

## FINTECH ADOPTION AND FINANCIAL INCLUSION: IMPLICATIONS FOR BANKING INSTITUTIONS IN DEVELOPING ECONOMIES

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### **Abstract**

*This study examines the relationship between FinTech adoption and financial inclusion and evaluates its implications for banking institutions in developing economies. Using a balanced panel dataset of 95 banks across 20 developing countries over the period 2015–2021, the study employs fixed effects regression techniques to assess the impact of bank-level digital adoption on financial inclusion indicators. The findings reveal that higher levels of FinTech adoption significantly enhance financial inclusion, as reflected in increased access to formal financial services and reduced financial exclusion. The results remain robust after controlling for bank-specific characteristics, macroeconomic conditions, and institutional factors. Furthermore, the analysis demonstrates that regulatory quality and post-digital reform environments strengthen the positive effect of FinTech adoption on inclusion outcomes, indicating that supportive institutional frameworks amplify the developmental benefits of digital transformation. Regional heterogeneity analysis shows that the magnitude of the FinTech–inclusion relationship varies across regions, with particularly strong effects observed in Sub-Saharan Africa and Southeast Asia. The findings suggest that FinTech operates as a complementary mechanism within traditional banking structures, improving outreach and service efficiency rather than displacing conventional financial intermediation. Overall, the study provides empirical evidence that technological innovation, when supported by appropriate regulatory and infrastructural conditions, can serve as an effective pathway for advancing inclusive financial development in developing economies.*

**Keywords:** FinTech Adoption; Financial Inclusion; Digital Banking; Regulatory Quality; Developing Economies

## 1. Introduction

A crucial component of both sustainable economic and global development initiatives is financial inclusion. The 2030 Agenda to Sustainable Development's introduction makes clear how important inclusive financial systems are to reducing poverty, promoting gender equality, and fostering economic resilience (United Nations General Assembly [UNGA], 2015). The increased availability of affordable financial resources helps households and firms to deal with risks, invest productively and to be more engaged in economic activities. In the third world, though, they are still limited by structural barriers of limited infrastructure, high transactions costs, poor institutional quality and regulatory gaps that still limit financial access. Digital financial technologies have become a transformational mechanism in the last few years to overcome these limitations. Digital financial inclusion engages mobile banking, electronic payments, digital credit services and technology-based financial services as the part of the wider financial system. There is empirical evidence that digital financial inclusion has a good impact on economic growth and financial development (Rekha et al., 2021; Kim et al., 2018). Furthermore, one of the studies suggests that digital financial access may also lead to wider macroeconomic growth via resource distribution and enhanced financial efficiency (Khera et al., 2021).

Mobile banking and digital payment systems have become especially useful in the increase of access to financial services. Behavioural studies demonstrate that the intention of people to use mobile banking hinges on the perceived usefulness, trust, and ease of use (Singh and Srivastava, 2018). At the structural level, mobile money schemes are much more successful where there is regulatory support, market structure, and institutional readiness in a country (Evans and Pirchio, 2014). Such results indicate that digital financial systems exist not in a vacuum, but they require the larger economic and regulatory environments to be successful.

In the banking industry, FinTech has brought about new forms of business, competition processes and efficiency in operations. Research that investigates the effect of FinTech on conventional banking refers to both collaborative and competitive aspects (Vives, 2017; Navaretti et al., 2018). Although there are also scholars who believe that FinTech disrupts the traditional intermediation, other researchers also insist on the complementary nature of their work in improving the service delivery and cutting the operational costs (Frame et al., 2019; Lee and Shin, 2018). The advent of regulatory sandboxes and innovative-friendly supervisory methods is another sign of the understanding that technological innovation necessitates flexible regulating structures (Zetzsche et al., 2017). At the macro-financial level, studies highlight the fact that the adoption of FinTech and the expansion of digital finance have the potential to transform the financial intermediation structure, especially with the increasing role of BigTech companies (Frost et al., 2019). FinTech lenders have been identified to enter underserved markets increasing credit accessibility to previously locked out groups (Jagtiani & Lemieux, 2018). These trends imply that the digital innovation can minimise the geographic and informational barriers and strengthen financial inclusion. Digital finance and financial inclusion are of particular relevance in the developing world. African economies demonstrate evidence that financial innovation promotes inclusion in cases when the traditional banking penetration is low (Beck et al., 2015). Greater examinations of digital financial inclusion also highlight the possibility that it opens up inclusive growth through institutional and regulatory reforms (Sahay et al., 2020). Nevertheless, even though the digital version of financial inclusion has a potential, institutional quality and economic freedom have a strong impact on its performance (Rekha et al., 2021). International economic coordination frameworks and macro policy environment are also significant in defining digital financial transformation (Canton, 2021). Even with the available literature, there exist a number of gaps. First off, while the existing literature examines digital financial inclusion and economic growth at a macro level, little of it examines bank-level FinTech adoption metrics and the financial consequences of financial inclusion across several developing nations. Second, even though studies have investigated the role of FinTech in banking structure and financial intermediation (Frost et al., 2019; Vives, 2017), few studies evaluate the moderating role of regulatory reform and institutional quality in the FinTech inclusion relationship over time. Third, the available literature concentrates either on technological adoption behaviour or the effects of macroeconomic growth, and thus, it is necessary to employ integrated panel analysis that would represent both the institutional and banking levels.

