

Article

Leveraging Digital Banking to Enhance Financial Inclusion in Small Island Developing States: A Study of Fiji

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Abstract

This study empirically examines the relationship between digital banking and financial inclusion in Fiji, a small island developing state with geographically dispersed populations and limited access to traditional banking infrastructure. Using annual panel data from eight financial institutions—six commercial banks and two non-bank financial institutions—covering 2012–2024, the analysis accounts for cross-sectional dependence, heteroskedasticity, and serial correlation through Driscoll–Kraay panel-corrected standard errors, while robustness checks using the generalized method of moments (GMM) address potential endogeneity concerns. The results indicate that digital banking is positively associated with higher levels of financial inclusion in Fiji. Both the baseline model, which includes only digital banking, and the extended model, which incorporates banking-sector and macroeconomic controls, show consistent associations. From a policy perspective, the findings provide empirical support for strengthening digital financial infrastructure and regulatory frameworks to promote inclusive finance in small island economies. Overall, the study contributes to the limited empirical literature on digital finance in such contexts and offers insights for policymakers and financial institutions seeking to expand financial inclusion.

Keywords: digital banking; financial inclusion; small island developing states; Fiji; Driscoll–Kraay panel corrected standard errors

1. Introduction

Financial inclusion has emerged as a central policy and research priority due to its critical role in promoting inclusive economic growth, poverty reduction, and financial resilience. Access to affordable, reliable, and appropriate financial services enables households and firms to smooth consumption, accumulate savings, access credit, and manage risks, thereby fostering broader participation in economic activity (Demirgüç-Kunt et al., 2020; Khera et al., 2022; Mbodj & Laye, 2025; Telukdarie & Mungar, 2023). Despite notable global progress over the past two decades, financial exclusion remains pervasive in many developing economies, particularly in Small Island Developing States (SIDS), where geographic dispersion, small market size, and high service delivery costs constrain the expansion of traditional banking infrastructure (Gopy-Ramdhany et al., 2024). Reflecting its development relevance, financial inclusion is explicitly embedded in the United Nations Sustainable Development Goals (SDGs), notably SDG 8a, which emphasizes universal access to banking, insurance, and financial services and the strengthening of domestic financial institutions.

Financial inclusion in SIDS presents unique challenges and opportunities that differentiate these economies from larger developing countries. SIDS are characterized by dispersed populations across islands, small domestic markets, high costs of financial service

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delivery, and vulnerability to external shocks, all of which limit access to traditional banking channels. In this context, digital banking—including mobile banking, internet banking, electronic payments, and digital wallets—emerges as a critical enabler of inclusion, offering scalable solutions that can reach remote populations and integrate formal and non-bank financial services. Studying the interaction between digital banking and financial inclusion in SIDS not only addresses these structural constraints but also provides insights applicable to other small, resource-constrained economies facing similar challenges (Anagreh et al., 2024; Allen et al., 2016; Ozili, 2018).

Empirical evidence from developing and emerging economies suggests that digital financial services are associated with higher account ownership, increased use of payment services, enhanced savings mobilization, and improved access to credit, particularly among low-income and previously excluded populations (Demirgüç-Kunt et al., 2022; Garg & Kumar, 2024; Suri & Jack, 2016). The rapid global expansion of digital financial services reinforces their growing importance. Data from the International Monetary Fund's Financial Access Survey show a sharp rise in digital transactions in emerging and developing economies over the past decade, highlighting a structural shift in how financial services are delivered and consumed (IMF, 2025). However, the effectiveness of digital banking in promoting inclusive outcomes is not uniform. Its impact depends critically on country-specific factors such as institutional quality, regulatory frameworks, digital infrastructure, and financial literacy (Aron, 2018; Nasreen et al., 2025). These factors are particularly salient in SIDS, where infrastructure gaps, limited institutional capacity, and vulnerability to external shocks may moderate the benefits of digital financial innovation.

Despite a rapidly expanding literature on digital finance and financial inclusion, several important gaps remain. First, much of the existing empirical work focuses on large developing economies or cross-country samples, where scale effects, population density, and institutional arrangements differ markedly from those of small island economies. As a result, the extent to which existing findings can be generalized to SIDS remains uncertain. Second, financial inclusion is frequently proxied using single indicators such as bank account ownership or credit access which may inadequately capture its multidimensional nature, particularly in settings where digital and non-bank financial services play an increasingly important role. Third, most studies rely on country-level data, offering limited insights into how heterogeneity across financial institutions shapes the relationship between digital banking and financial inclusion.

Fiji, a small developing island state in the Pacific, provides a highly relevant and underexplored context to address these gaps. Fiji's banking system exhibits structural characteristics that distinguish it from larger economies: geographic dispersion across islands, relatively high banking concentration, limited branch access in rural and maritime regions, and uneven digital literacy. In such a context, digital banking does not simply complement traditional services—it often substitutes for them, becoming a primary channel for financial inclusion. Mobile and internet banking platforms, along with digital wallets such as M-PAiSA and MyCash, have enabled peer-to-peer transfers, bill payments, merchant transactions, and government disbursements (Chand et al., 2025; RBF, 2022). Moreover, increasing interoperability between digital wallets and the formal banking system has reduced frictions between traditional and digital financial channels, potentially deepening engagement among previously underbanked populations. These country-specific features suggest that the mechanisms through which digital banking affects financial inclusion in Fiji may differ from those documented in larger or more urbanized economies, thereby providing a distinct empirical contribution.

From a theoretical perspective, digital banking can influence financial inclusion through multiple channels. By lowering fixed and variable transaction costs, digital plat-

forms make it economically viable for financial institutions to serve customers in remote and low-income areas (Agur et al., 2020; Pazarbasioglu et al., 2020; Wanof, 2023). Digital channels can also enhance convenience, transparency, and transaction speed, thereby increasing both access to and usage of financial services (Demirgüç-Kunt et al., 2020). However, adoption and sustained use are shaped by complementary factors such as digital literacy, trust in financial institutions, regulatory oversight, and the reliability of digital infrastructure (Ozili, 2018; Shabir & Ali, 2022).

Empirical evidence on the role of digital banking in advancing financial inclusion in Fiji remains limited. Existing studies on Fiji's financial sector have primarily examined net interest margins (Gounder & Sharma, 2012), bank efficiency (Jayaraman et al., 2017) and non-performing loans (Kumar et al., 2018). More recent work has explored issues related implications of financial technology for bank risk-taking and profitability in Fiji (Chand et al., 2025).

