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Financial Inclusion, Poverty, and Income Inequality: Evidence from High, Middle, and Low-income Countries

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Abstract

The past two decades have witnessed a high national importance to financial inclusion around the world. This paper intends to explore the impact of financial inclusion on poverty reduction and income inequality in the world, high, middle, and low-income countries. For this purpose, a new composite financial inclusion was constructed with three dimensions for finding various macroeconomic variables affecting the level of financial inclusion for 122 economies, including 32 from high-income, 38 from upper middle income, 38 from lower middle income, and 14 from low-income countries. Then the impact of financial inclusion, on poverty and income inequality, for the world and then for high, middle, and low-income countries was investigated. The estimates reveal that rule of law significantly affects financial inclusion for the world, high, middle, and low-income countries. But age dependency ratio influences the financial inclusion only for our full sample. However, population density significantly decreases financial inclusion just in the full sample and Upper middle-income countries. Education completion impacts significantly financial inclusion just in upper middle income. While literacy has a higher impact on financial inclusion in high-income countries. The findings also indicate that financial inclusion is significantly correlated with lower poverty for the full sample. The link between financial inclusion and income inequality has been found for high-income countries and lower-middle-income countries.

Keywords: financial inclusion; income level; inequality; poverty.

JEL classification: G18; O11; O16.

1. INTRODUCTION

Financial inclusion is considered as the process of guarantying access and usage to formal financial services at an affordable price for all individuals particularly the excluded and the poor people (Dev, 2006; Ozili, 2018). Formal financial services include saving, credit, remittance facilities, and insurance. The lack of these services leads people to use costly informal financial services, and consequently, it causes their financial exclusion. So, financial inclusion brings excluded individuals into formal banking services. Furthermore, the World Bank report (World Bank, 2014) has identified four main forms of financial exclusion, which

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are classified into voluntary and involuntary exclusion. Voluntary exclusion is a condition where a fraction of population or firms chooses to not use financial services due to religious, cultural reasons. On the contrary, involuntary exclusion emerges from poverty conditions: insufficient income, high-risk profile, gender discrimination, lack of information, or price barriers due to market imperfections. So, financial services help individuals escape poverty by making easier the investment in education, business, and health, especially with the use of digital services, including payment cards, mobile money, and other applications of financial technology (Asuming, Osei-Agyei, & Mohammed, 2019). In this perspective, the inclusion of individuals into the formal financial system plays a crucial role in reducing poverty and alleviating income inequalities especially for people with a low income (Bateman, Duvendack, & Loubere, 2019; Inoue, 2019).

In 2010, the Group of Twenty (G20) recognized that financial inclusion is a fundamental key for tackling poverty. For this reason, a global partnership for financial inclusion (GPFI) has been launched by developing a set of indicators for assessing the use of financial services across the globe. The data were powered by the World Bank's Data group. As a result, financial inclusion is on the rise. More than 515 million adults have a new account at banking institutions or use a mobile money service during the period 2014-2017. Furthermore Small and medium-sized businesses that have an account at a financial institution are in increase. For example, about 90% of firms have an account, with half having a line of credit or loan from a bank in Latin America and the Caribbean. Despite this rise, 1.7 billion adults are unbanked in the world with a high concentration in low and middle-income countries[1].

According to the World Bank, poverty is the state in which individuals are surviving on less than US$ 1.9 a day. The global poverty rate in 2019 is estimated to be 8.2% with high disparities among countries. For example countries like Syria, Zimbabwe, Madagascar, and Sierra Leone have between 82% to 70% of the population below the poverty line. On the other hand, Income inequality is much harder to measure, but the most common indicator of income inequality is the Gini index, which is a measure of how income is distributed among the population (Martínez Turégano & García Herrero, 2018): the main obstacle when coping with income distribution is the heterogeneity across different economies. Concerning the source of data, the most widely used database is the world income inequality database (WIID).

The research question of this study is: What is the impact of financial inclusion in alleviating poverty and reducing income inequality across countries? Two main reasons justify our focus on countries based on the income level (high, middle, and low-income). Firstly, according to the global index, 1.7 billion adults remain unbanked in middle and low-income economies. Also in high-income countries, the percentage of individuals who own a mobile phone is about 85%, while in low-income economies is only about 46%[2]. Secondly, poverty and income inequality are heterogenic across the globe. For instance, the World Bank estimates only 0.6% of all people in high-income countries lived on less than $1.90 a day, whereas in the middle and low-income countries are the home of 62% of the world's poor. More specifically, this study aims to answer two simple questions: first, what are the critical factors that influence financial inclusion in high, middle, and low-income countries? Second, are poverty and income inequality reduced by the financial inclusion in high, middle, and low-income countries?

This research contributes to the existing literature on financial inclusion: First, by constructing a novel finance inclusion index based on a multidimensional approach and the two-stage PCA method (Cámara & Tuesta, 2017; Tram, Lai, & Nguyen, 2021), sampling 122

countries and spanning the period 2014-2019. Second, by identifying the critical factors of financial inclusion and analyzing the impact of financial inclusion on poverty reduction and income inequality, focusing on our full sample and four samples: high, upper-middle, lower-middle and low-income. Third by assessing the relationship between financial inclusion and poverty and income for our five samples.

By using our financial inclusion index, we examine the determinants that affect financial inclusion. The estimates reveal that for the full sample, rule of law, age dependency ratio, population density significantly impact financial inclusion. Particularly, countries with a high rule of law, and age dependency ratio significantly have higher financial inclusion; while countries with higher population density have lower financial inclusion. The estimates reveal that rule of law and age dependency ratio are the main determinants for financial inclusion in the full sample. However, we find population negatively affects the level of financial inclusion. These results are partially consistent for High income, upper-middle-income, and lower-middle-income samples. Only the rule of law is the determinant of financial inclusion, with an exception for high income that literacy has a significant impact on financial inclusion and for upper middle income which population density significantly impact financial inclusion. For the Impact of financial inclusion on poverty reduction, the results indicate the negative relationship between financial inclusion and poverty rates for the full sample. But for other samples the relation is unconfirmed. In addition, income distribution has a significant impact on poverty reduction in the context of middle-income countries. Therefore, the association between financial inclusion and income distribution has a significant negative impact on poverty rates only for the full sample. Concerning the Impact of financial inclusion on income inequality, our findings indicate that the relationship between the level of financial inclusion and income inequality is confirmed for high and lower middle income.

