THE EFFECT OF DIGITAL FINANCIAL LITERACY ON FINANCIAL DEVELOPMENT AND GOVERNANCE: USING PANEL VECTOR AUTOREGRESSIVE MODEL

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Abstract

The study examined the impact of digital financial literacy on financial development utilizing a panel vector autoregressive (PVAR) model and panel data encompassing 108 countries from 2017 to 2021. In addition, Panel Granger causality tests were employed. The findings of the estimation indicated that enhancing digital financial literacy leads to an increase in financial development. The panel Granger causality tests strongly support the existence of a causal relationship between the Composite Digital Financial Literacy Index (CDFLI) and the Financial Development Index (FDI). Furthermore, the panel impulse response function demonstrated a significant and time-varying relationship between CDFLI and FDI. The variance decomposition revealed that variations in the FDI can be explained by changes in the CDFLI. Overall, digital financial literacy plays a crucial role in fostering financial. Given the continuous technological advancements in the financial industry, individuals must possess essential skills and knowledge to make well-informed decisions and effectively manage their finances. Policymakers bear the responsibility of promoting financial education and ensuring the accessibility and usability of digital financial services. This study contributes to the existent studies on the effect of digital financial literacy on financial development, building upon the works of Basha (2023) and Muat et al. (2024).

Keywords: Digital Financial Literacy, Financial Development, Panel Vector Autoregressive

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1. INTRODUCTION

Digital financial literacy is currently essential because all financial products and services are presented in digital form. Policymakers and governments are also focusing on the cashless and digital world. The significance of digital financial literacy appears after demonetization. The world re-evaluation of mobile services and quick growth in digital payment systems are generating opportunities to link poor groups to reliable and affordable financial tools through mobile phones

and other digital platforms. Moreover, the unbanked group accesses and uses services that were not accessible to them in the past (Wagner, 2019). Digital financial literacy is the strategy to protect clients' interests. This is achieved by providing groups with the critical knowledge to benefit from several available financial services and goods and make a financial decision to enhance their welfare.

Based on current global financial events, examining, and exploring how digital financial literacy contributes to and supports economies is vital. According to research, people with digital financial knowledge are more likely to take better financial plans, invest and gain more on their investments, and return facilities and loans on time. Financial literacy includes various dimensions, where the core can be the knowledge and the ability to earn and use the command (Zait & Bertea, 2014). Digital financial literacy can be identified as using technologies to create, find, communicate, and evaluate information, thus involving both technical skills and knowledge to use the technology. The Organisation for Economic Co-operation and Development (OECD) defined several aspects of digital financial literacy, including digital financial risks, knowledge of digital financial services and products, and consumer rights.

Digital financial literacy is identifying and managing personal finances using technologies and digital tools. The skills and knowledge individuals need to navigate online banking platforms, mobile payment apps, and other digital financial services are essential in today's increasingly digital world (Rahayu et al., 2023). This includes knowing how to use these tools to invest, save, budget, and make learned financial decisions (Marconi et al., 2023). In terms of financial development, economic growth and poverty drop. It allows individuals and businesses to gate credit, invest in valuable assets, and handle financial risks (Kang et al., 2022).

Nevertheless, without appropriate financial education and literacy, many people may not fully understand the potential benefits and risks associated with financial products and services (Özdemir, 2022). This may result in baleful financial choices, low savings, and eventual exclusion from financial services. In conclusion, promoting financial literacy, especially digital, as well as financial development is something that individuals, institutions, and governments should develop.

Digital financial literacy and financial development are synchronizing issues. Digital banking services are being widely utilized but knowledge of using these services should go hand in hand (Firmansyah & Susetyo, 2022). Financial literacy created in digital format can give people the facilities to manage their money more profitably, credit the services more quickly, and help people improve their economic status. However, along with accelerating financial inclusion and economic development, proper digital financial literacy can also be used as one of the factors that contributes to the progress of the entire monetary system (Chinoda & Mashamba, 2021).

To delve deeper into the significance of digital financial literacy, we pose the following research question.

RQ: To what extent does digital financial literacy provide a pathway for achieving overall financial development?

The advanced financial digital literacy skills can first be observed in the financial management skills of individuals which will be extraordinary as well as accessing financial services such as borrowing, saving or investing will be easy for individuals with advanced digital financial literacy. In contrast, individuals who have minimal digital financial literacy will find these activities difficult. In addition to that, we are also certain that spreading digital financial knowledge helps to increase financial inclusion as well as the scale and level of financial inclusion.