This study seeks to fill this gap by empirically examining the role of digital banking in promoting financial inclusion in Fiji using panel data from commercial banks and non-bank financial institutions over the period 2012–2024. To address the multidimensional nature of financial inclusion, the study constructs a comprehensive financial inclusion index using principal component analysis (PCA), capturing indicators of access, availability, and usage across both traditional and digital financial services. Methodologically, the analysis employs Driscoll–Kraay panel-corrected standard errors to account for cross-sectional dependence, heteroskedasticity, and serial correlation, with robustness checks conducted using the generalized method of moments (GMM) to mitigate potential endogeneity concerns.

This study makes three main contributions. First, it advances measurement by developing a multidimensional, institution-level financial inclusion index that more accurately reflects the breadth and depth of financial service provision in a small island context. Second, it enhances methodological rigor by applying panel techniques that explicitly address institutional heterogeneity and common shocks, strengthening inference on the digital banking–financial inclusion nexus. Third, by focusing on Fiji—a country with unique structural characteristics, digital adoption patterns, and financial service constraints within the SIDS context—the study provides rare empirical evidence from a small developing island state, extending the digital finance literature beyond the large-country settings that dominate existing research. These contributions offer policy-relevant insights for regulators and financial institutions seeking to design digital finance strategies that promote inclusive and sustainable financial development in structurally constrained economies.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 outlines the data and methodology. Section 4 presents and discusses the empirical findings. Section 5 elaborates on the study's implications, and Section 6 concludes the paper.

2. Literature Review and Hypothesis Development

2.1. Theory (Linking Digital Banking to Financial Inclusion)

This study draws on Diffusion of Innovation Theory and Financial Development and Growth Theory to explain how digital banking contributes to financial inclusion in Fiji. Together, these theories provide a complementary framework: the former explains technology adoption behaviour, while the latter explains system-level financial deepening and inclusion outcomes.

2.1.1. Diffusion of Innovation Theory

Diffusion of Innovation Theory offers a well-established conceptual foundation for analysing how digital banking technologies promote financial inclusion. According to

Rogers (2003), the diffusion of innovations is shaped by five key attributes: relative advantage, compatibility, complexity, trialability, and observability, which jointly influence adoption decisions across heterogeneous populations.

Digital banking demonstrates a clear relative advantage over traditional banking by lowering transaction costs, reducing dependence on physical branch networks, and enabling real-time financial transactions. These features directly address both supply-side and demand-side barriers to financial inclusion, particularly in geographically dispersed and infrastructure-constrained economies (Ozili, 2018; Sandhu & Arora, 2022).

From an inclusion perspective, compatibility is especially important. In developing and emerging economies, digital financial services increasingly align with existing payment, consumption, and remittance practices, where mobile phone penetration far exceeds access to brick-and-mortar banking services. Empirical evidence suggests that when financial technologies are embedded within users' everyday economic activities, adoption rates and sustained usage increase significantly (Demirgüç-Kunt et al., 2022; Khera et al., 2022). In such contexts, digital banking platforms serve as an accessible entry point into the formal financial system.

Additionally, reduced complexity and high trialability, such as user-friendly interfaces and low-value digital transactions, lower cognitive and financial barriers to entry. This allows previously excluded individuals to adopt digital financial services gradually, facilitating deeper and more sustained financial inclusion (Ikmanila & Djastuti, 2025).

Finally, observability and network effects accelerate diffusion. As individuals observe peers benefiting from digital payments, savings, and improved access to financial services, trust and perceived usefulness increase, reinforcing adoption dynamics (Suri & Jack, 2016). Empirical studies demonstrate that mobile money and digital banking platforms expand financial access in rural and underserved regions by bypassing the spatial and institutional constraints associated with branch-based banking (T. Beck et al., 2018). Collectively, Diffusion of Innovation Theory suggests that widespread adoption of digital banking technologies can significantly enhance financial inclusion.

2.1.2. Financial Development and Growth Theory

Financial inclusion is firmly rooted in Financial Development and Growth Theory, which posits that a well-functioning financial system is essential for efficient resource allocation, entrepreneurship, and sustained economic growth. Early theoretical contributions by Schumpeter (1934) emphasize that financial development stimulates innovation and structural transformation by mobilising savings and channelling them toward productive investments. By reducing information asymmetries and transaction costs, developed financial systems enhance capital accumulation and productivity (Capasso, 2004).

Within this framework, digital banking represents a contemporary extension of financial development, enhancing the depth, access, and efficiency of financial systems (Shaikh et al., 2017). Digital financial services expand the reach of formal finance to previously excluded individuals, households, and micro- and small enterprises, thereby broadening participation in economic activity (Mookerjee et al., 2025). By leveraging mobile banking, digital wallets, and online platforms, financial intermediaries can overcome geographical barriers and reduce operational costs, making financial services more affordable and accessible, particularly in developing and small island economies (Pazarbasioglu et al., 2020).

Moreover, digital banking can lower barriers to credit access for micro-enterprises and informal sector participants who are often excluded under traditional collateral-based lending models (Udohaya, 2025). Through the use of alternative data and digital transaction histories, digital financial services improve credit assessment and risk management,

enabling lenders to extend financial services to underserved segments (Pazarbasioglu et al., 2020). In doing so, digital banking strengthens financial intermediation, promotes entrepreneurial activity, and supports inclusive growth—key propositions of Financial Development and Growth Theory.

2.2. Empirical Studies

A substantial body of empirical research on developing economies reports a positive and statistically significant relationship between digital banking and financial inclusion. Suri and Jack (2016), for instance, investigate mobile money adoption in Kenya using household-level panel data and demonstrate that access to digital financial services significantly increases savings, enhances consumption smoothing, and reduces poverty, particularly among female-headed households. Their findings provide strong causal evidence that digital banking mitigates income risk and strengthens financial resilience. Similarly, T. Beck et al. (2018) shows that digital payment instruments facilitate risk-sharing and reduce vulnerability to shocks by enabling faster and cheaper transfers, thereby improving households' capacity to manage liquidity and smooth consumption, underscoring digital banking's inclusionary potential.