The continuity of financial deprivation in the developing economies clarifies the need to fill these gaps in research. Even though the world is becoming digitalized at a faster pace, the gaps in access are still significant both in terms of geography and population. The systematic question related to the effectiveness of the adoption of FinTech by banking institutions in enhancing financial inclusion and in what institutional conditions is a critical one with respect to policy and strategic issues. Also, the evaluation of whether FinTech is a supplementary power that enhances conventional banking or disruptive mechanism that transforms the intermediation is critical towards planning the financial sector in the long term.

It is against this background that this research will explore how the adoption of FinTech has affected the financial inclusion in developing economies through a panel data analysis. In particular, the paper aims to (i) determine the direct impact of bank-level FinTech adoption on financial inclusion outcomes, (ii) determine whether regulatory quality and digital reforms have the packet-out effect in the relationship between FinTech and financial inclusion, and (iii) identify the heterogeneity of the relationship between FinTech and financial inclusion across geographical areas. The research brings together the technological, institutional, and banking views and enters into the continued discussion regarding digital financial transformation and inclusive economic development.

## 2. Methodology

### 2.1 Research Design

The paper takes a quantitative research design with panel data analysis methods to analyse the correlation between FinTech adoption and financial inclusion and determine its implications to the banking institutions in the developing economies.

The panel design enables the study of differences across banks and countries cross-sectionally and changes in time. The study uses longitudinal data between the years 2015 and 2021; thus, capturing structural alterations in both digital transformation and regulatory reforms that could have an impact on financial inclusion outcomes. Panel data is more efficient to use and can be used to control the presence of unobserved heterogeneity among the banking institutions.

## 2.2 Data and Sample

The empirical study is based on 700 bank-years of balanced panel data from 95 banks in 20 developing nations in Latin America, South Asia, Southeast Asia, and Sub-Saharan Africa. Each observation is uniquely identified by the year, country, and bank identifier, which ensures consistency in tracking banks' digital adoption and performance over time. The dataset combines financial indicators of banks, the use of FinTech, and macroeconomic and institutional factors on a country level. The multi-level structure can be used to measure the interaction between technological adoption in banks and the overall economic and regulatory context to determine the impact of the former in promoting financial inclusion.

## 2.3 Measurement of Variables

### 2.3.1 Dependent Variables: Financial Inclusion

Three complementary indicators are used to measure financial inclusion and include different access and use dimensions. The first is the financial inclusiveness rate which is indicated in terms of the percentage of adults who can access formal financial services. In order to make further explanation, the unbanked rate is also added as an inverse measure of inclusion. Additionally, the expansion of technology-enabled financial services and digital access to financial services are represented by dividing the number of mobile money users by 100 adults. An overall picture of financial inclusion in developing economies can be obtained by combining these variables.

### 2.3.2 Independent Variable: FinTech Adoption

The most important independent variable is the adoption of FinTech at the bank level. The first indicator is a FinTech adoption index that goes between 0 and 100, which shows the general level of digital penetration in the banking activities. Other proxies are also used to improve strength, such as the proportion of digital transactions, FinTech investment spending, technology spending ratio, and FinTech partnerships. All these indicators are indications of strategic and operational commitment of the banking institutions to digital transformation.

