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Research Article

The Impact of Digital Financial Services on Financial Inclusion: A Panel Data Regression Method

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Abstract

This paper delves into the intricate relationship between digital financial services (DFS), traditional payment methods (TPM), economic factors, and demographic variables in a quest to enhance financial inclusion. Panel data regression models were employed to analyse the data encompassing credit card access, borrowing, mobile money accounts, electronic payments, and economic and demographic factors. The findings underscore the pivotal role of digital financial services in promoting financial inclusion, particularly mobile money accounts and electronic payments. These services offer cost-effective and efficient alternatives to traditional banking, facilitating greater economic participation. Furthermore, the study reveals the influence of conventional payment methods, with suggestive continuing relevance on a long run. Economic and demographic factors such as age, income, education, and gender emerge as crucial determinants of financial inclusion, emphasising the need for tailored strategies in diverse population segments. Overall, the results are promising with demonstrable statistically significant evidence in the approach to financial inclusion, leveraging digital innovations while addressing various economic factors and demographic groups' needs. The approach seems to guarantee a more equitable, accessible and efficient global financial system to foster economic growth and societal well-being. Thus, the output in this paper will be economically useful to financial institutions, modern digital technology companies and further researchers who aimed to continuously adapt and improve the approach to financial inclusion.

Keywords

Digital Payments, Financial Inclusion, Debit Cards, Credit Cards, Economic Factor, Demographic Variables, Quantitative Analysis

1. Introduction

Financial inclusion refers to a wide range of financial services accessible and available to every individual and business, especially those underserved or excluded from traditional banking systems. It strives to guarantee individuals with access to fundamental financial services such as credit, savings account and payment methods, that can aid in money management, planning and economic activity. Financial inclusion is crucial to the establishment and growth of an inclusive economy. Financial services help people and organisations manage their money more effectively, save money for emergencies or long-term goals, invest in new initiatives and mitigate risk. It allows people to increase their assets,

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enhance their standard of living, and support economic growth. The delivery of financial services using digital channels and technologies is termed *digital financial services* (DFS). In this regards, access to various financial products and services is made possible through digital platforms, including mobile phones, the internet and electronic payment systems. DFS includes multiple services such as mobile banking, electronic payments, online lending, insurance and investment management.

Previous works have shown the usefulness of financial inclusion [3, 5-7] in various case studies with identifiable gaps for further research. Governments, financial institutions, politicians and technology providers in recent time are a few stakeholders playing active role in achieving financial inclusion. There is need for regulatory bodies to set policies and create an enabling environment that supports financial inclusion, fosters innovation and protect consumer rights, for safety and sustainability. Financial institutions develop inclusive goods and services that are suited to the requirements of various consumer groups, which include those who live in rural areas or those with low income. Through mobile banking, digital payments, and other cutting-edge solutions, technology providers and fintech firms increase access to financial services. In recent years, the rapid advancement of digital technology has created new prospects for improving financial inclusion, which are now available to researchers and managers in digital financial services. Digital financial services are made up of creative solutions like mobile banking, digital payments, online lending and insurance through technology-driven platforms among others. With many thanks to digital infrastructure like mobile phones and the internet, these services can provide convenient, affordable and accessible financial solutions to people and organisations wherever applicable.

Financial inclusion comprises different aspects including access, use, quality and price of financial services. In terms of closeness to financial institutions and the simplicity of opening, accessing credit and borrowing describes the availability of financial services both physically and online. Credit access is a fundamental and pivotal component of financial inclusion for several reasons which includes empowerment and economic mobility, long run financial stability, entrepreneurship and job creation for promoting economic growth, education investment, credit access to foster economic well-being, inclusive economic growth, reduction in the use of informal lenders, women empowerment via inclusion in income-generating activities, community development and credit access as a whole. The usage gauges how actively consumers and organisations use financial services and products. Quality is the suitability and effectiveness of financial products and services in addressing the demands of various population segments. When determining whether financial services are accessible, affordability considers how much it will cost an individual's income level in terms of fees, interest rates, and transaction costs. The emergence of digital technology has completely transformed the financial industry, allowing financial institutions and technology firms to reach underserved economic factors and demographics and increase access to financial services. DFS offers some significant benefits and features such as accessibility, cost-effectiveness, financial inclusion in both urban and remote locations, speed and convenience, innovation and customisation via data analytics blockchain and artificial intelligence, risk management and security, and economic emergence for supporting business ventures and stimulating economic growth.

To combat poverty and reduce inequality, financial inclusion is essential. It enables people to build assets, manage risks, get investment financing, and save money by granting access to financial services. Additionally, it can support entrepreneurship and job development, advance gender equality, strengthen marginalized groups, and enhance social welfare in general. The development of digital technology over the past few years has significantly improved financial inclusion. The removal of obstacles such as geographic distance, high expenses, inadequate infrastructure, mobile banking and digital financial services has made financial services more accessible for previously underbanked or unbanked populations. This includes remote locations where people can transact, save, borrow and insure using digital financial services as simple and cost-effective approach. The goal of achieving universal financial inclusion still needs to overcome obstacles. These difficulties include societal and cultural norms, limited infrastructure, regulatory impediments, a lack of knowledge and financial literacy, and high transaction costs. A multifaceted strategy is needed to address these issues, including targeted legislation, public-private partnerships, infrastructure spending, the promotion of financial education, consumer protection laws, and stakeholder cooperation. Financial inclusion is pivotal in fostering inclusive economic growth, alleviating poverty, and promoting sustainable development worldwide. People and businesses can overcome financial obstacles, develop resilience, and embrace opportunities for socioeconomic growth through increasing access to financial services.