This study aims to investigate the direct linkage between digital financial literacy and financial development.

The rest of this paper is structured as follows. Section 2 gives the theoretical and empirical review that is relevant for studying the relationship between digital financial literacy and financial development. Section 3 answers the research question which examines the effect of digital financial literacy and financial development. Section 4 synthesizes the study results and Section 5 presents the contributions to the body of knowledge and policy recommendations.

2. LITERATURE REVIEW

2.1. Digital financial literacy

Digital financial literacy recognizes and effectively utilizes digital financial tools and technology. Online banking, mobile banking, and investing platform use are included in digital platform navigation, accessing financial accounts online, and using digital wallets (Rahayu et al., 2023). It includes learning about the benefits, setbacks, and features of such applications (Firmansyah & Susetyo, 2022). Digital financial literacy involves not just any individual financial expertise such as budgeting and managing a checking account. Rather, it also means understanding and utilizing different digital payment methods. These methods include credit/debit cards, QR code payments, and cryptocurrency. People should be mindful of the profits, obstacles, and precautions related to many payment methods so they can opt for the best payment option due to their needs (Wagner, 2019).

Fintech skills, through the use of digital apps and software, consist of being financially digitally literate. A category would include investment platform apps, featuring financial planning software, budgeting apps, and cost-tracking apps among others. Through ability to navigate through and use the funds management app is the key to prudent finances (van Deventer, 2020). They can differentiate between reliable and unreliable sources of information as well as falsely synthesized or fed data. These skills nowadays have become an integral part of our lives and are a must-knowledge for well-informed financial decisions and guarding us against fraudsters and misinformation (Firmansyah & Susetyo, 2022). Similarly, with digital collaboration and communication skills digital financial literacy is also involved. This involves talking with paid banks, customer support reps, and online community

members to handle financial questions, look for support, and resolve payment problems of electronic banking (Ocaña-Fernández et al., 2020). The significance of digital financial literacy arises from advancements in information technology and information management systems, as well as the influence of globalization. These factors have contributed to the constant evolution of new financial products and services, making them easily accessible to individuals. However, this accessibility also places a substantial responsibility on individuals' financial well-being (Lusardi & Messy, 2023). Analyzing digital financial illiteracy aims to assess individuals' understanding and knowledge of financial matters (Lusardi & Mitchell, 2011). Digital finance plays a major role in the financial inclusion agenda by facilitating the role that financial systems play in the relationship between financing and individual growth because growth is not achieved through banks and financial intermediaries only (El-Ansary & Rashwan, 2020). Rather, it is an attempt to involve the financially included and the financially uneducated (Dutta, 2022). In addition to the growing interest of policymakers in providing training regarding remittances and managing financial matters, digital financial literacy contributes to sustainable development by teaching young people how to manage their budgets, create a healthy financial future, and create generations with high financial knowledge in the long term. Thus, it is of great importance for economic stability (Buckingham, 2006). Various social and demographic factors, such as gender, age, and education level, influence digital financial literacy. Previous research and studies have identified different dimensions of digital financial literacy, including financial knowledge, financial communication, financial capability, financial behavior, and financial confidence (Azeez & Akhtar, 2021; Buckingham, 2006; Rahayu et al., 2022).

2.2. Financial development

The financial sector encompasses a range of institutions, products, markets, and regulatory frameworks that facilitate credit-based transactions. The development of this sector primarily focuses on reducing the associated costs of the financial system. Financial contracts, markets, and intermediaries have evolved to minimize expenses related to acquiring knowledge, executing contracts, and conducting transactions (Martiniello et al., 2020). The specific types and combinations of information, enforcement mechanisms, transaction costs, legal systems, regulations, and tax frameworks have varied throughout history and across different nations, leading to the emergence of diverse financial arrangements (The World Bank, 2020).

Furthermore, financial progress entails enhancing a country's financial system, which includes promoting financial inclusion, ensuring financial stability, and fostering the growth of financial markets. Financial stability aims to enhance the system's resilience to shocks and crises. In contrast, financial inclusion ensures that all individuals have access to financial services (Kushchik & Kryvosheenko, 2021).

