DALARNA UNIVERSITY

Degree Thesis

The Impact of Financial Inclusion On Economic Growth In Developing Countries: Evidence From Panel Data Analysis

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Cycle: Second Cycle
Course name: Master thesis
Course code: NA3010
Credits: 15hp
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Examiner: Reza Mortazavi
Date of examination: 2025-04-25

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The impact of financial inclusion on economic growth in developing countries: evidence from panel data analysis

Abstract

In recent years, financial inclusion has gained a very strong factor of economic growth to reduce inequality, yet significant gaps remain in understanding its multidimensional nature and impact across income groups. This thesis addresses the gap by constructing a comprehensive Financial Inclusion Index (FII) for 47 developing countries, using panel data from the World Bank's Global Findex database for 2014, 2017, and 2021. Employing a two-stage Principal Component Analysis (PCA) methodology, the study captures two essential dimensions of financial inclusion: access and usage of financial services. The findings reveal a positive relationship between financial inclusion and economic growth. Furthermore, it also shows significant disparities in financial inclusion, with low-income countries disproportionately facing challenges in access and usage compared to the upper middle-income. Moreover, this study has also used different variables of the access and usage of financial services to better assess their impact on economic growth. The results not only fill a gap in existing literature but also emphasize the important role for policymakers to implement targeted financial inclusion strategies especially in developing countries. By Addressing social challenges, enhancing financial infrastructure, and promoting digital and traditional financial solutions, we can get closer to narrow the financial inclusion gap and driving equitable economic participation.

Keywords

Financial Inclusion Index, Economic Growth, Panel Data, Principal Component Analysis, Developing Countries.

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1. Introduction

In today's interconnected global economy, financial inclusion is increasingly recognized as an important element of inclusive and sustainable development. However, there is no single and universal indicator to measure it. As Leyshon & Thrift (1995) and Arora (2010) highlight, access to financial services is crucial for reducing inequality and supporting private sector growth. While Pesqué-Cela et al. (2021) emphasizes that the usage of financial services such as digital transactions, is what ultimately determines their impact. However, this thesis adopts a multi-dimensional approach to financial inclusion, examining both access and usage across countries with varying income levels and including a variety of financial inclusion variables. By exploring this broader framework, the study aims to offer deeper insights into how financial systems can contribute to more equitable economic development, especially in regions where large segments of the population remain underserved.

While a substantial body of research has examined the relationship between financial inclusion and economic growth, most studies have predominantly focused on a supply-side perspective. These studies emphasize the role of financial institutions and service providers, often overlooking the behaviours, needs, and challenges faced by the population, particularly users of financial services. However, this study is based on survey results data of financial inclusion that is essential for understanding how financial inclusion can be improved to meet the needs of underserved populations (Klapper & Singer, 2017). The gap in the existing literature lies in the lack of this type of analysis that captures the different ways in which financial inclusion impacts economic growth, particularly in developing countries and across different income levels.

This research seeks to address this gap by answering the question: ***What effect does financial inclusion have on economic growth?*** Specifically, we aim to examine this relationship by focusing on the needs and behaviours of individuals and institutions. The hypothesis suggests that financial inclusion has a positive impact on a country's economic growth. By addressing the problematic, we aim to fill the research gap and contribute to the literature. The output of the research can also provide policymakers with valuable insights to design strategies that are better aligned with user needs, ultimately contributing to a greater financial inclusion and economic development.

To explore this question, we developed a multidimensional Financial Inclusion Index (FII) for 47 developing countries, using data from the World Bank's Global Findex database for the years 2014, 2017, and 2021. This index was constructed through a two-stage Principal Component Analysis (PCA) method, focusing on two key dimensions: access and usage of financial services. This study provides a strong empirical analysis for analysing financial inclusion and its implications for economic growth in different developing countries.

In this analysis we also aim to analyse the financial inclusion across different level of income and noticed some disparities across income groups. Low-income countries are shown to face more challenges in both access to and usage of financial services, whereas upper-middle-income countries exhibit relatively higher levels of inclusion. We also found a positive relationship between financial inclusion and economic growth. However, we found important to assess the impact not only of the financial inclusion index on economic growth but also analyse the impact of different components of the index to finally get a detailed and more accurate analysis. These results show the important role of financial inclusion in promoting equitable economic development and highlight the need for targeted policies in developing countries that better help decision makers build suitable strategies that takes into consideration various factors and components and to address structural barriers and enhance financial service accessibility and usage.

Finally, this thesis is organized as follows. The second section reviews the existing literature on financial inclusion and economic growth, providing key definitions, measurement approaches, and insights into their relationship. The third section outlines the theoretical framework, focusing on financial intermediation, Schumpeterian growth theory for a more understanding of financial inclusion and economic growth. The fourth section details the methodology used to construct the Financial Inclusion Index (FII) and the analytical techniques applied. The fifth section presents the results and discusses their implications for developing countries. Finally, the sixth section summarizes the study’s key insights, discusses policy recommendations, and highlights avenues for future research.

2. Literature Review

The relationship between financial inclusion and economic growth has garnered significant attention over the years, with various authors contributing to the field using different approaches and methodologies. Early studies primarily focused on understanding financial inclusion's accessibility dimension and its role in fostering economic growth, while more recent works have expanded to include technological advancements and multidimensional approaches to analyse this relationship.

One of the pioneering works in the field was conducted by Leyshon & Thrift (1995) who emphasized accessibility as the foundational dimension of financial inclusion in in the Britain and the United States from 1980 to early 1990. Their study highlighted that increasing access to basic financial services such as savings accounts and credit, could significantly contribute to economic growth by enhancing capital allocation efficiency. Using accessibility-focused indicators, they found that regions with higher accessibility exhibited stronger economic performance.

Building on this foundation, Sarma (2008) introduced a more comprehensive framework by developing the Financial Inclusion Index (FII), which incorporated dimensions such as availability, usage, and access to financial services. Using a sample of 55 countries Including developing countries in 2004 by construction financial inclusion index (IFI). Sarma's findings indicated that countries with higher financial inclusion indices also demonstrated improved GDP growth rates. This approach offered a more holistic perspective compared to earlier studies, which often limited their focus to individual dimensions of financial inclusion.

Demirguc-Kunt & Klapper (2012) further expanded the scope by incorporating both access and usage dimensions into their analysis. Using 148 economies in 2011 from the Global Findex Database and estimating using probit /logit regression covering a broad international sample and demonstrated that increased usage of financial services such as loans, deposits, and mobile banking, was positively correlated with economic growth.

In contrast, Arora (2010) used a sample of 98 countries including borh devloping and devloped countries examinig the access to financial services in different countries using a financial access index to compare it between the countries from 2004 to 2008. Through a focus on administrative fees, loan thresholds, and account-

opening requirements, Arora's research revealed that reducing the cost of financial services could significantly enhance financial access inclusion levels and, in turn, stimulate economic growth. This perspective was particularly relevant for low-income regions, where high service costs often acted as a barrier to financial inclusion.

Sarma (2012) later revisited the topic with a larger sample size equal to 94 countries from 2004 to 2010, emphasizing availability as an important dimension of financial inclusion by construction Inclusion financial index (IFI). The research also used indicators such as the number of ATMs and bank branches per 1,000 people, Sarma's work demonstrated a strong link between financial service availability and economic growth. The study concluded that enhancing financial infrastructure was essential for fostering economic development, particularly in underserved areas.

More recently, Pesqué-Cela et al. (2021) and Mao et al. (2023) shifted the focus towards digital financial inclusion. Pesqué-Cela et al. (2023) explored the role of mobile banking and digital payment systems using confirmatory factor analysis (CFA) found that these innovations significantly expanded access to financial services in remote and rural areas, thereby contributing to economic growth. Similarly, Sumanta et al. (2023) have found that financial inclusion has a significant positive impact on economic growth in developing countries, especially when both access to and usage of financial services are improved. Moreover, Mao et al. (2023) also reveals that digital financial inclusion had reshaped the financial landscape by reducing transaction costs and increasing the efficiency of financial service delivery, particularly in emerging markets from 2008 to 2020 using a fixed effect and dynamic panel models.

Gutiérrez-Romero & Mostak (2021) examined the impact of financial inclusion during the COVID-19 pandemic covering 130 countries from 2005 to 2018, providing evidence of its role in maintaining economic stability. Their study found that access to financial services, including savings and credit, helped mitigate the economic shock, particularly in low-income countries. They argued that accelerating financial inclusion was critical for poverty reduction and long-term economic recovery.

While many studies underscore the positive relationship between financial inclusion and economic growth, some have identified challenges and limitations.

For instance, International Monetary Fund (2013) research used a sample of 150 countries for the period 1975-2005 to reveal that weak financial systems and low literacy rates in certain regions reduced the impact of financial inclusion on growth. These disparities highlight the need for policymakers to address systemic barriers and ensure equitable access to financial services.

Overall, the evolution of financial inclusion research reflects a growing recognition of its multidimensional nature and its critical role in economic development. Early studies laid the groundwork by focusing on basic access and availability, while more recent research has incorporated digital innovations and broader socioeconomic factors, demonstrating a nuanced and dynamic relationship between financial inclusion and economic growth.

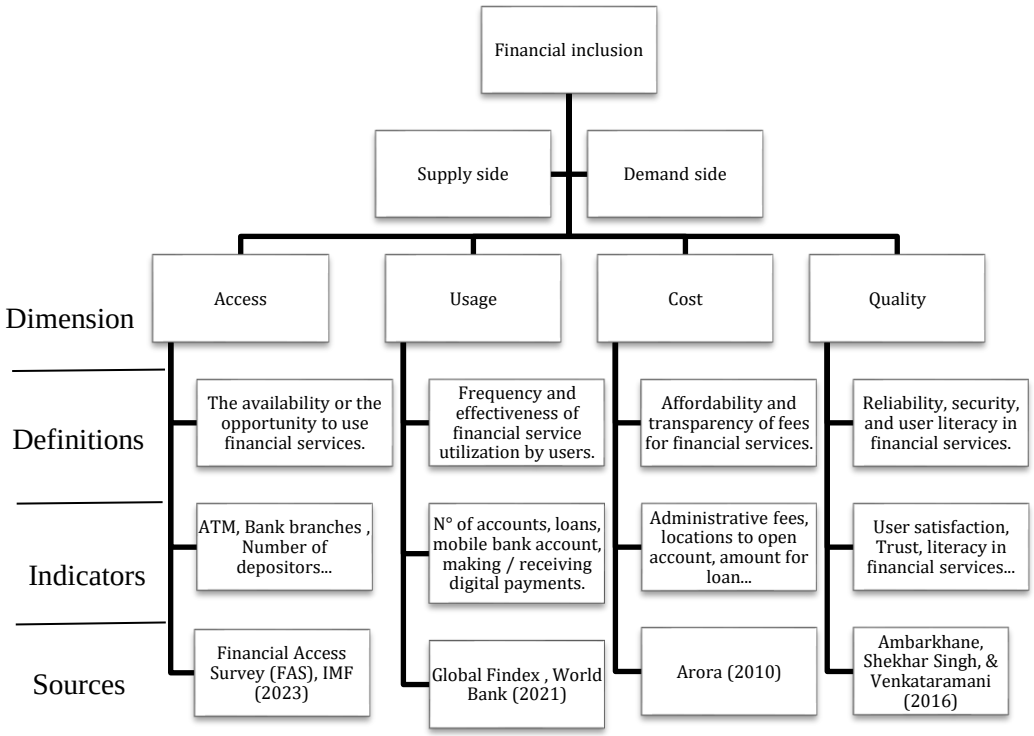

Figure 1 Conceptual Framework of Financial Inclusion

Sources(s): The author

3. Theoretical framework

The relationship between financial inclusion and economic growth is grounded in key concepts that have been explored by various scholars. Understanding how financial intermediation, Schumpeterian growth theory, and network effects contribute to economic development is essential in assessing the impact of financial inclusion on growth.