While the utilisation of digital financial services can enhance financial inclusion, it is necessary to consider how these services will impact the inclusion of underserved areas and the health of the economy. Although several studies have examined the connection between digital banking and financial inclusion, the literature that is currently accessible offers a fragmented perspective on the subject, with little empirical support and inconsistent results across contexts. Conducting a detailed analysis of how digital financial services affect financial inclusion is essential to filling this research gap. Achieving universal financial inclusion remains challenging, particularly in poorer countries and excluded communities. The traditional financial system, distinguished by physical transactions and brick-and-mortar institutions, usually fails to reach underserved areas due to barriers like geographic

distance, high transaction costs, and a lack of paperwork. However, there are obstacles and factors to take into account while implementing digital financial services. Some important issues to be addressed include provision of equal access to technology and connection, addressing challenges with digital literacy, assuring data privacy and security, addressing legal frameworks, and bridging the digital divide. The output of this study will help financial institutions, governments and other stakeholders establish policies and efforts to improve financial inclusion for the economic benefit of their citizenry.

The principal objective of this study is to investigate the influence of digital financial services on financial inclusion for a sustainable economy. Thus, the study aimed at evaluating the impact of digital financial services, assessing the relative importance of digital payments and traditional payment methods, investigating the role of economic factors and demographic characteristics, assessing whether traditional determinants could significantly influence individual's access to financial services in digital payment technology set-up, and providing policymakers with insights by pointing them to the right direction.

2. Literature Review

Financial technology has the potential to enhance financial inclusion significantly. New delivery methods, products, and providers, such as mobile money and crowdfunding platforms, have been critical in broadening access to financial services. The increase in accessibility has been incredibly substantial in Asia. Financial innovation has boosted financing access while eroding regulatory boundaries within the financial sector. Corporations other than traditional banks, such as telecom corporations and huge tech enterprises Alibaba and Tencent, have moved into financial services and financial intermediation. [15] has stated that the benefits of fintech are available to all sectors of the population, resolving privacy and security concerns, and finding a balance between innovation and regulation are all critical factors for realising fintech's full financial inclusion potential. People with higher income and educational attainment are more inclined to have access to financial services, underscoring the positive correlation between income, education, and financial inclusion in this context. Limited access to formal financial services can hurt households, particularly in Latin America and the Caribbean, where economic growth, savings, and investment rates are shallowed and volatile. The author employs the 2014 Global Findex database from the World Bank for the econometric analyses [14], with indicative evidence of usefulness.

Literature has documented that age and gender do not affect financial inclusion, particularly in terms of formal bank account ownership. Other characteristics, such as formal account status and automated teller machine (ATM) card possession, have no significant influence. However, education levels can influence the dependent variable, but the drivers vary. Financial inclusion is heavily influenced by the number of formal bank accounts and ATM ownership rather than the status of the official bank account. Financial inclusion can be hampered by issues linked to business management, unpleasant past experiences with banks, unfavourable economic climate, religious and familial considerations, and numerous document requirements for credit applications [16]. The introduction of debit cards to cash transfer recipients in Mexico significantly decreased travel lengths to access their bank accounts. This made it easier to access funds and led to increased financial activity, such as more frequent withdrawals and higher savings balances. Digital platforms for financial transactions may lower costs and increase underprivileged groups' access to financial services. Beneficiaries who experienced the most significant decreases in travel distance preferred to withdraw more frequently and keep more significant balances in their savings accounts. This implies that increased financial engagement is encouraged by improved access to formal financial services. These findings highlight the potential of debit cards to improve financial inclusion by improving the accessibility and use of formal financial services for those living in underserved areas [1].

Focusing on the evidence of digital financial inclusion in Ukraine, the emphasis is on removing non-price impediments to Ukrainians' formal financial inclusion. To ascertain the segment of the adult population that can engage with the formal financial system using innovative channels and financial service systems in comparison to other global countries, we must consider the main factors influencing access to financial services (both price and non-price barriers) in Ukraine's current stage of economic digitalisation. The fundamental principles of digital financial inclusion involve supervising financial institutions and their agents in providing digital financial services, enhancing regulatory oversight of inventive financial products and service systems, and safeguarding the interest of customers of financial services in Ukraine [8]. Key initiatives such as the Financial Digital Service (LKD) offered by the Bank of Indonesia (BI) and the Smart Act Branchless Banking Service for Financial Inclusion (Laku Pandai) provided by the Financial Services Authority (OJK) were introduced to improve financial inclusion in Indonesia. These programs are proven to be beneficial, with the quality of the agents playing a critical role. LPEM FEBUI conducted a preliminary study through a field survey of financial service agents in West Nusa Tenggara and Aceh to assess the progress of financial inclusion under these initiatives. Despite a considerable increase in agents, both programs act primarily as complements. While agents have achieved profitability and sustainability, significant infrastructure, finance, and technological skills concerns must be addressed [2].

Digital finance may affect systemic risks, market competitiveness, and regulatory frameworks, among other possible effects on financial stability. While digital banking and fi-

nancial inclusion significantly benefit users, providers, governments, and economies, a few persistent difficulties must be addressed to maximize the benefits to individuals, businesses, and governments. These problems are relevant to ongoing conversations and country-level initiatives to increase financial inclusion in developing and emerging economies through digital finance [4]. DFS are used by both banks and non-bank organizations, with non-bank-based DFS emerging as the most cost-effective option for providing financial services to people who were not previously part of the banking system. The growth in mobile phone usage and internet access are seen as factors that support each other and drive financial inclusion through digital financial services. They applied the ordinary least squares (OLS) and logistic regression models with Ghana as a case study. The Difference-In-Difference technique results confirm a strong positive trend in mobile money usage and a negative trend in bank-based DFS services in Ghana between 2011 and 2014. Following [9], we can draw significant policy implications, emphasising technical progress's necessity to achieve beneficial outcomes for a more comprehensive and egalitarian financial system.