2.3. The relationship between financial development and digital financial literacy

Financial development is defined as enhancement in the quality of key financial functions. First, economizing on monitoring and screening costs increases investments and resource allocation improvement. Second, pooling savings from individual savers helps in investments and allows the exploitation of scale economies. Third, easing the exchange of services and goods. Fourth, managers monitor corporate governance control after providing finance.

Previous studies, such as the research conducted by Basha et al. (2023) on the relationship between financial development and financial literacy, as well as the study by Ke et al. (2022) exploring the relationship between financial development and digitalization, have provided insights into the interconnected nature of these aspects. However, there is a gap in direct research explicitly focusing on the relationship between financial development and digital financial literacy. Nonetheless, existing studies have recognized the importance of digital financial literacy in improving overall financial development. Digital financial literacy is vital in facilitating financial development by enabling individuals to understand and effectively use digital financial services and technologies like mobile banking and digital wallets. Promoting digital financial literacy can increase financial inclusion, stability, and empowerment. Several countries have implemented policies and regulations to encourage financial inclusion (Dutta, 2022).

2.4. Previous studies

Numerous studies and sets of literature have investigated the matter of digital financial literacy and how it correlates to various other subjects using multiple approaches and perspectives and have come to diverse conclusions. According to studies, growing financial literacy positively impacts financial inclusion, and boosting digital financial literacy is essential to achieving better financial outcomes in finance and investment.

Likewise, studies have shown that digital financial services, such as mobile money and digital financial services, can increase financial inclusion, economic growth, and poverty reduction. However, ensuring that users have adequate digital financial literacy is crucial to benefit from these services fully. Governments and financial institutions should prioritize educating individuals, especially women and low-income individuals, on effectively using these services. Access to mobile phones and internet connectivity should be addressed, particularly in rural areas where these services are most needed. Partnerships between governments, financial institutions, and telecommunication companies can provide affordable mobile phones and internet services. For instance, Suri and Jack (2016) show that mobile money services improve income groups and alleviate poverty by allowing them to transfer and store funds by mobile phone. Moreover, Suri and Jack (2016) show that access to mobile money services presents benefits for women by enhancing their savings by around a fifth; it allows nearly 185 thousand women to leave farming and begin

retail activities or expand a business; and leads to poverty alleviation among women by more than fifth.

The most important of these studies are the analysis the financial literacy and financial inclusion in stock market participation in Ghana (Akakpo, 2020), the examination of gender disparity in financial literacy evidence from a homogeneous group (Adam, 2017), and the check of financial literacy and financial planning with implication for financial well-being of retirees (Adam et al., 2017). Also, Agarwalla et al. (2015) investigated financial literacy among working young in urban India. Similarly, Ali et al. (2014) show the financial literacy of young Australians. Almenberg and Dreber (2015) examine gender, stock market participation, and financial literacy. Esiebugie et al. (2018) show financial literacy and performance of small and medium-scale enterprises in Benue state, Nigeria. Grohmann (2018) studies financial literacy and financial behavior in the Asian middle class. Choung et al. (2023) examine the relationship between digital financial literacy and financial development in Korea using an online survey. The study shows that digital financial literacy has a positive effect on financial development. Ratnawati and Soelton (2022) used a questionnaire method to investigate the effect of digital financial literacy on firms' performance and development. They determined that the level of digital financial literacy has a significant effect on financial development. Moreover, Muat et al. (2024) investigated the connection between digital financial literacy and financial development using a self-administered questionnaire. They presumed that digital financial literacy and financial behavior have a positive impact on financial development.

The conclusions of this study suggest another important perspective on the idea of digital financial literacy. Through the theory test of aggregated data from 108 countries, this paper is the first of its kind to investigate the connection between digital financial literacy and continued economic growth using the panel vector autoregressive (VAR) model.

3. METHODOLOGY AND DATA

3.1. Variable and data

The study data from the International Monetary Fund (IMF) and the World Bank, for the period from 2017 to 2021 and for 108 countries for several variables related to digital financial literacy and financial development, which was used as a sub-indicator, was:

Composite Digital Financial Literacy Index (*CDFLI*): To assess financial literacy the study develops a Composite Digital Financial Literacy Index (CDFLI). This index combines numerous variables or sub-indices among selected countries using the following equation:

$$CDFLI_{c,t} = avrage\left(1 - \frac{DFL_{c,t,i} - Min_{DFL_{c,t,i}}}{Max_{DFL_{c,t,i}} - Min_{DFL_{c,t,i}}}\right) \quad (1)$$

where, *CDFLI* is the Composite Digital Financial Literacy Index, t is time, c is the country, and i is a sub-indicator of digital financial literacy as outlined in the World Bank Global Financial Inclusion (https://databank.worldbank.org/source/global-financial-inclusion). The data used for analysis was collected across 108 countries.