This paper is presented as follows: Section 2 reviews related literature review. Section 3 reveals data and methodology. Section 4 presents findings and discussions and Section 5 concludes with some policy implications.

2. LITERATURE REVIEW

2.1 Concept and measurement of financial inclusion

Financial inclusion is progressively being admitted as a crucial instrument for tackling poverty and promoting the growth of nations. However, there is no consensus about the concept of financial inclusion. Previous studies have taken up this concept in several ways, depending on the socio-economic context. For example, financial inclusion is defined as a situation where people and businesses have access to basic and affordable financial services (Amidžić, Massara, & Mialou, 2014; World Bank, 2014; Demirguc-Kunt, Klapper, & Singer, 2017). In addition, Cámara and Tuesta (2017) highlight that financial inclusion is the maximization of usage and access from the financial system, and the minimization of involuntary financial exclusion.

From a practical approach, financial inclusion should be defined through its dimensions (Cámara & Tuesta, 2017). For that, Sarma (2016) views financial inclusion as a process to ensure the ease of access, availability, and use of formal financial services for all sectors of the economy. Therefore, we adopt in our research Sarma's definition, which includes three dimensions namely: accessibility, availability, and usage, which can be presented and

discussed later. The lack of an appropriate measurement of financial inclusion complicates the understanding of its relationship with other factors. Like the definition of financial inclusion, the literature does not provide any robust method for measuring or assessing financial inclusion in an economy or a region. In the existent literature on financial inclusion's measurement, two methods are used: (1) Method based on a set of indicators (regrouped by dimensions) and (2) method based on single indicators.

To our knowledge, the paper of Beck, Demirguc-Kunt, and Martinez Peria (2007) was the first attempt at measuring banking access for three financial services(lending, payment, and deposits) using two dimensions: access and use of financial services. Honohan (2008) has measured the financial service's access by integrating data on account numbers (number of bank account and bank deposit size) with surveys data of the proportion of the adults that use formal financial intermediaries (banks and microfinance institutions).Unlike , Sarma and Pais (2008), Sarma (2016) and Cámara and Tuesta (2017) have developed a multidimensional financial index, because the concept of financial inclusion is also dimensional and it cannot be apprehended by single indicators (Cámara & Tuesta, 2017). Furthermore, these indicators when are used alone, provide incomplete and partial information about the financial system and a misunderstanding about the level of financial inclusion in an economy (Nguyen, 2021; Sarma & Pais, 2008). Many perspectives have been used when trying to identify a congruous measurement-called FI index- to widely assess the sphere of the financial system.

From an institutional perspective, the International Monetary Funding (IMF) -Financial access survey- has constructed a financial index based on several indicators such as the number of automated teller machines (ATMs), the number of banks branches, the number of deposit accounts, and outstanding deposits or loans. Since 2014, the World Bank provided through its database Global Findex a large set of indicators on financial inclusion related to the number of accounts, the use of financial services, also provides information about education, income, gender, and age. We also report that Financial Inclusion Insights (FII) Program was conceived in 2013 in partnership with the Bill and Melinda Gates Foundation to create knowledge about the financial inclusion in thirteen countries across Africa and Asia, and it constructs various indicators such as mobile phone access and ownership, mobile money, digital inclusion, financial behavior, financial literacy, etc. Also, we indicate that the approach of computing the human development index -implemented by the United Nations Development Program- was useful for constructing a financial inclusion index by several papers. The backbone of all studies developed about a multidimensional financial inclusion measurement is the study of Sarma and Pais (2008) and Sarma (2016), who computed the sub-index of each dimension and aggregated each index as the normalized inverse of the Euclidean distance, where the distance is calculated from a reference point and normalized by the number of dimensions included in the composite index. The weighting is assigned to dimensions based on the author's intuition (for accessible, usable, and used are 1,0.5 and 0.5 respectively). Following that, several papers have developed a financial inclusion index (Huang & Zhang, 2020; Omar & Inaba, 2020; Park & Mercado, 2018; Sethi & Sethy, 2019; Wang & Guan, 2017). These studies provide an appropriate measurement of the financial inclusion level than studies using single indicators for measurement. But the weights assigned for each dimension are subjectively chosen and based on the researcher's experience (Cámara & Tuesta, 2017), and a small change in weights can modify the results considerably (Lockwood, 2004). Subsequently, the lack of a rigorous approach based on a scientific foundation, made this approach very criticized by the academic community.

In this context, Amidžić et al. (2014) have constructed a financial inclusion index using Factor Analysis (FA) to determine dimensions and weights. Cámara and Tuesta (2017), have applied two-stage Principal Component Analysis (PCA) for the construction of a multidimensional financial inclusion index. Subsequently, several papers have followed Cámara and Tuesta (2017) and Amidžić et al. (2014) to construct a multidimensional financial inclusion index (Abdulmumin, Etudaiye-Muhtar, Jimoh, & Sakariyahu, 2019; Datta & Singh, 2019; Lenka & Bairwa, 2016; Mialou, Amidzic, & Massara, 2017; Tram et al., 2021; Yorulmaz, 2018). In this paper, we follow also the PCA method recommended by Cámara and Tuesta (2017).

