

BRIDGING FINANCIAL GAPS: HOW FINTECH DRIVES GLOBAL FINANCIAL LITERACY AND DEVELOPMENT UNDER CURRENCY EXPOSURE CONSTRAINTS

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Abstract

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This study examines the impact of financial technology (FinTech) on financial literacy (FinLit) and financial development (FinDev) across 119 countries, using data from the Global Financial Inclusion Database (Findex) for 2014, 2017, and 2021. The findings reveal a positive relationship between FinTech adoption and FinLit, particularly when measured through digital payments made and received. This aligns with G20 High-Level Principle 6, which emphasizes the role of FinTech in enhancing FinLit and accessibility. Furthermore, the study explores the impact of FinTech on FinDev, demonstrating a significant positive effect of digital payment adoption on FinDev across all regions. However, the results indicate that currency exposure negatively moderates the FinTech-FinDev relationship, suggesting that economies with higher exchange rate volatility may experience weaker FinTech-driven FinDev outcomes. These findings provide valuable insights for policymakers and financial institutions, highlighting the interconnectedness of FinTech, FinLit, currency exposure, and FinDev.

Keywords: Financial Technology, Financial Literacy, Financial Development, Currency Exposure, Global Findex

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1. INTRODUCTION

In recent years, financial technology (FinTech) has emerged as a transformative force in the global financial landscape, revolutionizing how individuals interact with financial services (AlHares & AlBaker, 2023). Through digital payments, mobile banking, and online investment platforms, FinTech has significantly enhanced financial literacy (FinLit) and financial development (FinDev) (Al-Majali et al., 2024; Al Zobi et al., 2025). According to

Klapper et al. (2025), 76% of the global adult population now has access to a formal financial account, a substantial increase from 51% in 2011. This 25% growth is largely driven by FinTech adoption, particularly in emerging economies, where traditional banking infrastructure is limited. Digital banking applications and mobile payment systems have provided millions with accessible financial services, reducing barriers to FinLit and financial inclusion.

The use of digital payments has also grown significantly, with 65% of adults making or receiving digital payments in 2021, reflecting a shift toward FinTech as a primary channel for financial transactions (Klapper et al., 2025). As individuals engage more frequently with FinTech solutions, they develop greater financial awareness, enabling them to manage finances, understand financial products, and make informed financial decisions. This trend aligns with the G20's High-Level Principles (Global Partnership for Financial Inclusion [GPFI], 2016), particularly Principle 6, which emphasizes FinTech's role in enhancing FinLit and accessibility. By integrating financial education tools such as automated savings plans, spending trackers, and personalized financial advice, FinTech platforms serve as interactive learning tools, helping users make better financial decisions. Consequently, FinTech has become a critical driver in bridging FinLit gaps, particularly for underserved populations, fostering greater financial empowerment on a global scale. Despite FinTech's positive role in FinLit, its impact varies across regions. Klapper et al. (2025), data highlight that while most regions experience FinLit growth due to FinTech adoption, some regions, including Europe, Central Asia, the Middle East, and North Africa, show inconsistencies. Barriers such as underdeveloped financial systems, limited financial inclusion, currency exposure, and corporate governance challenges hinder FinTech's ability to enhance FinLit in these regions. These findings underscore the need for a comprehensive global examination of FinTech's role in improving FinLit across diverse financial environments.

Beyond FinLit, FinTech also plays a pivotal role in FinDev. Klapper et al. (2025) highlight that digital payment systems have expanded financial infrastructure and service efficiency worldwide. In high- and upper-middle-income countries, over 70% of adults utilize digital payments, demonstrating FinTech's growing role in financial accessibility. In contrast, low- and middle-income countries rely heavily on mobile banking services, as FinTech often serves as a substitute for physical banking infrastructure. This trend aligns with global data showing a decline in automated teller machines (ATMs) and bank branches in regions with high FinTech penetration, reinforcing FinTech's disruptive role in financial service delivery. Most studies examining FinTech's economic impact, particularly within the context of Sustainable Development Goal 8 (SDG 8), focus on broad economic indicators, such as gross domestic product (GDP) and income inequality (Demir et al., 2022; Kanga, 2021). However, these macroeconomic measures fail to capture the depth of FinDev. To address this limitation, this study shifts the focus toward FinDev, measured through the FinDev index, while further analyzing financial institution and financial market development. Additionally, this study investigates the moderating role of currency exposure in the FinTech-FinDev relationship, a dimension that has received limited attention in prior research. By examining 119 countries using Global Findex data from 2014, 2017, and 2021, this study contributes to the existing literature by exploring the intersection of FinTech, FinLit, and FinDev on a global scale.

The results indicate a positive relationship between FinTech, FinLit, and FinDev. However, FinTech's impact is not uniform across its applications. Factors such as currency exposure

significantly influence financial transaction stability and predictability, particularly in FinTech applications, which are highly involved with foreign currency flow or fluctuating exchange rates. In these cases, currency volatility affects user confidence and FinTech adoption, highlighting the need for currency risk management strategies to stabilize digital financial ecosystems. This study also examines the role of financial inclusion in shaping FinTech's impact across different income-based regions. In high-, upper-middle-, lower-middle-, and low-income countries, increased FinTech adoption correlates with a decline in physical financial infrastructure, reducing the demand for ATMs and bank branches. This finding underscores the shifting financial landscape, where digital engagement is gradually replacing traditional banking services. Given these disparities, region-specific FinTech strategies are crucial. Policymakers should develop tailored regulatory frameworks, financial inclusion programs, and digital infrastructure investments to address the unique financial, regulatory, and infrastructural needs of different income groups.

The remainder of the paper is organized as follows. Section 2 discusses the relevant concept and empirical studies on FinTech, FinLit, FinDev, and currency exposure. Section 3 describes the data and methodology. Section 4 presents the analysis results. Section 5 discusses robustness checks. Section 6 highlights the conclusion.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Numerous studies have examined the factors influencing FinLit among specific population groups, such as students, workers, and the elderly, within countries or regions (Castañeda et al., 2022; Anshika et al., 2021). These studies highlight financial education, financial inclusion, and financial behavior as the primary determinants of FinLit. In the digital era, the increasing adoption of FinTech presents new opportunities to enhance FinLit, particularly through innovative platforms such as peer-to-peer lending (PTPL) and financial management applications (FMAs). However, despite these potential benefits, research on the direct impact of FinTech on FinLit remains limited. Most existing studies primarily examine the inverse relationship, focusing on how FinLit influences FinTech practices (Hasan et al., 2023; Khan et al., 2023).