The sub-indicators mentioned represent various percentages related to digital financial literacy among individuals aged 15 and above in country c at time t:

$DFL_{c,t,1}$: Ratio of people who have used a mobile phone or the internet to check their account balance.

$DFL_{c,t,2}$: Percentage of individuals who use a mobile phone or the internet to make payments, buy things, or send or receive money.

$DFL_{c,t,3}$: Ratio of people using a mobile money service.

$DFL_{c,t,4}$: Ratio of people who pay bills or send remittances directly from a financial institution account or through a mobile money account.

$DFL_{c,t,5}$: Ratio of people who use a mobile phone or the internet to buy something online.

$DFL_{c,t,6}$: Ratio of people using mobile phones or the internet to pay bills.

$DFL_{c,t,7}$: Ratio of people who use a mobile phone or the internet to send money to a relative or friend.

$DFL_{c,t,8}$: Ratio of people who have made a digital in-store merchant payment using a mobile phone.

$DFL_{c,t,9}$: Ratio of people who use the internet to buy something online.

$DFL_{c,t,10}$: Ratio of people who make regular payments for water, electricity, or trash collection using a mobile phone.

$DFL_{c,t,11}$: Ratio of people who received some money from an employer through a salary or wages and received it through a mobile phone.

$DFL_{c,t,12}$: Ratio of people in the private sector who receive any money from their employer through a salary or wages over a mobile phone.

$DFL_{c,t,13}$: Ratio of people receiving any government transfer through a mobile phone.

$DFL_{c,t,14}$: Ratio of people who pay bills, receive government transfers, receive wages, send or receive remittances, receive payments for agricultural products, or receive a public sector pension directly from or into a financial institution account or through a mobile money account.

$DFL_{c,t,15}$: Ratio of people who use a mobile money account, credit or debit card, or a mobile phone to receive a payment into an account.

$DFL_{c,t,16}$: Ratio of people who have used a mobile phone or the internet to pay, purchase, or send or receive money through their account.

Financial Development Index (*FDI*): The IMF has introduced another measure to assess financial inclusion. This indicator considers multiple factors, including access to financial services, the depth of financial markets, and the stability of financial institutions.

Log Population (*LPOP*): It has been used as a control variable to assist in considering the country's size.

Country Income Group level (*CIGL*): Using a dummy variable (taking one if the country has high income, two if low income, three if medium-low income, and four if medium-high income) is a severe factor to consider when analyzing digital financial inclusion. Countries with different income groups may exhibit varying levels of financial inclusion due to differences in economic development and infrastructure.

3.2. Model methodology

The panel VAR model proves valuable in exploring the connections and fluctuations between digital financial literacy and financial development across multiple countries within a panel data set. It enables us to delve into the relationships and dynamics among these variables, providing valuable insights. The general structure of a panel VAR model can be summarized as follows:

$$FDI_{c,t} = \sum_{t=1}^{p} A_{1i} FDI_{c,t-l} + \sum_{t=1}^{p} A_{2i} X_{c,t-l} + \mu_c + \varepsilon_{c,t} \quad (2)$$

where, $FDI_{c,t}$ is a $m \times 1$vector of endogenous variable (*FDI*) for the c cross-sectional country at time t; $X_{c,t}$ is a vector of strictly exogenous variables (*CDFLI*, *LPOP*, and *CIGL*), p is the lag time, μ_c is the fixed effect specific to the c cross-sectional country, ε is the error term.