Individuals can save for future stability, develop a steady deposit base, invest, and access credit through financial inclusion. Financial inclusion is accomplished through digital finance, resulting in a win-win situation for individuals and the financial system. Digital finance has reshaped the banking industry by delivering financial services via mobile phones, personal computers, the internet, or digital payment cards. It gives users greater control over their accounts, faster decision-making, and smoother financial transactions by providing inexpensive, convenient, and secure banking services [12]. In recent years, the financial services sector has seen a tremendous increase in technology usage. To evaluate the impact of technology on financial inclusion, a novel index for digital financial inclusion was developed, encompassing 52 emerging market and developing economies. People are more likely to become financially included when they access digital financial tools and services. The level of progress varies significantly across countries and areas. Notably, Africa and Asia have made the most significant strides in this area. However, improvement is inconsistent and fluctuates wildly [10]. Digital finance (DF) is essential in increasing financial inclusion (FI) in MENA countries. A composite index is used to evaluate FI, which considers access, availability, and utilisation of financial services. DF is determined based on the quantity of ATMs per 100,000 adults. Using data from 12 MENA nations from 2004 to 2020, the study uses a system-generalized method of moments (sys-GMM) panel approach. In addition, the study contains five control variables: the log of Gross Domestic Product Per Capita (GDPC), the change in consumer price index, the proportion of the population utilising the internet, the human development index, and the legal right index [11].

Although there have been significant strides in adopting alternative financial services by adults, the disparities in financial inclusion in Latin America persist relative to high-income or comparably developed nations and have not lessened and, in some circumstances, expanded. In particular, a lack of rule of law enforcement diminishes people's propensity to trust established financial organizations and poor institutional standards indirectly exacerbate negative consequences in adequate competition among banks affecting financial inclusion. Introducing non-traditional businesses into the digital financial services industry, such as mobile network carriers, is of particular concern since it may create hazards to the financial system. In response to these problems, the report adopts the suggested action from the 2016 CGD Task Force report regarding financial inclusion [13]. The studied literature showed consistent evidence that collaboration between banks and mobile network operators is essential, citing the increased financial inclusion in Kenya because of Safaricom's M-pesa. It is also vital to regulate fintech/digital financial services to protect data and consumers. Similarly, while digital financial services promote financial inclusion, missteps in the digital financial domain might prevent the unbanked and underbanked from adopting digital banking.

3. Research Methodology

A quantitative research methodology was adopted in this paper. The quantitative research approach enables the examination of correlations, trends, and patterns associated with digital financial services and financial inclusion. Secondary data from the World Bank's Global Findex database was obtained and used in this research. The data is from the Global Findex Database provided by the World Bank, World Bank Development Indicator, International Financial Statistics, and the International Monetary Funds. The World Bank Global Findex Database has extensive information on global financial inclusion. It is a part of the Global Findex initiative by the World Bank focused on global financial inclusion, which was created in partnership with other organisations to measure the global degree of financial inclusion. The database is updated every three years and contains valuable information about how people in different nations access and use financial services. Overall, the World Bank Global Findex Database is critical in furthering our understanding of global financial inclusion and guiding initiatives to increase access to financial services for underserved groups. It offers impartial, statistically supported evidence to pinpoint variables affecting financial inclusion, assess the effect of digital financial services, and support policy suggestions.

In this paper, financial inclusion measurement is based on the level of access to loans and credit cards. We use digital financial services for the explanatory variables, including mobile money and electronic bill payments. The debit card was adopted to represent the TPM in this paper. In the Economic factor, financial depth was controlled using the finan-

cial system asset to GDP and demographic variables such as age, income, education and gender. Six North American countries (Canada, Dominican Republic, Mexico, Nicaragua, Panama, and the United States) and nine South American countries (Uruguay, Venezuela, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador and Peru) are the case-study countries for this research. The measure of financial inclusion in this paper include access to credit cards, financial institutions and access to loans from financial institutions [10, 14].

Model Specification

For individual *i* in country *c* at time *t*, we estimate the following panel data regression model:

$$\text{FINCict} = \alpha + \beta * \text{TPMict} + \gamma * \text{DFSict} + \delta * \text{TPMict} * \text{DPMict} + \theta * \text{Z}_{\text{ict}} + \tau\text{t} + \kappa\text{c} + \varepsilon_{ictw} \quad (1)$$

where *FINC* is the metric for gauging financial inclusion,

TPM is used to quantify traditional payment method,

DFS is employed to access digital financial services,

DPM is used to quantify digital payment method,

Z encompasses a range of economic and demographic factors, τt and κc signify the fixed effect for country and year, respectively,

ε_{ictw} is a normally distributed error term, assumed to vary stochastically over i or c, t.

In 2014, q16 was extracted from the survey- made the payment online with the internet, and account_MOB- has a mobile money account to measure DFS. For FI, fin21a- borrowing and q7- access to a credit card were extracted; for the TPM, q2- has a debit card. In 2017 survey, q14a- made bill payments online using the internet, and account_MOBM- has a mobile money account to measure DFS were obtained. For FI, fin22a- borrowing and fin7- access to a credit card were obtained; for the TPM, fin2- has a debit card. In 2021 survey, q14a- made bill payments online using the internet, and account_MOBM- has a mobile money account to measure DFS were obtained. For FI, fin22a- borrowed in the past 12 months from a financial institution and fin7- has a credit card and for the TPM, fin2- has a debit card were obtained.