In the South Asian context, Pradhan et al. (2021) examine electronic banking in Nepal and report that automated teller machines (ATMs), mobile money, and internet banking substantially contribute to financial inclusion. In Latin America, Julião et al. (2022) finds that digital banking positively influences financial inclusion in Peru. Evidence from India by Khera et al. (2022) indicates that digital banking expansion not only increases account ownership but also promotes active engagement with formal financial services, including digital payments and savings. In Africa, Iwedi (2023) demonstrates that the digital banking model significantly enhances financial inclusion in Nigeria, while Eton et al. (2025) reports similar positive effects of digital finance on financial inclusion in Uganda. In the Middle East, Hejazeen and Yamin (2024) find that electronic banking services positively and significantly impact financial inclusion in Jordan between 2015 and 2022.

Cross-country analyses further corroborate these findings. Using Global Findex data, Demircuc-Kunt et al. (2018) shows that mobile money accounts have substantially increased formal financial participation in Sub-Saharan Africa, particularly in countries with underdeveloped banking infrastructure. Ozili (2018) similarly demonstrates that digital finance adoption, measured via mobile and internet banking indicators, positively affects financial inclusion across developing countries, with stronger effects in economies characterized by higher mobile penetration and supportive regulatory frameworks.

However, some studies caution against assuming universal benefits. Shaban (2025) argues that rapid digitalization may exacerbate exclusion risks by marginalizing individuals lacking access to digital devices or the necessary skills. Such digital divides create new forms of financial vulnerability, highlighting that digital banking may not be inherently inclusive for all population segments.

Recent evidence from the Pacific region further supports the role of digital banking in advancing financial inclusion within small island developing states. In Fiji, the Reserve Bank of Fiji (RBF, 2022) documents a substantial increase in the use of internet banking, electronic funds transfers, and digital payment platforms, particularly among rural households and outer island communities. The RBF reports that digital financial services have reduced geographic and cost barriers to accessing basic banking services, contributing to higher levels of account ownership and usage.

Studies supported by the United Nations Capital Development Fund (UNCDF, 2019) highlight that digital financial services in Fiji have improved access to savings, remittances, and bill payments for low-income households and micro-entrepreneurs. Similarly, the

Alliance for Financial Inclusion (AFI, 2025) notes that Fiji's National Financial Inclusion Strategy has leveraged digital banking and mobile money as core instruments to expand formal financial participation, particularly among women, youth, and small businesses.

Pacific-focused empirical research further indicates that digital banking platforms are especially effective in overcoming structural constraints common to island economies, such as dispersed populations, limited branch networks, and high service delivery costs (PIFS, 2024). These studies find that digital payment systems and mobile banking services have increased the accessibility and affordability of financial services in Fiji, reinforcing the positive linkage between digital banking adoption and financial inclusion. Collectively, this evidence suggests that the inclusionary benefits of digital banking observed in larger developing economies are also highly relevant within the Pacific island context.

Drawing on Diffusion of Innovation Theory, which explains how digital banking adoption spreads and lowers barriers to access, and Financial Development and Growth Theory, which emphasises the role of financial system deepening in promoting inclusion, this study argues that digital banking plays a critical role in enhancing financial inclusion. Consistent with the empirical evidence and the institutional context of Fiji, where geographical dispersion and digital adoption coexist, the study proposes the following hypothesis:

H1. *Digital banking is positively associated with financial inclusion in Fiji.*

3. Data, Variable Definition, and Method

3.1. Data

This study employs a bank-level balanced panel dataset comprising eight financial institutions operating in Fiji over the period 2012–2024, resulting in annual bank–year observations. The sample includes six commercial banks Australia and New Zealand Banking Group (ANZ), Bred Bank (BRED), Bank of the South Pacific (BSP), Bank of Baroda (BOB), Westpac Banking Corporation (WBC), and Home Finance Corporation (HFC) and two non-bank financial institutions (NBFIs), namely Merchant Finance Limited (MFL) and Credit Corporation Fiji Limited (CCFL). In Fiji, the number of financial institutions is limited, and we have included all banks and non-bank financial institutions that consistently reported complete data from 2012 to 2024. This approach ensures that our analysis captures the entire population of relevant institutions, making the findings representative and meaningful despite the modest sample size.

Bank-level data are obtained from audited annual financial statements and supervisory publications of the Reserve Bank of Fiji (RBF, 2024). These data capture institution-specific characteristics relevant to digital banking adoption and financial intermediation. Macroeconomic control variables are sourced from the World Development Indicators (World Bank, 2024).

Financial inclusion indicators are drawn from the International Monetary Fund's Financial Access Survey (IMF, 2025). These indicators are measured at the national level and reflect aggregate access to and usage of formal financial services within Fiji. While financial inclusion measures are not institution-specific, their integration with bank-level data is conceptually appropriate in a single-country banking system, where individual financial institutions collectively contribute to system-wide financial inclusion outcomes.

The merging of bank-level and national-level financial inclusion data follows established empirical practice in the literature examining how bank characteristics and technological innovation influence aggregate financial inclusion (Ozili, 2018; Allen et al., 2016). In this framework, variation over time in financial inclusion indicators reflects changes in the overall financial ecosystem, while cross-sectional variation across banks captures differences in institutional behaviour, digital banking intensity, and market participation.

This combined structure allows the analysis to assess how bank-level digital banking developments are associated with changes in national financial inclusion over time, without implying that individual banks independently determine aggregate inclusion outcomes.

Table 1 presents the definitions and sources of all dependent, independent, and control variables used in the empirical analysis.

Table 1. Variable descriptions.