2.2 Determinants of financial inclusion

As previously indicated, the determination of critical factors of financial inclusion is a must, especially with the economic disparities across the regions and nations. The literature on determinants of financial inclusion has identified two forms of determinants: micro-level factors and macro-level factors. For the micro-level factors, several studies have found that variables such as income level, gender education, and age are the critical determinants. A study conducted by Zins and Weill (2016), for a sample of 37 African countries has found that people who are rich, older, man and educated have more access to financial services. In addition, a study by Allen, Demirguc-Kunt, Klapper, and Martinez Peria (2016), which covered 123 countries and over 124,000 individuals, indicates that young, poor and those from rural areas are more financially exclude, and suggests the enhancement of lower accounts costs, proximity to financial institutions, a legal right and political stability are associated with a high level of financial inclusion. Similarly, a study by Khanh Chu (2019) using data of 150,000 adults from 144 countries, corroborates that male gender, level of educated, income level, occupation, and age increase access to financial services. Another study by Ghosh and Vinod (2017) in India using data of 110,800 households, finds that households led by females are 8% less likely to have financial services access and they use 20% fewer cash loans compared to householders led by males. They highlight those females with a low level of education and low wages are deprived of financial services. The study of Mohammed, Mensah, and Gyeke-Dako (2017), points out that people who are advance in age are more able to reduce poverty if they have access to financial services while females are more financially excluded. Using data across 18 countries of Central and West Africa with 18000 observations, Soumaré, Tchana Tchana, and Kengne (2016) indicate that access to financial services is driven by income level, education, gender, employment status, income level, household size, marital status, and trust in financial intermediaries.

Other strands of the literature identified the macro-level factors that explain the micro-level factors. In this context, Park and Mercado (2018) noted that per capita income, rule of law, and demographic characteristics significantly influence financial inclusion for both world and Asian countries. Similarly, a study on developing countries by Omar and Inaba (2020) also found that capita income, the ratio of internet users, age dependency ratio, inflation, and income inequality significantly influence the level of financial inclusion in developing countries. Moreover, Asuming et al. (2019) suggest that macroeconomic variables such as growth rate of GDP, availability of financial institutions, and an environment of Business Freedom are determinants for financial inclusion. Focusing on 15 African countries from 2005 to 2014, Evans and Adeoye (2016) find that internet access, literacy, per capita income, broad money, and Islamic banking institutions are key determinants of financial inclusion in Africa.

2.3 Linkages between financial inclusion, poverty reduction, and income inequality

To date, the literature on the impact of financial inclusion on poverty reduction, and income inequality covers relatively this topic. Perhaps due to the availability of data for a long-spanning time and an important number of missing data related to financial inclusion. Consequently, a few papers have studied the impact of financial inclusion on poverty and income inequality, with mixed results. Neaime and Gaysset (2018) highlight the importance of financial inclusion to reduce poverty and income inequality. Using a sample of 8 MENA economies from 2002 to 2015, measuring financial inclusion through the number of Automated Teller Machines (ATMs) per 100,000 adults and commercial banks per 100,000 adults. Income inequality was measured by the Gini index and, and poverty by using the log difference of the poverty headcount ratio at national poverty lines. The results suggest that a high number of banks can facilitate access for the poor to financial services and diminish eventually income inequality. Also, the authors conclude that an increase in inflation impacts negatively the purchasing power and subsequently the individual income which therefore intensifies poverty. In a parallel study, Omar and Inaba (2020) have shown that financial inclusion reduces poverty rate and income inequality for 116 developing countries from three regions in the world: Asia, Africa, and Latin America. They have measured financial inclusion by multi-dimensional based on three dimensions and each dimension has two variables. The weight of each dimension was intuitively computed.

Ouechtati (2020) studied the impact of financial inclusion on income inequality and poverty for 53 developing countries from 2004 to 2017. Financial inclusion was measured by four variables: Automated teller machines per 100,000 per adult, bank branches per 100,000, commercial bank borrowers per 1000 adults, and commercial bank deposit accounts per 1000 adults. As in the previous studies, poverty and income inequality were measured respectively by poverty headcount ratio and Gini index. The results revealed that the availability of credit and access to deposit accounts at commercial banks reduce significantly the poverty. Moreover, it was concluded that a high level of bank penetration and access to credit can alleviate income inequality. The study of Park and Mercado (2018), investigated the influence of financial inclusion in reducing poverty and income inequality for 176 economies with a comparison between the world and Asia region. The findings highlight that financial inclusion is significantly correlated with lower poverty and income inequality levels for the world sample. But for Asian countries, there is no relationship between financial inclusion and income inequality. Like Park and Mercado (2018), a study of Ratnawati (2020) has found any impact of financial inclusion on poverty reduction and income inequality for a sample of 10 Asian countries.

Kim (2016) assessed the impact of financial inclusion on income inequality, focusing on forty countries members of the European Union (EU) and the Economic Co-operation and Development (OECD) from 2004 to 2011. The results suggest that financial inclusion contributes to reduce inequality in low-income countries only. In contrast, for all sample financial inclusion play a role of mediator for changing the negative relationship between income inequality and economic growth to a positive relationship. In an early study, Mookerjee and Kalipioni (2010) have examined the relationship between financial access and income inequality for 70 developed and developing economies, spanning the period 2000-2005. The findings indicate that increasing access to financial services reduces income inequality. Using a sample of 62 countries covering the period 2001-2012, Mushtaq and

Bruneau (2019) have focused on two dimensions of financial inclusion (Inclusion by commercial banks and by microfinance institutes). A partial result of this study has found that a high level of financial inclusion corresponds to a low level of poverty and income inequality. A recent study by Churchill and Marisetty (2020) has evaluated the impact of financial inclusion on reducing poverty for 45000 households across 12 countries. The results enhance the hypothesis that financial inclusion has a strong poverty-reducing effect.

In light of the above arguments, it is clear that the impact of financial inclusion on reducing poverty and income inequality is not yet clarified and it depends on the contexts of each group of countries. This study adds some evidence to the literature by comparing four contexts namely: high income, upper middle income, lower middle income, and low income, with the full sample and investigating the possible relationships with a broad set of variables related to financial inclusion index. In line with previous literature, our hypothesis are as follows:

H1 – Financial inclusion has a positive impact on poverty reduction.

H2 – financial inclusion has a negative impact on income inequality.

3. DATA AND METHODS

Based on previous studies, this study is conducted to examine what role can play in financial inclusion in reducing poverty and income inequality. For that, we first construct our financial inclusion index.