Notwithstanding, other factors affect financial inclusion in the nation, which could be controlled for, in the study. The factors identified by [16] which include age, income, gender and education were considered in this study. In addition, economic factors such as the financial system assets to GDP were included. The demographic control variables are extracted from the Global Findex database survey of the World Bank. The economic factor control variable is extracted from International Financial Statistics (IFS), International Monetary Fund (IMF). For EDU, the respondent education level data was used; for AGE, the respondent age data was used; for income, the GDP per Capita (GDP_PC) was used, which is data categorised by household income quintiles within a specific economy; and for gender, the "respondent is female" data was used.

In this paper, the measure of the traditional payment method is the usage of debit cards. To gauge this, respondents were asked a specific question to determine whether they possess a card linked to their bank account that enables them to make immediate withdrawals. This question aimed to determine whether users had the means to access financial services without visiting a physical bank branch and if they could conduct transactions such as payments or money transfers from any location if they possessed the card. The responses were transformed into a binary format, with 1 indicating 'yes' and 0 indicating 'no'. Responses falling into other categories (e.g., 3 and 4 with corresponding identifiers of 'dk' and 'rf', respectively) were deemed not applicable to the analysis and were consequently excluded.

As an indicator of financial inclusion, the study focuses mainly on comprehending the degree of credit card availability among the population. Respondents were asked a straightforward question to determine if they have a credit card, which permits them to obtain funds for making purchases or payments, with the option to settle the balance later. Like the debit card access, we used a binary coding system, where 1 represents 'yes' and 0 represents 'no'. Responses classified under other categories, specifically 3 and 4 with identifiers 'dk' and 'rf' respectively, were considered irrelevant to our panel data regression analysis and were therefore omitted from the analysis.

The measures for DFS are *MOBM*, which is the access to a mobile money account, and *EPYT*, which is online payment for a transaction. Assessment for mobile money access relied on whether the respondent possessed a mobile money account, which is informative of how respondents have adopted DFS in the form of a mobile money account. The analysis focused exclusively on responses coded as 1 which indicates 'yes' and 0 which indicates 'no'. Responses that fell into other categories, specifically those coded as 3 and 4 were excluded from the analysis. The assessment of electronic payment adoption relied on questions that indicated users were making payments electronically via the internet or digital means. Over the three survey years, various questions aimed to discern how respondents incorporated digital payment methods into their financial activities. The question was structured to determine if, over the last years, the respondent had personally conducted online payments for bills or made purchases online.

The resulting multiple linear regression models are as follows:

$$FINC\_CC_i = \beta_0 + \beta_1 EPYT + \beta_2 (TPM * EPYT) + \beta_3 DPM + \beta_4 Age + \beta_5 Gender + \beta_6 GDP\_PC + \beta_7 Education + \beta_8 FSA\_GDP + \epsilon_i \quad (2)$$

$$FINC\_CC_i = \beta_0 + \beta_1 MOBM + \beta_2 (TPM * MOBM) + \beta_3 DPM + \beta_4 Age + \beta_5 Gender + \beta_6 GDP\_PC + \beta_7 Education + \beta_8 FSA\_GDP + \in_i \quad (3)$$

$$BRW\_FI_i = \beta_0 + \beta_1 EPYT + \beta_2 (TPM * EPYT) + \beta_3 DPM + \beta_4 Age + \beta_5 Gender + \beta_6 GDP\_PC + \beta_7 Education + \beta_8 FSA\_GDP + \in_i \quad (4)$$

$$BRW\_FI_i = \beta_0 + \beta_1 MOBM + \beta_2 (TPM * MOBM) + \beta_3 DPM + \beta_4 Age + \beta_5 Gender + \beta_6 GDP\_PC + \beta_7 Education + \beta_8 FSA\_GDP + \in_i \quad (5)$$

where $FINC\_CC_i$ is financial inclusion based on credit card (CC); BRW_FI_i is financial inclusion based on borrowing; and $\in_i$ is a normally distributed random error term with zero mean and constant variance.

The study incorporates nominal control variables *education* and *gender*, in addition to the quantitative variables *age* and *income*. Gender was coded as 1 for females and 0 for males. Education was categorized into three levels, using a scale where 1 represents primary education or less, 2 represents secondary education and 3 represents tertiary education. These nominal control variables were added for the regression analysis to consider their possible impact on financial inclusion and to investigate whether their inclusion as explanatory categorical covariates could improve the predictive task of the resulting model.

4. Results and Discussion

Table 1 gives a descriptive statistics analysis of our variables, revealing significant trends. 15% of respondents have access to borrow money from financial institutions. 24% have credit cards. Regarding digital financial services, 22% engage in electronic payment, and 17% have access to mobile money accounts. Remarkably, 51% of individuals possess debit cards. The economic factor has financial system assets to GDP gives a percentage of 4%, and the demographic landscape shows that the region comprises 46% female individuals, with an average age of 43 years.

Cointegration tests to examine the long-run relationships among *FINC*, *DFS*, *TPM*, and the *control variables were conducted*. The results affirm the presence of a long-run relationship among these variables. This signifies that they are interrelated and move together over time, providing a foundation for deeper analysis. The study employs four models to investigate how digital financial services affect financial inclusion in the North and South American regions. $FINC_1$ is *CC*, which is access to credit cards; $FINC_2$ is *BRW_FI*, which is access to loans (borrowing); DFS_1 is *EPYT*, which is electronic payment; DFS_2 is *MOBM*, which is access to mobile money account, TPM is *DC* which is access to a debit card. The financial system asset to GDP was used as one of the economic factors to be controlled.

