                                              | .075    | .041         | 1.83  | .067      | -.005      | .155     | *          |
| GI = 0 (mean)                                                                            | .146    | .034         | 4.37  | .000      | .081       | .212     | ***        |
| GI = +1 SD (high governance)                                                             | .217    | .038         | 5.71  | .000      | .142       | .292     | ***        |
| <i>Panel D: Model Fit Statistics</i>                                                     |         |              |       |           |            |          |            |
| Mean dep. var.                                                                           | -0.000  | SD dep. var. | 0.726 | R-squared | 0.224      | N (obs.) | 6,384      |
| F-statistic                                                                              | 587.181 | Prob > F     | .000  | AIC       | 12,420.692 | BIC      | 12,447.738 |

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .10$ . *D.* denotes first-difference operator. *ECT* = Error Correction Term; *FI* = FinTech Innovations Index; *GI* = Governance Index. The interaction term *SFI x GI* was mean-centred prior to estimation to reduce multicollinearity. Panel C reports simple slopes reflecting the conditional short-run effect of FinTech on financial inclusion at low (-1 SD), mean, and high (+1 SD) levels of governance quality.

### ECM Results

The ECM estimates are presented in Table 5, which shows the short-run and long-run relationships among FinTech, the quality of governance, and financial inclusion.

### Short-run Dynamics

The short run effects are estimated in Panel A, based on first differenced variables. The coefficient of the FinTech Index demonstrated as a direct and significant ( $\beta = 0.146$ ,  $p < 0.001$ ), suggesting that better performance of FinTech in the short run has a positive impact on financial inclusion. Specifically, at constant values of other factors, a 1% increase in the FinTech Index is correlated with a 0.146% increase in financial inclusion. This finding suggests that greater availability and adoption of digital financial technologies immediately enhance individuals' access to and use of formal financial services.

Similarly, the Governance Index (GI) exerts a direct and significant impact on financial inclusion ( $\beta = 0.098$ ,  $p < 0.001$ ). This suggests that enhanced governance quality such as greater regulatory effectiveness, institutional quality, accountability, and rule of law, helps to promote financial inclusion by establishing a more conducive institutional setting for financial services delivery.

The relationship between FinTech and Governance ( $SFI \times GI$ ) is also positive, with a p value of 0.001 and a  $\beta$  value of 0.071. The positive impact of FinTech on financial inclusion is greater the higher the quality of governance, confirming the moderating effect of governance. In other words, FinTech innovations are more effective in expanding financial inclusion when supported by stronger institutional and regulatory frameworks.

### **Long-run Equilibrium**

The ECT is reported in Panel B, and is small and significant ( $\beta = -0.446$ ,  $p < 0.001$ ). Negative sign indicates that a stable long-run equilibrium association amongst the variables. The regression coefficient magnitude suggests the adjustment towards short-run equilibrium takes around 44.6% in one period after a temporary shock, which indicates that the process of adjustment to long-run equilibrium is fairly quick.

### **Moderating Effect of Governance**

The third panel (Conditional (Simple) effects of FinTech on financial inclusion at varying levels of governance quality) shows the conditions under which the effects of the use of FinTech can be observed for financial inclusion at varying levels of governance quality. Under low governance quality ( $-1$  SD), the marginal effect of FinTech is relatively weak ( $\beta = 0.075$ ,  $p = 0.067$ ) and is only marginally significant. The effect is quite strong at the average level of governance ( $\beta = 0.146$ ,  $p < 0.001$ ). In the case of governance quality ( $+1$  SD), the effect of FinTech is the most powerful ( $\beta = 0.217$ ,  $p < 0.001$ ). The findings show a clear strengthening pattern where governance strengthens the effectiveness of FinTech in the promotion of financial inclusion. Countries with robust governance systems can thus capitalise on the development of FinTech, while those with weak governance are limited in the ability of digital financial innovations to enhance financial access.

### **Model Adequacy**

The estimated ECM is statistically sound, as shown in Panel D. The overall model is significant with  $F = 587.181$ ,  $p < 0.001$ , which means that the set of explanatory variables explains the variations in financial inclusion. The model accounts for 22.4% ( $R^2 = 0.224$ ) of

the short-run variation in financial inclusion and that is satisfactory for macro-panel ECM analysis for institutional and financial variables. In addition, the large size of the sample ( $N = 6,384$ ) increases the precision and reliability of the estimates of the coefficients. These findings validate the hypothesis that FinTech contributes to financial inclusion, that governance alone contributes to financial inclusion, and that governance can reinforce the beneficial impact of FinTech on financial inclusion. The large error correction term further testifies to the stability of these relationships in the long run yet short run fluctuations.