3.1 Data description and sources

Data are collected through two sources. The first set of variables consists of the indicators related to the financial inclusion index (FII) which is sourced from the Financial Access Survey of International Monetary Fund (FAS-IMF), whereas the second set of variables contains indicators from the World Development Indicators (WDI) database of World Bank (WDI) (Table no. A1). We select data for the period 2014-2019 in 122 countries around the world (Table no. A2). We don't cover all countries of the world due to missing data over the years. Also, we compute the average of the period 2014-2019 to face the fluctuation of data (Omar & Inaba, 2020; Park & Mercado, 2018; Tram et al., 2021).

3.2 Model specification and measurement variables

Development of a composite financial inclusion index

As we noted in the literature review, there are two approaches used in measuring financial inclusion: parametric and non-parametric methods. Based on the parametric method developed by Cámara and Tuesta (2017), we construct our financial inclusion index via the PCA method. Therefore, the appropriate weights that the latent variable (FII) is linearly determined as follows:

$$FII_i = w_1 Y_i^P + w_2 Y_i^a + w_3 Y_i^u + e_i \quad \text{(a)}$$

where : FII_i is composite FI index of country i.

w_1, w_2, w_3 : weights of each dimension; e_i is variation due to error.

(Y_i^P, Y_i^a, Y_i^u) are the dimension of penetration, availability, and usage, calculated as:

$$Y_i^P = \beta_1 \text{ deposit accounts }_i + \beta_2 \text{ mobile money accounts }_i + m_i \quad \text{(b)}$$

$$Y_i^a = \Theta_1 \text{ branches}_i + \Theta_2 \text{ ATMs }_i + u_i \quad \text{(c)}$$

$$Y_i^u = \gamma_1 \text{ deposits}_i + \gamma_2 \text{ loans }_i + \gamma_3 \text{ mobile money transactions }_i + z_i \quad \text{(d)}$$

In models (b), (c), (d), variables are used according to Sarma (2016). We construct our index by combining three dimensions: Penetration, Availability, and Usage.

(1) Penetration

Penetration of financial services is the first step for financial inclusion and a good financial system must include all individuals of an economy. If it is the case this dimension would be 1. Penetration represents the possibility offered to individuals to be users of a formal financial system. Increasing penetration is a result of intense competition between financial companies (Cámara & Tuesta, 2017). Based on the approach of Sarma (2016), we construct the penetration dimension from the data of deposit account only with commercial banks per 1000 adults, because we have a problem of missing data for credits unions, cooperative banks, and microfinance institutions. Sarma (2016) has suggested to include in this dimension new indicator called: the number of registered mobile money accounts per 1000 adults. For the reason that since 2012, the use of the mobile phone has increased and the financial services industry has exploited this progress by the inclusion of excluded individuals through mobile phone applications (Tram et al., 2021).

(2) Availability

The ease of availability is another attribute of an inclusive financial system. The proximity of financial services for all individuals and all regions contributes to include users in the financial system. According to Sarma (2016), we measure this dimension by three indicators: the number of branches, ATMs per 100,000 adults, and mobile money agent outlets per 100,000 adults. This last indicator is considered as a substitute in the areas where branches and ATM systems are not available.

(3) Usage

Despite having access to financial services, some individuals don't use these services for several reasons such as distance of banking outlets, bad experiences, or expensive financial services. Consequently, these factors impact negatively the inclusion of individuals into the financial system. Following Sarma (2016) in this dimension. First, we use the outstanding deposits with commercial banks (% of GDP). Secondly, we integrate the outstanding loans from commercial banks (% of GDP). The last indicator in this dimension is based on Tram et al. (2021), who added the value of money transactions (% of GDP) to ensure that financial services such as credit, deposits, and payment are fully used.

Construction of Financial inclusion index

Methodology

The first aim of our research is to construct a FI index for our full sample; Following the approach of, Cámara and Tuesta (2017) we calculate the FI index by using a two-stage of Principal Component Analysis (PCA) under the STATA 13 software:

Stage 1: the estimation of the three dimensions sub-indices (Penetration, Availability, and Usage). Where (Y_i^P, Y_i^a, Y_i^u) are unobserved endogenous variables, and (β, Θ, and γ) are parameters in the system of Equations (B), (c), and (d). In addition, the three dimensions are indices of estimation computed by the PCA method as linear functions of the explanatory variables.

Stage 2: the estimation of the weights in the FI index by following the same steps described in the first stage, to determine the weights of the three dimensions and the FI index by replacing Y_i^P, Y_i^a, Y_i^u into Equation (a).

Robustness of the FI index

Based on the suggestion of Park and Mercado (2018) and Tram et al. (2021), we examine the power of our FI index through its correlation with the index developed by the previous papers. For that, we chose the index built by Park and Mercado (2018). The motivation behind this choice is the similarity of the sample and the procedure used in data preparation (average of observations). All dimensions of the FI index have been winsorized at the 10th and 90th percentile.

Model specification

In our empirical analysis, we ran five regression models. First, we estimate which factors determine the financial inclusion for our full sample, high-income, upper middle income, lower middle income, and low-income countries. Following Honohan (2008), Omar and Inaba (2020) and Park and Mercado (2018), the log value was used for all the variables in the model except the variable Rule of law. To discover if different income-level groups will impact the results, we ran these regression models separately. First for the full sample of all countries including all income groups, second for a subset of the countries with high income, upper middle income, lower middle income, and low-income level.

$$\textit{Model (1): } FII_i = \alpha_0 + \beta_1 GNI_i + \beta_2 LAW_i + \beta_3 DEP_i + \beta_4 POP_i + \beta_5 EDU_i + \beta_6 LIT_i + e_i$$

$$\textit{Model (2): } POV_i = \alpha_0 + \beta_1 FII_i + \beta_2 INC_i + \beta_3 INF_i + \beta_4 EDU_i + \beta_5 BANC_i + \beta_6 GDPG_i + \beta_7 LAW_i + \beta_8 GNI_i * FII_{i+} e_i$$

$$\textit{Model (3): } GNI_i = \alpha_0 + \beta_1 FII_i + \beta_2 INF_i + \beta_3 EDU_i + \beta_4 BANC_i + \beta_5 GDPG + \beta_6 LAW_i + \beta_7 POV_i * FII_{i+} e_i$$

Before ran our model, we use the scatter plots technic for investigating a possible relationship between these variables and financial inclusion.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1 Estimation and robustness of FI index

The descriptive statistics of Indicators used for measuring the FI index are presented in Table no. 1. Especially, (Penetration, Availability, and Usage) dimensions are indices that we use in the PCA as linear functions of the explanatory variables. Before PCA, we have normalized[3] the indicators of each dimension to have values between 0 and 1. Where 1 indicates financial inclusion and 0 financial exclusion.

