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Does Financial Inclusion Matter for Economic Growth? Empirical Evidence of Lower-Income, Lower-Middle-Income, and Upper-Income Countries

Ahsan Aslam Khan[1]*, Mohammad Helmi Bin Hidthiir[1], Tan Bee Wah[1]

Abstract

The primary objective of this study is to create a more comprehensive index of financial inclusion and examine the role of this Financial Inclusion index (FII) in economic development, focusing on a group of 91 countries with lower income, lower middle income and upper income countries from 2011 to 2012. Our research introduces a novel composite index of FI, using a broader range of indicators and employing principal component analysis (PCA) to overcome previous limitations. Utilizing the generalized method of moments (GMM) for dynamic panel models, we analyze the impact of FI on economic growth in the region. Our findings reveal that FI significantly contributes to economic growth, highlighting the need for targeted financial inclusion efforts towards the illiterate and unemployed, who benefit the least from existing initiatives. The study underscores FI's potential in reducing inequality and enhancing sustainable economic growth by advocating for policies that improve the accessibility and utilization of financial services among vulnerable populations. By expanding financial inclusion indicators and applying advanced analytical methods, this research provides new insights into the positive effects of comprehensive FI on economic empowerment. It offers valuable guidance for policymakers, financial institutions, and development agencies in promoting inclusive growth and poverty reduction in developing economies.

Keywords: *Financial inclusion index, Economic growth, GMM, Principal components analysis*

Introduction

Financial inclusion (FI) has become a key element in economic development strategies as per the economic development literature since the mid-2000s. This prominence is driven by efforts from global organizations like the World Bank, the International Monetary Fund (IMF), and the United Nations (UN), along with contributions from national governments and private financial entities.

FI is about how easy it is for people to get and use financial services and products. Sarma (2012) explains FI as a process that ensures people have simple and effective access to the formal financial system. This includes not only being able to get financial services like savings, loans, remittance services, insurance, and payment methods but also ensuring these services are affordable and available through formal channels in a fair and timely way. People who can easily use these vital financial services are seen as being financially included.

FI is not merely a secondary aim of financial systems; it's important. Its significance goes beyond simple inclusion, intersecting with broader goals such as upholding financial stability (Siddik et al., 2018; Ahamed and Mallick, 2019) and providing financial security (Elsayed, 2020; Tomilova and Valenzuela,

[1] School of Economics, Finance and Banking, Universiti Utara Malaysia, Malaysia
*Correspondence Email: ahsan_aslam_khan@cob.uum.edu.my

2018). FI signifies the ease with which every individual can access and utilize a wide range of banking services. It empowers individuals and businesses to use diverse, valuable, cost-effective financial instruments offered responsibly and sustainably, encompassing transactions, payments, savings, credit, and insurance. The elimination of poverty and economic growth are fundamental elements in strategies focused on finance-driven growth in numerous developing economies. A wide array of scholarly research endorses the perspective that financial inclusion aids in spreading capital and risk among various income and social categories (Neaime and Gaysset, 2018; Allen et al., 2016).

There is substantial evidence that all people, particularly low-income individuals, can benefit significantly from adequate financial services (Anwar et al. 2017). Additionally, it has been noted that even advanced economic systems have not been able to include everyone, and some parts of residents still have no access to a financial system (Ozili, 2020).

When we talk about economic empowerment, it all starts with what's available to us. The first big step towards this goal is being able to use a basic bank account. Why is this important? Well, it lets people keep their money safe and handle their payments, both sending and receiving. So, the journey towards economic empowerment begins with having banks and ATMs that everyone can easily get to. And then, maybe a credit or debit card. But here's the thing: just having a bank account or a card doesn't mean people are actively part of the economy. It's not enough to say that our economic system includes everyone. What we need is a system where financial services are not just there, but they're being used by people. People should feel encouraged to use these services, not just have them sitting there. The real challenge for countries that have made these services available is to move beyond just access. We need to get people actively involved. And for economic empowerment to last, the financial services and products out there should meet what people need. This way, they'll keep using them, not just once in a blue moon. Keeping all this in mind, we can see economic empowerment as a process.

The importance of FI is well-recognized worldwide. However, we haven't yet reached a consensus on the best way to measure it. The most common indicators used for a select group of countries. These include number of ATMs, bank branches, borrowers, depositors, loan accounts, and deposit accounts, all calculated per 100,000 adults. Historical attempts to construct the FI index have been characterized by quantifying the number of adult households or populations with access to formal financial services such as bank accounts (Allen et al. 2016). Moreover, past indices of FI have suffered from conceptual and methodological shortcomings (Chakravarty et al. 2010). These problems arise from various factors such as failing to capture all facets of FI, the arbitrary or subjective assignment of weights to different dimensions, and reliance on generalized indicators that offer limited insights into people's access to or utilization of financial services (Chakravarty et al. 2010; Sarma and Jesim 2011).

While several studies (Chinoda & Kwenda, 2019; Nguyen (2020)) have explored the relationship between financial inclusion and economic growth using a limited number of variables to represent financial inclusion, our study stands out by incorporating a broader range of financial inclusion indicators. This approach marks a significant contribution to literature, moving beyond the traditional method of relying on single variables to measure financial inclusion (Arora, 2010; Olaniyi, 2015; Sarma, 2008). Instead, we construct a composite index that captures a more comprehensive set of financial inclusion indicators.