From the first model as illustrated in Table 2, the Pesaran CD, designed to uncover cross-sectional dependencies gives a statistically insignificant result, signifying the absence of such dependencies in the residuals. This reinforces the objectivity and impartiality of the fitted model. A panel data regression approach was applied to explore the relationship between EPYT, DC, TPM, the combination of TPM and EPYT in comparison to DFS, financial service assets to GDP, and demographic variables, to financial inclusion, specifically credit card (CC).

Table 1. *Descriptive Statistics.*

	Mean	Std. Dev.	Minimum	Maximum
Financial Inclusion				
Credit Card	0.2427	0.4287	0.0000	1.0000
Borrowing	0.1490	0.3561	0.0000	1.0000
Digital Financial Services				
Electronic Payment	0.2242	0.4171	0.0000	1.0000
Mobile Money Account	0.1711	0.3766	0.0000	1.0000
Traditional Payment Method				
Debit Card	0.5134	0.4998	0.0000	1.0000
Demographic Factors				
Age	43.6230	18.3911	15.0000	99.0000

	Mean	Std. Dev.	Minimum	Maximum
Education	1.9065	0.6564	1.0000	3.0000
Gender	0.4617	0.4985	0.0000	1.0000
GDP Per Capita	0.0032	0.1589	-5.0251	14.3218
Financial Depth				
Financial Asset to GDP	0.0365	1.3849	0.0000	82.2151

From Table 2, the results indicate that the coefficient for EPYT is positive, demonstrating a positive linear relationship with financial inclusion. In practical terms, for each one-unit increase in EPYT incidence, there is a corresponding increase in financial inclusion (CC) of 0.179914 units, which points to a positive link between EPYT and CC with a statistically significant evident. Also, TPM has a statistically significant impact on financial inclusion. More specifically, for each one-unit increase in TPM prevalence, there is a corresponding financial inclusion (CC) increase of 0.127868 units. This underscores a positive linear relationship between TPM and CC. Turning to the interaction between TPM and EPYT, the estimated coefficient is 0.043514 with a 1% statistically significant impact on financial inclusion. This implies that for each one-unit increase in the interaction of TPM and EPYT, there is a corresponding increase in financial inclusion (CC) by a factor of 0.043514 units. Thus, it suggests a significant positive linear relationship between the interaction of TPM and DFS with CC.

Table 2. *Determinants of Financial Inclusion: Credit Card.*

Variables	Credit Card	Credit Card
Electronic Payment	0.18***	
	(0.0127)	
Traditional Payment Method*Electronic Payment	0.0435***	
	(0.0135)	
Mobile Money		0.035**
		(0.0168)
Traditional Payment Method*Mobile Money		0.0374**
		(0.0179)
Debit Card	0.1278***	0.1822***
	(0.0043)	(0.0045)
Age	-0.0017***	0.0008***
	(0.0001)	(0.0001)
Gender	-0.0014	0.0021
	(0.0036)	(0.0040)
GDP per Capita	0.01	0.0112
	(0.0131)	(0.0163)
Secondary Education	0.0603***	0.0479***
	(0.0046)	(0.0049)
Tertiary Education	0.1678***	0.1571***
	(0.0062)	(0.0069)

Variables	Credit Card	Credit Card
Financial System Asset to GDP	-0.001	-0.0001
	(0.0015)	(0.0016)
Country FE	Yes	No
Time FE	Yes	Yes
R-squared	0.3972	0.1691
Observation	36041	28756

The results are presented with robust standard errors in parenthesis. *Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1% level.

The control variable *age* gives a negative regression coefficient. It indicates a strong statistically significant influence (p-value < 0.01) on the number of formal accounts, even though the relationship is negative. The control variable *gender* exhibits a positive regression coefficient but did not significantly impact on the number of credit cards, as judged by the p-value (p-value > 0.05 > 0.10). For the control variable *education*, the output revealed positive regression coefficients for secondary and tertiary education, respectively, with statistical evidence of significantly impacting the number of formal accounts. Furthermore, it was evident that the coefficient for individuals with tertiary education exceeded those with secondary education. This suggests that a more educated country is more receptive to digital financial inclusion. The GDP Per Capita (GDP_PC) which measures the income, yields a non-zero coefficient but it is not statistically significant at 10% significance level. There is a negative relationship between FSA_GDP and financial inclusion. However, FSA_GDP is statistically insignificant on financial inclusion.

From the result on country effect, it is also observed that only Brazil has a statistically insignificant relationship with financial inclusion. The result also shows that all countries examined except Canada, Uruguay and the USA have a negative coefficient to financial inclusion. From this, the negative coefficient result shows a lesser adoption in the 12 other countries examined (excluding Canada, Uruguay and the USA). The result of the time effect shows that in 2017, there is a negative relationship with financial inclusion. However, there is a noticeable improvement in 2021 with a positive coefficient. As displayed in the analysis, the year 2017 is statistically insignificant in relationship with financial inclusion.

The analysis of the standard errors for EPYT suggests a less than 1% chance of error in which these variables do not explain variations in financial inclusion within the estimated model. This low margin of error enhances the reliability of our fitted model. Regarding the statistical goodness of fit, the R-squared value indicates that the explanatory variables explain 39% of the variation in the dependent variable. In other words, it implies that about 39% of the variation in the response variable was accounted for by the fitted model. For the regression output in Table 2 where CC was regressed on the independent and control variables, a multiple linear regression approach was adopted to explore the relationship between MOBM, DC, TPM, a combination of TPM and MOBM, economic factor, and demographic variables concerning financial inclusion, specifically credit card. The findings revealed that MOBM has a positive statistically significant relationship with financial inclusion. For each one-unit increase in MOBM, there is a corresponding increase in financial inclusion by a factor of 0.0035 units. Similarly, TPM has a positive statistically significant relationship with financial inclusion. For every one-unit increase in TPM prevalence, there is a corresponding increase in financial inclusion by a factor of 0.1822.