Financial intermediation plays a critical role in the modern economy, facilitating the efficient allocation of resources between savers and borrowers. Financial institutions, such as banks and fintech companies, act as intermediaries to bridge the gap between these two parties. Theories have long linked financial intermediation to economic growth and development (Levine R. , 2004). Additionally, financial inclusion, defined as the accessibility and usage of formal financial services by all segments of society (Aespinosa-Vega, et al., 2020). By improving risk assessment, reducing transaction costs, leveraging technology, and addressing information asymmetry, financial intermediaries can extend their services to underserved populations, aiming to a greater financial inclusion (Boot, et al., 2020). This, in turn, helps reduce income inequalities and improves state welfare through the expansion of both traditional and modern financial services (Barr, 2020). However, some has contradicted the financial intermediation, such as the traditional Arrow–Debreu model that says: when markets are perfect and complete, the need for intermediaries is minimized, and the allocation of resources is already Pareto efficient (Debreu & Arrow, 1954).

Schumpeterian growth theory highlights the role of innovation in boosting economic growth (Aghion, et al., 2014). In the context of finance, this theory suggests that financial innovations are important for achieving the economic development. Traditional Schumpeterian models have often investigated the specific role of financial intermediaries in the innovation process, focusing primarily on innovations within the real sector. Recent studies have begun incorporating financial inclusion into Schumpeterian growth models, suggesting that improving financial inclusion can improve the innovation of an economy (G. King & Levine, 1993). Financial inclusion also provides entrepreneurs with the necessary capital to bring their ideas to market, according with Schumpeter's ideas on the importance of credit creation for economic development (Reinert & Reinert, 2006). In addition and with the rise of financial technology, a new dimension to this perspective has been added, reshaping more the financial sector and offering new

ways to expand different methods to improve financial inclusion and reduce financial exclusion (Carbó, Gardener, & Molyneux, 2005). Innovations such as mobile banking, peer-to-peer lending, and blockchain services are now minimizing the traditional challenges to financial inclusion and reducing transaction costs, this will then have a positive impact on economic growth and development of an entity (Ouma, et al., 2021).

Another relevant framework is the Endogenous Growth Theory, which emphasizes the role of internal factors, particularly human capital, innovation, and financial systems in driving long-term economic growth. Unlike neoclassical models that consider technological progress as exogenous, the endogenous approach emphasizes the role of policy measures, institutional quality, and access to financial services in shaping the economic growth. In the context of financial inclusion, this theory provides important insights to understand how improved access to credit, savings, and insurance can increase entrepreneurship, hence investments, support innovation, and enhance productivity (Levine R. , 2004). By reducing transaction costs and leveraging credit constraints, inclusive financial systems can then stimulate investment in education, health, and business activities, thereby reinforcing the relationship between finance and growth (Romer P. M., 1990).

4. Data and econometric methodology

Based on the theoretical concepts outlined above, this section turns to examine the impact of financial inclusion on economic growth in practice using econometric models. The aim focus of this section will be on understanding the data, its components, and the key indicators used to better analyse the relationship between financial inclusion and economic growth.

4.1 Data

To measure financial inclusion, this study uses annual data collected from the results of World Bank Global Findex survey of about 128,000 adults in 123 economies in 2011,2014,2017 and 2021 (World Bank, 2021). However, our research sample does not cover all the countries and all the years because data is incomplete, hence we select research data in 2014, 2017 and 2021 for the purpose of ensuring data collection of the most complete and consistent representative variables over time of countries. The list of countries included in this study is attached in Appendix A: List of countries. The data contains also different levels of income and large high geographical coverage. In addition, and for the economic

growth aspect, data on GDP and related macroeconomic indicators are sourced from the World Bank.

4.1.1 Dependent variable

In this study, the growth of Gross Domestic Product (GDP) is the dependent variable used to assess the impact of financial inclusion on economic growth. GDP growth serves as a primary indicator of a country's economic performance, capturing the overall increase or decrease of the gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources (World bank[1])

4.1.2 Independent variables

In our study, financial inclusion is our main independent variable, and to measure it, we have included two important dimensions of financial inclusion which are: Access and Usage of financial services, the indicators included in the data is the results from the survey from the Global Findex Database by the World Bank, this means that the responses are collected from individuals and users of financial services rather than the financial services providers. Hence this study will mainly focus on the population perspective because of various reasons. For instance, and as Sarma (2016) mentioned, having a bank account is not a sufficient indicator of financial inclusion since we do not know if they actively using the financial services provided by the bank, that is why, in this study, we attempt to fill the gap in the research by including different components of financial inclusion.

Dimension (1) – Access

A comprehensive financial system needs to have as many users as possible and equally in different regions and continents. Therefore, referring to the measure approach of Sarma (2016), we use the data of financial accounts and debit/credit card, to measure this dimension. However, to ensure the comprehensiveness of Financial Inclusion (FI) and from the suggestion of Sarma (2016), we added another variable in the financial inclusion index which is: the number of mobile money accounts. This is because, in recent years, the financial services have known a

development of its financial mainly by introducing new technologies described as FinTech.

Dimension (2): Usage
To measure the usage dimension, we used the approach of Sarma (2016) and considered three services of the banking system that are deposits, loans, withdrawal and add digital transactions that contains both the make and reception of digital payments and that is to consider for digital financial inclusion to fill the research gap

Moreover, to measure and analyse financial inclusion (FI) effectively, researchers have developed various methodologies, one of them is to create composite FI indices. Two common approaches to measuring through composite financial inclusion indices are non-parametric and parametric methods, the first consist of to assign weights to indicators exogenously depending on researcher's purposes, and parametric methods, which use statistical techniques to determine the weights more objectively (Ambarkhane, et al., 2016). Hence, the parametric approach, specifically via principal component analysis (PCA), is preferred and adopted in this study due to its ability to avoid subjective weight assignment, which can significantly alter results.

Our independent variable Financial Inclusion Index (FII) is then constructed using a two-stage PCA method, based on the approach developed by Camara & Tuesta (2014) and further applied by Nguyen (2020). This method aims to create a comprehensive index that captures various dimensions of financial inclusion. The FII is then linearly determined as follows:

$$FII_{it} = w_1 Access_{it} + w_2 Usage_{it} \quad (1)$$

The Financial Inclusion Index (FII) for each country *i* at time *t*, denoted as FII_{it}, is constructed using a parametric approach that incorporates two main dimensions: access and usage. These dimensions, represented as $Access_{it}$ and $Usage_{it}$ are measured based on the indicators described in Table 3. Each dimension is assigned a relative weight, with $w_1 \; and \; w_2$ denoting the weights for access and usage, respectively.

$$Access_{it} = \beta_1 Financial\ accounts_{it} + \beta_2 Mobile\ money\ account_{it} + \beta_3 Debit\ cards + \beta_4\ credit\ cards_{it} \quad (2)$$

The $Access_{it}$ component is calculated including financial accounts, mobile money account, debit and credit cards. These variables respectively refer to people who have access to financial accounts, mobile money accounts and debit & credit cards with relative coefficients (β).

$$Usage_{it} = \theta_1 Deposit\ account_{it} + \theta_2 Loans_{it} + \theta_3 Made\ Digital\ Payment + \theta_4\ Digital\ Payment + \theta_5 Withrawal_{it} \quad (3)$$

The Usage equation above is calculated including Deposits accounts, Loans, Digital payment and withdrawal referring respectively to people who report making deposits into their accounts, borrowing money, receiving digital payment and finally, people who report withdrawing money from their account.

To construct the financial inclusion Index, we use the two-stage PCA process and that begins with the first stage, which estimates the two dimensions: Access and Usage. $Access_{it}$, $Usage_{it}$ are unobserved endogenous, for each of the variables reported in model (2) and (3), eigenvalues are calculated, and the highest eigenvalue (greater than 1) is used in the analysis. Weights are then assigned to the indicators within each dimension using rotated components for each of the eigenvalue remaining. For the testing, a Kaiser-Meyer-Olkin (KMO) test is performed to verify the appropriateness of the factors, with a KMO score of 0.5 or higher considered significant (Kennedy, 2008)

The second stage PCA follows the same procedure as the first stage. It estimates the weights of the two dimensions and calculates the overall FII by applying these weights to the equation by replacing $Access_{it}$, $Usage_{it}$ that were estimated previously in the first stage PCA.

Before estimating the FII, we believe of the importance of standardization of the variables used in PCA before conducting a PCA since the approach is sensitive to the scale of the data, so we need to standardize the data before applying PCA so that we will give more importance to features with larger variances. Standardization involves scaling the data so that each feature has a mean of 0 and a standard

deviation of 1. After the standardization of the variables, we now present the descriptive statistics of the data set over the chosen explanatory variables. These explanatory variables are presented in relation to their dimensions, access and usage. This data set is used is a basic foundation for the construction of the index of financial inclusion for those different countries during three different periods of time (2014,2017 and 2021).

First-stage PCA results

Through the PCA method, we calculated eigenvalues for the sub-indices that represent the Access and Usage dimensions of financial inclusion. The first-stage PCA results reveal the latent variables $Access_{it}$ and $Usage_{it}$. Following the Kaiser criterion (Kaiser, 1960) we only consider principal components (PCs) with eigenvalues greater than 1 for further analysis, as these PCs account for the most variance in the data and represent meaningful latent variables.

Table 1 shows the results of the first-stage PCA for both dimensions, with the respective eigenvalues, proportion of variance explained, and cumulative variance for each component. For the Access dimension, the first two components have eigenvalues greater than 1, with the first component (Comp1) accounting for 50.7% of the total variance and the second component (Comp2) accounting for an additional 39.5%. Together, these two components explain 90.2% of the cumulative variance. The third, fourth, and fifth components each contribute significantly less to the total variance, with eigenvalues far below 1, indicating that they capture very little information. As a result, we retain only the first two components for further analysis of the Access dimension. In addition, Appendix- Table C1 also shows additional information about the rotation orthogonal varimax.