According to the normality test, the variables are abnormal, then we use logarithms in the equation, and according to EViews statistical package, we used the analysis of the equation form as follows:

$$LOG(FDI) = C(1,1) * LOG(FDI(-1)) + C(1,2) * LOG(FDI(-2)) + C(1,3) * LOG(CDFLI(-1)) + C(1,4) * LOG(CDFLI(-2)) + C(1,5) * LOG(LPOP(-1)) + C(1,6) * LOG(LPOP(-2)) + C(1,7) + C(1,8) * INC\_L \quad (3)$$

$$LOG(CDFLI) = C(2,1) * LOG(FDI(-1)) + C(2,2) * LOG(FDI(-2)) + C(2,3) * LOG(CDFLI(-1)) + C(2,4) * LOG(CDFLI(-2)) + C(2,5) * LOG(LPOP(-1)) + C(2,6) * LOG(LPOP(-2)) + C(2,7) + C(2,8) * INC\_L \quad (4)$$

$$LOG(LPOP) = C(3,1) * LOG(FDI(-1)) + C(3,2) * LOG(FDI(-2)) + C(3,3) * LOG(CDFLI(-1)) + C(3,4) * LOG(CDFLI(-2)) + C(3,5) * LOG(LPOP(-1)) + C(3,6) * LOG(LPOP(-2)) + C(3,7) + C(3,8) * INC\_L \quad (5)$$

The Generalized Method of Moments (GMM) model and the Structural Vector Autoregression (SVAR) model are two alternate approaches that could be useful in estimating the model.

4. ESTIMATION RESULT

4.1. Descriptive analysis

Table 1 shows that the mean *CDFLI* score is 0.802481, indicating a relatively high level of digital financial literacy among the population. The *FDI* mean is 0.418758, suggesting a moderate level of financial development. The median *POP* is 8509247, indicating that half of the observations have a population below this value. Overall, these statistics provide a useful snapshot of the state of financial literacy and development in the population under study. The normality test (Jarque–Bera test) shows the variables are abnormal; according to this result, we use natural logarithms in the estimation equation.

Table 1. Descriptive analysis

Quantitative metrics	*CDFLI*	*POP*	*FDI*
Mean	0.802481	45683563	0.418758
Median	0.842000	8509247	0.365000
Maximum	0.998000	1.15E+09	0.950000
Minimum	0.258000	364575.5	0.050000
Std. Dev.	0.155883	1.45E+08	0.238730
Skewness	-0.811087	6.359099	0.522039
Kurtosis	2.809292	44.86925	2.144962
Jarque-Bera	36.01557	25690.05	24.43429
Probability	0.000000	0.000000	0.000005
Observations	324	324	324

Note: CDFLI: Composite Digital Financial Literacy Index, FDI: Financial Development Index, POP: Population.

4.2. Unit root test results

In econometrics, we commonly employ unit root tests to determine the stationarity of time series data. When a variable is referred to be stationary, it means that throughout time, its mean, variance, and autocovariance structure stay unchanged. Unit roots, on the other hand, show that the data indicate non-stationary behavior or a stochastic trend. In unit root testing for panel data, the Fisher statistic is a frequently employed test statistic. It enables the examination of whether a panel dataset's variables have a unit root, which may indicate that the variable is non-stationary. The variable may not be appropriate for some types of econometric analysis if the Fisher statistic suggests the presence of a unit root since it suggests that the variable displays a long-term trend or structural change. The results of the stationary test (unit root test) for panel data using the Fisher statistic in Table 2 are shown under different specifications, the inclusion or exclusion of a constant term and a time trend that are stationary at a level for all variables.

Table 2. Unit root test results

		At level		
		CDFLI	***POP***	***FDI***
With constant	t-Statistic	-6.9083	-6.8891	-5.4308
	Prob.	0.0000	0.0000	0.0000
		***	***	***
With constant & trend	t-Statistic	-6.9045	-6.8729	-5.5164
	Prob.	0.0000	0.0000	0.0000
		***	***	***
Without constant & trend	t-Statistic	-0.1503	-1.9571	-4.7475
	Prob.	0.6311	0.0483	0.0000
		no	**	***
		At first difference		
		d(CDFLI)	***d(POP)***	***d(FDI)***
With constant	t-Statistic	-8.9249	-11.4532	-11.6175
	Prob.	0.0000	0.0000	0.0000
		***	***	***
With constant & trend	t-Statistic	-8.8981	-11.4293	-11.5985
	Prob.	0.0000	0.0000	0.0000
		***	***	***
Without constant & trend	t-Statistic	-8.9404	-11.4719	-11.6372
	Prob.	0.0000	0.0000	0.0000
		***	***	***