Existing research shows that FinTech platforms can enhance FinLit (Dwijayanti et al., 2022; Van Nguyen et al., 2022). Dwijayanti et al. (2022) highlight the role of PTPL in improving FinLit through three features: accessible design via websites and mobile apps, effective borrower-lender communication, and access to historical transaction data for better credit assessment. These features illustrate PTPL's potential to bridge FinLit gaps through technology. FMAs are another FinTech innovation supporting FinLit. Van Nguyen et al. (2022) report that in emerging economies, where only 41.7% use FMAs, adoption is linked to higher FinLit in savings, investments, and insurance. Similarly, French et al. (2020) found that FMAs enhance FinLit, skills, and financial habits.

The ability of FinTech platforms to enhance FinLit is further supported by cognitive theories that explain how individuals process financial information. Cognitive load theory posits that

individuals have limited cognitive resources, including attention span, memory capacity, and processing ability, which can hinder their understanding of financial concepts and, consequently, their ability to make sound financial decisions. Kakinuma (2024), using a sample from Thailand, demonstrated that FinTech can effectively reduce cognitive load and improve financial comprehension of financial concepts through providing instant, easily accessible financial information while raising awareness of financial services. These features enhance users' attention span and processing ability, leading to a better understanding of financial concepts. This evidence underscores the potential of FinTech as a tool to mitigate cognitive limitations and enhance FinLit.

Although many empirical studies suggest that FinTech enhances FinLit, the relationship is not consistent. Psychological factors, economic conditions, and inadequate financial policies can hinder their effectiveness. For example, Ben Belgacem et al. (2024) found that in Saudi Arabia, psychological factors shape FinTech's impact differently across genders. Similarly, Gautam et al. (2022) examined FinTech adoption and digital FinLit across 29 Indian states and two union territories using 2017–2020 data. Their analysis shows that FinTech adoption, measured by Kisan credit card and ATM usage, improves FinLit when moderated by poverty levels. However, without this moderation, ATM usage negatively affects FinLit. These mixed findings highlight that the FinTech-FinLit nexus is context-dependent and varies across regions. To address this gap, the present study explores the relationship across six regions, leading to the following hypothesis:

H1: Financial technology is positively related to financial literacy.

A growing body of research has examined the role of financial FinTech in advancing the SDGs, particularly SDG 8 (decent work and economic growth) (Demir et al., 2022; Kanga, 2021) and SDG 9 (industry, innovation, and infrastructure) (Choudhary et al., 2025; Ferilli et al., 2024). These studies provide diverse insights into FinTech's contribution to economic development, including reducing income inequality and fostering technological innovation. Demir et al. (2022), utilizing mobile phone bill payments as an indicator of FinTech adoption based on data from the Global Financial Inclusion Database (Findex), found that FinTech indirectly reduces income inequality through enhancing financial inclusion, which mediates its effect on income disparity. Similarly, Kanga (2021), who classified 139 countries by income levels (low, middle, and high income), observed consistent effects across different FinTech products, such as ATMs and mobile payments, reinforcing FinTech's critical role in economic development. Beyond SDG 8, Choudhary et al. (2025), using Global Findex data from 86 countries, identified FinTech as a crucial factor influencing SDG 2 (zero hunger) and SDG 3 (good health and well-being) by mitigating undernourishment and maternal mortality. Additionally, their quantile regression analysis demonstrated that FinTech positively impacts quality education (SDG 4) while enhancing GDP growth (SDG 8) and internet usage (SDG 9), particularly at the lower 50th percentile, though with diminishing effects at higher percentiles.

Other studies have further examined FinTech's influence on economic growth and financial stability. Risman et al. (2021), analyzing 120 samples from Bank Indonesia data, found that FinTech improves financial stability, as reflected in the availability of bank loans. Extending this perspective, Tong and Yang (2025), through web crawling technology and text mining on 33 listed Chinese banks, concluded that FinTech enhances commercial bank profitability, with technologically innovative playing a significant mediating role. Similarly, Muganyi et al. (2022), using data from 290 Chinese cities based on the Peking University Digital Financial Inclusion Index, found that FinTech facilitates financial sector development, particularly in loan access, deposit depth, and savings growth.

Despite these valuable contributions, a significant research gap remains. Most FinTech-SDG 8 studies have not incorporated FinDev as a key determinant of economic growth, instead relying on GDP or income inequality as primary indicators (Demir et al., 2022; Kanga, 2021). According to diffusion of innovation theory (Jalal et al., 2023), technological adoption accelerates financial transactions and enhances economic efficiency. This aligns with the research gap identified by Lisbinski and Burnquist (2024), who highlighted the importance of examining the FinTech-FinDev nexus. Their study, using domestic financing value as an indicator of FinDev, demonstrated that institutional factors such as government accountability, political stability, regulatory quality, and economic freedom significantly influence FinDev in emerging economies. However, their findings were non-significant for developed economies, suggesting greater institutional resilience to change and a more substantial role for technological advancements in shaping FinDev. Given the limited research incorporating FinDev into FinTech-SDG 8 studies, and in alignment with diffusion of innovation theory, this study proposes the following hypothesis:

H2: Financial technology is positively related to financial development.

The financial contagion effect in financial markets explains how shocks or distress propagate across systems, often challenging the assumptions of traditional economic theories that emphasize equilibrium and market efficiency (Almansour et al., 2023; Kolb et al., 2011). Conceptually, contagion refers to the mechanism by which instability in one market or asset class spreads to others, including through exchange rate channels in open economies. This is consistent with the open-economy macroeconomic framework (Mundell, 1963), which emphasizes the central role of exchange rates in transmitting external shocks. The interconnectedness of financial networks further facilitates and amplifies these spillovers, making them systemic in nature and aligning with financial contagion theory, which views volatility transmission as an inherent feature of globally integrated markets. Within the context of FinTech and FinDev, the increasing coexistence of cryptocurrencies and traditional foreign exchange (Forex) markets underscores the importance of understanding volatility interdependencies, as these interactions can either enhance or constrain the developmental benefits of digital financial innovations.

Given the financial contagion effect, previous empirical studies have primarily focused on the interconnectedness between cryptocurrencies and exchange rates (Kostika & Laopodis, 2020; Mallick & Mallik, 2023). These studies discovered that certain cryptocurrencies exhibit significant relationships with foreign exchange currencies. For example, Kostika and Laopodis (2020) observed dynamic interactions between Bitcoin, Dash, XRP, Ethereum, Monero, and Stellar with the Chinese Yuan. Meanwhile, Mallick and Mallik (2023) identified a negative association between cryptocurrencies and the USD, while also noting that the Indian foreign exchange market has minimal impact on cryptocurrency prices.