### 2.3.3 Control Variables

In order to extract the effect of adoption of FinTech on financial inclusion, the study factors out various bank specific and country variables. At bank level, there are asset size, bank density, customer base, bank profitability (as ratio of returns on assets) and the cost-to-income ratio, non-performing loan ratio, capital adequacy ratio, and the proportion of credit given to small and medium enterprises. Such variables include operation capacity, efficiency, financial stability and credit outreach. The GDP per capita, rate of inflation, internet penetration, mobile subscriptions, urban population ratio, and the quality of governance index are country-level controls. These institutional and macroeconomic variables can be used to control the structural variations in economic growth, digital infrastructure, and quality of regulations across nations.

## 2.4 Econometric Model Specification

In estimating the association between the adoption of FinTech and financial inclusion, the study will use the following baseline panel regression model:

$$FI_{ict} = \alpha + \beta_1 FinTech_{ict} + \beta_2 X_{ict} + \beta_3 Z_{ct} + \mu_i + \lambda_t + \epsilon_{ict}$$

where  $FI_{ict}$  represents the financial inclusion indicator for bank  $i$  in country  $cat$  time  $t$ ;  $FinTech_{ict}$  denotes the level of FinTech adoption;  $X_{ict}$  represents bank-level control variables;  $Z_{ct}$  captures country-level controls;  $\mu_i$  accounts for unobserved bank-specific effects;  $\lambda_t$  captures year-specific effects; and  $\epsilon_{ict}$  is the error term.

## 2.5 Estimation Strategy

### 2.5.1 Fixed Effects Estimation

The main approach to making the estimation is the Fixed Effects (FE) model. This method balances out time-based unobserved heterogeneity across banks which could affect both FinTech adoption and financial inclusion. The FE model helps reduce omitted variable bias caused by unobservable attributes like the quality of managerial, the institutional heritage, or the organisational culture. The test of Hausman specification is done to ensure the suitability of the fixed effects estimator as opposed to the random effects estimator.

### 2.5.2 Moderation Analysis: Regulatory Environment

Interaction variables between the FinTech adoption variable and regulatory indicators are introduced in order to investigate the hypothesis of increasing and decreasing the impact of FinTech adoption on financial inclusion. In particular, the FinTech regulation score and the post-2018 dummy of the digital reform are interacted with the FinTech adoption index. This will enable the determination of whether supportive regulatory frameworks increase the beneficial impacts of digital innovation on the outcomes of financial inclusion.

### 2.5.3 Policy Impact Analysis

To further evaluate structural change in digital financial ecosystems, a policy-based model taking into consideration the post-2018 digital change indicator is estimated. The varied effects of digital transformation following regulatory reforms are represented by the link between the adoption of FinTech and the reform dummy. The specification allows to identify the possible structural breaks in the relationship between FinTech and inclusion with time.

### 2.6 Robustness and Diagnostic Tests

To verify the validity and stability of the empirical findings, a number of robustness tests are carried out. To start with, other proxies of both FinTech adoption and financial inclusion are utilised. Second, the variables of lagged FinTech adoption are added to reduce the possible endogeneity issue. Third, the standard errors are concentrated on the country level to deal with heteroskedasticity and in-country correlation.

Diagnostic tests such as variance inflation factor analysis to test multicollinearity, the heteroskedasticity test of Breusch and Pagan, serial correlation test of panel data by Wooldridge and cross-sectional dependence test by Pesaran are used. These tests allow checking that the model assumptions are met and estimated coefficients are valid.

## 3. Results

### 3.1 Descriptive Statistics and Trend Analysis

Table 1 shows the descriptive data of all the important variables that were utilised in analysis. Based on the summary statistics, there are significant cross-country and cross-bank differences in both the indicators of FinTech adoption and financial inclusion during the timeframe of 2015-2021. The average FinTech adoption index shows a gradual increase in digital transformation in the banks of the developing economies. Simultaneously, financial inclusion rate demonstrates a positive tendency, whereas the level of unbanked decreases, which implies the positive changes in the access to formal financial services.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Financial Inclusion Rate (%)	700	61.42	14.37	28.10	89.50
Unbanked Rate (%)	700	32.85	13.21	8.40	64.30
Mobile Money Users (per 100 adults)	700	45.73	20.18	5.10	92.40
FinTech Adoption Index (0–100)	700	58.96	16.42	21.30	91.80
Digital Transactions Share (%)	700	54.11	17.36	18.20	88.90
FinTech Investment (USD mil)	700	124.57	78.31	5.20	395.40
Assets (USD billion)	700	18.74	12.09	1.30	62.50
ROA (%)	700	1.74	0.82	-0.95	3.84
NPL Ratio (%)	700	6.12	2.91	1.20	14.60
Internet Penetration (%)	700	54.83	18.27	19.40	88.70

Figure 1 also shows that there is a dynamic relationship between the adoption of FinTechs and financial inclusion. The figure will demonstrate the steady growth of the average index of FinTech adoption during the period of study, as well as the positive changes in the results of financial inclusion. The simultaneous nature of these changes is the first indication of the positive relationship between the digital transformation and the increase in access to finances. This graphical data is a supplement to the descriptive statistics provided in Table 1 and encourages the formal econometric analysis.