*Note: CDFLI: Composite Digital Financial Literacy Index, FDI: Financial Development Index, and POP: Population. The significance levels used in the analysis are as follows: * denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. The term "(no)" indicates that the result is not statistically significant. The probabilities are calculated based on MacKinnon's (1996) one-sided p-values.*

4.3. Panel cointegration test (Johansen-Fisher test)

The Johansen-Fisher panel cointegration test is commonly used to examine cointegration among variables in a panel dataset. This test allows for investigating long-term relationships and dependencies among variables across different individuals or countries. The test can assess whether stable linear combinations of variables exhibit a stationary behavior. This information is crucial for understanding the long-run equilibrium relationships and conducting accurate econometric analysis in panel datasets. Table 3 displays the outcomes of the Johansen-Fisher method employed for the panel cointegration test. Based on the statistical analysis, both the trace and max-eigen tests of the Fisher statistics show high significance at a 1% level relationship.

Table 3. Panel cointegration test (Johansen–Fisher test)

Hypothesized No. of CE(s)	***Fisher stat. (from trace test)***	***Prob.***	***Fisher stat. (from max-eigen test)***	***Prob.***
None	564.2	0.0000	581.2	0.0000
At most 1	523.2	0.0000	431.1	0.0000

4.4. Panel Granger causality tests

The panel Granger causality tests presented in Table 4 indicate a strong causality between *FDI* and *CDFLI*. The p-value causality with the relationship between *CDFLI* and *FDI* is nearly zero, suggesting a significant causality. On the other hand, the p-value for the reverse relationship is statistically significant at 0.0022. These findings suggest that enhancements in digital financial literacy can lead to higher levels of financial development.

Table 4. Panel Granger causality tests

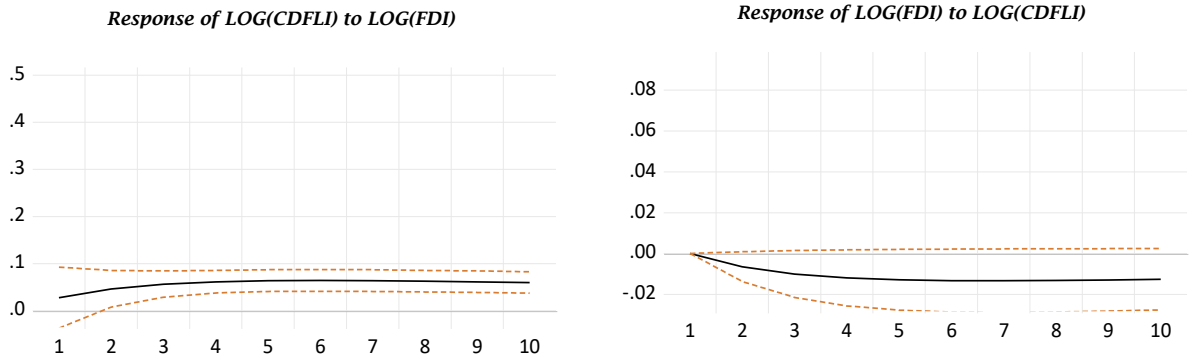
Null hypothesis	***Obs.***	***F-test***	***Prob.***
CDFLI does not Granger cause FDI.	213	21.15	0.0022
FDI does not Granger cause CDFLI.		9.617	0.0000

Note: CDFLI: Composite Digital Financial Literacy Index, FDI: Financial Development Index.

4.5. Panel impulse response function

The panel impulse response function (PIRF) provides evidence of a significant relationship between *CDFLI* and *FDI*. The conclusions suggest that variations in *CDFLI* can direct to changes in *FDI*, and vice versa. These conclusions have worthy implications for policymakers and stockholders interested in understanding the factors that drive *FDI*.

Figure 1. Panel impulse response function



4.6. Panel variance decomposition using Cholesky

The variance decomposition in Table 5 shows the variation in LOG(FD) that can be explained by changes in LOG(CDFLI) and LOG(POP) over 10 years. As assumed, the influence of LOG(CDFLI) rises over time, while the influence of LOG(POP) remains relatively small. This indicates that changes in the financial development index are largely driven by changes in CDFLI.