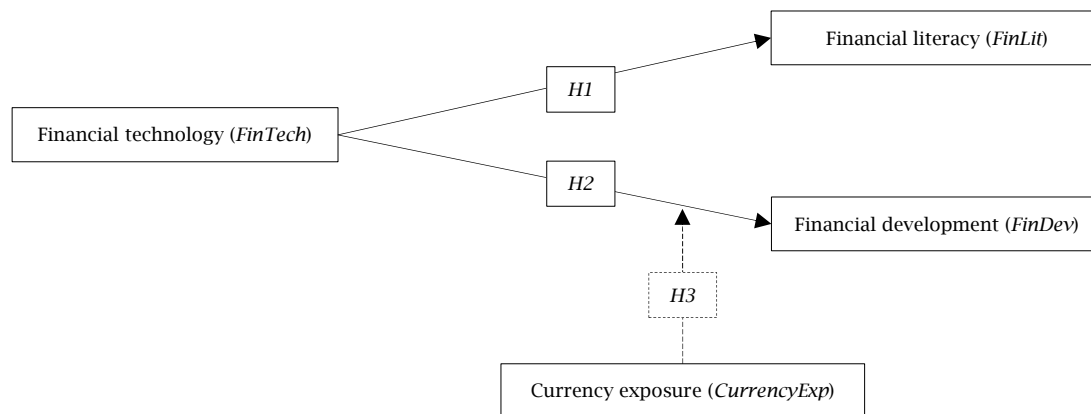
Exposure to currency fluctuations, particularly in economies with high FinTech adoption, introduces systemic risk, potentially moderating the relationship between FinTech and FinDev. As digital financial systems become increasingly integrated with traditional banking and forex markets, exchange

rate volatility may either enhance or constrain the benefits of FinTech-driven FinDev. However, no prior studies have examined the contagion effect within the context of FinTech applications and FinDev on a global scale. Some research has explored the moderating role of systematic risk in FinTech's impact on financial stability. For example, Risman et al. (2021), using Bank Indonesia data, found that systematic risk reduces the positive impact of FinTech, measured through internet-based payments, on bank loan growth, bank liquidity, and stability. However, their study measured systematic risk using the ratio of total derivatives to total assets, rather than directly analysing exchange rate fluctuations or currency exposure. Building on these insights, this study proposes the following hypothesis:

H3: Currency exposure moderates the relationship between financial technology and financial development.

Our conceptual framework is compiled in Figure 1 below.

Figure 1. Conceptual framework



3. DATA AND METHODOLOGY

3.1. Data and variables

This study utilizes a dataset comprising three key variables: financial technology (*FinTech*) as the independent variable, currency exposure (*CurrencyExp*) as the moderating variable, and financial literacy (*FinLit*) and financial development (*FinDev*) as the dependent variables. To address *H1*, that *FinTech* is positively related to *FinLit* (*FinTech-FinLit*), we employ secondary data from 119 countries for the years 2014, 2017, and 2021, obtained from the Global Findex of the World Bank. *FinTech* is measured across four dimensions: *Digital payments*, *Digital receipts*, *Digital public sector wages*, and *Digital private sector wages*, which align with the framework used in prior studies (Sharma & Changkakati, 2022). Similarly, *FinLit* is assessed based on four dimensions: *Saving money*, *Saving at financial institutions*, *Saving for old age*, and *Borrowing*, as adopted in previous research (Bui & Luong, 2023).

Beyond *FinLit*, this study also examines *FinDev* as an additional dependent variable to address the second research objective. *FinDev* is measured using the *FinDev* index, which comprises *Financial institution development* (measured by the financial institution index) and *Financial market development* (measured by the financial market development index), as reported by the International Monetary Fund (IMF). To test *H3*, that *CurrencyExp* moderates the relationship between *FinTech* and *FinDev*, this study incorporates merchandise trade as a percentage of GDP as a proxy for *CurrencyExp*, using data sourced from the World Bank. Unlike past research, which commonly included *Population* and financial inclusion (*FinInclusion*) as control variables, this study follows the approach of prior *FinTech* and *FinLit* studies by incorporating mortality rate, GDP, and education expenditure. A comprehensive list of the dependent, independent, and control variables is presented in Table 1, while Table 2 and Table A.1 (see Appendix) present the summary statistics and correlation matrix, respectively.

Table 1. Definitions of the variables

Variable	Source	Definition and measurement
Dependent variable — FinLit		
<i>Saving money</i>	Global Index	• Saving any money, primary education or less (% age 15+ years old) • Saving any money, secondary education or more (% age 15+ years old)
<i>Saving at financial institutions</i>	Global Index	• Saving at formal financial institutions, primary education or less (% age 15+ years old) • Saving at formal financial institutions, secondary education or more (% age 15+ years old)
<i>Saving for old age</i>	Global Index	• Saved for old age, primary education or less (% age 15+ years old) • Saved for old age, secondary education, or more (% age 15+ years old)
<i>Borrowing</i>	Global Index	• Borrowing from formal financial institutions, primary education or less (% age 15+ years old) • Borrowing from formal financial institutions, secondary education or more (% age 15+ years old)
Dependent variable — FinDev		
<i>FinDev</i>	IMF	Aggregate of financial institutions and the financial market development index
<i>Financial institution development</i>	IMF	Financial institution development index
<i>Financial market development</i>	IMF	Financial market development index
Independent variable — FinTech		
<i>Digital payments</i>	Global Index	Made a digital payment
<i>Digital receipts</i>	Global Index	Received a digital pay
<i>Digital public sector wages</i>	Global Index	Received public sector wages mobile phone
<i>Digital private sector wages</i>	Global Index	Received private sector wages mobile phone
Moderating variable		
<i>CurrencyExp</i>	World Bank	Merchandise trade to GDP
Control variable		
<i>Population</i>	Global Index	Total number of the adult population (age 15+ years old)
<i>FinInclusion</i>	Global Index	Own a debit/credit card in the labor force

Note: This table presents the variables used in this paper, definitions, sources, and measurements.

3.2. Empirical model for econometric analysis

To test *H1*, that *FinTech* is positively related to *FinLit*, the following Eq. (1) is constructed:

$$FinLit_{i,t} = \beta_0 + \beta_1 FinTech_{i,t} + \beta_3 Population_{i,t} + \beta_4 FinInclusion_{i,t} + \varepsilon_{i,t} \quad (1)$$

where, *i* represents a particular country and *t* is the time period. *FinLit* is measured by the four indicators: *Saving money*, *Saving at financial institutions*, *Saving for old age*, and *Borrowing*. *Population* refers to the total number of adults (15 years old and above), while *FinInclusion* is proxied by the number of individuals who own debit or credit cards in the labor force. β_0 is the constant, β_1 – β_6 are the estimated coefficients, and $\varepsilon_{i,t}$ is the error term. To test *H2*, that *FinTech* is positively related to *FinDev*, the following Eq. (2) was constructed:

$$FinDev_{i,t} = \beta_0 + \beta_1 FinTech_{i,t} + \beta_3 Population_{i,t} + \beta_4 FinInclusion_{i,t} + \varepsilon_{i,t} \quad (2)$$

where, *FinDev* denotes the *Financial institution development* extract. Building on Eq. (2), *H3*, an interaction term between *FinTech* and *CurrencyExp*, is tested. The coefficient of this interaction term is anticipated to be significant, suggesting that *CurrencyExp* mitigates the impact of *FinTech* on *FinDev*. *H3* is tested using Eq. (3) as follows.

$$FinDev_{i,t} = \beta_0 + \beta_1 FinTech_{i,t} + \beta_2 (FinTech * CurrencyExp)_{i,t} + \beta_3 Population_{i,t} + \beta_4 FinInclusion_{i,t} + \varepsilon_{i,t} \quad (3)$$

In addition, multivariate analysis is conducted using the ordinary least squares (OLS) method as applied in the Eqs. (1)–(3).