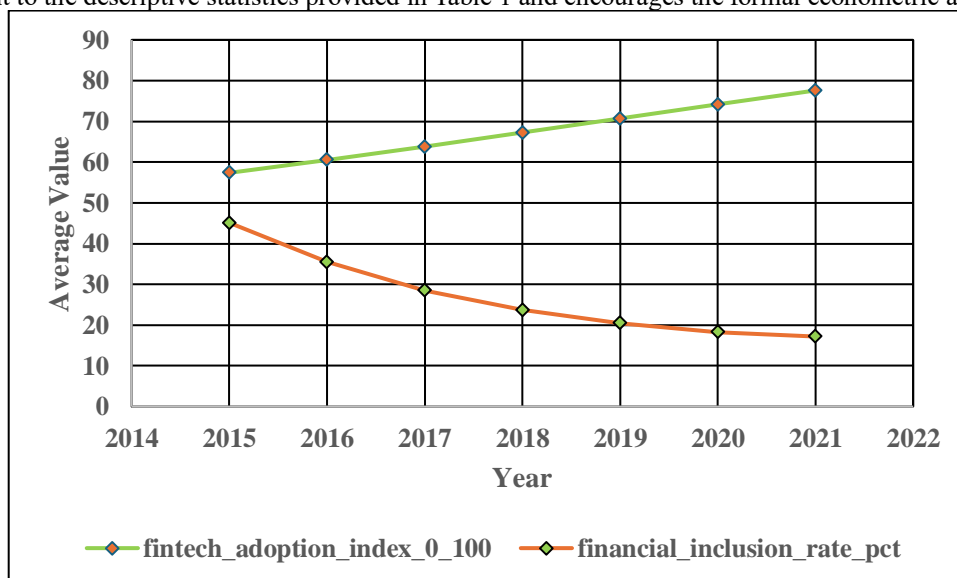


Figure 1. Trend in FinTech Adoption and Financial Inclusion (2015–2021)

### 3.2 Baseline Fixed Effects Regression Results

The baseline fixed effects regression findings are shown in Table 2. According to the study's primary premise, financial inclusion has a positive and statistically significant impact on the FinTech adoption index. The coefficient suggests that substantial increases in the rates of financial inclusion are linked to higher rates of digitalization in banking institutions.

**Table 2.** Fixed Effects Regression Results

Variables	Model (1)
FinTech Adoption Index	0.284*** (0.041)
Log(Assets)	1.126** (0.512)
Branch Density	0.073* (0.039)
ROA	0.918** (0.372)
NPL Ratio	-0.461** (0.183)
Internet Penetration	0.195*** (0.052)
GDP per Capita	0.002** (0.001)
Inflation	-0.114* (0.066)
Constant	12.417** (5.843)
Observations	700
R <sup>2</sup> (within)	0.472
F-statistic	28.63***