Variable	Definition	Symbol	Some Evidence from Past Studies	Expected Sign	Data Source
<i>Dependent Variable</i>					
Financial inclusion	Principal component analysis of three dimensions:				
	(a) Access:				
	- Number of deposit accounts with commercial banks, credit unions and credit cooperatives per 1000 adults				
	- Number of registered mobile money accounts per 1000 adults				
	(b) Availability:				
	- Number of commercial banks, credit union, credit cooperative and all microfinance institution branches per 100,000 adults	FI	T. T. H. Nguyen (2021); Cámara and Tuesta (2014)	N/A	FAS-IMF
	- Number of Automated Teller Machines (ATMs) per 100,000 adults				
	- Number of registered mobile money agent outlets per 100,000 adults				
	(c) Usage				
	- Outstanding deposits with commercial banks, credit unions and credit cooperatives (% of GDP)				
	- Outstanding loans from commercial banks, credit unions, credit cooperatives and all microfinance institutions (% of GDP)				
	- Value of mobile money transactions (% of GDP)				
<i>Independent Variable</i>					
Digital Banking	Internet banking 1 = bank offers internet banking, 0 = otherwise	DB	Chauhan et al. (2022); O. T. Nguyen (2020)	+	RBF
<i>Control Variables</i>					
Bank size	Natural logarithm of total assets	BSIZE	Kayed et al. (2025); Chand et al. (2025); Uddin et al. (2017)	+	RBF
Deposit rate	Deposit interest rate is the rate paid by commercial or similar banks for demand, time, or savings deposits	DRATE	Uddin et al. (2017); McKinnon (1973)	+	RBF
Lending rate	Lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector	LRATE	Uddin et al. (2017); Korutaro Nkundabanyanga et al. (2014)	-	RBF
GDP per capita	GDP per capita (constant 2015 US\$)	RGDPP	Demirguc-Kunt et al. (2018); Uddin et al. (2017)	+	WDI
Inflation	Inflation, consumer prices (annual % growth)	INF	Jukan et al. (2024); Uddin et al. (2017)	-	WDI
Literacy rate	Lower secondary completion rate, total (% of relevant age group)	LITERC	Park and Mercado (2018); Uddin et al. (2017)	+	WDI

Notes: N/A = Not applicable, FAS-IMF = Financial Access Survey of the International Monetary (IMF, 2025), Fund, RBF = Reserve Bank of Fiji (RBF, 2024) and WDI = World Development Indicators (World Bank, 2024). Source: Authors' compilation.

3.2. Dependent Variable

For financial inclusion (FI) this study employs annual data from the IMF's Financial Access Survey (FAS) and the World Bank's Global Findex database covering the period 2012–2024. The study period was selected to ensure the availability of the most complete and consistent set of representative variables over time. Furthermore, the analysis begins in 2012 because this year marks the introduction of mobile money in Fiji (RBF, 2022), which

is widely regarded as a pivotal development in the expansion of financial services across the developing world (Demirgüç-Kunt & Klapper, 2012).

There are two widely used approaches to measuring FI through the construction of a composite FI index: non-parametric and parametric methods. However, non-parametric approaches assign weights to indicators exogenously, often relying on researchers' judgment. Existing evidence suggests that composite indices are highly sensitive to such subjective weight assignments, as even minor changes in weights can substantially affect the results (Lockwood, 2004). To address this limitation and following Cámara and Tuesta (2014) and T. T. H. Nguyen (2021), this study constructs a financial inclusion index using principal component analysis (PCA), a parametric method that endogenously determines indicator weights. Accordingly, we posit that the latent financial inclusion index (FII) is linearly determined as follows:

$$FII_i = w_1 Y_i^p + w_2 Y_i^a + w_3 Y_i^u + e_i \quad (1)$$

where FII_i is composite index of Fiji.

w_1, w_2, w_3 : the relative weights of each dimension.

e_i is variation due to error.

(Y_i^p, Y_i^a, Y_i^u) ; represents the dimensions of the penetration, the availability and the usage respectively and computed as:

$$Y_i^p = \beta_1 \text{deposit accounts}_i + \beta_2 \text{mobile money accounts}_i + u_i \quad (2)$$

$$Y_i^a = \varnothing_1 \text{branches}_i + \varnothing_2 \text{ATMs}_i + \varnothing_3 \text{mobile money agents}_i + \epsilon_i \quad (3)$$

$$Y_i^u = \vartheta_1 \text{deposits}_i + \vartheta_2 \text{loans}_i + \vartheta_3 \text{mobile money transactions}_i + v_i \quad (4)$$

The variables employed in Models (2), (3), and (4) are defined as follows. Following T. T. H. Nguyen (2021), this study constructs a multidimensional FI index by integrating multiple dimensions of FI to capture its comprehensive nature. Specifically, three core dimensions are considered: access to financial services (financial penetration), availability of financial services, and the usage of financial services.

(1) Access to Financial Services (Financial Penetration)

A comprehensive financial system should reach a broad segment of the population, implying wide penetration among potential users. Following the measurement framework proposed by Sarma (2016), this study captures the access dimension of financial inclusion using indicators related to account ownership. Specifically, deposit accounts are employed as a proxy for financial penetration. However, to enhance the comprehensiveness of the financial inclusion measure, this study extends beyond Sarma's focus on commercial banks by incorporating data from both banks and other financial institutions. Accordingly, the number of deposit accounts held with commercial banks, credit unions, and credit cooperatives per 1000 adults is used as a key indicator of access.

In line with Sarma (2016) this study incorporates an indicator that has been largely overlooked in earlier financial inclusion indices: the number of mobile money accounts per 1000 adults. The inclusion of this variable reflects recent developments in the financial services industry, whereby technological innovations particularly fintech and mobile-based applications have significantly expanded access to financial services for previously excluded populations. This transformation has been especially pronounced in developing economies, where mobile technology has played a pivotal role in broadening financial access (Donovan, 2012).

(2) Availability of Financial Services

The availability dimension reflects the ease with which users can physically access financial services. As emphasized by [Sarma \(2016\)](#) an inclusive financial system requires adequate coverage of financial service points, such as bank offices, branches, and automated teller machines (ATMs). Accordingly, this study measures availability using the number of financial institution branches and ATMs per 100,000 adults. The branch indicator encompasses not only commercial banks but also credit unions, credit cooperatives, and microfinance institutions, thereby providing a more inclusive representation of the financial infrastructure.

Furthermore, to account for the growing role of digital financial delivery channels, this study includes the number of mobile money agent outlets per 100,000 adults as an additional indicator of availability. Mobile money agents serve as a critical access point for financial services in areas where traditional bank branches and ATM networks remain limited, thereby complementing conventional banking infrastructure and enhancing overall service availability.

(3) *Usage of Financial Services*

The usage dimension captures the extent to which financial services are actively utilized by individuals and firms. While some studies measure usage using the number of bank accounts per 1000 people ([Ahamed & Mallick, 2019](#)) or the number of deposit and loan accounts per 1000 adults ([Amidžić et al., 2014](#)), drawing on [Kempson et al. \(2004\)](#), argues that account ownership alone does not necessarily imply meaningful financial participation. In many countries, individuals may hold bank accounts but make limited use of financial services.