3.3. Descriptive statistics

Table 2 presents the descriptive statistics for all variables. Both *Digital payments* and *Digital receipts* exhibit the highest mean values (0.493 and 0.420, respectively), compared to other *FinTech* indicators, suggesting robust adoption of digital financial services across the sampled economies. For *FinLit*, secondary education indicates higher mean values across all indicators compared to primary education. Specifically, the mean values for secondary education are 0.580 (*Saving money*), 0.296 (*Saving at financial institutions*), 0.248 (*Saving for old age*), and 0.278 (*Borrowing*). The results suggest that higher educational attainment may be associated with improved *FinLit*, particularly in critical areas such as savings and borrowing behavior.

The *FinDev* index shows a mean value below 0.378, indicating an underdeveloped financial infrastructure. Despite this, certain sub-components, particularly *Financial institution development* (mean: 0.465), perform relatively better than *Financial market development* (mean: 0.273). This disparity underscores the possibility that while banking institutions are advancing, capital markets are lagging behind. *CurrencyExp* exhibits moderate variability with a mean value of 66.95%. Thus, supporting its inclusion as a moderating variable factor in the empirical analysis, as fluctuations in *CurrencyExp* may significantly impact the relationship between *FinTech* adoption and *FinDev*. Table A.1 (see Appendix) presents the Pearson correlation between the main variables in the regression model. Although significant correlations were observed between *FinTech* indicators, to mitigate multicollinearity, each *FinTech* indicator will be examined separately. Furthermore, the Breusch-Pagan/Cook-Weisberg test was employed to assess heteroskedasticity, while the Durbin-Wu-Hausman test was used to check for endogeneity. The results indicate that both issues are not present in the estimations.

Table 2. Summary statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
<i>Saving money</i> (primary education or less (% age 15+ years old)	354	0.410	0.170	0.090	0.970
<i>Saving money</i> (secondary education or less (% age 15+ years old)	354	0.580	0.173	0.140	0.930
<i>Saving at financial institutions</i> (primary education or less (% age 15+ years old)	354	0.150	0.150	0.000	0.730
<i>Saving at financial institutions</i> (secondary education or less (% age 15+ years old)	354	0.296	0.203	0.010	0.870
<i>Saving for old age</i> (primary education or less (% age 15+ years old)	354	0.165	0.128	0.000	0.750
<i>Saving for old age</i> (secondary education or less (% age 15+ years old)	354	0.248	0.174	0.010	0.740
<i>Borrowing</i> (primary education or less (% age 15+ years old)	354	0.152	0.127	0.000	0.670
<i>Borrowing</i> (secondary education or less (% age 15+ years old)	354	0.278	0.190	0.020	0.840
<i>FinDev</i>	354	0.378	0.241	0.040	0.960
<i>Financial institution development</i>	354	0.465	0.219	0.090	0.990
<i>Financial market development</i>	354	0.273	0.283	0.000	0.950
<i>Digital payments</i>	354	0.493	0.309	0.020	0.999
<i>Digital receipts</i>	354	0.420	0.257	0.028	0.932
<i>CurrencyExp</i> (% of GDP)	354	66.945	39.309	17.906	251.948
<i>Digital public sector wages</i>	354	0.082	0.131	0.000	0.684
<i>Digital private sector wages</i>	354	0.064	0.101	0.000	0.605
<i>Population</i> (adult 15+)	354	4.39e+07	1.38e+08	364575.5	1.15e+09
<i>FinInclusion</i>	354	0.397	0.321	0.002	0.991
<i>Financial institution accessibility</i>	354	0.403	0.262	0.010	1.000
<i>Financial institution efficiency</i>	354	0.576	0.105	0.250	0.800

4. EMPIRICAL ANALYSIS AND FINDINGS

4.1. Result analysis: Financial technology and financial literacy

This section presents the OLS regression results. To investigate the *H1*, which concerns the relationship between *FinTech* and *FinLit*, we estimated the initial model using OLS for 119 countries while controlling for other variables. *FinLit* was categorized into two groups: 1) primary education and below, and 2) secondary education and above. The OLS results from Table 3a (primary education and below) indicate that *FinTech*, measured by *Digital payments*, is significantly positively associated with all *FinLit* indicators (i.e., *Saving money*, *Saving at financial institutions*, *Saving for old age*, and *Borrowing*). However, *Digital receipts* are significantly associated only with *Saving money* and *Saving at financial institutions*. Moreover, among individuals with secondary education and above, both *FinTech* indicators (payments made and received digitally) show significant associations with all indicators of *FinLit*. In general, both *Digital payments* and *Digital receipts* exhibit a positive and significant relationship with *FinLit*. These findings align with the cognitive load theory developed by Chandler and Sweller (1991), which posits that individuals have limited cognitive resources when processing information. Building upon this theory, Zhonggen et al. (2019) found that digital platforms can reduce cognitive load and enhance *FinLit*. Furthermore, specific *FinTech* services provide personalized

guidance and real-time assistance to customers, aiding them in making better financial decisions (Lai & Langley, 2024).

Tables 3a and 3b further illustrate that individuals with secondary education and above demonstrate a positive and significant correlation between both *Digital receipts* and *Digital payments* with all aspects of *FinLit*. Conversely, those with primary education or below show significant correlations with only two *FinLit* indicators. These findings are consistent with general trends. For instance, Bui and Luong (2023) examined *FinTech* practices in Thailand and discovered that more than half of individuals utilizing mobile phones or the internet to access financial accounts had completed secondary education, while 30% had tertiary education. In summary, their findings suggest that higher education levels correspond to greater engagement in *FinTech* practices. This finding could be elucidated through cognitive ability theory, aligning with the findings of Le Carret et al. (2003), who identified a positive correlation between education level and cognitive ability. Cognitive ability encompasses individual capacities in controlled processes and conceptual understanding. Therefore, higher levels of education enhance these abilities, leading to reduced cognitive load and improved *FinLit*. Consequently, *FinTech* serves as a platform that can enhance cognitive ability, particularly among highly educated individuals. All control variables, including *Population* and *FinInclusion*, are found to have a positive and significant relationship with *FinLit*.