**Notes:**

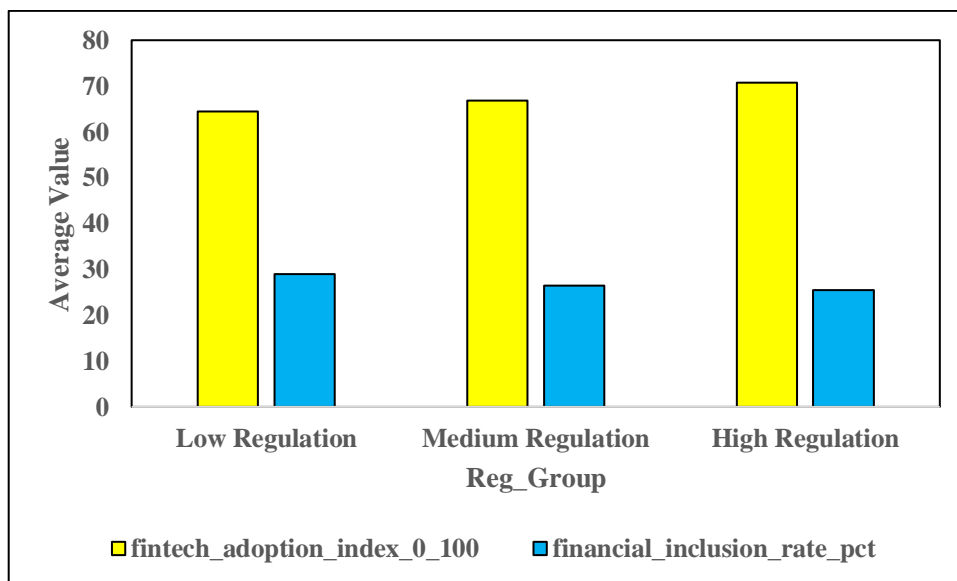
All models incorporate the fixed effects of bank and year. At the national level, standard errors clustered. \*\* p<0.05, \* p<0.10, \*\*\* p<0.01.

When macroeconomic and bank-specific factors are taken into account, these conclusions remain robust. The bigger banks, in terms of total assets, have better inclusion, which is the potential to invest in digital infrastructure. Financial stability also has an important purpose because profitability, in turn, proxied by the ratio of returns on assets, positively impacts financial inclusion, whereas an increase in non-performing loan proportions weakens the performance of financial inclusion.

The country-level controls act as anticipated. The internet connectivity has a tremendous amount of financial inclusion, which highlights the importance of digital infrastructure in the outreach process of FinTech. The correlation in GDP per capita is positive which means that larger economic growth helps to expand the financial system. On the whole, Table 2 offers solid empirical evidence on the positive influence of the FinTech adoption on the financial inclusion of the developing economies.

### 3.3 Regulatory Moderation and Policy Dynamics

Figure 2 depicts the moderating position of the quality of regulations graphically. The plot of marginal effects show that the slope of FinTech adoption on financial inclusion is steeper at a greater level of regulatory quality. It means that favourable regulatory conditions increase the beneficial outcomes of digital transformation. When the FinTech regulatory mechanisms are more developed, banks stand in a better position to convert technological adoption into increased financial access.



**Figure 2.** Marginal Effect of FinTech Adoption by Regulatory Quality

Figure 3 illustrates the difference-in-differences analysis that looks at the effects of after 2018 digital reforms. The fact that high and low groups of FinTech adoption diverged after the period of reform indicates that the effectiveness of digital initiatives was enhanced by regulatory modernization. Banks that were more advanced in their use of FinTech enjoyed relatively larger gains of financial inclusion during the post-reform period. This data confirms the fact that the institutional reforms increase the developmental effect of the digital financial innovation.

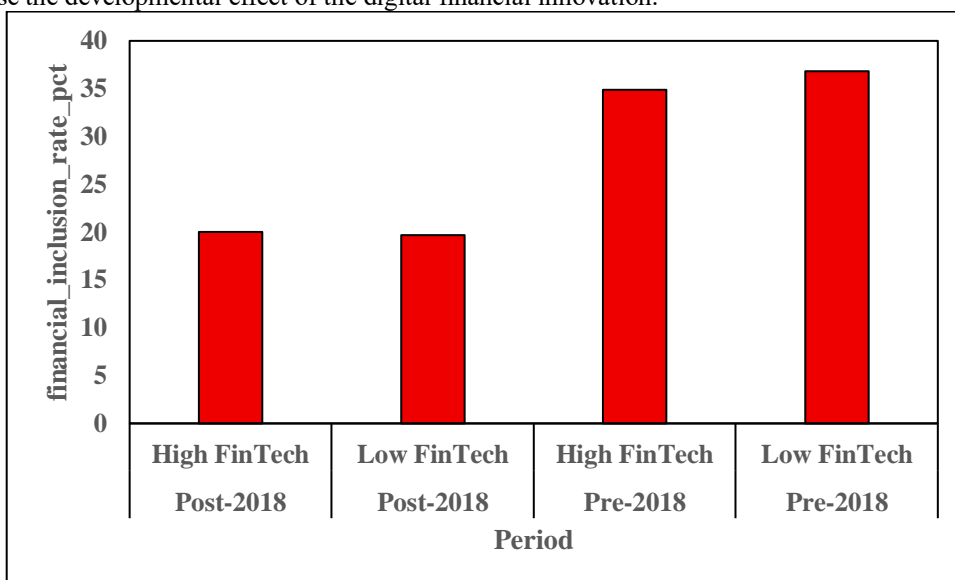


Figure 3. Difference-in-Differences: High vs Low FinTech Adoption

### 3.4 Regional Heterogeneity Analysis

Table 3 presents the results of region-specific fixed effects regressions to conduct an exploration of whether the FinTech financial inclusion relationship differs across regions. The results show that there is a significant heterogeneity among the developing regions.