For the Usage dimension, the first component (Comp1) has an eigenvalue of 2.906, which explains 58.1% of the total variance. The second component (Comp2) accounts for an additional 25.5%, bringing the cumulative variance explained by the first two components to 83.6%. Similar to the Access dimension, the subsequent components have eigenvalues significantly lower than 1, and together they explain very little of the total variance. Therefore, we retain the first two components for further analysis in the Usage dimension as well. Based on these results, it is evident that the first two components for both Access and Usage dimensions account for the majority of the variance, while the remaining components contribute minimally. The high eigenvalues of the first two components reflect their importance in capturing the underlying structure of financial inclusion in both dimensions. The

scree plot associated with Access and Usage are presented respectively in *Figure 2* and *Figure 3* .

As detailed in Appendix- Table D1 the weights assigned to each indicator are derived from the first two PCs for each dimension. In the Access dimension, the Z_Financial_account (0.551), Z_Credit_Card (0.559), and Z_Debit_Card (0.619) indicators carry higher weights in the first component (Comp1), reflecting their strong influence in determining financial access. On the other hand, Z_Mobile_money_account_age15-24 (0.682) and Z_Mobile_money_account_age 25 (0.684) have higher weights in the second component (Comp2), which highlights their role in representing more specific forms of mobile banking access.

In the Usage dimension, Z_Made_digital_payment (0.610) and Z_Receive_digital_payment (0.573) have the highest weights in the first component, indicating their importance in capturing digital payment behaviour. Z_Withrawal (0.688) and Z_Deposit_account (0.673) are more influential in the second component, reflecting more traditional forms of financial usage.

To make sure of the adequacy of the factors we also performed Kaiser-Meyer-Olkin (KMO) test and got an overall kmo for the access dimension equal to 5.99 as it is mentioned in Appendix- Table E1 . On the other hand, the usage dimension had a KMO value equal to 5.585. Since a KMO value that exceed 5 is considered acceptable, we then assigned the extracted weights mentioned before to the equations **(2)** and **(3)** obtaining $Access_{it}$ (Access dimension) and $Usage_{it}$ (Usage dimension).

Table 1 Principal components (eigenvectors) –First stage PCA

Component	Eigenvalue	Difference	Proportion	Cumulative
(1) Access (FinAccount, Mobile account age 15-25, Mobile account age +25, DebitCard, CreditCard) – Estimate ($Access_{it}$)				
Comp1	2.534	0.558	0.507	0.507
Comp2	1.975	1.616	0.395	0.902
Comp3	0.360	0.278	0.072	0.974
Comp4	0.082	0.032	0.016	0.990
Comp5	0.050	.	0.010	1.000
(2) Usage (Withrawal, Loans, Deposit Account, Made digital payment, Receive digital payment) – Estimate ($Usage_{it}$)				
Comp1	2.906	1.631	0.581	0.581
Comp2	1.275	0.575	0.255	0.836

Comp3	0.701	0.623	0.140	0.976
Comp4	0.078	0.037	0.016	0.992
Comp5	0.041	.	0.008	1.000

Source(s): Calculated by the author using PCA on Stata 14

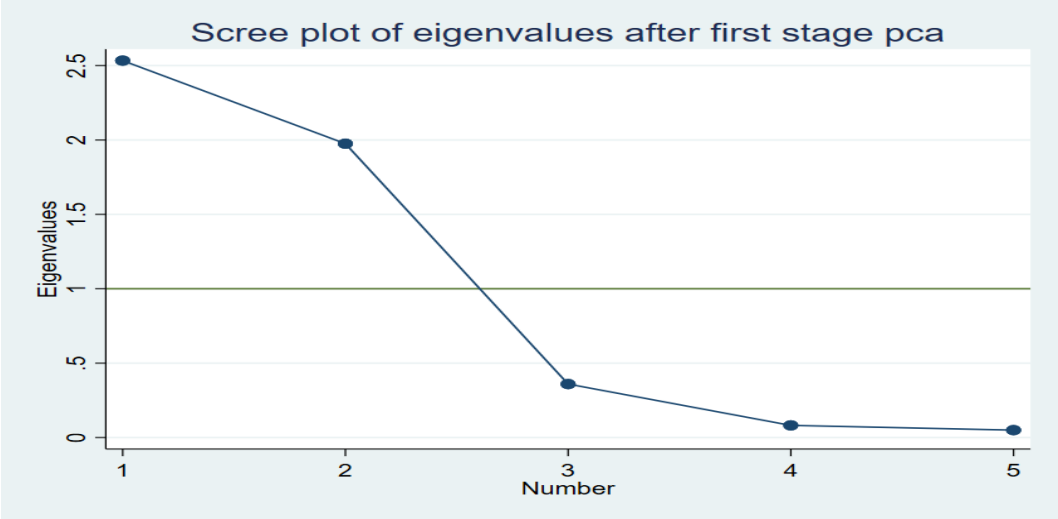

Figure 2 Screeplot of eigenvalues after first stage PCA for Access dimension

Source(s): Drawn by the author using PCA on Stata 14

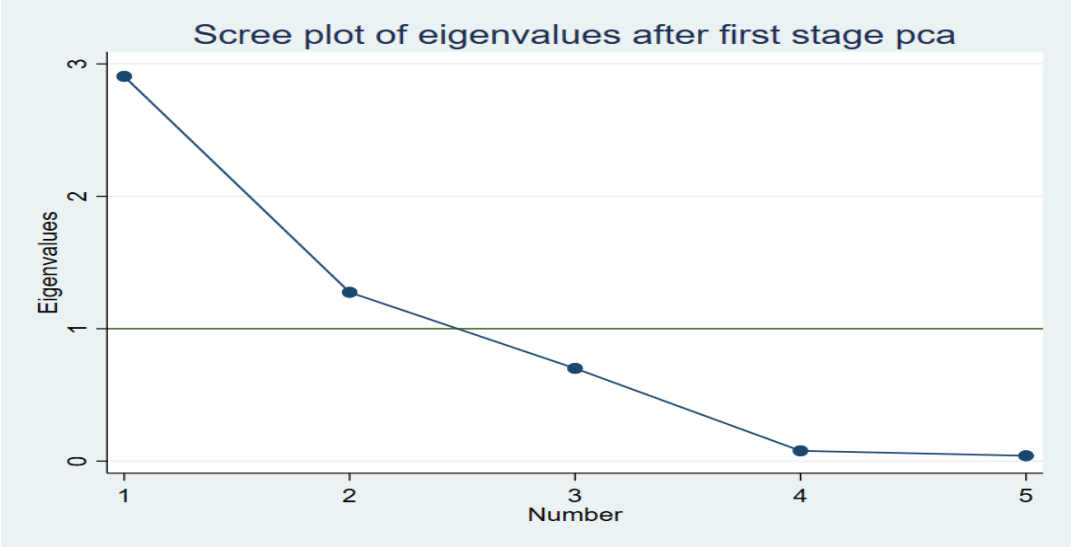

Figure 3 Screeplot of eigenvalues after first stage PCA for Usage dimension

Source(s): Drawn by the author using PCA on Stata 14

Second-stage PCA results

In the second stage, we applied PCA to the two dimensions (Access and Usage) derived from the first stage to calculate their respective weights for the overall Financial Inclusion Index (FII). As we have done in the first-stage PCA, we follow the same procedures. As it shows in Table 2, the first principal component (Comp1) has an eigenvalue of 1.746, accounting for 87.3% of the total variance in the data. As the eigenvalue of the second component is less than 1, only the first component is retained for further analysis. This is consistent with the Kaiser criterion, which suggests that only components with eigenvalues greater than 1 should be included. The high proportion of variance explained by Comp1 suggests that it captures most of the information in the two sub-indices, indicating a strong latent structure in the financial inclusion data. We also performed a KMO test associated with the second-stage PCA as detailed in Appendix- Table E2 resulting an overall value equal to 0.5 which is again considered acceptable for further analysis.

Table 2 Principal components (eigenvectors) –Second stage PCA

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.746	1.492	0.873	0.873
Comp2	0.254	.	0.127	1.000

Source(s): Calculated by the author using PCA on Stata 14

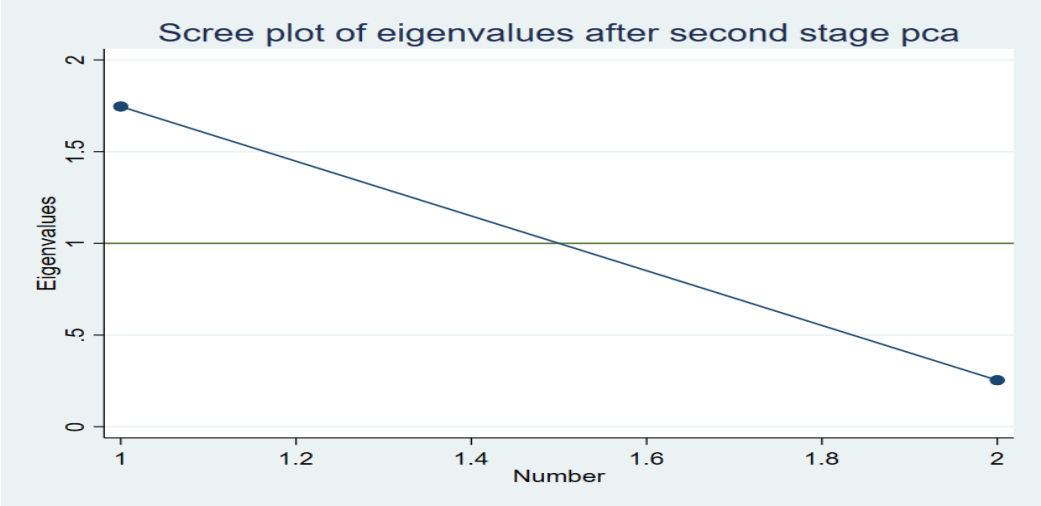

Figure 4 Screeplot of eigenvalues after second stage PCA

Source(s): Drawn by the author using PCA on Stata 14

After we made sure of the adequacy of the sampling data, we follow the same methodology as the first stage PCA and assign the weights to both the Access and

Usage dimensions reported in Table D2 . In addition, the unexplained variance for each variable is relatively small (0.127), further reinforcing the reliability of the PCA in summarizing the data. Thus, by doing this we estimate the overall Financial Inclusion Index (FII), which reflects the combined effect of the Access and Usage dimensions. It is important to note that the FII is normalized to simplify the interpretation, a value that exceeds 0.5 is considered as high FII. On the other hand, a value of FII that is below 0.5 is representing a low FII. The change of the level of FII across 47 countries and throughout 2014, 2017 and 2021 can clearly be seen through the graph illustrated in Appendix - Figure F1 . This also allow us to rank the final FII for each country that Kenya, and Mongolia and Iran respectively lead with the highest average FII, reflecting strong financial inclusion progress while Myanmar, Cambodia and Nicaragua are considered having a very low FII.