The interaction between TPM and MOBM gives a statistically significant relationship with financial inclusion. An increase of one unit in the interaction of TPM and MOBM corresponds to a 0.03745 unit increase in financial inclusion. In this case, TPM plays a complementary role in financial inclusion. When TPM with DFS are combined, it results in a statistically significant impact on financial inclusion. The control variable *age* reveals a positive statistically significant influence on the number of access to credit cards, as judged by the p-value at a 5% significance level. The control variable *gender* shows a positive insignificant impact on the access to credit cards. The control variable *education* revealed a positive coefficient of for secondary education and a positive coefficient for tertiary education, signifying a significant impact on the number of formal accounts. The higher coefficient associated with tertiary education reveals that as a country's level of education increases, financial inclusion is likely to increase. The control variable *income*, measured by GDP_PC reveals a positive linear relationship between financial inclusion, but gives a non-statistically significant impact. The study controlled for the economic factor *financial system asset to GDP* (FSA to GDP), and the result shows a negative relationship with FINC and a non-statistically significant impact.

Table 3. *Determinants of Financial Inclusion: Borrowing.*

Variables	Borrowing	Borrowing
Electronic Payment	0.0873***	
	(0.0109)	
Traditional Payment Method*Electronic Payment	0.0114	
	(0.0118)	
Mobile Money		0.0773***
		(0.0125)
Traditional Payment Method*Mobile Money		0.0273**
		(0.0138)
Debit Card	0.112***	0.1143***
	(0.0041)	(0.0043)
Age	0.0002**	0.0002**
	(0.0001)	(0.0001)
Gender	0.0053	0.0116***
	(0.0033)	(0.0036)
GDP per Capita	-0.0009	-0.0004
	(0.0014)	(0.0014)
Secondary Education	0.0005	-0.005
	(0.0122)	(0.0140)
Tertiary Education	0.0196***	0.0231***
	(0.0043)	(0.0046)
Financial System Asset to GDP	0.0462***	0.0517***
	(0.0058)	(0.0064)
Country FE	Yes	Yes
Time FE	Yes	Yes
R-squared	0.0701	0.0701
Observation	44267	35528

The results are presented with robust standard errors in parenthesis. *Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1% level.

The time effects reveal that 2017 and 2021 have statistically significant relationship with financial inclusion. However, there was a negative relationship in 2017. In 2021, there is a noticeable increase in financial inclusion, owing to its positive coefficient estimate. The analysis of the standard errors for MOBM indicated a 1% chance of error where these variables do not explain the variations in financial inclusion within the fitted model. This low margin of error enhances the model's reliability. In terms of statistical goodness of fit, the R-squared value indicates that the independent variables explain about 16% of the variation in the dependent variable. In Table 3, The dependent variable *borrowing* is regressed against the independent variable and controls. The research aimed to ensure the reliability of its model by conducting cross-sectional dependency tests. These examinations, such as the Bruesch-Pagan LM test, Pesaran scaled LM test, and the Pesaran CD test did not provide evidence of cross-sectional dependency in the model's residuals. This outcome affirms the model's objectivity and impartiality. A multiple linear regression approach was used to investigate the factors influencing financial inclusion. The study found that the prevalence of electronic payment (*EPYT*) and tradi-

tional payment methods (*TPM*) have significant positive relationship with financial inclusion (*BRW_FI*). For EPYT, a unit increase corresponds to 0.087327 unit increase in financial inclusion. In the same vein, a unit increase in TPM leads to 0.112016 unit increase in financial inclusion.

The interaction between TPM and EPYT indicates a positive linear relationship with financial inclusion, but the relationship is not statistically significant. A one-unit increase in this interaction results in 0.0114 unit increase in financial inclusion (BRW_FI/Borrowing). Age and gender do not significantly influence the number of formal accounts, as judged by their respective p-values. In contrast, the level of education gives a positive effect, with higher education levels contributing more to digital financial inclusion. Controlling for income using *GDP_PC* results shows a non-statistically significant but positive relationship with access to credit. The economic factor control *FSA_GDP* has a positive relationship, but it is statistically insignificant on credit card. In assessing the model's reliability, it was found that there was only a 1% chance of error in which the variables do not explain variations in financial inclusion within the model. The R-squared value indicates that the fitted model accounts for approximately 7% of the variation in the dependent variable. On the Country effect, only Venezuela has a negative relationship with borrowing. Chile, on the other hand, is the only country that is statistically insignificant to borrowing.

The study confirmed the model's robustness and identified significant positive relationships between electronic payments, traditional payment methods, education, and financial inclusion. Also it highlights the importance of policies targeting income equality and educational improvement to enhance digital financial inclusion further. In Table 3, borrowing was regressed against the explanatory and control variables. To avoid spurious regression and ensure robustness of the model, the cross-sectional dependency test was conducted, including the Bruesch-Pagan LM test, Pesaran scaled LM test, and the Pesaran CD test, which investigates cross-sectional dependency. The result shows a non-significant outcome, indicating no evidence of cross-sectional dependency in the residuals. This validates the integrity, unbiasedness and consistency of the fitted models. Thereafter, a multiple linear regression model to examine the relationship between MOBM, TPM, Combination of TPM with DFS, economic factor (FSA to GDP), and demographic variables on financial inclusion.