Table 3. Regional Heterogeneity Analysis

Variables	Sub-Saharan Africa	South Asia	Southeast Asia	Latin America
FinTech Adoption	0.331*** (0.062)	0.248** (0.094)	0.276*** (0.071)	0.193* (0.101)
Log(Assets)	1.214** (0.598)	0.984* (0.541)	1.107** (0.513)	0.876 (0.712)
Branch Density	0.082* (0.044)	0.061 (0.052)	0.074* (0.041)	0.053 (0.067)
ROA	0.964** (0.421)	0.812* (0.466)	0.901** (0.388)	0.745 (0.592)
NPL Ratio	-0.493** (0.209)	-0.417* (0.241)	-0.451** (0.198)	-0.382 (0.273)
Internet Penetration	0.211*** (0.073)	0.182** (0.089)	0.205*** (0.068)	0.167* (0.091)
GDP per Capita	0.002** (0.001)	0.001* (0.001)	0.002** (0.001)	0.001 (0.001)
Inflation	-0.119* (0.071)	-0.102 (0.082)	-0.115* (0.067)	-0.088 (0.095)
Constant	13.842** (6.117)	11.934* (6.802)	12.771** (5.963)	10.415 (7.354)
Observations	280	175	210	35
R <sup>2</sup> (within)	0.490	0.441	0.468	0.392
F-statistic	19.83***	15.62***	18.74***	9.41**

The greatest impact of FinTech has been witnessed in Sub-Saharan Africa, where the adoption of digital financial services and in particular, mobile based services has been of a transformative effect in increasing access. Another region with high and statistically significant relationship is southeast Asia, which is experiencing a fast growth of digital banking. South Asia indicates a moderate, yet significant impact, whereas Latin America indicates a relatively lower one, which could be due to the disparity in the regulation frameworks and the level of digital penetration.

These findings indicate that, although FinTech adoption positively affects financial inclusion everywhere, the extent of its effect is influenced by the degree of digital infrastructure, regulatory maturity and market factors. Table 3 analysis of heterogeneity supports the relevance of contextual factors in determining the digital financial results.

### 3.5 Synthesis of Empirical Findings

Combined, Table 1-3, and Figures 1-3 evidence give full support of the main point of the study. Descriptive trends and visual analysis reveal a similar growth in the use of FinTech and financial inclusion. Despite these macroeconomic and institutional factors, the econometric analysis's findings show a statistically significant positive association. Moreover, the quality of regulations and digital reforms enhances this association, and regional analysis proves that there are significant differences in the magnitude of effects.

On the whole, the findings indicate that the use of FinTech is a complementary factor in banking organisations in developing economies, which can help them reach their extended bounds and contribute to improved financial access.

#### 4. Discussion

The empirical evidence in this research gives solid and consistent results that the use of FinTech is a highly beneficial factor in terms of financial inclusion in developing economies. The statistically significant and favourable findings in Table 2 are in line with other studies that have proposed that digital finance is a transformative factor to enhance access to formal financial services (Allen et al., 2016; Ozili, 2018). This correlation is further supported by the upward trends as seen in Figure 1, which shows that the gains in the FinTech adoption are accompanied with the constant positive change in the financial inclusion outcomes over time. These results align with larger post-crisis studies that characterise FinTech as a structural change in financial intermediation as opposed to an innovation that is transient (Arner et al., 2015; Philippon, 2016).

The findings also substantiate the fact that digital finance causes a decrease in the barriers to access, and especially in emerging markets, where the banking infrastructure is weak. Based on mobile money systems evidence, there are long-run poverty reduction and higher economic engagement through digital financial channels (Suri and Jack, 2016). Likewise, global Financial inclusion reports present the potential of technology in speeding up the process of account ownership, and usage (Demirguc-Kunt et al., 2018). This research adds to the existing body of work as it offers multi-country panel results that show that bank-level digital adoption is directly linked to better inclusion indicators.