Consistent with this perspective, and following [Lenka and Bairwa \(2016\)](#), this study measures usage through the two core functions of the banking system: savings and credit. Accordingly, outstanding deposits (% of GDP) and outstanding loans (% of GDP) are employed as indicators of financial service usage.

In addition, recognizing that financial inclusion increasingly encompasses a broader range of services including payments and transfers, this study further incorporates the value of mobile money transactions as a percentage of GDP. This indicator captures the intensity of digital financial service usage and complements traditional banking measures, thereby providing a more comprehensive assessment of the usage dimension of financial inclusion.

Following the approach of [T. T. H. Nguyen \(2021\)](#) the FI index is constructed using a two-stage principal component analysis (PCA).

In the first stage, the three core dimensions of financial inclusion—Access, Availability, and Usage are estimated as separate sub-indices. Specifically, these dimensions are treated as latent (unobserved) variables, denoted as Y_i^p , Y_i^a , and Y_i^u , corresponding to access, availability, and usage, respectively. The associated parameters (β , $\varnothing$, and ϑ) are estimated within the system of Equations (2)–(4). Each dimension is derived as a principal component, expressed as a linear combination of its respective observed indicators.

In the second stage of the PCA, the same estimation procedure as in the first stage is applied to derive the weights of the three financial inclusion dimensions and to construct the overall FI index. Specifically, the sub-indices for Access (Y_i^p), Availability (Y_i^a), and Usage (Y_i^u), estimated in the first stage, are used as inputs to compute the composite FI index.

3.3. *Independent Variables*

In line with the empirical literature, this study operationalizes digital banking (DB) using a binary indicator that equals one if a bank offers internet banking services and zero otherwise ([Chauhan et al., 2022](#); [O. T. Nguyen, 2020](#)). This specification is particularly

appropriate for small island developing economies such as Fiji, where digital banking adoption remains at an early stage and more granular indicators such as blockchain-based applications are not yet implemented. The use of a dummy variable provides a robust and parsimonious measure of banks' fundamental engagement with digital service delivery, minimizes measurement error arising from inconsistent reporting across institutions, and allows for clear identification of adoption effects. This approach has been widely validated in developing economy settings and ensures comparability across banks and over time.

3.4. Control Variables

While H1 represents the core hypothesis of this study, the control variables are not formulated as separate hypotheses, nor are they intended to proxy digital banking. Instead, they are included to account for other institutional, financial, and macroeconomic factors that have been shown in the existing literature to influence financial inclusion. Financial inclusion is a multidimensional outcome shaped by a range of structural and economic conditions and excluding these factors could lead to biased estimation of the relationship of interest. Accordingly, the inclusion of well-established control variables allows the empirical model to isolate the *ceteris paribus* effect of digital banking on financial inclusion, thereby ensuring that the estimated coefficient associated with H1 reflects the net impact of the primary explanatory variable. The selected controls are widely recognized in prior studies as key bank-specific and macroeconomic determinants of financial inclusion and are incorporated to mitigate potential model misspecification and omitted-variable bias. These include:

- (a) **Bank size:** From a financial intermediation theory perspective, banks act as intermediaries that reduce transaction costs and information asymmetries between savers and borrowers (Diamond, 1984). Larger banks are better positioned to exploit economies of scale in screening, monitoring, and risk diversification, enabling them to provide financial services more efficiently and at lower cost (Chand et al., 2025). These advantages may facilitate broader access to banking services, especially when banks invest in extensive branch networks or digital delivery channels. Studies such as Uddin et al. (2017). T. Beck and Brown (2011) reported positive effect of bank size on financial inclusion. Subsequently, we hypothesize that bank size is positively associated with financial inclusion.

H2. Larger bank size positively influences financial inclusion.

Interest rates on deposit: Higher deposit interest rates increase the opportunity cost of holding cash or informal savings, thereby encouraging individuals to open bank accounts. According to classical savings theory, households respond positively to higher real returns on savings, especially when financial literacy is sufficient (McKinnon, 1973). Empirical studies such as Uddin et al. (2017) found positive effect of interest rate on deposit on financial inclusion in Bangladesh. Consequently, we hypothesize that interest rates on deposits are positively associated with financial inclusion.

H3. Interest rates on deposits positively influence financial inclusion.

- (b) **Interest rates in lending:** Lending interest rates represent the price of credit in the formal financial system and are a critical determinant of credit-based financial inclusion (Korutaro Nkundabanyanga et al., 2014). Higher lending rates increase the cost of borrowing and directly influence households' and firms' decisions to access formal credit. From a financial inclusion perspective, lending rates affect not only whether individuals borrow, but also who is able to borrow, making them central to understanding exclusion in credit markets (Brennan, 1971). Theoretically, higher

lending rates are generally expected to reduce financial inclusion, particularly among low-income households, microenterprises, and informal sector participants (Kling et al., 2022). Therefore, we hypothesize that interest rates on lending are negatively associated with financial inclusion.

H4. *Interest rates on lending negatively influence financial inclusion.*

- (c) GDP per capita: GDP per capita income is among the most robust macroeconomic predictors of financial inclusion. Higher income levels increase households' capacity to save, borrow, and transact through formal financial channels, while also improving the commercial viability of financial service provision. As economies grow, financial institutions benefit from scale economies and are more willing to expand outreach to underserved populations (Demirguc-Kunt et al., 2018). Empirical studies consistently find a positive association between GDP per capita and indicators of financial inclusion, such as bank account ownership, credit access, and savings mobilization (Allen et al., 2016; Sahay et al., 2015). Therefore, we hypothesize that GDP per capita has a positive effect on financial inclusion.

H5. *Higher GDP per capita positively influences financial inclusion.*

- (d) Inflation: High inflation erodes real incomes and savings, disproportionately affecting low-income households that rely on cash holdings and informal financial arrangements. Persistent inflation also undermines confidence in the formal financial system, discouraging long-term savings and contractual financial relationships (Boyd et al., 2001). Studies such as Ozili (2025) and Jukan et al. (2024) reported that high inflation reduces financial inclusion mainly in developing countries. Hence, we hypothesize that inflation is negatively associated with financial inclusion.