Table 3a. The impact of *FinTech* on *FinLit* (Primary education and below)

Variables	Model 1				Model 2			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
<i>Digital payments</i>	0.236*** (5.250)	0.297*** (4.170)	0.229*** (3.260)	0.314*** (4.42)				
<i>Digital receipts</i>					0.111*** (3.120)	0.120** (2.130)	-0.019 (-0.330)	0.033 (0.580)
Obs.	354	354	354	354	354	354	354	354
R-squared	0.838	0.828	0.818	0.822	0.854	0.848	0.842	0.842

Note: (1) *Saving money*, (2) *Saving at financial institutions*, (3) *Saving for old age*, and (4) *Borrowing from financial institutions*. * Represents the value of the coefficient, and the value in brackets represents the t value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

Table 3b. The impact of *FinTech* on *FinLit* (Secondary education and above)

Variables	Model 1				Model 2			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Digital payments	0.353a*** (7.230)	0.389*** (6.090)	0.489*** (7.450)	0.318*** (4.070)				
Digital receipts					0.208*** (5.200)	0.267*** (5.250)	0.218*** (4.100)	0.202*** (3.330)
Obs.	354	354	354	354	354	354	354	354
R-squared	0.851	0.845	0.844	0.825	0.859	0.861	0.854	0.848

Note: (1) Saving money, (2) Saving at financial institutions, (3) Saving for old age, and (4) Borrowing from financial institutions. ^a Represents the value of the coefficient, and the value in brackets represents the t value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

4.2. Result analysis: Financial technology and financial development

This study examines the relationship between *FinTech* and *FinDev*, focusing on the extent to which different *FinTech* dimensions contribute to overall *FinDev*, financial institutions, and financial markets. The regression results presented in Tables 4a and 4b provide empirical evidence on these relationships. Table 4a reports the impact of *FinTech* on *FinDev* across different models. Among the four *FinTech* indicators, *Digital payments* have a significant positive impact on *FinDev*, suggesting that greater engagement in *Digital payments* facilitates *FinDev* by increasing transactional efficiency and *FinInclusion*. However, the other *FinTech* indicators, which receive digital payments, *Digital public sector wages*, and *Digital private sector wages*, do not exhibit significant relationships with *FinDev*. The R-squared values across all models range from 0.014 to 0.032, indicating relatively low explanatory power and suggesting that *FinDev* is influenced by additional factors beyond *FinTech* adoption.

Table 4b provides further insights by disaggregating *FinDev* into *Financial institution development* and *Financial market development*. The results indicate that making *Digital payments* and *Digital receipts* has a significant positive impact on *Financial institution development*, underscoring the role of digital payment adoption in strengthening financial institutions. However, their effects on *Financial market development* are negative and

insignificant, suggesting that digital payment adoption does not necessarily translate into immediate capital market growth. Regarding digital wage payments, *Digital public sector wages* positively influence *Financial institution development* but show no significant effect on *Financial market development*. Meanwhile, *Digital private sector wages* exhibit an insignificant effect on both *Financial institution development* and *Financial market development*.

4.3. Result analysis: Currency exposure moderates the relationship between financial technology and financial development

Table 5 presents the result of regression analysis, which examines the moderating effect of *CurrencyExp* on the relationship between *FinTech* and *FinDev*. The findings indicate that the moderating effect of *CurrencyExp* varies across different *FinTech* indicators. Specifically, the interaction term *Digital payments * CurrencyExp* is negative and significant, suggesting that higher *CurrencyExp* weakens the positive impact of *Digital payments* on *FinDev*. This result implies that while *Digital payments* facilitate *FinDev* by improving transactional efficiency and *FinInclusion*, increased exposure to exchange rate fluctuations introduces systematic risk, potentially reducing the stability of financial transactions in economies reliant on cross-border digital payments.

Table 4a. The impact of *FinTech* on *FinDev*

Variables	Model 1: <i>FinDev</i>	Model 2: <i>FinDev</i>	Model 3: <i>FinDev</i>	Model 4: <i>FinDev</i>
Digital payments	0.034** (1.730)			
Digital receipts		0.026 (1.340)		
Digital public sector wages			0.0024 (1.450)	
Digital private sector wages				0.039 (1.640)
Obs.	354	354	354	354
R-squared	0.022	0.032	0.019	0.014

Note: ^a Represents the value of the coefficient, and the value in brackets represents the t value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

Table 4b. The impact of *FinTech* on financial institutions and financial markets development

Variables	Model 1		Model 2		Model 3		Model 4	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Digital payments	0.088*** (3.520)	-0.027 (-0.900)						
Digital receipts			0.075*** (2.970)	-0.031 (-1.000)				
Digital public sector wages					0.047** (2.070)	(-0.000) (-0.000)		
Digital private sector wages							0.052 (1.640)	0.023 (0.61)
Obs.	354	354	354	354	354	354	354	354
R-squared	0.002	0.060	0.007	0.051	0.001	0.059	0.059	0.002

Note: (1) Financial institution development and (2) Financial market development. ^a Represents the value of the coefficient, and the value in brackets represents the t value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

Similarly, the interaction term *Digital receipts * CurrencyExp* is also negative and significant, reinforcing the notion that currency volatility dampens the benefits of digital payment inflows. This suggests that economies experiencing greater exchange rate fluctuations may struggle to maintain financial stability, particularly where foreign remittances or international transactions constitute a substantial portion of digital payment flows.

Conversely, the interaction terms for *Digital public sector wages * CurrencyExp* and *Digital*

*private sector wages * CurrencyExp* are insignificant. This suggests that *CurrencyExp* does not significantly influence the relationship between digital wage payments (both public and private) and *FinDev*. Unlike general digital transactions, digital wage payments are often more stable and less sensitive to exchange rate fluctuations, particularly in economies where wages are predominantly paid in local rather than foreign currency.

Table 5. The impact of *FinTech * CurrencyExp* on *FinDev*

Variables	Model 1	Model 2	Model 3	Model 4
Digital payments	0.0157 ^a (0.570)			
Digital payments * <i>CurrencyExp</i>	-0.010** (-1.880)			
Digital receipts		0.0466 (1.250)		
Digital receipts * <i>CurrencyExp</i>		-0.001** (-2.010)		
Digital public sector wages			0.015 (0.450)	
Digital public sector wages * <i>CurrencyExp</i>			-0.002 (-0.570)	
Digital private sector wages				-0.010 (-0.190)
Digital private wage * <i>CurrencyExp</i>				-0.000 (-0.190)
Obs.	354	354	354	354
R-squared	0.6307	0.6424	0.5969	0.5974

Note: ^a Represents the value of the coefficient, and the value in brackets represents the *t* value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

4.4. Robustness checks results

This section examines how *FinInclusion* moderates the relationship between *FinTech* adoption and *Financial institution development* across income groups. Initial results in Table 4b show a significant positive link between *FinTech* and institutional development, highlighting the role of digital financial services. *FinInclusion*, measured by debit/credit card

ownership among the labor force, is introduced as a moderating variable, while *FinTech* adoption is assessed through four indicators. Regression results in Table 6 reveal how *FinInclusion* influences this relationship across high-, upper-middle-, lower-middle-, and low-income countries, offering insights into its enhancing or constraining effects across different economic contexts.