Another novel aspect of our research is the application of principal component analysis (PCA) over the previously favored Human Development Index (HDI) technique. This shift addresses the limitations of the HDI method, which did not fully account for financial access dimensions, temporal trends, and the diversity of institutions involved in financial inclusion.

Furthermore, this study employs the generalized method of moments (GMM), as introduced by Arellano and Bover (1995) and Blundell and Bond (1998). This technique, designed for dynamic panel models, allows us to analyze the effects of a multidimensional composite index of financial inclusion on economic growth. Specifically, our focus is set of 91 countries characterized by their income brackets, using an extensive dataset covering the years 2011 to 2021. This methodological choice enhances our ability to provide insightful analysis into the impact of financial inclusion on economic growth in the region.

The implication of this research is that in countries with low levels of financial inclusion, those who are illiterate or unemployed are not gaining the benefits equally, posing a significant challenge that affects a country's growth. It's clear that efforts to include more people in the financial system should focus on the most vulnerable segments of society. Typically, without access to a broad and inclusive financial framework, families are forced to rely on their limited resources to support their lives. This extends inequality and restrains economic growth. Financial inclusion, therefore, stands as a beacon of hope for impoverished and low-income families who are currently overlooked or excluded from financial services.

The rest of this document is structured in the following manner: Section 2 focuses into the existing research on the financial inclusion index and its influence on economic growth, as well as the theoretical underpinnings. Section 3 discusses the creation of the financial inclusion index, the methodology employed, and the model specifications. Section 4 shares the findings from our research and engages in a discussion about them. Finally, Section 5 wraps up with our conclusions and suggestions for policy.

Literature Review

Empirically speaking, the literature on developing the financial inclusion index is still evolving to understand the full direction, interrelation, and trajectory of financial inclusion's influence on economic expansion — an emerging paradox (Azimi 2022). However, the latest theories on growth cause scholars to focus on the alternative sources of economic growth and development in many countries

Insufficient research on country-specific, developed, and developing economies has resulted in a lack of compelling evidence to support a policy agenda for the issue, leading to mixed and, at times, unclear results (Gómez Rodríguez et al. 2021).

According to several studies, financial inclusion can be defined as a simple and accessible means for all segments of the economy to utilize formal financial services, starting with the opening of a bank account, frequent usage, and affordable payments (Brown et al. 2009). This definition underscores the importance of creating an inclusive financial system that ensures access to financial services for all, regardless of social or economic status. Leyshon and Thrift (1995) and Honohan (2008) estimated the percentage of households with access to formal financial services using an econometric methodology. This econometric strategy has been used in recent initiatives to develop a measure of financial inclusion.

Financial inclusion for underdeveloped countries is measured by (Tram et al. 2021). In their article, they created the FI index by including an additional indicator of "mobile money"- linked factors to the various measures of financial service accessibility, adoption, and depth. By assigning endogenous weights, a two-stage principal component analysis (PCA) method was utilized to build the financial inclusion index. Amidžic (2014) calculated a new financial inclusion index. Pesqué Cela et al. (2021) calculated the financial inclusion through confirmatory factor analysis and reviewed other financial inclusion systematically.

Financial inclusion (FI) is about meeting the basic financial needs of every part of the country in a way that every person has access to financial services. This brings us to three key things: the depth of the financial sector, known as penetration, having services available, and getting people to use them actively. The literature review revealed that researchers are using a mix of indicators to calculate FI. Some of the most common indicators used are the number of bank branches, ATMs, borrowers, depositors, loan accounts, and deposit accounts. These indicators, while useful, only give us a piece of the puzzle. They don't really provide a full picture of how inclusive a country's financial system is, nor do they tell us much about the overall level of FI in the country. If we don't get a clear picture of the current state of FI, efforts to improve it might backfire, leading to defaults and other problems. That's where the FI Index comes in. It's not just a way to measure how inclusive our financial systems are; it also helps us set realistic goals, make sound policies, and keep an eye on the results.

Studies in different regions have shown that financial inclusion positively affects economic growth. Emara and El Said (2021) looked at (MENA) countries from 1990 to 2018, studying how financial inclusion affects economic expansion and the role of governance. and using a index, they found that financial inclusion notably improves economic expansion in countries with strong institutions. Similarly, Ifediora et al. (2022) examined financial inclusion's impact on economic development in 22 African countries from 2012 to 2018. They used a combined index to measure FI, finding that more ATM and bank branches results in significant economic expansion. In their study, Ali et al. (2021) looked at how FI influences economic expansion in 45 countries of the IDB from 2000 to 2016. They used an financial inclusion and GMM and panel VAR tests, finding a two-way link between FI and economic expansion. Table 1 below describes the previous studies which calculated FI index using different methodologies and different indicators.

Table 1: Previous Studies Financial Inclusion Index.