First stage PCA results

By using the PCA technique, we computed eigenvalues of each sub-index and estimate the latent variables: Penetration (Yp), Availability (Ya), and Usage (Yu). The eigenvalue of more than 1 indicates a more standardized variance among other components and it is retained for the analysis (Kasier, 1960).

Table no. 1 – Descriptive statistics

Dimensions/Variables	Observations	Mean	Std. Dev.	Min	Max
Penetration	Yp				
Daccounts	122	1295.92	960.28	128.53	3763.38
Maccounts	122	748.36	576.74	50.63	1607.64
Availability	Ya				
Branches	122	274.07	179.01	26.02	562.49
ATMs	122	205.48	129.68	43.40	380.97
Magents	122	53.62	28.62	19.20	112.68
Usage	Yu				
Deposit	122	15.90	11.21	2.74	36.43
Loans	122	6.86	10.12	0.07	25.03
MBTransactions	122	46.06	27.29	11.95	96.94

Source: author compilation

Table no. 2 – Principal components estimates for sub-indices

Component	Eigenvalue	Difference	Proportion	Cumulative
Penetration				
Comp1	**1.31286**	.625728	0.6564	0.6564
Comp2	.687136		0.3436	1.0000
Availability				
Comp1	**1.11623**	.108531	0.3721	0.3721
Comp2	**1.0077**	.131617	0.3359	0.7080
Comp3	.876078		0.2920	1.0000
Usage				
Comp1	**1.16954**	.174792	0.3898	0.3898
Comp2	.994747	.159034	0.3316	0.7214
Comp3	.835713		0.2786	1.0000

Source: author compilation

Table no. 2 presents the estimation of the principal components for sub-indices. The eigenvalues of the principal component for all dimensions are respectively: 1.31; 0.68

(Penetration); 1.11; 1.00; 0.87 (Availability) and 1.16; 0.99; 0.83 (Usage). So, we take only the components that have an eigenvalue more than 1, for our PCA results only the first component of each dimension is greater than 1. Consequently, the four components (1.31; 1.11; 1.003; 1.16) are selected for our analysis. For each component selected, the weights given by the PCA analysis are assigned. Therefore, the variables of penetration, availability, and usage dimensions are estimated.

The Table no. A3 shows that the principal components and eigenvalues provide information about the weights. Appropriately, concerning the penetration dimension, the weights assigned to the first component are 0.7071 (Daccounts) and 0.7071 (Maccounts). Concerning the availability dimension, the weight of ATMs indicator is higher (0.7121) than (Magents) indicator (0.0012) and Branches indicator (-0.7021). According to Tram et al. (2021), it can be explained by the high availability of ATMs in mature markets than others, and the difference between countries is remarkable. The indicator's weight of the last Usage dimension (Deposit, Loans, and MBTransactions) are respectively: 0.6503, -0.7012, and 0.2922.

To examine the convenience of the factors and to assign the above-extracted weights to equations (b-d), we have performed the Kaiser-Meyer-Olkin (KMO) test (Table no. A4). The computed value results of FI indicators by dimensions are indicated in Table no. A5.

Second stage PCA results

In this stage, by following the procedure of the first stage, the PCA method was applied to the three sub-indices for computing their weights in the FI index. The results of PCs estimate for the composite FI index are shown in Table no. 3.

For the three PCs, the eigenvalues respectively are 1.77, 0.74, and 0.47. This indicates that we take only the first component because its eigenvalue is more than 1. So, we consider it for finding the weights assigned to the PCs.

Table no. A7 indicates that the KMO value is 0.61 (more than 0.5) (Hair, Black, Babin, & Anderson, 2018). Consequently, the factor analysis is fit with the data**.** Similarly, to the method applied in the first stage, we also computed weights for the three dimensions. Particularly, Table no. A6 indicates that the PCA assigns to Usage (0.62) followed by Penetration (0.50) and Availability (-0.59). Soo, doing that, we estimate the FI index for our full sample as indicated in Table no. 4.

Table no. 3 - Principal components estimates for FI index

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.77965	1.03655	0.5932	0.5932
Comp2	0.743097	0.265842	0.2477	0.8409
Comp3	0.477255	0.1591		1.000

Source: author compilation

Robustness of the FI index

Figure no. 1 indicates the correlation between our indicator and FI of Park and Mercado (2018). The results show that the correlation of the FI index computed by applying the PCA method is very strong with the index of Park and Mercado (2018) who followed the Euclidean approach.