Table 6. The impact of *FinTech * FinInclusion* on *Financial institution accessibility* based on income group

Variables	Financial institution accessibility			
	High income	Upper middle income	Low-middle-income	Low income
Digital payments	0.641 ^a *** (3.120)	0.071 (0.860)	0.092 (1.620)	0.010 (0.590)
Digital payments * <i>FinInclusion</i>	-1.395*** (-3.780)	-0.223*** (-1.780)	-0.093 (-0.910)	-0.052 (-0.360)
Digital receipts	0.618*** (1.840)	0.065 (0.670)	0.164** (2.020)	0.015 (0.490)
Digital receipts * <i>FinInclusion</i>	-0.738 (-1.660)	-0.247* (-1.760)	-0.271** (-2.210)	-0.059 (-0.280)
Digital public sector wages	0.780** (2.160)	0.220 (1.630)	0.051 (0.980)	0.019 (1.420)
Digital public sector wages * <i>FinInclusion</i>	-1.585*** (-3.110)	-0.801*** (-2.740)	-0.211 (-1.510)	-0.055 (-0.310)
Digital private sector wages	1.171* (1.880)	0.264 (1.670)	0.050 (0.640)	0.018 (0.560)
Digital private sector wages * <i>FinInclusion</i>	-2.275 (-3.170)	-1.000*** (-2.890)	-0.188 (-1.200)	-0.206 (-0.730)
Obs.	114	99	101	40
R-squared	0.030–0.170	0.005–0.070	0.003–0.060	0.040–0.080

Note: ^a Represents the value of the coefficient, and the value in brackets represents the *t* value. ***, ** and * are significance levels at 1%, 5%, and 10%, respectively.

The results indicate that the moderating effect of *FinInclusion* on the *FinTech*-*Financial institution accessibility* relationship varies significantly across income group countries. In high-income countries, *Digital payments* and *Digital receipts* are positively and significantly associated with *Financial institution accessibility*, indicating that digital transactions

enhance banking access. However, the interaction terms for *Digital receipts * FinInclusion* and *Digital public sector wages * FinInclusion* are negative and significant. This suggests that while *FinTech* adoption improves access, its marginal impact decreases when *FinInclusion* is already high. A likely explanation is that in high-income countries, where

financial services are widely accessible, additional digital adoption offers limited incremental benefits (Fu & Liu, 2023).

In upper-middle-income countries, digital public and private sector wages show weak, insignificant effects on *Financial institution accessibility*. However, interaction terms for *Digital receipts * FinInclusion* and *Digital private sector wages * FinInclusion* are negative and significant. These findings align with Fu and Liu (2023), who reported that some developed countries still rely on both traditional and *FinTech* services. With low *FinTech* penetration in Japan (33.3%) and Italy (22.2%), higher *FinInclusion* may reduce *FinTech*'s effectiveness due to the substitution effect of strong traditional banking systems.

In lower-middle-income countries, *Digital receipts* have a significant positive impact on *Financial institution accessibility*, highlighting the role of digital transactions in improving financial services access. The interaction term *Digital receipts * FinInclusion* is negative and significant, implying that while *Digital payments* enhance financial access, higher *FinInclusion* levels limit the marginal benefits of *FinTech* adoption. This may result from a lack of complementary financial infrastructure or challenges in digital *FinLit*. Our findings are in line with the Indian context presented by Singh and Mallick (2024).

In low-income countries, none of the *FinTech* indicators show significant direct relationships with *Financial institution accessibility*. Similarly, all interaction terms between *FinTech* and *FinInclusion* are insignificant, suggesting that *FinInclusion* does not significantly moderate the relationship between *FinTech* adoption and *Financial institution accessibility* in these settings. This finding aligns with Kodongo (2024), who reported that Kenya's *FinTech* ecosystem has not performed well in promoting financial inclusion. Such outcomes may be attributed to limited digital infrastructure, weak regulatory frameworks, and low adoption rates of formal financial services in these economies.

5. DISCUSSION

The findings of this study support the hypothesis that *FinTech* adoption positively influences *FinLit*, particularly through digital payments. The results indicate that individuals with secondary education or above benefit more significantly from *FinTech* services compared to those with primary education or below. This aligns with cognitive load theory, which suggests that digital platforms can reduce cognitive strain and improve financial decision-making (Chandler & Sweller, 1991; Lin & Lin, 2016). Moreover, the findings are consistent with Bui and Luong (2023), who observed that individuals engaging in *FinTech* practices tend to have higher education levels, reinforcing the link between cognitive ability and *FinLit*.

The study also suggests that *FinTech*, particularly digital payments, plays a crucial role in strengthening financial institutions' development, but has a limited effect on financial market development. This aligns with previous research highlighting the role of *FinTech* in promoting financial inclusion by expanding access to banking services and facilitating transactions (Sharma & Changkakati, 2022). The positive association between digital wage payments, particularly in the public sector and financial institution

development, suggests that digitizing government payrolls strengthens banking infrastructure by broadening formal financial inclusion. However, the lack of significant impact on financial markets indicates that *FinTech* adoption, while enhancing banking systems, does not immediately foster capital market expansion. This may reflect structural inefficiencies or limited investor engagement. Thus, future research should investigate how innovations such as blockchain, crowdfunding, and decentralized finance (DeFi) can bridge this gap and support more robust capital market development.

Additionally, the results highlight the importance of considering currency exposure as a moderating factor in the *FinTech*-*FinDev* nexus. While digital payments enhance *FinDev*, excessive exposure to exchange rate fluctuations can erode these benefits by increasing transaction costs, financial uncertainty, and systemic risk. This is particularly relevant for emerging markets, where reliance on digital payments for cross-border transactions and remittances is high. The negative moderating effect of currency exposure on made digital payments and received digital payments aligns with previous research suggesting that exchange rate volatility increases financial instability and deters digital financial adoption in some economies (Kostika & Laopodis, 2020; Mallick & Mallik, 2023). This finding emphasizes the need for robust financial regulations to manage currency risk, ensuring that digital payments contribute positively to *FinDev* without being undermined by exchange rate fluctuations. The insignificant interaction effects suggest *FinTech*'s impact on *FinDev* varies by transaction type, with domestic payments less affected by exchange volatility than cross-border transactions, reflecting macroeconomic sensitivities.