4.1.3 Control variables

In addition to the primary independent variable of financial inclusion, several control variables are incorporated into the analysis to account for other factors that may influence economic growth (measured by GDP growth). These control variables help isolate the specific impact of financial inclusion on economic performance by considering additional economic, social, and institutional determinants of growth.

First, we include the Government expenditure since it can affect growth by influencing public investment in infrastructure, health, and education, with its measurement typically based on total government spending as a percentage of GDP (Barro, 1991). Trade openness, measured as the ratio of trade to GDP, reflects the extent to which a country participates in international trade, which is often associated with higher growth through access to markets and technology (Romer e. A., 1999). Gross fixed capital formation (GFCF), also called "investment" is also an important determinant of economic growth according to neoclassical growth theory (Solow, 1956). Literacy rate, an indicator of human capital, directly impacts workforce productivity and innovation potential (Lucas, 1988). The Gini index indicator is also included, a measure of income inequality, captures disparities in income distribution that can hinder inclusive economic growth (Bergh, 2009) and finally inflation as measured by the consumer price index Us dollar.

Table 3 Description of the variables

Variable	Description	Variable Id	Data source
Independent Variables			
(1) Access:			
Financial accounts	The percentage of respondents who report having an account[2] at a bank or another type of financial institution or report personally using a mobile money service in the past year.	FinAccount	Global Findex database
Mobile Money	The percentage of respondents who report personally has access to a mobile money service in the past year.	MBAccount	Global Findex database
Debit / credit cards	The percentage of respondents who report having a debit or credit card.	DebitCard/ CreditCard	Global Findex database
(2) Usage:			
Withdrawal	Among respondents with a financial institution account, the percentage who report withdrawing money from their account one or more times in the past year.	Madewithrawal	Global Findex database
Deposit account	Among respondents with a financial institution account, the percentage who report making one or more deposits into their account in the past year. This includes cash,	MadeDeposit	Global Findex database

[1] By themselves or together with someone else.

	electronic deposits, or any transfer of money into the account by the respondent, an employer, or another person or institution.		
Loans	The percentage of respondents who report borrowing any money (by themselves or together with someone else) for any reason and from any source in the past year.	Borrowmoney	Global Findex database
Digital Transaction	The percentage of respondents who report using mobile money, a debit or credit card, or a mobile phone to make/ receive a payment from an account or report using the internet to pay bills or to buy something online or in a store-- in the past year.	madeDigPaym/ receiveDigPaym	Global Findex database
Dependent Variable:			
GDP growth	GDPD Growth refers to the growth rate of Nominal Gross Domestic Product.	GDP_growth	IMF
Control Variables:			
Inflation rate	The inflation rate is the percentage change in the general price level of goods and services in an economy.	Inflationrate	WORLD BANK
Trade Openness	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	TradeOpeness	WORLD BANK

Investment	Investment is defined as the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their own use, minus disposals (%of GDP).	Investment	WORLD BANK
Literacy rate	Adult literacy rate is the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life.	Literacyrate	WORLD BANK
Government Expenditure	General government total expenditure, Percent of GDP	GovExpendit	IMF
Gini Index	Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	giniindex	WORLD BANK

Source(s): The author

4.1.4. Descriptive statistics

The table in Appendix- Table G1 presents summary statistics of variable for financial inclusion indicators and dimensions, GDP growth and other macroeconomic variables as a control variable across 144 observations.

Normalized_FII, our dependent variable, ranges from 0 to 1 and has an average of 0.358, reflecting moderate levels of financial inclusion in the sample. In addition, GDP growth, which averages around 2% (ranging from about -54% to 52%), shows that some countries faced significant contractions while others experienced rapid expansions. Other control variables highlight diverse socio-economic contexts, for instance, trade openness ranges from 22.49 to 333, literacy from 33 to 98, and the GINI index from 26.40 to 59.10. Inflation between -2.410 and 65,374, while investment varies from 9.98 to 54.03, and government spending from 11.05 to 46.19. These differences reveal significant economic and social disparities among the countries.

To further analyse the relationship between the variables, we also checked for correlation coefficients as shown in Table G2. The results reveal positive relationships between various financial inclusion variables, such as account ownership, mobile money usage, and digital transactions, indicating that individuals engaged in one form of financial activity are likely to participate in others. Financial inclusion is moderately correlated with literacy rates, suggesting that higher literacy may foster greater financial access. However, the correlation with economic indicators like GDP growth, inflation government expenditure is weaker, highlighting that financial inclusion's impact on economic growth might be influenced by other factors beyond these variables and finally and as expected, the results also showed a high correlation between Investment and economic growth.

4.2 Econometric methodology

After creating the FII, we now assess the impact of Financial Inclusion on economic growth based respectively on FII and GDP growth data across the countries. To do so, we create the econometric model to estimate the relationship between the variables and analyse the results.

The econometric model used for this analysis is the following model:

$$GDPgrowth_{it} = \beta_0 + \beta_1 FII_{it-1} + \beta_2 Gov\ Expenditure_{it} + \beta_3 Inflation\ rate_{it} + \beta_4 Investment_{it} + \beta_5 Literacy\ rate_{it} + \beta_6 Gini\ Index_{it} + \beta_7\ \text{Trade Opness}_{\text{it}} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (4)$$

In model (4) above, GDPgrowth_{it} measured for each country in 2015, 2018, and 2022, reflecting macroeconomic performance. FII_{it-1} captures the level of financial inclusion from the previous year, while $Govexpenditure_{it}$ refers to government expenses measured in % of GDP $Inflation\,rate_{it}$ indicates price stability. $Investment_{it}$ referring to the acquisition of produced assets , $Literacy\,rate_{it}$ represents human capital development, and $Gini\ Index_{it}$ referes to income inequality. Tradeopness_{it} accounts for both imports and exports, signaling the degree of economic development. Finally, α_i (country fixed effects) controls for time-invariant characteristics, λ_t (time fixed effects) captures global shocks and broader trends, and ε_{it} is the error term encompassing unobserved factors.

Using the same methodology and to have better understanding of the impact of FI on GDP growth, we also ran multiple analysis considering the two dimensions of FI which are Access and Usage in the model below:

$$GDPgrowth_{it} = \beta_0 + \beta_1 Access_{it-1} + \beta_2\, Usage_{it-1} + \beta_3 Govexpenditure_{it} + \beta_4 Inflation\,rate_{it} + \beta_5\, Investment + \beta_6 Literacy\,rate_{it} + \beta_7 Gini\ Index_{it} + \beta_8\, \text{Tradeopness}_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (5)$$

The additional variables used in the model (5) above are mainly $Access_{it-1}$ and $Usage_{it-1}$ refering to the financial inclusion Access and financial inclusion Usage for the past year respectively.

Additionally, To better analyse the contribution of each of the financial inclusion component variable chosen for this analysis, we have also ran the regression including all the components from both the Access and Usage dimensions along with the same control variables described before:

$$
\begin{aligned}
GDPgrowth_{it} = {} & \beta_0 + \beta_1\, Financial\ Account_{\,it-1} \\
& + \beta_2 debit\ and\ credit\ card15_{\,it-1} \\
& + \beta_3 \text{Mobile Money Account Age 15 to 24}_{\,it-1} \\
& + \beta_4 \text{Mobile Money account age superior to 25}_{\,it-1} \\
& + \beta_5 Made\ withrawal_{it-1} + \beta_6 \text{Deposit Account}_{\,it-1} \\
& + \beta_7 \text{Loans } 15_{it-1} + \beta_8 Made\ digital\ Payment_{\,it-1} \\
& + \beta_9 Receive\ digital\ Payment_{\,it-1} \\
& + \beta_{10} \text{Government Expenditure}_{it} \\
& + +\beta_{11} Inflation\ rate_{it} + \beta_{12} Investment_{it} \\
& + \beta_{13} Literacy\ rate_{it} + \beta_{14} Gini\ Index_{it} \\
& + \beta_{15}\ \text{Tradeopness}_{it} + \alpha_i + \lambda_t + \varepsilon_{it}
\end{aligned}
\tag{6}
$$

The additional variables used in the model (6) above includes all the components of Access which are *Financial Account*, referring to financial bank account used, *debit and credit card*, *Mobile money account* for two different age ranges, the first referring to people from 15 to 24, the second refers to adults (superior to 15 years old) having a mobile money account. On the other hand, Usage dimension includes variables such as *Made withdrawal*, referring to the people reporting making withdrawal. Deposit Account referring to people who have deposit in their account. *Loans* referring to money borrowing and finally the component indicating the number of adults making and receiving digital payments.

Hence the econometric model examines the impact of financial inclusion on economic growth while controlling for key macroeconomic variables mentioned before. To estimate different models, we used the Fixed Effects (FE) method and that after conducting the Hausman reported in Table 4 below. The results means that we reject the null hypothesis, meaning that the Fixed effect method is preferred. In addition to the statistical results provided by the Hausman test, Fixed effects models allow for controlling unobserved, time-invariant characteristics across countries, such as institutional quality, legal systems, and cultural attitudes toward finance that may otherwise bias the estimates if omitted. Since these factors are likely to influence both financial inclusion and economic growth, failing to account for them could lead to endogeneity issues. By using fixed effects, we can also isolate the within-country variation over time, focusing on how changes in financial inclusion are associated with changes in economic growth. Finaly and to also

address potential endogeneity concerns, particularly the issue of reverse causality between financial inclusion and GDP growth, the Financial Inclusion Index (FII) and its different components are lagged by one year in all the models.

Table 4: Hausman test result

	Coef.
Chi-square test value	11.946
P-value	.002

Source(s): Calculated by the author on Stata 14

5. Results and discussion

To investigate the impact of FII on economic growth, this section represents empirical results mainly from estimating model (4) and model (5) that are reported respectively in Column 1 and Column 4 in Table *5.* On the other hand, the results from estimating the model (6) are reported in Table *8* (in Column 1). Moreover, the regression results reflect average effects under the ceteris paribus assumption.

Firstly, in Column (1), we estimate the impact of FII on GDP growth. The regression results indicate that financial inclusion index (FII) has a positive effect on GDP growth, and it is statistically significant at 1%. with a coefficient of 0.166, meaning that a 1 unit increase in FII is associated with a 0.166 percentage point increase in GDP growth. This result aligns with financial intermediation and Schumpeterian growth theories explained in the theoretical section, which suggest that greater access to financial services supports economic development. It also supports previous empirical findings, such as those by Sarma (2008) and Demirguc-Kunt & Klapper (2012), which highlight the positive role of financial inclusion in economic growth.