Table no 4 – Estimation of FI index for the full sample

Country Name	Code	Penetration	Availability	Usage	FI	Rank
San Marino	SMR	0.56	0.09	1	1.00	1
Korea. Rep.	KOR	0.86	0	0.49	0.78	2
Japan	JPN	0.82	0.15	0.54	0.74	3
Portugal	PRT	0.51	0.15	0.57	0.68	4
Iceland	ISL	0.87	0.39	0.55	0.67	5
Panama	PAN	1	0.43	0.50	0.66	6
Spain	ESP	0.48	0.31	0.62	0.64	7
Switzerland	CHE	0.56	0.35	0.58	0.62	8
Belgium	BEL	0.70	0.42	0.55	0.61	9
Bulgaria	BGR	0.26	0.24	0.59	0.59	10
Austria	AUT	0.41	0.14	0.48	0.59	11
Bahamas. The	BHS	0.43	0.27	0.53	0.58	12
Croatia	HRV	0.36	0.25	0.53	0.58	13
Malta	MLT	0.65	0.48	0.54	0.58	14
Turkey	TUR	0.48	0.26	0.49	0.57	15
Seychelles	SYC	0.23	0.31	0.59	0.56	16
Montenegro	MNE	0.24	0.27	0.56	0.55	17
Cyprus	CYP	0.51	0.49	0.57	0.55	18
Poland	POL	0.53	0.43	0.53	0.55	19
Italy	ITA	0.14	0.24	0.57	0.55	20
Mongolia	MNG	0.40	0.40	0.55	0.55	21
Ireland	IRL	0.32	0.25	0.50	0.54	22
Sweden	SWE	0.72	0.54	0.49	0.54	23
Georgia	GEO	0.27	0.28	0.53	0.54	24
Thailand	THA	0.25	0.21	0.48	0.53	25
Brunei Darussalam	BRN	0.49	0.41	0.50	0.53	26
Chile	CHL	0.57	0.47	0.49	0.52	27
Estonia	EST	0.53	0.43	0.48	0.52	28
Finland	FIN	0.53	0.52	0.53	0.52	29
North Macedonia	MKD	0.30	0.33	0.51	0.52	30
Latvia	LVA	0.50	0.45	0.49	0.51	31
Costa Rica	CRI	0.27	0.30	0.50	0.51	32
Peru	PER	0.22	0.20	0.46	0.51	33
Czech Republic	CZE	0.47	0.47	0.51	0.51	34
Liberia	LBR	0.16	0.68	0.73	0.50	35
Fiji	FJI	0.40	0.39	0.48	0.50	36
Namibia	NAM	0.28	0.29	0.4	0.50	37
Samoa	WSM	0.25	0.34	0.5	0.50	38
Jordan	JOR	0.34	0.39	0.4	0.49	39
Bosnia and Herzegovina	BIH	0.18	0.34	0.53	0.49	40
Armenia	ARM	0.20	0.33	0.5	0.49	41
United Arab Emirates	ARE	0.41	0.45	0.49	0.49	42
Guatemala	GTM	0.22	0.39	0.53	0.49	43
Saudi Arabia	SAU	0.40	0.42	0.47	0.48	44
Hungary	HUN	0.40	0.45	0.49	0.48	45
Netherlands	NLD	0.45	0.49	0.49	0.48	46
Colombia	COL	0.25	0.35	0.49	0.48	47
Mauritius	MUS	0.24	0.37	0.50	0.48	48
South Africa	ZAF	0.18	0.28	0.47	0.48	49
Indonesia	IDN	0.23	0.34	0.49	0.48	50
Argentina	ARG	0.24	0.349	0.48	0.47	51
Malaysia	MYS	0.23	0.36	0.48	0.47	52

Trinidad and Tobago	TTO	0.44	0.50	0.48	0.47	53
Tonga	TON	0.21	0.41	0.51	0.47	54
Suriname	SUR	0.24	0.36	0.47	0.47	55
Azerbaijan	AZE	0.30	0.40	0.47	0.46	56
Lebanon	LBN	0.17	0.40	0.51	0.46	57
Albania	ALB	0.16	0.38	0.50	0.45	58
Oman	OMN	0.40	0.54	0.49	0.45	59
Botswana	BWA	0.31	0.41	0.46	0.45	60
Belize	BLZ	0.15	0.38	0.50	0.45	61
Kosovo	XKX	0.19	0.41	0.49	0.45	62
Norway	NOR	0.40	0.51	0.47	0.45	63
Mexico	MEX	0.13	0.34	0.48	0.45	64
Dominican Republic	DOM	0.16	0.39	0.47	0.43	65
Greece	GRC	0.68	0.84	0.52	0.43	66
Bolivia	BOL	0.15	0.55	0.55	0.42	67
Ecuador	ECU	0.16	0.41	0.47	0.42	68
Ukraine	UKR	0.39	0.40	0.37	0.42	69
Jamaica	JAM	0.13	0.40	0.46	0.41	70
Maldives	MDV	0.14	0.44	0.48	0.41	71
Paraguay	PRY	0.15	0.42	0.46	0.41	72
Moldova	MDA	0.27	0.53	0.46	0.40	73
Guyana	GUY	0.10	0.42	0.46	0.40	74
Mauritania	MRT	0.02	0.46	0.49	0.38	75
Equatorial Guinea	GNQ	0.10	0.46	0.45	0.37	76
Congo. Dem. Rep.	COD	0.14	0.50	0.44	0.37	77
Eswatini	SWZ	0.17	0.55	0.461	0.37	78
Uzbekistan	UZB	0.21	0.60	0.46	0.36	79
Comoros	COM	0.01	0.44	0.45	0.36	80
Haiti	HTI	0.02	0.46	0.45	0.35	81
Bhutan	BTN	0.25	0.56	0.42	0.35	82
Gambia. The	GMB	0.03	0.49	0.46	0.35	83
Afghanistan	AFG	0.018	0.45	0.44	0.35	84
Vanuatu	VUT	0.17	0.54	0.43	0.35	85
Central African Republic	CAF	0	0.45	0.44	0.35	86
Myanmar	MMR	0.02	0.48	0.45	0.35	87
Nicaragua	NIC	0.12	0.61	0.47	0.34	88
Sao Tome and Principe	STP	0.19	0.60	0.43	0.34	89
India	IND	0.25	0.60	0.40	0.33	90
Honduras	HND	0.19	0.59	0.42	0.33	91
Chad	TCD	0.01	0.51	0.44	0.33	92
El Salvador	SLV	0.18	0.56	0.40	0.33	93
Madagascar	MDG	0.048	0.49	0.42	0.33	94
Mozambique	MOZ	0.09	0.54	0.42	0.32	95
Zambia	ZMB	0.20	0.67	0.44	0.32	96
Morocco	MAR	0.09	0.59	0.44	0.32	97
Nepal	NPL	0.11	0.67	0.481	0.32	98
Solomon Islands	SLB	0.07	0.46	0.37	0.31	99
Pakistan	PAK	0.07	0.59	0.446	0.31	100
Kyrgyz Republic	KGZ	0.17	0.57	0.38	0.31	101
Vietnam	VNM	0.19	0.60	0.39	0.31	102
Ghana	GHA	0.26	0.63	0.38	0.31	103
Yemen. Rep.	YEM	0.08	0.59	0.41	0.30	104
Lesotho	LSO	0.18	0.68	0.41	0.29	105
Micronesia. Fed. Sts.	FSM	0.13	0.62	0.40	0.29	106