Table 5. Variance decomposition of LOG(FD)

Period	*S.E.*	*LOG(FD)*	*LOG(CDFLI)*	*LOG(POP)*
1	0.089390	100.0000	0.000000	0.000000
2	0.126231	98.63016	1.369719	0.000119
3	0.155627	95.19277	4.806748	0.000487
4	0.182628	89.61575	10.38305	0.001204
5	0.209690	82.11364	17.88402	0.002346
6	0.238427	73.18095	26.81511	0.003945
7	0.270024	63.49318	36.50084	0.005978
8	0.305376	53.75432	46.23731	0.008377
9	0.345144	44.55722	55.43173	0.011050
10	0.389797	36.30592	63.68018	0.013899

4.7. Diagnostic test

The stability of the VAR model was evaluated through VAR stability tests, and the results are displayed in Table 6. The tests involve analyzing the roots of the characteristic equation. In Table 6, all the roots provided have absolute values below 1, indicating that the VAR model meets the stability requirement. This suggests that none of the roots extend beyond the unit circle.

Table 6. VAR stability tests

Root	*Modulus*
0.982293	0.982293
0.967312	0.967312
0.898974 - 0.593858i	0.598868
0.898974 + 0.593858i	0.598868
-0.538655	0.538655
0.462052	0.462052

The VAR residual serial correlation Lagrange Multiplier (LM) tests were conducted to examine the presence of serial correlation at lags 1 to h (Table 7). The null hypothesis assumes no serial correlation. For lag 1, the LRE* statistic is 72.86500 with 9 degrees of freedom, yielding a probability value of 0.0000. Additionally, the Rao F-statistic is 8.657460 with 9 and 494.2 degrees of freedom, resulting in a probability value of 0.000. These results provide evidence to conclude that there is no serial correlation at lag 1.

Table 7. VAR residual serial correlation LM tests

Null hypothesis: No serial correlation at lags 1 to h.						
Lag	*LRE* stat*	*df*	*Prob.*	*Rao F-stat*	*df*	*Prob.*
1	72.86500	9	0.0000	8.657460	(9, 494.2)	0.0000
2	91.04523	18	0.0000	5.404787	(18, 566.2)	0.0000

The VAR residual heteroskedasticity tests in Table 8 indicate that there is evidence of homoscedasticity in the levels and squares of the residuals. This suggests that the variance of the residuals be constant over time.

Table 8. VAR residual heteroskedasticity tests (levels and squares)

Chi-squared	*df*	*Prob.*
3.2674	48	0.5423

4.8. Discussion results

The findings of these studies underscore the role of digital financial literacy in driving financial inclusion. They highlight the importance of ensuring that individuals, especially those with adequate digital financial literacy fully benefit from digital financial services. Financial institutions and telecommunication companies working together are crucial to increase access to mobile devices and the Internet, especially in rural areas. The study found a strong link between the Composite Digital Financial Literacy Index, CDFLI (an indicator of digital financial literacy) and the Financial Development Index, FDI (a measure of financial development). This supports previous research, including Choung et al. (2023), which shows that digital financial literacy helps financial growth. Likewise, Ratnawati and Soelton (2022) discovered that the level of digital financial literacy affects financial decision-making.

5. CONCLUSION

The study investigated the effect of digital financial literacy on financial development using a panel vector autoregressive (PVAR) model and panel data for 108 countries from 2017 to 2021. The study's results showed that there was a strong relationship between the FDI and the CDFLI in the sample country. The Johansen–Fisher panel cointegration test shows that the variables are cointegrated. There is a causality relationship between the FDI and the CDFLI, as shown by the panel Granger causality tests there is a strong link between the CDFLI and the FDI, likewise as shown by the panel impulse response function (PIRF). The variance decomposition shows changes in the CDFLI have a big effect on changes in the FDI.

Overall, digital financial literacy performs a necessary task in progressing FDI. Undertaking the continuous growth in technology in the financial industry, people must keep improving essential skills and knowledge to make well-informed decisions and effectively manage their finances. Furthermore, policymakers (central banks, financial institutions, and banks) bear the responsibility of pushing financial education and ensuring the availability and usability of digital financial services. Additionally, governmental regulations to promote digital payment systems and accessible mobile applications, collaboration with mobile network providers, digital platforms like social media and mobile apps, and Fintech companies are important.

The study suggests future research on the influence of education level, income, technology access, and cultural financial values on digital financial literacy and the impact of these factors on the FDI.

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