Among the control variables, investment and literacy rate positively and significantly impact GDP growth at 5%, the coefficients revealed that a 1 percentage point increase in investment or literacy rate leads to a 0.165 and 0.137 percentage point increase in GDP growth, respectively. While literacy rate is significant at the 1% level. Inflation has a negative effect and significant at 1% with a coefficient of -0.032, indicating that a 1 percentage point rise in inflation reduces GDP growth by 0.032 percentage points. Government expenditure, trade openness, and the Gini index do not show statistically significant effects. The R-

squared value of 0.633 suggests that the model explains 63% of the variation in GDP growth.
Before estimating the impact of Access and Usage in Column (4), we ran the regression to investigate the impact of Access and Usage separately on GDP growth. The Access coefficient reveals a positive impact on GDP growth and statistical significance at 1%. With a coefficient of 0.093, indicating that a one-unit increase in access is associated with a 0.093 percentage point rise in GDP growth. while in Column (3) the Usage dimension shows a negative impact with a statistical significance at 10%. These findings are unexpected especially regarding the negative coefficient of the Usage contrary with what it is discussed by Levine (2004) and Pesqué-Cela et al. (2021).

However, in column (3) the Usage dimension has a negative and significant effect at the 10% level, with a coefficient of 0.118, indicating that a one unit increase in usage of financial services is associated with 0.118 percentage point decrease in GDP growth, which contradict the theory mentioned earlier. For instance, Demirguc-Kunt & Klapper (2012) highlight that financial usage, particularly through formal savings and credit, fosters entrepreneurship and long-term growth. However, Thornton & Poudyal, (1990) and Shaw (1973) hypothesis argues that financial deepening and increased credit usage can be beneficial only in well-functioning financial systems. In poorly regulated environments, excessive financial usage can lead to inefficiencies, while other control variables such as Investment and Literacy Rate show positive and significant effects, in contrast of Inflation for instance. This model explains 43% of the variation in GDP growth, indicating a strong fit.

In Column (4), we estimate the impact of both Access and Usage on GDP growth presented in model (5). The Access coefficient has a positive and statistically significant effect on GDP growth at the 1% level, with a coefficient of 0.079, meaning that a one unit increase in Access is associated with a 0.079 percentage point increase in GDP growth. This is consistent with the theoretical framework, which suggests that improved financial inclusion contributes to economic growth by enhancing access to financial services, as seen in studies by Sarma (2016). However, the usage coefficient remains negative and statistically significant at 5%.

Table 5 Fixed Effect Regression – FII, Access and Usage

VARIABLES	**Column (1)** gdp_growth	**Column (2)** gdp_growth	**Column (3)** gdp_growth	**Column (4)** gdp_growth
FII	0.166***			
	(0.094)			
Access		0.093***		0.079***
		(0.024)		(0.016)
Usage			-0.118*	-0.128**
			(0.042)	(0.054)
GovExpendit	0.022	0.050***	0.072***	0.056***
	(0.023)	(0.009)	(0.011)	(0.012)
giniindex	0.002	0.026	0.120***	0.072***
	(0.034)	(0.016)	(0.022)	(0.034)
Inflation	-0.032*	-0.023**	0.025*	-0.012*
	(0.018)	(0.009)	(0.015)	(0.014)
tradeopness	-0.007	0.090	0.041***	0.034***
	(0.013)	(0.004)	(0.009)	(0.007)
Investment	0.165**	0.035**	0.254***	0.143***
	(0.016)	(0.004)	(0.013)	(0.012)
Literacyrate	0.137***	0.101***	0.095***	0.088***
	(0.021)	(0.024)	(0.022)	(0.022)
Year				
2018	0.049**	0.036	0.038	0.029**
	(0.062)	(0.036)	(0.002)	(0.076)
2022	0.009*	0.004	0.002*	0.065
	(0.056)	(0.063)	(0.001)	(0.034)
Constant	-11.56**	-10.72***	-18.43***	-18.22***
	(4.870)	(2.875)	(1.801)	(1.801)
Observations	56	56	56	56
R-squared	0.633	0.551	0.434	0.395

Source(s): Calculated by the author using Fixed Effect on Stata 14

Finally and before estimating the model (6) we first estimated the impact of each of the Access component in Table *6* and the impact of each of the Usage component in Table *7*.

Table 6 Fixed Effect Regression – Individual components of Access and GDP growth

VARIABLES	**Column (1)** gdp_growth	**Column (2)** gdp_growth	**Column (3)** gdp_growth	**Column (4)** gdp_growth	**Column (5)** gdp_growth
Access					
Financial Account	0.787***				0.454***
	(0.133)				(0.183)
Debit/credit card		2.371**			0.183*
		(0.943)			(0.265)
Mobile money age +15			1.457***		0.253**
			(0.312)		(0.273)
Mobile money account age 15-25				1.767***	0.445**
				(0.204)	(0.127)
Gov expenditure	0.045***	0.079***	0.060***	0.0429***	0.562***
	(0.007)	(0.019)	(0.008)	(0.007)	(0.002)
Gini index	0.050***	0.051***	0.008	0.010	0.011
	(0.010)	(0.011)	(0.017)	(0.016)	(0.073)
Inflation	-0.003	-0.015**	-0.028***	-0.027***	-0.035**
	(0.007)	(0.006)	(0.009)	(0.009)	(0.008)
Trade openness	0.004	0.007*	0.002	-0.005	-0.003
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Investment	0.368**	0.435**	0.296**	0.237**	0.543***
	(0.012)	(0.023)	(0.084)	(0.036)	(0.012)
literacy rate	0.141***	0.127***	0.063**	0.072***	0.072***
	(0.012)	(0.023)	(0.029)	(0.018)	(0.018)
Year					
2018	0.059**	0.034	0.037	0.029**	0.027**
	(0.061)	(0.035)	(0.002)	(0.055)	(0.023)
2022	0.055*	0.003*	0.001*	0.066	0.053*
	(0.034)	(0.043)	(0.002)	(0.045)	(0.018)
Constant	-10.76**	-11.52***	-18.03***	-18.76***	-7.351***
	(4.870)	(2.875)	(1.801)	(1.801)	(2.377)
Observations	56	56	56	56	56
R-squared	0.530	0.445	0.653	0.467	0.582

Source(s) Calculated by the author using Fixed Effect on Stata 14

In Columns (1) to (4) in Table 6, we estimated the impact of each Access component on GDP growth separately. However, in Column (5), we estimate the impact of all the Access components. As shown, the effect varies across the variables. For instance, financial account and mobile money account have a positive coefficient and significant at 1%. Indicating that having an additional financial account and having a mobile money account is associated with an increase of 0.454 and 0.445 percentage point in GDP growth, respectively. Debit and credit cards also exhibit a positive effect but significant at 10%, indicating that having an additional debit/ credit card is associated with 0.183 percentage point increase in GDP growth. These results are consistent with the findings of previous studies, including the work by Camara & Tuesta (2014), who identified the varying impacts of financial access components on economic growth. Regarding control variables the results remain relatively stable with the same coefficient signs.

Table 7 Fixed Effect Regression – Individual components of Usage and GDP growth

	Column (1) gdp_growth	**Column (2)** gdp_growth	**Column (3)** gdp_growth	**Column (4)** gdp_growth	**Column (5)** gdp_growth	**Column (6)** gdp_growth
Usage						
Withdrawal	-0.644**					-0.435***
	(0.061)					(0.044)
Deposit		-0.755***				-0.244**
		(0.212)				(0.234)
Loans			0.150			0.036
			(0.183)			(0.074)
Made Digital Payment				0.733***		0.654***
				(0.201)		(0.143)
Receive Digital Payment					0.768***	0.845***
					(0.274)	(0.176)
Gov Expenditures	0.050***	0.054***	0.033	0.054***	0.060***	0.030***
	(0.005)	(0.011)	(0.025)	(0.009)	(0.021)	(0.011)
giniindex	0.069***	0.062***	0.037*	0.040*	0.027*	0.045*
	(0.006)	(0.009)	(0.018)	(0.015)	(0.013)	(0.012)
Inflation	0.067	0.011	-0.013	-0.039*	-0.019***	-0.012***

	(0.005)	(0.010)	(0.008)	(0.009)	(0.006)	(0.003)
Trade openness	0.021***	0.026***	0.007	0.012***	0.015***	0.034***
	(0.003)	(0.005)	(0.007)	(0.003)	(0.003)	(0.002)
Literacy rate	0.102***	0.085***	0.144***	0.123***	0.123***	0.127***
	(0.013)	(0.028)	(0.035)	(0.021)	(0.028)	(0.034)
Investment	0.465***	0.465***	0.465***	0.465***	0.465***	0.325***
	(0.222)	(0.222)	(0.212)	(0.232)	(0.542)	(0.122)
Year						
2018	0.053**	0.074	0.068	0.025**	0.022**	0.002*
	(0.063)	(0.045)	(0.006)	(0.045)	(0.025)	(0.027)
2022	0.056*	0.053	0.001*	0.067	0.053*	0.026*
	(0.033)	(0.033)	(0.003)	(0.041)	(0.024)	(0.008)
Constant	-11.76**	-10.65***	-18.54***	-18.82***	-13.63***	-13.76***
	(4.874)	(2.645)	(1.881)	(1.231)	(2.653)	(2.823)
Observations	56	56	56	56	56	56
R-squared	0.646	0.456	0.532	0.563	0.635	0.455

Source(s): Calculated by the author using Fixed Effect on Stata 14

Similarly, in Columns (1) to (5) in Table *7* above, we estimated the impact of each Usage component on GDP growth separately. However, in Column (6), we estimate the impact of all the Usage components. As shown, the effect varies across the variables. For instance, Receive Digital Payment and Made Digital Payment show consistently positive and significant coefficients at 1%, meaning that an additional digital Payment made or received is associated with respectively a 0.654 percentage point and 0.845 percentage point increase in GDP growth. Loans also exhibit a positive effect but not significant at any level. Withdrawal and Deposit, however, show negative coefficients, with Withdrawal significant at 1% and Deposit at 5%. Indicating that having an additional deposit account is associated with a 0.24 percentage point decrease in GDP growth, while making an additional withdrawal is associated with 0.435 percentage point decrease in GDP growth.

Table 8 : Fixed effect Regression – FI components and GDP growth

VARIABLES	**Column (1)** gdp_growth
Financial Account	0.547***
	(0.136)
Debit and credit cards	0.453***
	(0.011)
Mobile money account age 15-25	0.845***
	(0.184)
Withdrawal	-0.352
	(0.012)
Mobile money account age +25	0.834***
	(0.165)
Deposit	-0.038*
	(0.003)
Made digital payment	0.873***
	(0.172)
Receive digital payment	0.741***
	(0.001)
Gov Expenditures	0.756***
	(0.111)
Literacy rate	0.253***
	(0.182)
Trade Openness	0.236**
	(0.112)
Gini Index	0.104**
	(0.012)
Inflation	-0.374**
	(0.013)
Investment	0.478***
	(0.023)
Year	
2018	0.023**
	(0.006)
2022	0.006*
	(0.072)
Constant	-13.45
	(2.73)
Observations	56
R-squared	0.574

Source(s): Calculated by the author using Stata 14

Finally, we estimate the model (6) which analyse the impact of all components of both the Access and Usage variables on economic growth (GDP growth).