Author's	Measurement Method	Dimensions	Indicator Used
Nguyen (2020)	PCA	Availability	Bank Branches No of ATM Mobile money agents
		Access	No of deposit accounts Mobile money accounts
		Usage	Total deposits Total loans Mobile Transaction
Avom et al. (2021)	PCA	Availability	Adults accounts Bank cards ownerships Adults mobile account
		Access	ATM Bank branches Branches and ATMS per 1000 km per square
		Usage	Saving accounts Digital payments Life and non-life insurance policies Withdrawal of funds
Park and Mercado (2015,2018)	Multidimensional Approach similar to HDI from UNDP	Availability	ATM Branches
		Usage	Bank Borrowers Bank Depositors Household credit
Camara and Tuesta (2014)	PCA	Access	ATM and branches per 100000 adults ATM and branches per 1000 km square
		Usage	Deposit accounts Loans accounts Savings
		Barriers	Distance Affordability Documentation Lack of trust
Sarma (2012, 2016)	Multidimensional Approach similar to HDI from UNDP	Availability	Bank branches Atm
		Access	Deposit accounts
		Usage	Volume of credit and deposits

Theoretical Framework

In this study, we're looking at a standard production model where what we produce relies on the amount of capital we have and how productive our workforce is. The interesting part is that making financial services more accessible could boost both the amount of capital we have and how effective our workers are. More people being able to bank means better savings habits and smarter distribution of money to those who want to invest it, which in turn could make everything more productive. This idea is supported by research from Claessens (2006) and Sethi & Acharya in 2018.

Research in the field suggests there are two primary ways through which financial inclusion boosts economic growth. The first way involves making financial services more accessible and affordable to those who are often left out, including the less privileged and vulnerable populations. This approach, as noted by (Rajan, 2009), aims to elevate living standards and overall well-being. By providing low-income and disadvantaged individuals with access to affordable credit, it kick-starts a cycle of economic activity and production, enhancing the availability of goods and services. This increase in economic activity not only boosts income generation and improves the quality of life for many but also contributes to national economic growth.

The second method focuses on offering attractive saving and insurance options to those without bank accounts, encouraging them to participate in the financial and stock markets. This inclusion helps funnel savings into financial markets, promoting the efficient allocation of these funds towards long-term, productive investments. Financial markets play a crucial role in managing liquidity shocks and ensuring there's enough capital available to spur further investment. According to (Claessens & Perotti, 2007), this not only increases output and employment opportunities but also facilitates income redistribution and boosts the earnings of the vulnerable. Yoko (2010), highlighted that including everyone in financial services, particularly the weaker sections of society, is essential for reducing income inequality and poverty, enhancing living standards, and driving economic growth and sustainability. Ramkumar (2017) findings reinforce the idea that sustainable development hinges on the active economic participation of all societal segments.

Methodology

For an index to get the most out of a given data set, proper weights must be assigned to the various indicators and sub-indices that make up the index. Rather than giving too much weight to any dimension, a good composite index will incorporate just the most pertinent data from all indicators. Thus, using a two-stage principal components methodology to measure the level of financial inclusion as an indexing strategy (Honohan 2008), we aim to establish the optimally weighted combination of indicators that describe our underlying structure.

Initially, in the first stage of PCA, we approximate the financial inclusion dimensions: penetration, accessibility, and usability. In the second stage, PCA, we use the dimensions as explanatory variables to assess the weights for each component and the overall financial inclusion index. PCA can handle many variables in our index without being overly affected by redundant data.

Two goals are served by slicing the complete index into three smaller indices. One positive aspect is that we obtain more granular, actionable data for policymaking because of the three sub-indices. To account for the presence of highly related indicators within each dimension, we opted to assess the sub-indices separately instead of calculating the total index by selecting all the variables

simultaneously. This approach enabled us to effectively address the issue of intercorrelation between indicators, thus resulting in a more precise and robust measure of financial inclusion. This method is favored because it eliminates the potential for errors caused by giving more weight to indications with a higher association. We reduce weight-biasedness by applying the two-stage principal component.

First Stage PCA

As described earlier, in the first stage of PCA, we estimate the three dimension's sub-indices: Penetration, Accessibility, and Usage. That is, the three unobserved endogenous ($\gamma_i^p, \gamma_i^a, \gamma_i^u$) and the parameters ($\beta$, α, and θ) in equations (1), (2), and (3).

$$\gamma_i^p = \beta_1 accounts_i + \beta_2 creditcards_i + \beta_3 debitcards_i + \beta_4 mobileaccounts + \mu_i \quad (1)$$

$$\gamma_i^a = \alpha_1 atm + \alpha_2 bankbranch_i + \mu_{i_i} \quad (2)$$

$$\gamma_i^u = \theta_1 mobileTransac + \theta_2 digitalpayments_i + \theta_3 bankcredit_i + \theta_4 borrowers_i + \theta_5 savings_i + \theta_6 loanaccounts_i + \mu_i \quad (3)$$

Second Stage PCA

$$FII_i = w_i\gamma_i^p + w_i\gamma_i^a + w_i\gamma_i^u + e_i \quad (4)$$

Where.

FII_i = the composite financial inclusion index of the country i;
w_i = relative weight of each dimension.
γ_i^p = Penetration dimension.
γ_i^a = accessibility dimension.
γ_i^u = Usability dimension

The overall FI index is computed in the second stage by replacing $\gamma_i^p, \gamma_i^a, \gamma_i^u$ Equations (4), with the computed value from equations 1,2, and 3, apply a similar method to that described in the first stage. This produces the following estimator of the FI index:

Table 2: Correlation Analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) da	1.000											
(2) dc	0.600*	1.000										
(3) cc	0.359*	0.723*	1.000									
(4) mra	-0.019	-0.179*	-0.300*	1.000								
(5) atm	0.193*	-0.097*	-0.160*	0.198*	1.000							
(6) bb	0.229*	0.472*	0.247*	-0.118*	-0.102*	1.000						
(7) mt	-0.084*	-0.076*	-0.135*	0.550*	-0.049	-0.108*	1.000					
(8) dp	0.176*	0.241*	0.145*	0.122*	0.036	0.056	0.109*	1.000				
(9) bc	0.246*	0.518*	0.418*	-0.227*	-0.145*	0.320*	-0.109*	0.034	1.000			
(10) borr	-0.156*	0.227*	0.278*	-0.033	-0.312*	0.123*	0.156*	0.022	0.324*	1.000		
(11) cs	0.410*	0.644*	0.345*	-0.032	0.025	0.248*	-0.018	0.207*	0.550*	0.276*	1.000	
(12) bl	0.238*	0.459*	0.549*	-0.173*	-0.106*	0.275*	-0.074*	0.068*	0.424*	0.178*	0.287*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Table 2 shows the correlation among each indicator, and a high correlation among different indicators shows that the data is fit to proceed for PCA. Values above 0.1 are considered

correlated variables. High correlation variables can not only be used for PCA but also considerably benefit from it.

Table 3: Descriptive Analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
da	1034	47.915	31.463	0	213.277
dc	1034	26.477	18.565	0	87.21
cc	1034	7.478	7.76	-.862	45.08
mra	1029	231.676	458.555	-25.533	2876.5
atm	1024	2646.263	11671.712	.006	111309
bb	1028	13.666	12.174	.313	72.065
mt	1029	3973.617	18220.424	-1.48	228876
dp	1033	45.052	54.164	-6.073	634.551
bc	1032	37.746	32.057	0	182.868
borr	1034	36.957	19.679	0	102.51
cs	1023	12.922	8.918	-.367	52.28
bl	993	251.549	454.706	-34.562	7822.03

Table 3 represents the descriptive data analysis for the indicators related to dimensions. Before applying the PCA technique, we standardize the variables for each dimension to remove any potential bias introduced by the different measurement scales.

First Stage PCA Results

In PCA, each variable's weight represents its relative relevance in describing the data's variability and is calculated by multiplying its absolute value by its proportional contribution to the principal component. The principal component is designed to explain the most significant portion of the variability in the data, and the weights indicate the relative importance of each variable in explaining that variability.

Table 4: Principal Component Analysis for Sub-Dimensions.

Component	Eigenvalue	Difference	Proportion	Cumulative
Penetration Dimension (No of Accounts, Credit Cards, Debit Cards, Mobile Accounts) – Estimate "Yp"				
Comp 1	2.207	1.191	0.552	0.552
Comp 2	1.017	0.454	0.254	0.806
Comp 3	0.563	0.349	0.141	0.947
Comp 4	0.214		0.053	1.00
Availability Dimension (ATM and Bank Branches) – Estimate "Ya"				
Comp 1	1.102	0.203	0.551	0.551
Comp 2	0.898	0	0.449	1
Usage Dimension (Mobile Transactions, Digital Payments, Bank Credit, Borrowers, Saving, Loans) – Estimate "Yu"				
Comp 1	2.066	0.892	0.544	0.544
Comp 2	1.174	0.179	0.162	0.706
Comp 3	0.995	0.257	0.145	0.851
Comp 4	0.738	0.108	00.082	0.931
Comp 5	0.634	0.241	0.044	0.975
Comp6	0.394		0.025	1.000

Source: Author Calculation.

Table 4 showcases the results from a Principal Component Analysis (PCA) applied to three dimensions, analyzing data from 93 countries divided into lower income, lower middle income, and upper income categories. The analysis focuses on the eigenvalues of principal components that demonstrate significant variance, highlighting those with values above 1. In the Penetration dimension, only the first two components have eigenvalues exceeding 1, with values of 2.207 and 1.017, respectively. These components are instrumental in capturing the variance within this dimension, indicating their importance in the analysis of financial penetration among the different income groups. For the Availability dimension, which assesses the accessibility of ATMs and bank branches, the first component's eigenvalue is 1.102. This underscores the crucial role of ATM and bank branch availability in the financial landscape across various income levels, as only the first component meets the criteria for further examination. In the Usage dimension, focusing on aspects such as mobile transactions, digital payments, bank credit, borrowers, savings, and loans, the first two components are identified as significant, with eigenvalues of 2.066 and 1.174. These components are deemed vital for understanding the variance in financial usage patterns among the countries studied, emphasizing their relevance in the PCA findings.

Following the general rule of thumb in PCA analysis, components with eigenvalues greater than one are deemed significant and retained for in-depth examination. Based on this criterion, the first and second components in both the "Penetration" and "Usage" dimensions are identified as critical, alongside the first component in the "Availability" dimension. Components with eigenvalues below one are considered less important for further analysis.

This analysis underscores the differing levels of digital financial services penetration, availability, and usage across countries with varying income levels, highlighting the importance of specific components in understanding the multifaceted nature of financial inclusion.

Table 5: Principal Components (Eigenvectors).

Penetration Dimension			
Variable	Comp 1	Comp 2	Unexplained
Deposit Accounts	0.481	0.451	0.283
Credit Cards	0.618	0.133	0.1386
Debit Cards	0.573	0.156	0.2502
Mobile Account	-0.214	0.869	0.1044
Availability dimension			
ATM	-0.707		0.4492
Bank Branches	0.707		0.4492
Usage dimension			
Mobile Transaction	-0.036	0.773	0.2959
Digital Payments	0.553	0.310	0.137
Bank Credit	0.578	-0.189	0.2707
Borrowers	0.380	0.307	0.5912
Saved at a Financial Institution	0.546	0.061	0.3799
Bank Loans	0.448	0.195	0.541

Source: Author Calculation.