The mediating effect of regulatory quality as shown in Figure 2, further supports the explanation that adoption of FinTech would be most effective in conducive institutional conditions. The studies conducted by previous researchers highlight that regulatory transparency and financial oversight systems are critical to make innovation beneficial, not disruptive, to financial systems (Claessens et al., 2018; Löber and Houben, 2018). The increased marginal impacts at the increased regulatory quality indicate that institutional structures enhance the inclusive effects of the digital transformation. The result is consistent with the worldwide policy debate that recommends coherent regulatory actions to exploit the opportunities of FinTech and reduce the systemic risks (Philippon, 2016).

Figure 3 evidence of the difference-in-differences also indicates that the post-reform environments reinforce the nexus of FinTech and inclusion. This reinforces claims that financial inclusion and inclusive growth are two inseparable concepts in a situation where digital finance is practised in compatible policy environments (Demirgüç-Kunt and Singer, 2017). The amplification effect observed after the regulatory modernization shows that institutional reforms develop facilitating conditions to digital innovation to turn into a wider financial engagement.

The reported regional heterogeneity in Table 8 further shows the fact that the strength of the relationship between FinTech and financial inclusion in different developing regions is different. These more significant impacts in Sub-Saharan Africa are in line with the existing literature that notes the transformative aspect of mobile-based financial ecosystems within low-infrastructure settings (Suri & Jack, 2016; Gabor & Brooks, 2020). Comparatively, the areas with a relatively high baseline banking penetration can see more incremental benefits of becoming digital. This difference reinforces more general results that the economic factors of FinTech adoption are country-specific based on market structure, infrastructure, and regulatory circumstances (Frost, 2020).

The results are also relevant to the existing evidence assessing the developmental contribution of financial inclusion programmes. There is a systematic evidence that financial inclusion may create favourable welfare impacts, but results vary widely based on the institution setting and quality of implementation (Duvendack & Mader, 2020). This research involves both bank-level digital adoption outcomes and macro-institutional controls, which introduces an empirical vagueness to the argument on whether FinTech fosters inclusive growth or is only a redirection of channels of financial service delivery.

The findings, in general, confirm the perspective that FinTech implementation is a supportive phenomenon in the banking institutions and not a disruptive alternative. Digital innovation has been found to make organisations more efficient and reach more people and increase their competitiveness in institutions, which aligns with studies of digital finance effects on stability and inclusion (Ozili, 2018, 2021). The facts indicate that in those cases, when banks implement the technology in a strategic way and exist in favourable regulatory conditions, FinTech can be a driver of inclusive financial growth.

The combination of the empirical results of Tables 1- 3 and Figures 1- 3 indicates that technological innovation and institutional quality have a synergistic effect to enhance financial inclusion in developing economies. The paper supports the thesis that the digital finance, when regulated effectively and with proper banking being practised, will be a structural development of the financial intermediation that will be able to help in the development of the economy inclusively.

#### 5. Conclusion

This study investigated the impact of FinTech adoption on financial inclusion across 95 banks operating in 20 developing countries over the period 2015–2021. Using panel data techniques, the findings provide strong empirical evidence that higher levels of bank-level digital adoption significantly enhance financial inclusion outcomes. The results indicate that banks investing in digital platforms, technology infrastructure, and innovative financial delivery systems are better positioned to expand access to formal financial services. The positive relationship remains robust after controlling for bank-specific characteristics and macroeconomic factors, suggesting that FinTech adoption independently contributes to reducing financial exclusion. Importantly, the analysis demonstrates that the effectiveness of FinTech is amplified in environments characterized by stronger regulatory quality and digital reforms, highlighting the complementary role of

institutional frameworks. Regional heterogeneity analysis further reveals that the magnitude of the FinTech–inclusion relationship varies across developing regions, with particularly strong effects observed in Sub-Saharan Africa and Southeast Asia, where digital financial ecosystems have expanded rapidly. These findings suggest that FinTech functions not as a disruptive substitute for traditional banking but as a strategic complement that enhances outreach, efficiency, and service accessibility. However, the results also underscore that digital transformation must be supported by sound risk management and adequate digital infrastructure to ensure sustainable inclusion gains. Overall, the study contributes to the growing literature on digital finance by demonstrating that technological innovation, when aligned with regulatory support and institutional stability, represents a viable pathway for advancing inclusive financial development in developing economies.

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