From the results in Table 3, *MOBM* has a positive statistically significant relationship with financial inclusion. Specifically, for every one-unit increase in the prevalence of MOBM, there is a corresponding increase in financial inclusion by a factor of 0.077354 units. This suggests a positive linear relationship between *MOBM* and *BRW_FI*. It is worth noting that TPM has a positive statistically significant relationship with financial inclusion. This implies that, for every one-unit increase in the prevalence of *TPM*, there is a corresponding increase in financial inclusion by a factor of 0.114288 units. Again, it indicates a positive linear relationship between *TPM* and *BRW_FI*. Also, the interaction between *TPM* and *MOBM* indicates a positive statistically significant relationship with financial inclusion. It is evident that, for every one-unit increase in the interaction *TPM *MOBM*, there is a corresponding increase in financial inclusion by a factor of 0.027369 units. This reveals a positive linear relationship between the interaction *TPM*MOBM* and *BRW_FI*.

The control variable *age* exhibits a positive regression coefficient, with a statistically significant evident of influencing the number of formal accounts. The control variable *gender* gives a strong statistically significant influence on the number of formal accounts at a 1% significance level. The control variable *education* is estimated in primary education or less, secondary education, and tertiary education. The regression output reveals a significant impact on the number of formal accounts. It is noticeable that the coefficient of respondent's impact with tertiary education is more significant than those with secondary education. This proves that the more educated a country is, the more open the economy will be to embracing digital financial inclusion. The control variable *income* measured by *GDP Per Capita* reveals a positive, but insignificant relationship with financial inclusion. The controlling for economic factor- *FSA_GDP* give a positive relationship with borrowing, but the relationship with borrowing is not statistically significant. The analysis of the robust standard errors for *MOBM* suggests a 1% chance of error in which these variables do not explain the variations in financial inclusion within the estimated model. This low margin of error enhances the reliability of our model. Turning to the statistical goodness of fit, the R-squared value reveals that approximately 7% of the variation in the dependent variable was explained or accounted for, by the model.

The analysis of country effect results indicate that Brazil and Chile have insignificant relationship with financial inclusion. However, Venezuela had a negative connection to borrowing. These findings suggest that financial inclusion had a lower uptake in these countries during the respective years. Furthermore, both year 2017 and 2021 have negative relationship with financial inclusion, even though they appeared to be statistically significant. In the overall performance of the fitted models, the probability of F-Statistics is statistically significant in all four estimated models, which says that the independent variable rightly explains the dependent variable. The models also reaffirm that digital financial services promote financial inclusion, consistently seeing how their statistically significant relationship with *DFS* has been and *FINC* and *DFS*, combined with *TPM* on *FINC*. This comprehensive analysis demonstrates the role of digital financial services in advancing financial inclusion in North and South America. The absence of cross-sectional dependency confirms the unbiasedness, consistency and validity of our fitted model. These findings offer valuable insights for

policymakers and financial institutions seeking to advance financial inclusion in North and South America.

4.1. Key Findings

The research revealed several significant discoveries concerning the influence of digital financial services on enhancing financial inclusion. Evidently, DFS significantly impacts financial inclusion, but the results were diverse with demographic factors. Interestingly, income consistently showed a lack of statistical significance in its influence on financial inclusion. The key findings in this paper are as follows:

1) Digital financial services, particularly mobile money accounts and electronic payments, are vital in promoting financial inclusion. They significantly contribute to expanding access to credit card usage and borrowing, demonstrating their potential to bridge financial disparities.
2) Traditional payment methods like debit cards complement the expansion of financial services. They are essential in providing users with alternative means of accessing financial resources, contributing to the overall improvement in financial inclusion.
3) While digital financial services are influential, economic and demographic factors such as age, income, education, financial system assets, GDP, and gender continue to shape financial inclusion.
4) This facet of the analysis evaluates financial depth, and we employed the financial system asset to GDP as a control. The results revealed a consistent, but non-statistically significant relationship with financial inclusion.
5) A key finding reveals that several countries including Argentina, Bolivia, Brazil, Colombia, Mexico, Nicaragua, Panama, Venezuela, Chile, Uruguay, the Dominican Republic and Peru showed a notably low degree of engagement with financial inclusion. It implies that these countries faced challenges or need more initiatives to promote widespread financial inclusion in this direction.
6) Policymakers and financial institutions should prioritize the development of digital financial infrastructure to ensure that the benefits of digital financial services are accessible to all segments of society. This includes targeted efforts to reach marginalized communities and lower-income groups.
7) The challenge ahead is to sustain and expand the gains achieved in financial inclusion through digital financial services. This requires addressing access disparities and ensuring that the digital financial revolution benefits everyone, regardless of economic factors and demographic characteristics.
8) Consistently across all estimates, it is evident that the higher the educational level of the populace, the higher the likelihood of embracing digital financial inclusion.
9) The findings seems to highlight the potential for a more financially inclusive future, where financial services are universally accessible, transcending economic factors and demographic boundaries and contributing to the prosperity of individuals and economies.
10) GDP per Capita could not demonstrate a statistically significant relationship with financial inclusion, specifically credit card access and borrowing. This suggests that a country's economic output per person does not strongly correlate with the extent of financial inclusion in this perspective.

Thus, the findings emphasize the transformative power of digital financial services and the importance of leveraging the power to build a more inclusive and equitable financial ecosystem.

4.2. Policy Recommendation

These recommendations can serve as a roadmap for governments, financial institutions, and other stakeholders to advance financial inclusion and promote the adoption of digital financial services, ultimately contributing to economic growth and social well-being.