Table 5 details the Eigenvectors findings from a Principal Component Analysis (PCA). In the Penetration dimension, the first component assigns weights of 0.481 to "deposit accounts in all financial institutes," 0.618 to "credit cards of 15 years and above," and 0.573 to "debit cards of 15 years and above." The highest weight is attributed to "credit cards of 15 years and above," highlighting its significant role in explaining the variability in this dimension. For the Availability

dimension, both "ATMs" and "bank branches" receive an equal weight of -0.707, indicating their equal importance in the accessibility of financial infrastructure across the countries studied. In the Usage dimension, the weights for the first component are -0.036 for "Mobile Transaction," 0.553 for "Digital Payments," 0.578 for "Bank Credit to private sectors," 0.380 for "Borrowers," 0.546 for "Saved at a Financial Institution," and 0.448 for "Bank Loans." "Bank Credit to private sectors" emerges as the most impactful indicator, followed by "Digital Payments" and "Saved at a Financial Institution," suggesting their significant contributions to explaining variability. In contrast, "Mobile Transaction" exhibits the least influence on the first component's variability in financial usage patterns across the assessed countries.

Table 6: Kaiser-Meyer-Olkin Measure of Sampling Adequacy.

Penetration		**Availability**		**Usage**	
Variable	kmo	Variable	kmo	Variable	Kmo
Deposit Accounts	0.622	ATM	0.5	Digital Payments	0.430
Credit Cards	0.561	Bank Branches	0.5	Total Deposits	0.433
Debit Cards	0.53			Bank Credit	0.609
Mobile Account	0.658			Borrowers	0.695
				Saved at a Financial Institution	0.635
				Bank Loans	0.738
Overall	0.588	Overall	0.5	Overall	0.629

Source: Author Calculation.

Table 6 shows Kaiser-Meyer-Olkin to check the adequacy of the data. KMO value comes at 0.58,0.5 and 0.6976 of penetration, availability, and usage dimensions, respectively. An overall result above 0.5 shows the sampling adequacy of the data.

Second Stage PCA Results

We use the PCA approach in the second stage by adhering to the identical methodology as in the first stage to determine the weights of the three dimensions we calculated (penetration, availability, and usage) in the overall FI index.

Table 7: Principal Component Analysis for Penetration.

Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
Comp 1	**1.78865**	**1.00459**	**0.5962**	**0.5962**
Comp 2	0.784061	0.356773	0.2614	0.8576
Comp3	0.427289	.	0.1424	1.000

Table 7 shows the eigenvalue of PCA. The result highlights the eigenvalues for the components examined, with the first component giving an eigenvalue of 1.78865. This indicates that the first component significantly captures overall variation, making it the primary focus for further analysis due to its eigenvalue exceeding the threshold of 1. This component alone accounts for 59.62% of the total variation observed in the data, emphasizing its pivotal role in explaining the variability in financial infrastructure accessibility across the assessed countries.

Table 8: Principal Components (Eigenvectors).

Variable	**Comp1**	**Unexplained**
Penetration	0.6007	0.3545
Accessibility	0.5922	0.4775
Useability	0.6412	0.2646

Table 8, the weights assigned by the PCA to each dimension are as follows: the Useability dimension receives the highest weight at 0.6412, indicating its paramount importance, followed by the Penetration dimension at 0.6007, and finally, the Accessibility dimension at 0.4775. These weights suggest a nuanced view of financial inclusion, where Useability, Penetration, and Accessibility all play vital roles but with varying degrees of impact. The unexplained variance for each dimension is also provided, offering insight into the amount of variance in the data that the PCA does not capture. The unexplained variances are 0.2646 for the Useability dimension, indicating the highest level of explained variance among the three dimensions, followed by 0.3545 for the Penetration dimension, and 0.5922 for the Accessibility dimension, which has the highest unexplained variance.

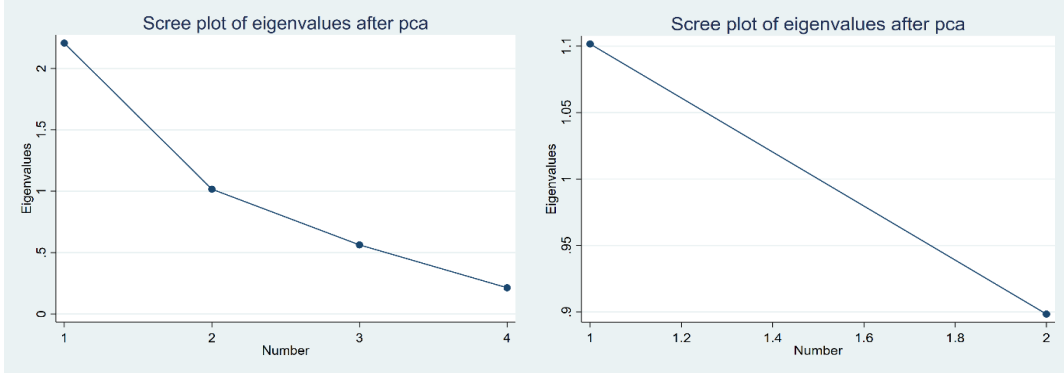
Table 9: Kaiser-Meyer-Oklin.