Kenya	KEN	0.39	0.78	0.38	0.28	107
Lao PDR	LAO	0.15	0.60	0.37	0.28	108
Malawi	MWI	0.10	0.66	0.41	0.28	109
Egypt. Arab Rep.	EGY	0.08	0.73	0.46	0.28	110
Algeria	DZA	0.14	0.63	0.38	0.28	111
Djibouti	DJI	0.11	0.63	0.38	0.27	112
Cameroon	CMR	0.06	0.67	0.41	0.26	113
Papua New Guinea	PNG	0.05	0.64	0.38	0.25	114
Bangladesh	BGD	0.15	0.83	0.43	0.24	115
Guinea	GIN	0.06	0.73	0.38	0.22	116
Philippines	PHL	0.10	0.40	0.18	0.21	117
Rwanda	RWA	0.25	0.98	0.40	0.19	118
Cambodia	KHM	0.06	0.52	0.19	0.16	119
Uganda	UGA	0.22	0.85	0.30	0.16	120
Tanzania	TZA	0.33	1	0.29	0.13	121
Zimbabwe	ZWE	0.26	0.76	0	0.01	122

Source: Author compilation

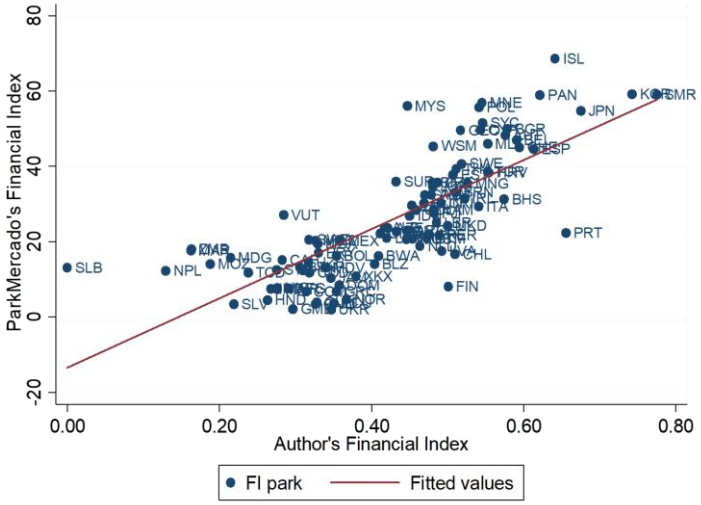

Figure no. 1 – Author's Financial inclusion index and Park and Mercado (2018) index
Source: author compilation

4.2 Determinants of financial inclusion

Following the work of Park and Mercado (2018), who have tested the significance of various factors impacting financial inclusion by using scatter plots, we will use the same procedure for examining the possible linkage between these factors and financial inclusion.

A higher per capita income probably increases financial inclusion level, because the financial sector is more developed in higher-income economies, and consequently provide better access to financial service (Figure no. 2). Literacy rates and higher primary school completion may reach for high access to financial services because these will positively impact financial literacy (Figure no. 5).

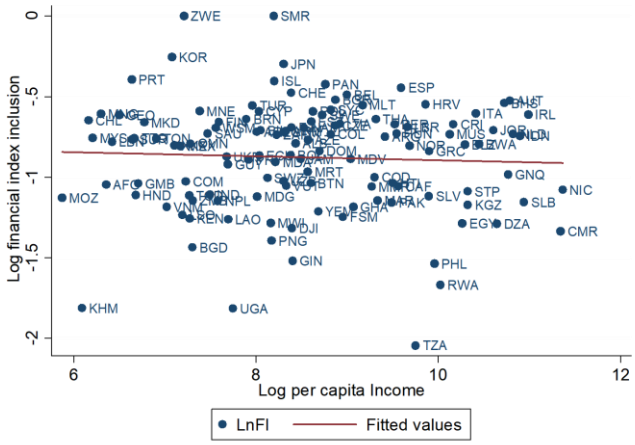

Figure no. 2 – Financial inclusion and Per Capita Income
Source: author compilation

Table no. 5 shows the empirical results on the determinants that impact the financial inclusion level in our full sample, high income, upper middle income, lower middle income, and low-income samples. Various variables are considered in our regression analysis after running the multicollinearity test (see Table no. A8).

The results show that for the full sample, rule of law, age dependency ratio, population density significantly impact financial inclusion. Particularly, countries with a high rule of law, and age dependency ratio significantly have higher financial inclusion; while countries with higher population density have lower financial inclusion.