### **Discussion**

This study offers evidence that FinTech Innovations and the quality of governance have strongly positive impacts on FI in developing economies. Based on the ECM, the analysis concludes that about 44.6 percent of the deviations in the long-run equilibrium are corrected on yearly basis, thus, validating the stability and responsiveness of the financial system. Such findings are aligned with the perspective that innovations brought forth by FinTech, combined with well-established institutional infrastructure, can increase access to financial services in underbanked populations. These findings are supported by the recent literature that provides FinTech with a transformative potential in inclusive finance. Gupta (2024), found that mobile platforms and alternative credit scoring in new markets significantly overcome the traditional banking barriers and consequently expanded access to the marginalized populations (Gupta, 2024). Similarly, Guo (2024) establishes that online payments and the use of digital technology have widened the reach of financial institutions particularly in economies with low banking facilities (Guo, 2024). The study by Lyons et al. (2021) shows further that advancement in FinTech is positively correlated with the enhancement of savings, borrowing, and remittance behavior in emerging economies, underlining the impact of FinTech on development of economies and on the other hand its capability of achieving FI (Lyons et al., 2021).

Another important factor that defines the outcomes of FI is governance. As demonstrated in the analysis, the governance indicators, together, governance, rule of law, control of corruption, and regulatory quality indicate a strong explanatory variable of

inclusion trends. These findings are in line with other researchers such as Barik & Pradhan (2021), who highlights that governance in itself when worked in conjunction with FinTech enhances the performance of the latter particularly in the political stable BRICS markets. According to Hossain et al. (2024), the FinTech policy innovation should also become a critical part of the favorable regulatory conditions to maximize the benefits of FI (Hossain et al., 2024).

Although the recent empirical evidence is generally consistent with the hypothesis that FinTech and governance co-contribute to financial inclusion, the hypothesis is not universally confirmed. According to Ediagbonya and Tioluwani (2022), in Nigeria, despite significant financial investments in digital platforms, the FI gaps have not been reduced due to ongoing infrastructure gaps, substantial data privacy issues, and trust in digital finance amongst rural residents (Ediagbonya & Tioluwani, 2022). Koloseni and Mandari (2024) elaborate on these points, pointing out that despite the existence of an efficient FinTech ecosystem, poor governance can render the advantages of technology dull by creating regulatory gaps and low digital literacy records (Koloseni & Mandari, 2024). The findings as a whole highlight that although FinTech is an element that is critical to inclusive financial systems, its effectiveness relies on simultaneous initiatives of governance reform and capacity-building efforts.

Moreover, several previous investigations question the assumption that an increased access inevitably leads to meaningful use. Lyons et al. (2021) caution that while FinTech can broaden access, its usage—particularly for savings and credit—remains uneven across gender and socioeconomic lines. This distinction between access and active engagement underscores the need for policy interventions tailored to user behavior and social inclusion.

### **Conclusion and Recommendations**

This research seeks to explore the effects of FinTech Innovations and governance on FI in emerging markets, through panel data analysis and a sound econometric approach. Our findings reveal the presence of a significant long-run association between these variables, supporting the hypothesis that both FinTech growth and quality of institutions are important for financial inclusion. A

crucial insight is the role of governance for FinTech. The findings reveal that strong governance, as captured by the rule of law, quality of regulation and control of corruption, creates a conducive framework for the successful application of FinTech. In the absence of strong governance structures, even the most innovative digital financial technologies may not deliver inclusive outcomes, especially in a low-trust financial environment. In addition, the existence of a cointegrated long-run relationship amongst FinTech Innovations, governance and FI highlights the inter-relationship between these aspects. The results of the model show that the ECT is negative, statistically significant, implying that the short-term deviations from the financial system are gradually removed and the system returns to the long-run equilibrium. This finding shows that FI and economic inclusion can be enhanced in the long run by investing in governance and digital infrastructure.

### **Policy Implications**

The empirical results have significant implications to policymakers in developing countries willing to increase financial inclusion through digital innovation. Firstly, there is a need to promote a sustainable digital finance by making active state investments in infrastructure and encouraging mobile banking, digital payment, and other FinTech services. Efforts should be specifically made to ensure the affordability and availability of such services to enable the underserved groups, particularly people living in rural or low-income areas, to participate effectively in the digital economy. In tandem with these technological projects, building of institutions is imperative. The study establishes that the effectiveness of FinTech is significantly boosted in environments characterized by strong governance and therefore, policy changes should target to increase the rule of law, improve the quality of regulatory frameworks as well as strengthen anti-corruption measures. These are important steps that create confidence amongst consumers and reduce the chances of fraudulent activities, data abuse, and market manipulation.

### **Future Research Directions**

The current research contributes to the understanding of the FinTech governance inclusion nexus, yet some other dimensions

should also be studied in the future. First, the heterogeneity within continents or economic blocks could be elucidated by regional or sub-regional panel analyses. Second, household-level or firm-level data can be used to conduct micro-level studies, which can identify the ways in which various groups of the population can benefit due to the adoption of FinTech. Third, the place of certain types of regulatory tools, including sandboxes or digital ID frameworks, in restricting the impact of FinTech on inclusion deserves to be explored. Fourth, the interplay of the new emerging themes including green finance and digital currencies with financial inclusion in diverse governance contexts is an area that warrant further research.

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