Robustness checks confirm that financial inclusion significantly moderates the relationship between *FinTech* adoption and financial institution accessibility, with varying effects across income groups. In high- and upper-middle-income countries, financial inclusion may limit *FinTech*'s marginal benefits due to saturation in financial access. Conversely, in lower-middle-income countries, digital payments enhance accessibility, though moderated by financial inclusion levels. For low-income countries, the absence of significant results points to structural barriers such as limited digital infrastructure and financial illiteracy that hinder *FinTech*'s effectiveness. These findings support prior studies emphasizing the need for strong infrastructure, regulatory support, and *FinLit* to maximize the benefits of digital finance (Choudhary et al. 2025; Kakinuma, 2024).

6. CONCLUSION

The impact of *FinTech* on *FinLit* and *FinDev* has been widely recognized. However, previous studies have primarily focused on the determinants of *FinTech* adoption or the evolution of *FinTech* infrastructure, with limited research examining the direct relationship between *FinTech* and *FinLit* and *FinDev*, particularly within a global context. To address this gap, this study utilizes Global Findex data to test three key hypotheses: *H1*, the impact of *FinTech* on *FinLit*; *H2*, the impact of *FinTech* on *FinDev*; and *H3*, the moderating role of currency exposure.

The findings confirm that *FinTech* adoption positively influences both *FinLit* and *FinDev*, with

currency exposure moderating this relationship. Specifically, the study highlights that education and cognitive ability are critical in enhancing FinLit through FinTech adoption, underscoring the necessity for policy interventions to strengthen FinLit. Regarding FinDev, the study finds that FinTech adoption, particularly digital payments, significantly enhances FinDev, primarily through strengthening financial institutions rather than financial markets. However, the relatively low explanatory power of the model suggests that additional macroeconomic and institutional factors beyond FinTech adoption contribute to FinDev, warranting further investigation.

Additionally, the study reveals that currency exposure negatively moderates the relationship between FinTech and FinDev, particularly in the case of digital payments received and made. These results highlight the need for policy measures to mitigate exchange rate risks, such as hedging mechanisms, regulatory frameworks, and the adoption of stable digital currencies, to ensure that FinTech-driven FinDev is sustained in volatile currency environments. Furthermore, financial

inclusion moderates the relationship between FinTech adoption and financial institution accessibility, with variations across income groups. This suggests that policymakers should tailor FinTech adoption strategies based on income levels.

Despite its contributions, this study has limitations. It relies on Global Findex data, which may not fully reflect country-specific regulatory, technological, and behavioral factors influencing FinTech adoption and FinDev. Future research should incorporate more granular, country-level data. Additionally, the focus on digital payments overlooks other FinTech innovations such as PTPL, blockchain finance, and DeFi, which may also drive FinDev. The study also limits risk analysis to currency exposure; future work should assess broader macroeconomic risks, including interest rate volatility and geopolitical instability. Research may also extend to exploring blockchain-based FinTech across countries with different income levels. Overall, the findings underscore the need for context-specific policies to harness FinTech's potential while mitigating systemic risks.

REFERENCES

- Al Zobi, M. K., Qawqzeh, H. K., & Abu-Allan, A. (2025). FinTech governance and firms' performance: Does financial literacy matter? *Journal of Governance & Regulation*, 14(3), 39–48. <https://doi.org/10.22495/jgrv14i3art4>
- AlHares, A., & AlBaker, Y. (2023). Corporate governance and effect in FinTech: Evidence from Gulf Cooperation Council banking sector. *Corporate & Business Strategy Review*, 4(1), 99–111. <https://doi.org/10.22495/cbsrv4i1art9>
- Al-Majali, A. A., Al Oshaibat, S. D., Al-Sarayreh, A. A., & Al Manaseer, S. R. (2024). The effect of digital financial literacy on financial development and governance: Using panel vector autoregressive model [Special issue]. *Journal of Governance & Regulation*, 13(2), 465–473. <https://doi.org/10.22495/jgrv13i2siart21>
- Almansour, B. Y., Uddin, M. M., Elkrghli, S., & Almansour, A. Y. (2023). The dynamic connectedness between cryptocurrencies and foreign exchange rates: Evidence by TVP-VAR approach. *Industrial Engineering & Management Systems*, 22(3), 349–362. <https://doi.org/10.7232/iems.2023.22.3.349>
- Anshika, Singla, A., & Mallik, G. (2021). Determinants of financial literacy: Empirical evidence from micro and small enterprises in India. *Asia Pacific Management Review*, 26(4), 248–255. <https://doi.org/10.1016/j.apmrv.2021.03.001>
- Ben Belgacem, S., Khatoon, G., Bala, H., & Alzuman, A. (2024). The role of financial technology on the nexus between demographic, socio-economic, and psychological factors, and the financial literacy gap. *Sage Open*, 14(2). <https://doi.org/10.1177/21582440241255678>
- Bui, M. T., & Luong, T. N. O. (2023). Financial inclusion for the elderly in Thailand and the role of information communication technology. *Borsa Istanbul Review*, 23(4), 818–833. <https://doi.org/10.1016/j.bir.2023.02.003>
- Castañeda, F., Ormazábal, F., & Cisternas, C. (2022). Sociodemographic determinants of financial literacy levels. *Studies in Business and Economics*, 17(2), 44–61. <https://doi.org/10.2478/sbe-2022-0024>
- Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, 8(4), 293–332. https://doi.org/10.1207/s1532690xci0804_2
- Choudhary, P., Ghosh, C., & Thenmozhi, M. (2025). Impact of FinTech and financial inclusion on sustainable development goals: Evidence from cross-country analysis. *Finance Research Letters*, 72, Article 106573. <https://doi.org/10.1016/j.frl.2024.106573>
- Demir, A., Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2022). FinTech, financial inclusion and income inequality: A quantile regression approach. *The European Journal of Finance*, 28(1), 86–107. <https://doi.org/10.1080/1351847X.2020.1772335>
- Dwijayanti, N., Iqbal, M., & Zulfikar, M. (2022). The role of Islamic FinTech P2PL in increasing inclusion and financial literacy of MSMEs. *Journal of Islamic Finance*, 11(1), 94–101. <https://doi.org/10.31436/jif.v11i1.638>
- Ferilli, G. B., Palmieri, E., Miani, S., & Stefanelli, V. (2024). The impact of FinTech innovation on digital financial literacy in Europe: Insights from the banking industry. *Research in International Business and Finance*, 69, Article 102218. <https://doi.org/10.1016/j.ribaf.2024.102218>
- French, D., McKillop, D., & Stewart, E. (2020). The effectiveness of smartphone apps in improving financial capability. *The European Journal of Finance*, 26(4–5), 302–318. <https://doi.org/10.1080/1351847X.2019.1639526>
- Fu, Y., & Liu, L. (2023). On the accessibility of financial services and income inequality: An international perspective. *Technological and Economic Development of Economy*, 29(3), 814–845. <https://doi.org/10.3846/tede.2023.18722>
- Gautam, R. S., Rastogi, S., Rawal, A., Bhimavarapu, V. M., Kanoujiya, J., & Rastogi, S. (2022). Financial technology and its impact on digital literacy in India: Using poverty as a moderating variable. *Journal of Risk and Financial Management*, 15(7), Article 311. <https://doi.org/10.3390/jrfm15070311>
- Global Partnership for Financial Inclusion (GPFI). (2016). *G20 high-level principles on digital financial inclusion*. <https://g20.utoronto.ca/2016/high-level-principles-for-digital-financial-inclusion.pdf>