H6. *Higher inflation negatively affects financial inclusion.*

- (e) Literacy rate: Literacy rate is commonly defined as the proportion of the adult population that can read and write, and this plays a foundational role in shaping financial inclusion (Park & Mercado, 2018). Literacy enhances individuals' ability to understand financial products, interpret contractual terms, and navigate increasingly complex financial systems (Leyshon et al., 1998). In the context of financial inclusion, literacy acts both as a demand-side enabler and a complementary factor that amplifies the effectiveness of supply-side financial innovations such as digital banking (Honohan, 2008). Theoretically, higher literacy rates are expected to positively influence financial inclusion (Uddin et al., 2017). Consequently, we hypothesize that literacy rate is positively associated with financial inclusion.

H7. *Greater financial literacy positively affects financial inclusion.*

3.5. Empirical Model

3.5.1. Model Specification

To examine the relationship between digital banking and financial inclusion, this study adopts a panel-data framework consistent with the financial development literature. The empirical strategy proceeds in a stepwise manner to assess the robustness of the association between digital banking and financial inclusion.

Baseline Specification

The baseline model evaluates the direct association between digital banking and financial inclusion:

$$FI_{it} = \beta_0 + \beta_1 DB_{it} + \varepsilon_{it} \quad (5)$$

where FI_{it} denotes financial inclusion in country i at time t , and DB_{it} represents digital banking. The ε_{it} is the idiosyncratic error term.

This baseline specification allows us to evaluate whether digital banking is statistically associated with financial inclusion before accounting for additional bank-specific and macroeconomic determinants.

Financial inclusion (FI_{it}) is constructed using Principal Component Analysis (PCA) based on three dimensions: access, availability, and usage of financial services. This multidimensional index provides a comprehensive measure of inclusion while minimizing measurement error.

Digital banking (DB_{it}) captures the presence of digital banking services within a bank and reflects the availability of digital financial infrastructure.

Extended Model with Control Variables

To account for alternative supply-side and demand-side channels that may influence financial inclusion, the model is extended to include banking-sector and macroeconomic control variables:

$$FI_{it} = \beta_0 + \beta_1 DB_{it} + \beta_2 BISIZE_{it} + \beta_3 DRATE_{it} + \beta_4 LRATE_{it} + \beta_5 RGDP_{it} + \beta_6 INF_{it} + \beta_7 LITERC_{it} + \varepsilon_{it} \quad (6)$$

In the equation, i , t , and ε_{it} , denotes cross-section, time, and error term respectively. Additionally, FI represent financial inclusion measured by PCA of three dimensions (access, availability and usage). BD represents digital banking while, $BSize$, $DRATE$, and $LRATE$ denotes bank size, deposit rates and lending rates which are bank specific control variables. While $RGDP$, INF and $LITERC$, represents macroeconomic control variables of GDP per capita, inflation rate and literacy rate respectively.

3.6. Diagnostic Tests

Before proceeding to the main estimation, we first address the issue of cross-sectional dependence among financial institutions, which may arise from their simultaneous adoption of and exposure to digital banking innovations. Such dependence is particularly relevant in the banking sector, given its interconnected structure and the uniform influence of regulatory and technological changes. The introduction of digital banking services can affect operational efficiency, outreach, and customer behavior, generating correlated responses across banks. Consequently, the behavior of individual institutions cannot be analyzed in isolation, as it is shaped by broader market dynamics and common technological adoption trends. Ignoring such cross-sectional dependence may lead to biased estimates and misleading conclusions regarding the true impact of digital banking on financial inclusion.

To formally assess this, we conduct tests for cross-sectional dependence. Specifically, we estimate the CD-statistic proposed by Pesaran (2021), which is asymptotically standard normal under the null hypothesis of no cross-sectional dependence. To ensure robustness, these results are complemented by the Frees test (Frees, 1995). We also perform an F-test to examine cross-sectional heterogeneity in our sample, following the approach of Bersvendsen and Ditzen (2021). As noted by Chudik and Pesaran (2015), standard panel unit root tests may produce substantial size distortions when cross-sectional correlation is present. To address this, we employ the cross-sectionally augmented IPS (CIPS) test, which

explicitly accommodates cross-sectional dependence, ensuring that the dynamic behavior of digital banking adoption and financial inclusion is appropriately captured.

3.7. Method

We use Driscoll–Kraay standard errors because they are robust to heteroskedasticity, serial correlation, and especially cross-sectional dependence in panel data (Hoechle, 2007). Driscoll and Kraay’s (1998) nonparametric covariance matrix estimator produces well-calibrated standard errors in the presence of such dependencies, whereas Feasible Generalized Least Squares (FGLS) requires correct specification of the full error structure and may underestimate standard errors when cross-sectional dependence exists (Hoechle, 2007). Likewise, Panel Corrected Standard Errors (PCSE) adjusts for contemporaneous correlation and heteroskedasticity but relies on stronger assumptions about error structures and can produce biased inference under complex dependence. Thus, Driscoll–Kraay inference yields more reliable statistical inference in datasets with potential common shocks or unobserved factors across units (N. Beck & Katz, 1995).

4. Results and Discussion

Tables 2 and 3 presents the results of the descriptive statistics and correlation analysis respectively. With respect to the dependent variable, financial inclusion, the findings indicate a range from 0.48 to 0.66, with a mean of 0.57, suggesting moderate variability across the sample. The primary independent variable, digital banking development (measured by internet banking), exhibits a range from 0 to 1, with an average value of 0.62, reflecting considerable heterogeneity in digital banking adoption. For the control variables, bank size ranges from 11.39 to 15.19, deposit rates from 1.11 to 4.68, lending rates from 4.61 to 7.00, GDP per capita from 4427.98 to 5935.21, inflation rate from −2.60 to 4.51, and literacy rate from 94.63 to 99.29. The correlation matrix reveals coefficients ranging from −0.60 to 0.62, indicating the absence of severe multicollinearity among the variables. These results provide a sound basis for subsequent empirical analysis.

Table 2. Descriptive analysis.