Dimensions	Kmo
Penetration	0.5761
Accessibility	0.7030
Useability	0.5597
Overall	0.5886

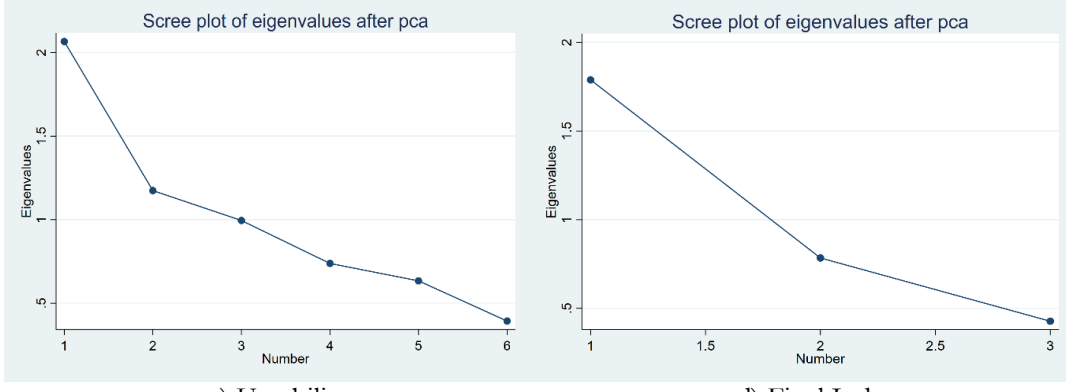
Table 9 Displays the KMO Values. The KMO Measure Value = 0.5886 Satisfies KMO > 0.5.

In a principal component analysis, a scree plot is a visual representation of the eigenvalues linked to each principal component. It aids in choosing the ideal quantity of major components to keep for additional research.

Figure 1: Scree plot of Eigenvalues after PCA



a) Penetration b) Availability



c) Useability d) Final Index

Figure 1: The figure shows the scree plot for all three components, which shows only the one above 1. The graphs below show the scree plot of all three dimensions separately and the loading plot after the PCA of all three dimensions and the final PCA.

Fig (a) The scree plot of penetration dimension with eigenvalues of 2.207, 1.017, 0.563 and 0.214 tells the relative importance of each principal component in explaining the variance in the data. The plot indicates that the first principal component explains the most variance. Fig (b) For the availability dimension, the first principal component has a relatively high eigenvalue of 1.102, indicating that it explains more variance in the data. Fig (c) For the usage dimension, the first principal component has the highest eigenvalue of 2.066, followed by the second component with an eigenvalue of 1.174.

Table 10: Country Ranks according to Financial Inclusion.

Rank	Country	FI index	Rank	Country	FI index
1	China	0.788717	47	Peru	0.459487
2	Malaysia	0.75732	48	Morocco	0.452955
3	Thailand	0.753759	49	Ukraine	0.450051
4	South Africa	0.709668	50	Angola	0.449001
5	Brazil	0.698029	51	Kosovo	0.448455
6	Namibia	0.639883	52	Bangladesh	0.447126
7	Mauritius	0.631521	53	Ecuador	0.445765
8	Mongolia	0.614028	54	Zambia	0.443013
9	Costa Rica	0.607018	55	Paraguay	0.440857
10	Lebanon	0.599442	56	Ghana	0.435702
11	Kenya	0.592651	57	Gabon	0.422671
12	Panama	0.588257	58	Cameroon	0.42152
13	Maldives	0.584391	59	Nicaragua	0.418653
14	Turkiye	0.57416	60	Argentina	0.413963
15	Jamaica	0.565779	61	Azerbaijan	0.40707
16	Vietnam	0.564612	62	Rwanda	0.406643
17	Bulgaria	0.558785	63	Mauritania	0.406528
18	Nepal	0.55271	64	Iraq	0.389769
19	Botswana	0.540336	65	Tanzania	0.387594
20	Dominican Republic	0.533758	66	Algeria	0.385609
21	Russian Federation	0.533518	67	Egypt, Arab Rep.	0.385492
22	Bolivia	0.527603	68	Haiti	0.379937
23	India	0.524906	69	Benin	0.376692
24	Cambodia	0.517603	70	Myanmar	0.360279
25	Bosnia and Herzegovina	0.517052	71	Uzbekistan	0.360102
26	Georgia	0.51657	72	Zimbabwe	0.358313
27	Serbia	0.515694	73	Comoros	0.346605
28	Montenegro	0.511619	74	Kyrgyz Republic	0.346152
29	Belarus	0.511042	75	Cote d'Ivoire	0.344813
30	North Macedonia	0.503878	76	Uganda	0.343218
31	Tunisia	0.502585	77	Togo	0.337574
32	Honduras	0.500417	78	Pakistan	0.337494
33	Jordan	0.493314	79	Congo, Rep.	0.3283
34	El Salvador	0.491482	80	Liberia	0.312
35	Romania	0.490636	81	Senegal	0.305768
36	Lesotho	0.489841	82	Burkina Faso	0.292872
37	Armenia	0.486063	83	Sudan	0.289971
38	Guatemala	0.486055	84	Mali	0.285022
39	Indonesia	0.485626	85	Malawi	0.258045
40	Moldova	0.484279	86	Madagascar	0.218503
41	Mexico	0.48082	87	Central African Republic	0.203752
42	Mozambique	0.477121	88	Niger	0.195962
43	Kazakhstan	0.47569	89	Guinea	0.190632
44	Nigeria	0.47236	90	Congo, Dem. Rep.	0.181436
45	Colombia	0.462511	91	Chad	0.173173
46	Albania	0.459828			