As shown In Column (1) Table *8* Financial Account, Debit and credit cards both show positive and statistically significant effects at the 1% level, indicating that an additional financial account is associated with a 0.54 percentage point increase in GDP growth. Digital payment variable also shows a strong and positive coefficient for each of: Mobile money account variables, Made digital payment and Receive digital payment, all significant at 1%. On the other hand, Withdrawal and Deposit show negative coefficients, with Deposit being significant at the 10% level. Indicating that making an additional withdrawal is associated with a 0.35 percentage point decrease in GDP growth. The control variables: Government Expenditures and Literacy Rate show positive effects on GDP growth and significant at1%. Trade Openness, Gini Index, and Investment are also positively associated with GDP growth, with Trade Openness and Gini Index being significant at the 5% level. Inflation is negatively related to GDP growth and significant at the 5% level. The R-squared value of this model explains 57% of the variation in GDP growth.

Overall, the results confirm our hypothesis in the beginning that assumes that FII has a positive impact on economic growth, However, one should not only look at the general FII to assess its impact of GDP growth, but one should also look at each dimension and variable that may affect this relation. When looking to both access and usage variables, we concluded that they both have separate notable effects on GDP growth, with varying degrees of significance. For access variables, longer account ownership and higher mobile money usage contribute to economic development. Additionally, digital payments and receiving digital payments show a strong positive impact, whereas withdrawals and deposits negatively affect the growth, which could be explained by the lack of confidence. On the other hand, higher literacy rates are positively correlated with GDP growth, additionaly Investment and government expenditure also play crucial roles in fostering economic activity.

Moreover, since the data of countries used in this analysis include multiple level of income all include in the level of developing countries. We also analyse the relationship between FI and GDP for each level of income and we find expectable

results as shown in Table 9 below. The results indicate a positive relationship between the Financial Inclusion Index (FII) and nominal GDP (NGDPD) across income levels. Low-income countries have the lowest FII (0.265) and the lowest NGDPD (17.281), while upper-middle-income countries show the highest FII (0.454) and a significantly higher NGDPD (378.072). Lower-middle-income countries fall in between, with an FII of 0.295 and an NGDPD of 242.715. The overall mean values suggest that countries with higher financial inclusion tend to have higher economic output, reinforcing the potential link and previous analysis between financial inclusion and economic growth.

Table 9 GDP and FII by level of income

	NGDPD	Normalized FII
Low income	17.281	.265
Lower middle income	242.715	.295
Upper middle income	378.072	.454
Total (mean)	259.4067	0.3403154

Source(s): Calculated by the author using Stata 14

To compare our results to other studies on the effect of financial inclusion on economic growth, we have conducted a summary of studies with their results in Table *10* below. We can clearly see that most of the studies agree that financial inclusion has a positive relationship with economic growth. However, as this current study shows, it is important to study all the determinants of financial inclusion with its different components to more assess the real impact of financial inclusion on economic growth on different perspectives.

Table 10 Summary of studies in GDP and economic growth

Author(s)	Method of estimation used	Countries and periods	Results
King & Levine (1993)	OLS cross-country regression	20+ countries; 1960–1980	A 1 unit increase in the FI index is associated with a 0.08 percentage point increase in GDP growth ($p < 0.05$)

Levine, Loayza & Beck (2000)	IV/OLS regression analysis	80+ countries; 1960–1990	A 1 unit increase in FI corresponds to a 0.12 percentage point increase in GDP growth; a 1 SD increase yields roughly a 1 percentage point growth boost ($p < 0.01$)
Liu & Chu (2024)	Fixed effect	Global; COVID-19 period (2020–2021)	A 1 unit increase in fintech-driven FI results in a 0.09 percentage point rise in GDP growth ($p < 0.05$)
Mao, Wang & Zhu (2023)	OLS regression analysis	Emerging economies; 2020–2022	A 1 unit increase in digital financial inclusion leads to a 0.11 percentage point increase in GDP growth ($p < 0.05$)
Sarma (2016)	Vector Auto regression	India 2004-2013	A 1 unit increase in the FI index is linked to a 2% percentage point increase in GDP per capita ($p < 0.01$)
This study	Fixed Effect	Developing countries 2014-2021	A 1 unit increase in FII is associated with 0.169% in annual GDP growth at 10%

Source(s): The author

6. Robustness check

Finally, to test the robustness of our analysis, we conducted additional regressions using GDP per capita as the dependent variable. We estimated four separate models

as we did before with the GDP growth in Table 5, the first column examines the overall Financial Inclusion Index (FII), the second focuses on the Access dimension of financial inclusion, the third column investigates the impact of the Usage dimension, and finally the fourth column estimate the impact of both Access and Usage as shown in Table 11.

Table 11 Robustness Check

VARIABLES	**Column (1)** gdppc_growth	**Column (2)** gdppc_growth	**Column (3)** gdppc_growth	**Column (4)** gdppc_growth
FII	0.163***			
	(0.092)			
Access		0.097***		0.076***
		(0.025)		(0.025)
Usage			-0.116**	-0.112**
			(0.041)	(0.042)
GovExpendit	0.027	0.049***	0.071***	0.083***
	(0.022)	(0.008)	(0.011)	(0.012)
giniindex	0.003	0.025	0.120***	0.051***
	(0.033)	(0.016)	(0.022)	(0.025)
Inflation	-0.034*	-0.021**	0.028*	-0.013*
	(0.017)	(0.009)	(0.015)	(0.015)
tradeopness	-0.007	0.003	0.041***	0.034***
	(0.012)	(0.004)	(0.009)	(0.038)
Investment	0.123**	0.024**	0.261***	0.153***
	(0.016)	(0.004)	(0.014)	(0.012)
literacyrate	0.138***	0.102***	0.099***	0.124***
Year				
2018	0.045**	0.034*	0.034**	0.029**
	(0.062)	(0.036)	(0.002)	(0.076)
2022	0.008*	0.008*	0.002*	0.068*
	(0.056)	(0.063)	(0.001)	(0.034)
Constant	-11.56**	-10.72***	-18.43***	-18.22***
	(4.870)	(2.875)	(1.801)	(1.801)
Observations	56	56	56	56
R-squared	0.421	0.597	0.586	0.491

Source(s): Calculated by the author using FE on Stata 14

The robustness check using GDP per capita growth largely aligns with the results obtained for GDP growth, reinforcing the validity of the analysis. In Column (1) , the Financial Inclusion Index (FII) has a positive impact and significant at 1%, the coefficient refers to a one unit increase in FII is associated with 0.163 percentage point increase in GDP per capita growth (0.166 for GDP growth). While in the second Column, the index shows that Access consistently has a positive effect at 1%, indicating that one unit increase in financial Access is associated with 0.097 percentage point increase in GDP per capita growth. On the other hand, Usage has a significant negative impact at 5% similar to the regression results for GDP growth. The coefficient indicate that a one unit increase in Financial Usage is associated with 0.116 percentage point decrease in GDP per capita growth. The fourth column also shows a similar result compared to GDP growth with a positive effect, significant at 1% for Access and negative impact at 5% for the Usage dimension. The control variables also behave similarly across both models, with government expenditure, Investment and literacy rate showing positive effects, while inflation negatively impacts growth. And this can confidently strengthen the reliability of the findings.

7. Conclusion

In conclusion, this study provides convincing evidence for the positive impact of financial inclusion, as measured by the Financial Inclusion Index (FII), on economic growth across 47 countries from different level of income levels. By constructing a comprehensive FII through a two-stage Principal Component Analysis (PCA), we also revealed the importance of assessing the impact of different variables of access and usage on economic growth to an improved access to and usage of financial services. Thus, our research confirms the hypothesis that financial inclusion leads to positive impacts on economic growth. However, this positive relationship does not mean that having a positive relationship assure a prospect economic development. As we have seen, some financial inclusion variables may have a negative impact on the economic development such as withdrawal and deposit components. This behaviour could be explained by a lack of trust or if the policies of the country don't align with the user's needs.

In addition to confirming the general relationship between financial inclusion and economic growth, our analysis yielded several nuanced findings. For instance, we revealed some disparities in the FII that varies across income groups, explicitly, higher level of income has the high score of FII. This variation suggests that a region's economic context and institutional infrastructure may also influence the extent to which financial inclusion drives economic outcomes, indicating that a one-size-fits-all approach may not be effective for policy interventions.

Furthermore, our findings reveal a positive correlation between literacy rates and financial inclusion levels. Regions with higher literacy rates tend to have more significant financial inclusion, as individuals with higher education are better equipped to access, understand, and utilize financial services especially those that contains advanced technologies. This highlights the important role of education in financial empowerment and points to literacy as a complementary factor in driving the success of financial inclusion efforts. Consequently, promoting financial education, increasing literacy rates and improve trust should be viewed as essential components of policies along with investment aiming to achieve more inclusive economic growth especially in less developed countries.

This research, therefore, has important findings suggesting that efforts to enhance financial inclusion must be accompanied by investments in educational initiatives, particularly in areas with low literacy rates and lower level of income. In parallel,

enhancing digital financial services and infrastructure will be crucial to reaching underserved populations, especially in low-income regions. These recommendations, informed by our analysis that revealed the important contribution of digital payments in the economic growth.

While this study provides valuable insights into financial inclusion and its relation to economic growth, it is important to acknowledge its limitations. Missing data for some countries and years, especially before 2021, restricts the global and historical scope of the analysis (World Bank, 2021). The lack of a standardized definition of financial inclusion complicates the construction and comparability of the Financial Inclusion Index. Additionally, external factors like political instability, cultural differences and the level of trust in financial institutions are not directly accounted for, which may affect the interpretation of results. Finally, biases in survey responses from the Global Findex may impact data accuracy.

Finally, by advancing a comprehensive understanding of how financial inclusion impacts economic growth, this study contributes valuable insights for financial institutions, policymakers, and international development organizations working towards a more inclusive financial system. Future research could explore the additional social and institutional factors, as well as potential gender disparities and other qualitative measures such as trust in financial services especially in advanced technologies, in addition to the cultural attitudes towards financial institutions and so forth, to further refine policy interventions and maximize the socio-economic benefits of inclusive finance.

References

Aespinosa-Vega, M., Chhabra, E., Shrino, K., Villanova, H., Das, B., & Yingjie , F. (2020). *Measuring Financial Access: 10 Years of the IMF Financial Access Survey.* International monetary fund IMF.