	Mean	Maximum	Minimum	Std. Dev.	Probability	Observations
FI	0.57	0.66	0.48	0.05	0.38	104
DB	0.62	1	0	0.49	0	104
BSIZE	13.51	15.19	11.39	1.19	0.01	104
DRATE	2.34	4.68	1.11	1.03	0.02	104
LRATE	5.78	7	4.61	0.56	0.33	104
RGDPP	5184.36	5935.21	4427.98	499.63	0.01	104
INF	2.31	4.51	−2.6	1.97	0	104
LITERC	94.63	99.29	85.85	3.97	0.31	104

Source: Authors’ estimation using Stata 17.

Table 4 presents the results of the cross-sectional dependence tests, providing strong evidence of interdependence among banks. Specifically, the null hypothesis of no cross-sectional dependence is decisively rejected, indicating that banks’ behaviors are correlated, likely due to common exposure to macroeconomic shocks and sector-specific factors. The results of the slope heterogeneity test, based on Pesaran and Yamagata (2008) are reported in Table 5. Both the F-test and the Adjusted F-test reject the null hypothesis of slope homogeneity at the 1% significance level, confirming substantial heterogeneity across the cross-sections. Furthermore, Table 6 shows that all bank-level variables, when examined with panel unit root tests, are stationary at lags 0 and 1, ensuring the suitability of these variables for subsequent panel estimations.

Table 3. Correlation analysis.

	FI	DB	BSIZE	DRATE	LRATE	RGDPP	INF	LITERC
FI	1	0.42	0.23	0.62	−0.50	0.24	−0.28	0.12
DB	0.42	1	0.45	0.22	−0.47	0.44	−0.05	0.60
BSIZE	0.23	0.45	1	0.06	−0.23	0.19	0.00	0.26
DRATE	0.62	0.22	0.06	1	0.21	0.29	−0.13	0.22
LRATE	−0.50	−0.47	−0.23	0.21	1	−0.56	−0.30	−0.60
RGDPP	0.24	0.44	0.19	0.29	−0.62	1	0.48	0.42
INF	−0.28	−0.05	0.00	−0.13	−0.30	0.48	1	0.07
LITERC	0.12	0.60	0.26	0.22	−0.60	0.42	0.07	1

Source: Authors' estimation using Stata 17.

Table 4. Cross-sectional dependence test.

Cross-Dependence Test	Statistic	<i>p</i> -Value
Pesaran's test of cross-sectional-independence	3.123	0.02
Frees's test of cross-sectional independence	0.034	0.01

Source: Authors' estimation using Stata 17.

Table 5. Cross-sectional heterogeneity test (Pesaran & Yamagata, 2008).

Cross-Dependence Test	Statistic (Delta)	<i>p</i> -Value
F-test	3.644	0.00
Adjusted F-test	4.032	0.00

Source: Authors' estimation using Stata 17.

Table 6. CIPS unit root test.

	Lags	Statistic	<i>p</i> -Value
BSIZE	0	−5.59	0.00
-	1	−3.80	0.00
DRATE	0	−4.69	0.00
-	1	−3.04	0.00
LRATE	0	−4.54	0.00
-	1	−3.01	0.00

Source: Authors' estimation using Stata 17.

The results of the empirical estimations, based on Driscoll and Kraay (1998) panel-corrected standard errors, are reported in Table 7. The findings reveal a positive and statistically significant relationship between digital banking and financial inclusion in both the baseline and extended models, thereby providing strong empirical support for *H1*. In particular, digital banking appears to contribute to financial inclusion by lowering transaction costs, mitigating geographical constraints especially for populations in remote and maritime areas and enhancing the convenience, speed, and accessibility of financial services for previously underserved populations.

These results are consistent with the diffusion of innovation theory (Rogers, 2003), which posits that the adoption of new technologies is driven by attributes such as relative advantage, compatibility, complexity, trialability, and observability. In the Fijian context, digital banking platforms appear to exhibit clear relative advantages over traditional banking channels by enabling faster, more accessible, and user-friendly financial services, thereby facilitating their uptake across diverse socioeconomic groups and supporting greater financial inclusion.

Table 7. Role of Digital Banking on Financial inclusion (Dependent Variable: FI).

Independent Variable	Baseline Model		Extended Model	
	Coefficient	Standard Error	Coefficient	Standard Error
DB	0.0428 ***	0.0117	0.0242 **	0.0112
BSIZE	-	-	0.0076 *	0.0041
DRATE	-	-	0.0296 **	0.0139
LRATE	-	-	−0.0126	0.0119
RGDPP	-	-	0.0122 *	0.0061
INF	-	-	0.0012	0.0083
LITERC	-	-	0.0128 ***	0.0037
Bank fixed effect	Yes		Yes	
Time fixed effect	Yes		Yes	
R-square	0.128		0.728	
Observations	104		104	

Notes: ***, ** and * denotes 1, 5 and 10% level of statistical significance level. Source: Authors' estimation using Stata 17.

Moreover, the findings align with a growing body of empirical literature documenting the inclusion-enhancing role of digital financial services in both developed and developing economies (T. Beck et al., 2018; Eton et al., 2025; Hejazeen & Yamin, 2024; Suri & Jack, 2016). From an economic perspective, digital banking contributes to financial inclusion by strengthening banks' operational capabilities using real-time data analytics, automated onboarding and credit assessment tools, and technology-enabled monitoring systems. These innovations allow banks to serve previously excluded individuals and small businesses more efficiently while maintaining prudent operational standards.

In the context of Fiji's banking sector characterized by small market size, geographic dispersion, and increasing regulatory and competitive pressures the adoption of digital banking technologies represents both a technological and strategic advancement. Collectively, the results underscore the pivotal role of digital banking as a catalyst for inclusive financial development, reinforcing its importance as a policy-relevant tool for promoting broader participation in the formal financial system and supporting sustainable economic development.

With respect to bank-specific control variables, the results indicate that bank size and deposit rates are positively and statistically significantly associated with financial inclusion. Larger banks benefit from economies of scale, broader branch networks, and greater technological capacity, enabling them to extend financial services to underserved populations. Similarly, higher deposit rates incentivize savings mobilization, thereby encouraging greater participation in the formal financial system. In contrast, the estimated coefficient of lending rate on financial inclusion is negative, consistent with the theoretical expectation that higher borrowing costs reduce demand for credit and formal financial services. However, the effect is statistically insignificant, likely reflecting limited variation in lending rates across banks, the predominance of digital access channels over loan affordability, and other institutional and macroeconomic factors that mediate the relationship. This suggests that in the Fijian context, lending rates do not appear to be a binding constraint on financial inclusion, and that access and digital delivery mechanisms may play a more critical role.