The FI index table reveals a wide spectrum of global standings, with China leading the pack thanks to its robust performance, marked by an FI index of 0.788717. This is closely followed by Malaysia and Thailand, showcasing their significant achievements with indexes of 0.75732 and 0.753759, respectively. On the other end, countries like Chad and the Democratic Republic of Congo face substantial challenges, as evidenced by their lower rankings, with FI indexes of 0.173173 and 0.181436, highlighting critical areas needing attention. The contrast between the top performers such as South Africa and Brazil, with their relatively high indexes, and the struggles faced by nations like Malawi and Madagascar, underscores a diverse global landscape. This diversity reflects varying levels of success and challenges across the countries, with the top 10 demonstrating strong outcomes in the metrics measured by the FI index, and the bottom 10 indicating urgent areas for improvement.

Estimation Technique

In our methodology, we aimed to validate the reliability of our Index and compare it with findings from previous studies. To achieve this, we opted for the Generalized Method of Moments (GMM) technique, recognizing its strength in addressing endogeneity issues. This approach enhances both the consistency and accuracy of our results. Specifically, we employed the dynamic panel model estimation technique developed by Arellano and Bover (1995) and further refined by Blundell and Bond (1998). The GMM technique stands out for its robustness and reliability, offering deep insights into financial inclusion (FI) across a diverse set of 91 countries. These countries span various income levels, including low-income, lower-middle-income, and upper-income categories, enabling us to formulate nuanced policy recommendations.

The GMM technique is particularly adept at accommodating the evolving patterns of data, a feature that sets it apart from other analytical methods. This capability is crucial for understanding the dynamics of FI across all countries under study. Additionally, the GMM approach is well-suited for implementing some reduced-form models, which results in a more parsimonious model. One of the critical challenges in cross-country analysis is accounting for differences in financial inclusiveness, growth, foreign direct investment, trade openness, and income. While other models may struggle with these variations, the GMM technique uniquely addresses country-specific effects by utilizing differences, thus controlling for unobserved heterogeneityThis approach significantly reduces the risk of omitted variable bias, ensuring that any unseen influence from missing variables doesn't skew our results. It also addresses issues where the error term might be mistakenly linked with the variables we're trying to study, making sure these variables can be considered independent of each other again.

Furthermore, the Generalized Method of Moments (GMM) technique is specially designed to deal with variability in data (heteroskedasticity) without losing its effectiveness. An advanced version of this method, known as the Arellano-Bover/Blundell-Bond dynamic panel GMM, builds upon the traditional GMM approach. It introduces extra conditions based on moment calculations, helping to solve some of the common problems found in earlier models. Through this sophisticated analytical approach, our study stands on a solid methodological foundation, ensuring the reliability of our findings on financial inclusion across a broad spectrum of countries. The estimation equation is thus presented as follows:

$$\ln(GDP_{it}) = \gamma\ln(GDP_{it-1}) + \beta_2 \ln(fii_{it}) + \beta_3 \ln(fdi_{it}) + \beta_4 \ln(income_{it}) + \beta_5 \ln(to_{it}) + + \mu_{it}$$

In our analysis, we look at GDP as economic growth of a country, where the term GDP_{it-1} refers to the GDP from the previous period, acting as our lagged variable of interest. The Financial

Inclusion Index (FII) measures how accessible financial services are within a country, while Foreign Direct Investment (FDI) describes the investments made by individuals or companies in business interests in another country. "Income" is another way of referring to per capita GDP, and "TO" stands for trade openness, indicating the extent to which a country allows trade with others. The μ_{it} term represents any random fluctuations that can't be explained by our model. The subscript "i" is used to denote a specific country, and "t" represents the time. The β symbol signifies the coefficients in our model, showing the relationship strength between variables, and Δ is used to show the change from one period to the next.

To check if our data had any patterns of serial correlation, which can skew results, we used AR (1) and AR (2) tests. These tests help us understand if current values in our series are influenced by past values. Additionally, we conducted the Sargan test, a method to verify if our model's assumptions hold true and if the external instruments, we used are valid. This step is crucial for ensuring our analysis stands on solid theoretical and empirical ground.

Empirical Results

Table 12 shows the regression results of GMM analysis, where the coefficient for Lag is estimated at 0.900, with a standard error of 0.0063. This coefficient exhibits statistical significance at the 0.01 level (***), indicating a positive relationship between the specified exogenous variable and economic growth. The results indicate that the financial inclusion index has a significantly positive impact on the world's economic growth. Specifically, it suggests that a one percent increase in financial inclusion—encompassing the penetration, availability, and usage of financial services—leads to a 0.90% increase in the country's economic growth, all else being equal (ceteris paribus).

Table 11: Regression results of GMM.