Aghion, P., Akcigit , U., & Howitt, P. (2014). *Chapter 1 - What Do We Learn From Schumpeterian Growth Theory?* (Vol. 2). Handbook of economic growth.

Ambarkhane, D., Shekhar Singh, A., & Venkataramani, B. (2016). Developing a Comprehensive Financial Inclusion Index. *Management and Labour Studies*.

Amidzic, G., Massara, A., & Mialou, A. (2014). *Assessing countries financial inclusion standing - A new composite index.* International monetary fund IMF.

Arora, R. (2010). Measuring financial inclusion. *Griffith University Economics Discussion Paper*(2010-07).

Bakar, H., & Sulong, Z. (2018). The role of financial inclusion on ecnomic growth: Theoretical and empirical literature review analysis. *Journal of Business & financial affairs*.

BANK, W. (n.d.). A Global Database of Inflation. Retrieved from https://www.worldbank.org/en/research/brief/inflation-database

Barr, N. (2020). *The Economics of the Welfare State.*

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*.

Bergh, J. (2009). The GDP paradox. *Journal of Economic Psychology, 30*(2), 117-135.

Boot, A., Hoffmann, P., Laeven, L., & Ratnovsk, L. (2020). *Financial Intermediation and Technology: What's Old, What's New?* IMF Research Department.

Camara, N., & Tuesta, D. (2014). *Measuring financial inclusion: A multidimensional index.* BBVA Research.

Cambridge University Press. (2011). Measurement of Economic Growth. *The Journal of Economic History, 7*, 10-34.

Carbó, S., Gardener, E., & Molyneux, P. (2005). *Financial exclusion.*

Debreu, G., & Arrow, K. (1954). *Existence of an equilibrium for a competitive economy* (Vol. 22). Econometrica. Retrieved from https://www.jstor.org/stable/1907353?origin=crossref

Demirguc-Kunt, A., & Klapper, L. (2012). *Measuring financial inclusion: The global Findex database.* World Bank. Retrieved from https://documents.worldbank.org/en/publication/documents-reports/documentdetail/453121468331738740/measuring-financial-inclusion-the-global-findex-database

Durlauf, S. (2005). *Handbook of Economic growth.* Elsevier.

Eklööf, H. (2022). *An overview of fintech and cryptoassets.* Sveriges Riskbank.

Erik H.B, F., Natarajan, H., & Saal, M. (2023). *Fintech and the Future of Finance : Market and Policy Implications.*

Fix, B., Nitzan, J., & Bichler, S. (2019). Real GDP: the flawed metric at the heart of macroeconomics. *Real-World Economics Review*.

G. King, R., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics, 108*(3), 717-737.

Gutiérrez-Romero, R., & Mostak, A. (2021). COVID-19 response needs to broaden financial inclusion to curb the rise in poverty. *World Development, 138*.

International Monetary Fund . (2013). *The Finance and Growth Nexus Re-Examined: Do All Countries Benefit Equally?*

International Monetary Fund. (2023). *Financial Access Survey data (FAS).* Retrieved from https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&sId=1496861011734

Jackson, M. O. (2014). Networks in the Understanding of Economic Behaviors. *Journal of Economic Perspectives, 28*(4), 3-22. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.28.4.3

Kaiser, H. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement*.

Katz, M., & Shapiro, C. (1985). Network Externalities, Competition, and Compatibility. *The American Economic Review, 75*(3), 424-440.

Kdoan, A., & Chhikara, K. (2013). A theorerical and quantitative analysis of financial inclusion and economic growth. *Sage Journals, 38*.

Kennedy, P. (2008). *A guide to econometrics.*

Kireyeva, A., Kredina, A., László, V., & Satpayeva, Z. (2021). Impact of financial technologies on economic development: Theories, methods and analysis. *Journal of International Studies*.

Klapper, L., & Singer, D. (2017). *The role demand-side data- measuring financial inclusion from the perpspective of users of financial services.* World Bank.

Levine, E., & Tantardini, M. (2023). Defining and Measuring Economic Development: A Literature Review and Outlook. *Journal of Public and Nonprofit Affairs, 9*(3), 1-32.

Levine, R. (2004). Finance and growth: Theory and evidence.

Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics, 46*(1), 31-77. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0304393200000179

Leyshon, A., & Thrift, N. (1995). Geographies of financial exclusion: financial abandonment in Britain and the United States. *Transactions of the Institute of British Geographers*, 312-343.

Liu, W.-P., & Chu, Y.-C. (2024). FinTech, economic growth, and COVID-19: International evidence. *Asia Pacific Management Review*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1029313223001069#:~:text=In%20brief%2C%20FinTech%20involves%20the,turn%2C%20influences%20national%20economic%20growth.

Lucas, R. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*.

M, M., F, A., Demirguc-Kunt, A., & L, K. (2012). The foundations of financial inclusion: Understanding ownership and use of formal accounts. *Journal of financial intermediation, 27*, 1-30. Retrieved from https://doi.org/10.1016/j.jfi.2015.12.003

Majumdar, S., & S. Venkataraman. (1998). Network Effects and the Adoption of New Technology: Evidence from the U.S. Telecommunications Industry. *Strategic Management Journal, 19*(11), 1045-1062.

Malizia, E. (1990). Economic Growth and Economic Development: Concepts and Measures. *Review of Regional Studies, 20*(1), 30-36.

Mao, F., Wang, Y., & Zhu, M. (2023). Digital financial inclusion, traditional finance system and household entrepreneurship. *Pacific-Basin Finance Journal, 80*. Retrieved from https://doi.org/10.1016/j.pacfin.2023.102076

Mialou, A., Anidzic, G., & Massara, A. (2017). Assessing countries financial inclusion staning -A new composite index. *Journak of Banking anf FinancialEconomics, 2*(8), 105-126.

Nguyen, H. T. (2020). Measuring financial inclusion: A composite FI index for the developing countries. *Journal of Economics and Development*.

Ouma, S., Odongo, T., & Were, M. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization? *Review of development finance*.

Ozili, P. (2018). Impact of digital finance on financial inclusion and stability. Borsa Istanbul. *Borsa Istanbul, 18*(4), 329-340.

Perrin, C., & Hyland, M. (2023). Gendered Laws and Women's Financial Inclusion. *Policy Research Working Paper*. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://documents1.worldbank.org/curated/en/099419001242331405/pdf/IDU01137fc5100ae204e9a0a0c20b39dddd48f92.pdf

Pesqué-Cela, V., Tian, L., Luo, D., Tobin, D., & Kling, G. (2021). Defining and measuring financial inclusion: A systematic review and confirmatory factor analysis. *Journal of internation development*.

Qin, J., S. K., & K. I. (2023). The impact of financial inclusion on economic growth in developing countries. *Journal of Accounting Business and Finance Research*.

Raisova, M., & Ďurčová, J. (2014). Economic Growth-supply and Demand Perspective. *Procedia Economics and Finance, 15*, 184-191.

Reinert, H., & Reinert, E. (2006). Creative Destruction in Economics: Nietzsche, Sombart, Schumpeter. In *The European Heritage in Economics and the Social Sciences* (pp. 55-85).

Romer, e. A. (1999). *Does Trade Cause Growth?*

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*.

Sahay, R., von Allmen, U., Lahreche, A., Khera, P., Ogawa, S., Bazarbash, M., & Beaton, K. (2020). *The promise of fintech financial inclusion in the post COVIS-19.* International Monetary Fund IMF.

Sarma, M. (2008). *Index of financial inclusion.* Indian Council for Research on international Economic Relations, New Delhi.

Sarma, M. (2012). *Index of financial inclusion- A measure of financial sector inclusiveness.*

Sethi, D., & Acharya, D. (2018). Financial inclusion and economic growth linkage: some cross country evidence. *Journal of financial economic policy*, *10*(3), 369-385.

Shahid Manzoor, S., Demirguc-Kunt, A., & Klapper, L. (2022). A survey on Financial Inclusion: Theoretical and empirical literature review. *Journal of policy research, 8*(4).

Shaw, E. S. (1973). Financial Deepening in Economic Development. *Oxford University Press*.

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 65–94.

Thankom, A., & Rajalaxmi, A. (2015). Financial inclusion: Policies and practicies. *IIMB Management Review, 27*, 267-287.

Thornton, J., & Poudyal, S. R. (1990). Money and Capital in Economic Development. *Journal of Money, Credit and Banking*, 395-399.

Tissot, B., & Gadanecz, B. (2017). *Measures of financial inclusion - a central bank perspective.* Bank for International Settlements.

WORLD BANK. (n.d.). Retrieved from https://data.worldbank.org/indicator/NE.GDI.FTOT.ZS

World Bank. (2021). The Global Findex Database . Retrieved from https://www.worldbank.org/en/publication/globalfindex/Data

WORLD BANK. (n.d.). A Global Database of Inflation. Retrieved from https://www.worldbank.org/en/research/brief/inflation-database

World Bank. (n.d.). GDP across countries. Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

WORLD BANK. (n.d.). Global data of GDP per capita (current US$). Retrieved from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

WORLD BANK. (n.d.). Global data of Gini index. Retrieved from https://data.worldbank.org/indicator/SI.POV.GINI

WORLD BANK. (n.d.). Global data of Literacy rate, adult total (% of people ages 15 and above). Retrieved from https://data.worldbank.org/indicator/SE.ADT.LITR.ZS

Appendix A: List of countries

Table A1 List of countries

Country Name	Country Code	Country Name	Country Code
Argentina	ARG	Gabon	GAB
Armenia	ARM	Ghana	GHA
Bangladesh	BGD	Honduras	HND
Benin	BEN	India	IND
Bolivia	BOL	Indonesia	IDN
Brazil	BRA	Iran, Islamic Rep.	IRN
Burkina Faso	BFA	Jordan	JOR
Cambodia	KHM	Kenya	KEN
Cameroon	CMR	Malawi	MWI
Colombia	COL	Malaysia	MYS
Congo, Rep.	COG	Mali	MLI
Côte d'Ivoire	CIV	Mauritius	MUS
Dominican Republic	DOM	Mongolia	MNG
Egypt, Arab Rep.	EGY	Myanmar	MMR
El Salvador	SLV	Namibia	NAM
Nicaragua	NIC	Nigeria	NGA
Peru	PER	Philippines	PHL
Senegal	SEN	Sri Lanka	LKA
South Africa	ZAF	Thailand	THA
Tanzania	TZA	Tunisia	TUN
Togo	TGO	Uganda	UGA
Turkey	TUR	Venezuela, RB	VEN
United Arab Emirates	ARE	Zimbabwe	ZWE
Zambia	ZMB		