1) The interaction between *TPM* and *EPYT* yields a statistically insignificant relationship with financial inclusion in model 4. Policymakers should carefully assess the impact of combining these payment methods to avoid potential conflicts and ensure they complement each other.
2) Governments and financial institutions should invest in developing and expanding digital payment infrastructure, particularly in remote or underserved regions. This will enhance access to digital financial services and promote financial inclusion.
3) Since mobile money gives a positive impact on financial inclusion, incentivizing its usage through promotions, reduced transaction fees or government partnerships with mobile network operators (*MNOs*) could encourage active participation among the citizenry. This could encourage greater adoption, particularly in lower-income countries.
4) As traditional payment methods gives a positive relationship with financial inclusion, there is potential for policymakers to support and modernize these methods. Encouraging digital upgrades to these systems could facilitate relevance in the digital era.
5) Encourage fintech innovation in the financial services sector, which can lead to the development of more user-friendly digital financial solutions. Offering regulatory support and fostering innovation ecosystems can promote the creation of tailored, affordable digital services for various population segments.
6) The study highlights the significant role of education in promoting financial inclusion. Governments and institutions should continue to invest in educational pro-

grams that may improve financial literacy and encourage the adoption of digital financial services.

7) Gender was found to have no significant impact on financial inclusion in models 1, 2 and 3. Nonetheless, gender-neutral policies should be maintained to ensure equal access to financial services for all. Monitoring and addressing gender disparities in financial access should remain a useful practice.

5. Conclusion

This paper has shed light on the intricate interplay between digital financial services, traditional payment methods, economic factors, and demographic variables in enhancing financial inclusion. The findings resonate with the growing recognition of technology's transformative impact on the global financial landscape. The adoption of digital financial services such as mobile money accounts and electronic payment methods, stands out as a driving force in the quest for financial inclusion. These services have emerged as powerful tools, providing accessible, cost-effective and efficient alternatives to traditional banking and, in turn, breaking down barriers to financial inclusion.

The empirical evidence consistently observed across the models, underscores the significance of digital financial services in promoting financial inclusion. Mobile money accounts and electronic payments have demonstrated robust positive relationships with dimensions on access to credit facilities such as credit card access and borrowing. This indicates their role in expanding financial horizons and facilitating greater economic participation, especially for marginalized and underserved populations. While the study highlights the pivotal role of digital financial services, it also reveals the nuanced influence of traditional payment methods, particularly debit cards. The interaction between traditional and digital payment methods yields intriguing insights. While digital financial services are driving progress in financial inclusion, traditional payment methods remain relevant.

Economic and demographic factors including age, income, education, financial service asset to GDP, and gender have all emerged as influential determinants of financial inclusion. These findings emphasize the need for tailored strategies to address the unique requirements and challenges faced by different economic factors and demographic groups. For instance, educational campaigns and targeted interventions can play a critical role in empowering individuals with the knowledge and skills necessary to harness digital financial services effectively. Digital financial services hold great promise as tools for advancing global financial inclusion. Governments, financial institutions, and policymakers must recognize the transformative potential of these services and invest in their development and accessibility, particularly for underserved regions' economic factors and demographics. Strategies to address the unique financial needs and constraints of different population segments will be pivotal in ensuring that the benefits of digital financial inclusion are distributed equitably. Looking at the future, the digital revolution in finance is set to continue its trajectory. Continuous monitoring, research, and adaptation will be essential to keep pace with evolving trends and technologies. We must leverage this momentum to drive global economic growth and social well-being, reducing disparities in access to financial services and offering a brighter, more inclusive financial future for all.

In conclusion, the outcome of this paper underscore the complex and multifaceted nature of financial inclusion across different nations. While some countries may have made significant strides in promoting financial inclusion, there remain areas and regions where the uptake of these inclusive financial practices are yet to be improved, as evidenced by the statistically insignificant relationships with access to credit and borrowing. These findings have implications for policymakers, financial institutions and stakeholders, emphasizing the need for targeted efforts to enhance and expand financial inclusion in these regions in the nearest future. Additionally, further research is warranted to explore the underlying factors contributing to these patterns and develop strategies to overcome the observed challenges in promoting financial inclusion. The findings advocate for a holistic approach to financial inclusion, blending digital innovation with tailored support for various economic factors, demographic groups and income levels. Consequently, one can work toward a more equitable, accessible and efficient global financial system that benefits individuals and economies. Credit access is a crucial player in the broader goal of financial inclusion. It provides economic opportunities to individuals and businesses and contributes to economic growth, poverty reduction and overall financial stability. Therefore, fostering credit access is vital to promoting financial inclusion at individual, societal and country levels across the globe.

Abbreviations

DFS	Digital Financial Services
TPM	Traditional Payment Methods
DPM	Digital Payment Methods
ATM	Automated Teller Machine
BI	Bank of Indonesia
LPEM	Institute for Research on Economics and Society (Lembaga Penyelidikan Ekonomi dan Masyarakat)
FEBUI	Faculty of Economics and Business, University of Indonesia
OLS	Ordinary Least Squares
DF	Digital Finance
FI or FINC	Financial Inclusion
MENA	Middle East and North Africa
Sys-GMM	System-Generalized Method of Moments

GDP_PC	Gross Domestic Product Per Capita
CGD	Centre for Global Development
GDP	Gross Domestic Product
IFS	International Financial Statistics
IMF	International Monetary Fund
MOBM	Mobile Money
EPYT	Electronic Payment
FINC_CC	Financial Inclusion based on Credit Card
BRW_FI	Financial Inclusion based on Borrowing
DC	Debit Card
CC	Credit Card
CD	Cross-sectional Dependence
FSA	Financial System Asset to GDP
FE	Fixed Effects
MNOs	Mobile Network Operators

Author Contributions

Aruoriwo Ocharive: Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft

Jonathan Iworiso: Conceptualization, Investigation, Methodology, Software, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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