	(1)	**(2)**
VARIABLES	LOGGDP	LOGGDPPERCAPITA
L.LOGGDP	0.900***	
	(0.00603)	
LOGFDI	0.0148***	0.00853***
	(0.00126)	(0.00259)
LOGINCOME	0.0378***	
	(0.00309)	
LOGTO	0.0290***	0.102***
	(0.00320)	(0.00504)
LOGNFII	0.0203*	0.0936***
	(0.0110)	(0.0133)
L.LOGGDPPERCAPITA		0.956***
		(0.00262)
Observations	793	793
Number of id	84	84
Sargan	0.0695	0.0313

Standard Errors in Parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

These findings are in alignment with theoretical expectations regarding the positive nexus between economic growth and financial inclusion. Furthermore, the results corroborate the empirical evidence from various studies (Kim et al., (2018);Siddik et al., (2019) ;Singh and Stakic (2021) ; Huang et al., 2021). It suggests that improving access to financial inclusion can contribute to

economic development and higher income levels for individuals within the countries which show high level of financial inclusion. It underlines the importance of promoting inclusive financial systems that enable broader participation in economic activities and facilitate access to financial services for underserved populations. The result is parallel to the study of Gabor and Brooks (2020), where the positive correlation between financial inclusion index and economic growth in lower income, lower middle income and upper income countries is highlighted, emphasizing the role FI on economic profit. To check the consistent of the regression model, we analyze two models which vary in dependent variables. Every equation has 793 observations and 91 groups. We also tested AR and Sargant test of overidentify. All the P value of AR(1) test are less than 5% and the P value of AR(2) test are greater than 5%. This means that the error term has no serial correlation.

In our second model we used GDP per capita as a proxy for income as a dependent variable. Based on the analysis results, we found that IFI has positive effect on GDP per capita in second regression models. The significance of IFI variable is less than 1% for both equations. These results are similar with some previous studies such as: Emara & Said (2021), Nandi et al. (2021), Khusniati & Wardani (2022) which support the positive relationship between financial inclusion and GDP per capita.

Conclusion

Financial inclusion plays a critical role in driving economic growth and reducing poverty, acting as a key mechanism to ward off social exclusion. Ensuring everyone has access to formal financial services is vital for preventing anyone from being left out. Despite its importance, there's a noticeable gap in efforts to thoroughly measure financial inclusion. It's a complex, complex issue that can't be fully understood through a handful of indicators. The reality is, to truly grasp financial inclusion, we need to consider a much broader range of factors than current research typically acknowledges. Financial systems are complicated and diverse by nature. To achieve a genuinely inclusive financial environment, special attention must be paid to encourage the participation of the most vulnerable members of society—those who face the greatest barriers to accessing financial services.

The way we currently assess financial inclusion through composite indices raises some eyebrows, mainly because of the arbitrary way weights are assigned to different factors. In this study, we introduce a novel approach using a two-stage Principal Component Analysis (PCA) to more accurately gauge financial inclusion levels across countries or regions. This method stands out for its statistical reliability in constructing indices and its effectiveness with complex, multi-variable data.

We've developed a composite index to evaluate financial inclusion in 91 countries, drawing on 12 key variables identified as critical determinants of financial inclusion for the years 2011 and 2021. This index is designed to be consistent for comparisons both between countries and over time. It operates on the principle that true financial inclusion is achieved by maximizing the reach, ease of access, and usability of formal financial services, while also reducing the barriers that prevent people from using these services voluntarily. Crucially, incorporating data on how people use these services and the obstacles they face offers a more nuanced understanding of financial inclusion levels. This includes considering the perspective of those who already have access to banking services, as well as those who are currently excluded, to provide a fuller picture of financial system inclusivity.

Our contribution to the field is significant in two ways. Firstly, we apply a sophisticated parametric technique that filters out noise from our data, allowing us to precisely calculate the impact of each indicator on our overall index of financial inclusion without relying on subjective judgments. Secondly, our index is comprehensive, incorporating both the demand for and supply of financial services, offering a more complete view of the state of financial inclusion.

Our findings indicate that accessibility is a crucial factor in determining the level of financial inclusion, acting as a necessary, though not alone sufficient, condition for utilizing formal financial services. However, our ability to measure access comprehensively is hindered by data limitations, allowing us to only account for physical access to financial systems. Despite significant advancements in data collection over the past five years, there remain notable gaps. Traditional metrics for assessing access now seem inadequate, failing to capture the scope of today's financial sector that extends beyond physical bank branches to include mobile banking and online financial services. These digital platforms have transformed access to financial services, breaking down previous barriers like distance. Although accurately measuring these modern access channels presents challenges due to the absence of uniform data across many countries, we have tried to incorporate mobile and internet banking data into our analysis, particularly within the usage dimension of financial inclusion. This inclusion represents a step forward in understanding the dynamics of financial inclusion, providing insight into its drivers and effects, even if it does not yet offer a perfect representation of all access channels.

Despite these challenges, developing this index has proven valuable in highlighting the factors that drive financial inclusion and its impact on economic growth and development. Our index is straightforward to understand and calculate. We're convinced that having more detailed data, including specifics about different financial products, how often they're used, and geographical details about where services are accessed, would greatly enhance our ability to evaluate financial inclusion accurately. Such detailed insights would be incredibly beneficial for guiding policy recommendations and strategies aimed at improving access to financial services.

Limitations

The unrecorded economy is widespread in the developing countries, including both legal and illegal activities like drug and arms trading. This large, hidden economy significantly affects the official financial sector. First, it damages trust in formal financial systems. People lose confidence in banks and financial services when much of the economy operates outside these institutions, especially when illegal activities are involved. Second, it impacts financial services. Fewer people have bank accounts or use formal borrowing methods, preferring cash or informal credit. This reduces overall economic growth and financial inclusion in the region.

Measuring the unrecorded economy is hard due to its hidden nature. Future research should develop new methods to better understand its size and effects. It's important to study how the unrecorded economy relates to formal financial indicators like borrowing rates. Likely, more unrecorded activity means less formal borrowing, as people rely more on the informal economy.

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