- Hasan, M., Noor, T., Gao, J., Usman, M., & Abedin, M. Z. (2023). Rural consumers' financial literacy and access to FinTech services. *Journal of the Knowledge Economy*, 14, 780-804. <https://doi.org/10.1007/s13132-022-00936-9>
- Jalal, A., Al Mubarak, M., & Durani, F. (2023). Financial technology (FinTech). In A. Hamdan & E. S. Aldhaen (Eds.), *Artificial intelligence and transforming digital marketing* (pp. 525-536). Springer. https://doi.org/10.1007/978-3-031-35828-9_45
- Kakinuma, Y. (2024). *FinTech as a gateway to enhancing financial literacy*. <https://doi.org/10.2139/ssrn.4367898>
- Kanga, M. (2021). Engineering a more sustainable world. In United Nations Educational, Scientific and Cultural Organization (UNESCO) (Ed.), *Engineering for sustainable development: Delivering on the sustainable development goals* (pp. 16-38). UNESCO. <https://doi.org/10.18356/9789214030089c005>
- Khan, M. T. I., Liew, T. W., & Lee, X. Y. (2023). FinTech literacy among millennials: The roles of financial literacy and education. *Cogent Social Sciences*, 9(2), Article 2281046. <https://doi.org/10.1080/23311886.2023.2281046>
- Klapper, L., Singer, D., Starita, L., & Norris, A. (2025). *The Global Findex Database 2025: Connectivity and financial inclusion in the digital economy*. World Bank Group. <https://www.worldbank.org/en/publication/globalfindex>
- Kodongo, O. (2024). Financial inclusion effects of engaging with the fintech ecosystem. *International Review of Economics & Finance*, 96(Part B), Article 103671. <https://doi.org/10.1016/j.iref.2024.103671>
- Kolb, R. W. (2011). *What is financial contagion: The viral threat to the wealth of nations*. John Wiley & Sons. <https://doi.org/10.1002/9781118267646>
- Kostika, E., & Laopodis, N. T. (2020). Dynamic linkages among cryptocurrencies, exchange rates and global equity markets. *Studies in Economics and Finance*, 37(2), 243-265. <https://doi.org/10.1108/SEF-01-2019-0032>
- Lai, K. P. Y., & Langley, P. (2024). Playful finance: Gamification and intermediation in FinTech economies. *Geoforum*, 151, Article 103848. <https://doi.org/10.1016/j.geoforum.2023.103848>
- Le Carret, N., Lafont, S., Letenneur, L., Dartigues, J. F., Mayo, W., & Fabrigoule, C. (2003). The effect of education on cognitive performance and its implication for the constitution of the cognitive reserve. *Developmental Neuropsychology*, 23(3), 317-337. https://doi.org/10.1207/S15326942DN2303_1
- Lin, Y.-T., & Lin, Y.-C. (2016). Effects of mental process integrated nursing training using mobile device on students' cognitive load, learning attitudes, acceptance, and achievements. *Computers in Human Behavior*, 55(Part B), 1213-1221. <https://doi.org/10.1016/j.chb.2015.03.076>
- Lisbinski, F. C., & Burnquist, H. L. (2024). Institutions and financial development: Comparative analysis of developed and developing economies. *Economia*, 25(2), 347-376. <https://doi.org/10.1108/ECON-11-2023-0201>
- Mallick, S. K., & Mallik, D. M. A. (2023). A study on the relationship between cryptocurrencies and official Indian foreign exchange rates. *Materials Today: Proceedings*, 80(Part 3), 3786-3793. <https://doi.org/10.1016/j.matpr.2021.07.383>
- Muganyi, T., Yan, L., Yin, Y., Sun, H., Gong, X., & Taghizadeh-Hesary, F. (2022). Fintech, regtech, and financial development: Evidence from China. *Financial Innovation*, 8, Article 29. <https://doi.org/10.1186/s40854-021-00313-6>
- Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science*, 29(4), 475-485. <https://doi.org/10.2307/139336>
- Risman, A., Mulyana, B., Silvatika, B. A., & Sulaeman, A. S. (2021). The effect of digital finance on financial stability. *Management Science Letters*, 11, 1979-1984. <https://doi.org/10.5267/j.msl.2021.3.012>
- Sharma, U., & Changkakati, B. (2022). Dimensions of global financial inclusion and their impact on the achievement of the United Nations Development Goals. *Borsa Istanbul Review*, 22(6), 1238-1250. <https://doi.org/10.1016/j.bir.2022.08.010>
- Singh, R., & Mallick, H. (2024). Financial inclusion in India: An analysis from the user-side perspective. *International Journal of Social Economics*, 51(9), 1167-1181. <https://doi.org/10.1108/IJSE-03-2023-0162>
- Tong, X., & Yang, W. (2025). Empirical analysis of the impact of financial technology on the profitability of listed banks. *International Review of Economics & Finance*, 98, Article 103788. <https://doi.org/10.1016/j.iref.2024.103788>
- Van Nguyen, H., Ha, G. H., Nguyen, D. N., Doan, A. H., & Phan, H. T. (2022). Understanding financial literacy and associated factors among adult population in a low-middle income country. *Heliyon*, 8(6), Article e09638. <https://doi.org/10.1016/j.heliyon.2022.e09638>
- Zhonggen, Y., Ying, Z., Zhichun, Y., & Wentao, C. (2019). Student satisfaction, learning outcomes, and cognitive loads with a mobile learning platform. *Computer Assisted Language Learning*, 32(4), 323-341. <https://doi.org/10.1080/09588221.2018.1517093>

APPENDIX

Table A.1. Pearson correlation coefficient result

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Digital payments	1.0000						
(2) Digital receipts	0.9377*	1.0000					
(3) Digital public sector wages	-0.0871	-0.1407*	1.0000				
(4) Digital private sector wages	0.0231	-0.0440	0.7944*	1.0000			
(5) CurrencyExp (% to GDP)	0.2457*	0.2820*	-0.0786	-0.1187*	1.0000		
(6) FinInclusion	0.9242*	0.8977*	-0.2769*	-0.2074*	0.2666*	1.0000	
(7) Population	-0.0560	-0.0984	0.0159	0.0995	-0.2053*	-0.0282	1.0000

Note: The table reports the Pearson correlation matrix for the full sample of (354 countries-year observations). The description of the variables is available in Table 1. ***, **, and * indicate statistical significance level at 1%, 5%, and 10% levels ($p < 0.01$, $p < 0.05$, and $p < 0.10$), respectively.