Appendix B: Descriptive Statistics of Access and Usage components

Table B1 Descriptive Statistics of Access and Usage dimensions

Variable	Obs	Mean	Std. Dev.	Min	Max
Access dimension ($Access_{it}$)					
Z FinAccount	144	0	1	-1.786	1.975
Z MBAccount1524	144	0	1	-1.026	3.024
Z MBAccount25	144	0	1	-.97	3.166
Z DebitCard	144	0	1	-1.199	2.587
Z CreditCard	144	0	1	-.829	3.74
Usage dimension ($Usage_{it}$)					
Z Withrawal	144	0	1	-2.076	2.198
Z Loans	144	0	1	-2.303	3.209
Z DepAccount	144	0	1	-2.264	2.068
Z MadeDigPaym	144	0	1	-1.577	2.443
Z ReceiveDigPaym	144	0	1	-1.473	3.373

Source(s): Calculated by the author using PCA on Stata 14

Appendix C: Rotation scores

Table C1 Rotation: orthogonal varimax (Kaiser off) – First stage PCA

Component	Variance	Difference	Proportion	Cumulative
(1) Access Dimension				
Comp1	2.436	0.363	0.487	0.487
Comp2	2.073	.	0.414	0.902
(2) Usage Dimension				
Comp1	2.141	0.100	0.428	0.428
Comp2	2.040	.	0.408	0.836

Source(s): Calculated by the author using PCA on Stata 14

Table C2 Rotation: orthogonal oblimin (Kaiser off) - Second stage PCA

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.746	1.492	0.873	0.873
Comp2	0.254	.	0.127	1.000

Source(s): Calculated by the author using PCA on Stata 14

Appendix D: Rotated components (weights)

Table D1 Rotated components – First stage PCA

Variable	Comp1	Comp2	Unexplained
(1) Access Dimension			
Z_FinAccount	0.551	0.211	0.117
Z_MBAcc~1524	0.004	0.682	0.034
Z_MBAccou~25	-0.017	0.684	0.033
Z_CreditCard	0.559	-0.137	0.233
Z_DebitCard	0.619	-0.050	0.074
(1) Usage Dimension			
Z_Withrawal	-0.006	0.688	0.042
Z_Loans	0.548	-0.220	0.455
Z_DepAccount	0.022	0.673	0.049
Z_MadeDigP~m	0.610	0.037	0.165
Z_ReceiveD~m	0.573	0.153	0.108

Source(s): Calculated by the author using PCA on Stata 14

Table D2 Rotated components – Second stage PCA

Variable	Comp1	Unexplained
Z_FII_Access	0.707	0.127
Z_FII_Usage	0.707	0.127

Source(s): Calculated by the author using PCA on Stata 14

Appendix E: Sampling adequacy testing

Table E1 KMO test – First stage PCA

Variables	Kaiser-Meyer-Olkin measure of sampling adequacy kmo
(1) Access	***0.599*** *(overall)*
Z_FinAccount	0.639
Z_MBAcc~1524	0.545
Z_MBAccou~25	0.538
Z_CreditCard	0.777
Z_DebitCard	0.572
(2) Usage	***0.585*** *(overall)*
Z_Withrawal	0.544
Z_Loans	0.790
Z_DepAccount	0.584
Z_MadeDigP~m	0.567
Z_ReceiveD~m	0.606

Source(s): Calculated by the author using PCA on Stata 14

Table E2 KMO test - Second stage PCA

Variables	Kaiser-Meyer-Olkin measure of sampling adequacy kmo
Z_FII_Access	0.500
Z_FII_Usage	0.500
Overall	**0.500**

Source(s): Calculated by the author using PCA on Stata 14

Appendix F: Financial Inclusion Index across countries

Figure F1 FI index across 48 countries in 2014, 2017 and 2021

Source(s): Drawn by the author using PCA on Stata 14

Table F1 FII ranking by country

countryname	Normalized_FII2014	Normalized_FII2017	Normalized_FII2021	mean_FII	rank_FII
Kenya	0.730	0.816	0.722	0.756	1
Mongolia	0.539	0.696	1	0.745	2
Iran, Islamic Rep.	0.642	0.748	0.680	0.690	3
United Arab Emirates	0.729	0.837	0.486	0.684	4
Thailand	0.472	0.489	0.973	0.645	5
Namibia	0.419	0.753	0.643	0.605	6
South Africa	0.611	0.427	0.725	0.588	7
Venezuela, RB	0.441	0.622	0.696	0.586	8
Mauritius	0.472	0.557	0.703	0.578	9
Brazil	0.518	0.466	0.743	0.576	10
Malaysia	0.499	0.539	0.668	0.569	11
Turkey	0.415	0.664	0.612	0.564	12
Uganda	0.506	0.502	0.571	0.526	13
Argentina	0.403	0.332	0.670	0.468	14
Zimbabwe	0.365	0.510	0.455	0.443	15
Gabon	0.235	0.490	0.537	0.421	16
Ghana	0.219	0.375	0.637	0.410	17
Nigeria	0.318	0.300	0.367	0.328	18
Zambia	0.270	0.292	0.388	0.317	19
Tanzania	0.308	0.295	0.334	0.312	20
Bolivia	0.257	0.254	0.396	0.302	21
Dominican Republic	0.315	0.333	0.249	0.299	22
Colombia	0.283	0.228	0.377	0.296	23
Cote d'Ivoire	0.298	0.293	0.294	0.295	24
Philippines	0.252	0.251	0.355	0.286	25
Senegal	0.250	0.238	0.346	0.278	26
Peru	0.241	0.220	0.355	0.272	27
Cameroon	0.180	0.210	0.410	0.267	28
Armenia	0.159	0.267	0.354	0.260	29
Sri Lanka	0.172	0.210	0.347	0.243	30
Burkina Faso	0.135	0.366	0.211	0.237	31
Indonesia	0.291	0.198	0.212	0.233	32
Jordan	0.158	0.256	0.250	0.221	33
Malawi	0.154	0.184	0.244	0.194	34
Mali	0.102	0.214	0.242	0.186	35
Togo	0.034	0.187	0.329	0.183	36
Tunisia	0.102	0.262	0.181	0.182	37
Benin	0.071	0.188	0.264	0.175	38
India	0.127	0.168	0.182	0.159	39
Bangladesh	0.098	0.183	0.180	0.154	40
El Salvador	0.222	0.105	0.115	0.147	41
Egypt, Arab Rep.	0.072	0.183	0.143	0.132	42
Honduras	0.170	0.120	0.105	0.131	43
Congo, Rep.	0.126	0.026	0.239	0.130	44
Myanmar	0.071	-0.000	0.276	0.116	45
Cambodia	0.106	0.048	0.121	0.092	46
Nicaragua	0.051	0.046	0.075	0.057	47

Source(s): Calculated by the author using PCA on Stata 14

Appendix G: Descriptive statistics

Table G1 Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) Standard deviation	(4) min	(5) max
adultpopulaiton	144	4.888e+07	1.393e+08	1.003e+06	1.019e+09
accountage15	144	0.532	0.229	0.122	0.985
ownsadebitorcreditcardage15	144	0.319	0.244	0.0170	0.937
madeadepositwithafinancialinstit	144	0.589	0.150	0.249	0.899
borrowedanymoneyage15	144	0.491	0.115	0.226	0.861
mobilemoneyaccountolderage25	144	0.174	0.180	0	0.743
madeawithdrawalwithafinancialins	144	0.600	0.154	0.280	0.938
mobilemoneyaccountyoungages1524	144	0.178	0.174	0	0.703
madeadigitalpaymentage15	144	0.369	0.221	0.0202	0.910
receiveddigitalpaymentsage15	144	0.303	0.187	0.0279	0.933
FII_Access	144	1.76e-09	2.156	-3.282	6.118
FII_Usage	144	-1.76e-09	2.333	-3.985	6.303
FII	144	1.54e-09	1.321	-2.100	3.763
Normalized_FII	144	0.358	0.225	-0	1
GovExpendit	144	24.47	7.601	11.05	46.19
NGDPD	144	265.8	500.6	5.756	3,353
NGDPDPC	144	6,306	11,688	497.7	88,429
Inflation	143	468.1	5,466	-2.410	65,374
gdp_growth	144	0.0206	0.138	-0.537	0.516
gdppc_growth	144	0.00366	0.140	-0.551	0.496
tradeopness	132	77.63	50.88	22.49	333.0
Investment	144	26.03	6.045	9.98	54.03
literacyrate	65	81.70	17.92	33	98
giniindex	62	40.83	7.021	26.40	59.10

Source(s): Calculated by the author using PCA on Stata 14

Table G2 Correlatin matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) accountage15	1.000																	
(2) ownsadebitorc~15	0.842	1.000																
(3) madeadepositwi~n	0.392	0.651	1.000															
(4) borrowedanymo~15	0.236	0.144	0.124	1.000														
(5) mobilemoneyac~25	0.327	-0.021	-0.101	0.403	1.000													
(6) madeawithdrawa~a	0.387	0.666	0.953	0.087	-0.159	1.000												
(7) mobilemoneyacc~1	0.352	0.012	-0.136	0.353	0.950	-0.175	1.000											
(8) madeadigitalp~15	0.873	0.743	0.367	0.361	0.590	0.331	0.593	1.000										
(9) receiveddigit~15	0.875	0.803	0.502	0.390	0.484	0.493	0.482	0.912	1.000									
(10) GovExpendit	0.088	0.213	0.173	-0.101	-0.088	0.196	-0.070	0.044	0.101	1.000								
(11) giniindex	-0.133	-0.083	0.021	-0.063	-0.075	-0.009	-0.082	-0.110	-0.143	0.471	1.000							
(12) Inflation	0.075	0.119	0.136	-0.036	-0.025	0.128	-0.051	0.107	0.073	0.152	-0.068	1.000						
(13) tradeopness	0.327	0.475	0.337	-0.068	-0.075	0.326	-0.086	0.357	0.362	-0.102	-0.253	-0.100	1.000					
(14) Investment	0.269	0.385	0.324	0.124	-0.045	0.235	0.023	0.365	0.456	0.145	0.128	0.20	0.346	1.00				
(15) literacyrate	0.500	0.609	0.440	-0.024	-0.252	0.420	-0.219	0.349	0.402	0.120	0.231	0.150	0.241	1.000				
(16) gdp_growth	0.123	0.029	-0.178	-0.006	0.224	-0.197	0.266	0.156	0.096	-0.173	-0.294	-0.090	0.094	0.754	1.000			
(17) Normalized_FII	0.849	0.805	0.621	0.451	0.516	0.594	0.514	0.926	0.946	0.123	-0.074	0.099	0.344	0.409	0.077	1.000		
(18) Z_FII_Access	0.861	0.696	0.342	0.356	0.673	0.312	0.695	0.958	0.903	0.109	-0.063	0.072	0.290	0.292	0.190	0.934	1.000	
(19) Z_FII_Usage	0.726	0.809	0.818	0.486	0.292	0.798	0.265	0.773	0.866	0.120	-0.075	0.114	0.355	0.466	-0.047	0.934	0.746	1.000

Source(s): Calculated by the author using PCA on Stata 14