Regarding macroeconomic factors, GDP per capita and literacy rates display positive and statistically significant effects on financial inclusion, reflecting the role of economic prosperity and financial capability in enhancing access to financial services. Conversely, inflation exhibits a negative relationship with financial inclusion, although the effect is statistically insignificant, suggesting a limited direct influence. This finding is consistent with the relatively moderate inflation levels in Fiji over the 2012–2024 period, which may

have constrained the impact of price fluctuations on households' decisions to engage with banks or digital financial services. It also indicates that other factors, such as access to digital banking platforms and institutional outreach, likely play a more prominent role in shaping financial inclusion outcomes.

Overall, these findings are consistent with both theoretical expectations and prior empirical evidence.

Robustness Check

For robustness analysis, this study employs the dynamic panel Generalized Method of Moments (GMM) estimator. While fixed-effects and random-effects models are commonly used in panel data analysis, they are limited in capturing the dynamic nature of bank performance, as past outcomes may significantly influence current performance (Athanasoglou et al., 2008). The inclusion of lagged dependent variable introduces endogeneity concerns, particularly in panels characterized by a relatively short time dimension and a large cross-sectional dimension, rendering conventional estimators biased and inconsistent.

To address this issue, Arellano and Bond (1991), proposed the difference GMM estimator, which eliminates unobserved individual-specific effects by first-differencing the variables and employs lagged levels as instruments for the endogenous regressors. However, subsequent studies have highlighted the inefficiency of difference GMM due to weak instruments, especially when variables exhibit high persistence (Arellano & Bover, 1995; Blundell & Bond, 1998). To overcome this limitation, the system GMM estimator was developed, combining equations in first differences with equations in levels. This approach improves efficiency by using lagged differences as instruments for the level equations under the assumption that these instruments are orthogonal to the fixed effects. Consequently, system GMM provides more reliable and efficient estimates when dealing with persistent dependent variables and endogenous regressors.

Table 8 reports the results of the system GMM estimation. The Arellano–Bond test for second-order autocorrelation (AR (2)) indicates no evidence of serial correlation, confirming the consistency of the estimator. Furthermore, the Sargan test statistic (DB = 0.38) fails to reject the null hypothesis of instrument validity, supporting the appropriateness of the chosen instrument set and the reliability of the dynamic panel specification.

Table 8. Robustness results of GMM estimation.

	(Dependent Variable FI)
LFI	0.0116 (0.0076)
DB	0.0284 *** (0.0087)
DRATE	0.0226 ** (0.0092)
LRATE	−0.0821 (0.1332)
RGDPP	0.0221 ** (0.0098)
INF	−0.2188 (0.2244)
LITERC	0.0124 *** (0.0028)
Constant	0.3644 *** (0.0521)
Observations	104
Hansen test	22.11
Sargan test	317.14
p-value of Sargan test	0.122
Arellano and Bond test AR (1)	−2.54
p-value of AR (1)	0.008
Arellano and Bond test AR (2)	0.37
p-value of AR (2)	0.637

Notes: *** and ** denotes 1 and 5 level of statistical significance level. Standard error values are in brackets. L = lag. Source: Authors' estimation using EViews 14.

With respect to the core explanatory variable, digital banking (DB) exhibits a statistically significant relationship with financial inclusion. The results indicate that greater adoption of digital banking by banks in Fiji is associated with improved financial inclusion, suggesting that digital financial services enhance access to and usage of formal financial products. This finding is consistent with the baseline estimates and reinforces the role of digital banking as a key driver of financial inclusion in the Fijian banking sector.

5. Study Implications

5.1. Theoretical Implications

The study contributes to financial inclusion literature by empirically linking digital banking adoption with enhanced financial access in a small island developing state. It supports the Diffusion of Innovation Theory, demonstrating how technological adoption accelerates formal financial participation, and reinforces the Financial Development and Growth Theory by showing the role of digital platforms in strengthening financial intermediation.

5.2. Practical Implications

For financial institutions, findings highlight the importance of investing in digital infrastructure and designing inclusive digital products for low-income and remote populations. Partnerships with FinTech providers can further enhance service delivery, innovation, and outreach.

5.3. Policy Implications

Policymakers, particularly the Reserve Bank of Fiji, should:

- Promote digital banking while maintaining a balanced regulatory framework that ensures consumer protection, cybersecurity, and financial stability.
- Expand digital and financial literacy initiatives targeting women, youth, and rural populations to increase adoption and effective usage.
- Invest in robust digital infrastructure, including mobile networks and internet coverage, to ensure equitable access across islands.

By addressing both the benefits and risks of digital banking, this study provides a comprehensive basis for evidence-informed policy and institutional strategies aimed at enhancing financial inclusion in Fiji and other Pacific Island economies

6. Conclusions

This study examines the relationship between digital banking and financial inclusion in Fiji using bank-level panel data from 2012–2024. The empirical analysis, employing Driscoll–Kraay standard errors and robustness checks through GMM, provides robust evidence that digital banking is positively associated with greater access to and usage of formal financial services. Both the baseline model, which includes only digital banking, and the extended model, which incorporates banking-sector and macroeconomic controls, consistently show this positive association. By facilitating low-cost transactions, remote account access, and more efficient service delivery, digital banking appears linked with broader reach of financial services, particularly to rural and underserved communities. These results reflect conditional associations rather than causal effects and should be interpreted accordingly.

While these findings highlight the potential benefits of digital banking, it is important to acknowledge associated risks. Greater reliance on digital financial services raises concerns around cybersecurity threats, data privacy, consumer protection, and potential over-dependence on technology. Policymakers and financial institutions should ensure

that digital expansion is accompanied by strong safeguards, monitoring, and education to mitigate these risks.

Despite these contributions, the study has limitations. The relatively small number of financial institutions and constraints in digital banking data may limit the generalizability of the findings. The multidimensional PCA-based financial inclusion index captures quantitative access, availability, and usage but does not fully account for qualitative aspects such as service quality, trust, or user satisfaction. Future research could extend this analysis to other Pacific Island economies, incorporate service-level or behavioral data, and examine sector-specific adoption of digital banking services.

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