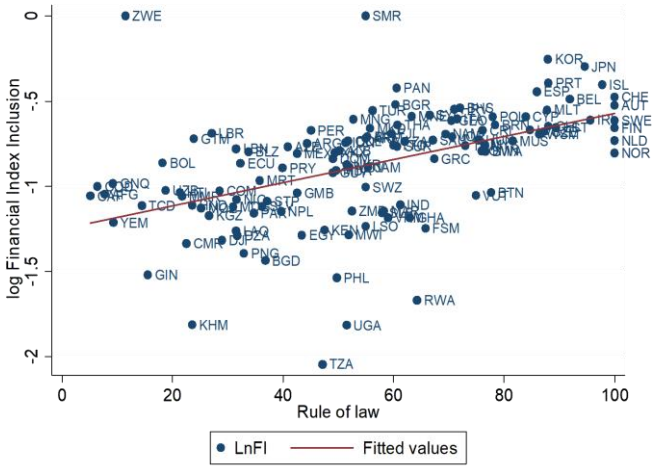

Figure no. 3 – Financial inclusion and Rule of law
Source: author compilation

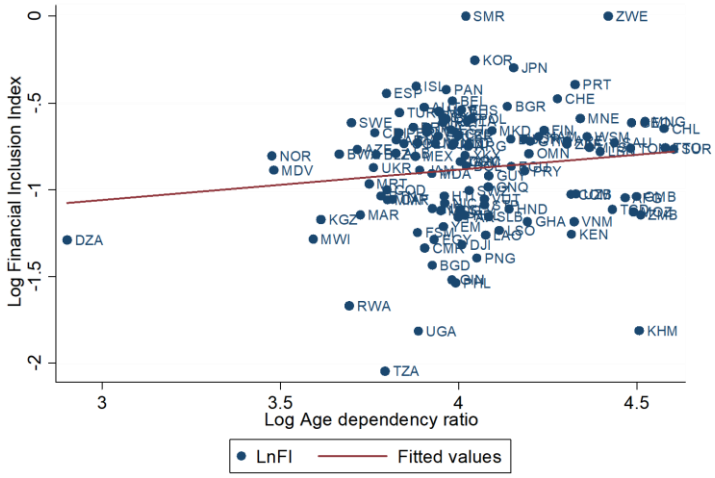

Figure no. 4 – Financial inclusion and Age dependency ratio
Source: author compilation

The estimate per capita income is positive for the four samples (high, middle and low income), meaning that economies with a high per capita income have a high financial inclusion level .this result is similar to Omar and Inaba (2020), Park and Mercado (2018) and Cámara and Tuesta (2017). Similarly, the law would enhance financial inclusion as it enforces financial contracts (Figure no. 3). Rule of law is also positive and highly significant for all samples, indicating that countries with a high institutional quality and good governance alleviating involuntary financial inclusion. This finding is consistent with Omar and Inaba (2020) but not with Park and Mercado (2018).

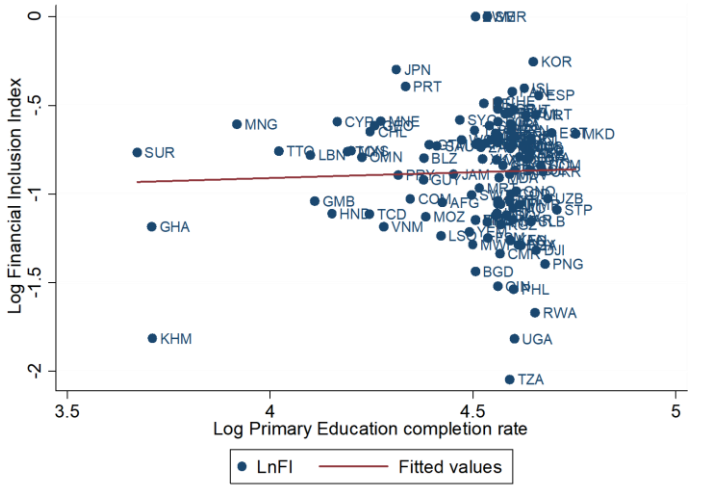

Figure no. 5 – Financial inclusion and Primary education completion rate
Source: author compilation

Only for the high-income countries higher age dependency ratio would decrease the level of financial inclusion for the reason that very younger and older people (especially after retirement) probably slow down their earn income and consequently their access to financial access. this finding is similar to Omar and Inaba (2020) and Park and Mercado (2018). Countries with a high population size are supposed to have higher financial inclusion level due to the effect of networking among people. This finding is consistent with Omar and Inaba (2020) but in contrast with Allen et al. (2016) and Park and Mercado (2018).

Table no. 5 – Determinants of financial inclusion

Variables	Full Sample	High income	Upper middle income	Lower middle income	Low income
GNI per capita	-0.010	0.006	0.062	0.040	0.135
	[-0.340]	[0.06]	[1.29]	[0.25]	[0.33]
Rule of law	0.007***	0.007***	0.005***	0.006**	0.008
	[-6.318]	[3.64]	[5.03]	[2.08]	[1.76]
Age Dependency	0.325***	-0.041	0.287	0.415	0.098
Ratio	[2.384]	[-0.14]	[1.63]	[1.25]	[0.09]
Population	-0.040**	-0.049	-0.052***	-0.047	-0.044
Density	[-2.258]	[-1.20]	[-3.01]	[-0.75]	[-0.72]
Education	0.201	-1.063	0.455**	0.187	0.293
Completion	[1.033]	[-1.22]	[2.34]	[0.37]	[0.64]
Literacy	0.174	7.345*	0.612	-0.163	0.165
	[1.025]	[1.74]	[0.80]	[-0.34]	[0.44]
Constants	-3.987***	-29.745	-7.450**	-3.275	-4.303
	[-3.423]	[-1.55]	[-2.07]	[-0.91]	[-0.52]
Observations	122	32	38	38	14
R-squared	0.323	0.435	0.593	0.181	0.583

Notes: Values in brackets are t-stat. ***, ** and * refer to significance at 1%, 5% and 10%, respectively.
Source: authors' estimates

To sum up, the results show that for the full sample, rule of law, age dependency ratio, population density significantly impact financial inclusion. Particularly, countries with a high rule of law, and age dependency ratio significantly have higher financial inclusion; while countries with higher population density have lower financial inclusion. The estimates reveal that rule of law and age dependency ratio are the main determinants for financial inclusion in the full sample. These findings are consistent with the results of Park and Mercado (2018), Honohan (2008) and Omar and Inaba (2020). However, unlike these authors, we find population negatively affects the level of financial inclusion.

These results are partially consistent for the high income, upper middle income, lower middle income, and low-income samples, only the rule of law is the determinant of financial inclusion. This result enhances the idea that involuntary financial exclusion is linked to the weak enforcement of contracts Park and Mercado (2018).

4.3 Impact of financial inclusion on poverty

In the previous section, we have examined the determinants of financial inclusion. In this section, we will test the effect of financial inclusion on poverty reduction. Figure no. 6 gives an idea about the negative relationship between financial inclusion and poverty

reduction. We include various control variables (Honohan, 2008; Park & Mercado, 2018), such as Income distribution; inflation which indicates the macroeconomic stability; Education completion rate, which significantly influences the poverty reduction; Bank claims growth which measures the financial depth; Also, we add rule of law, growth rates and the interaction between financial inclusion and per capita. We have tested the multicollinearity between these variables (Table no. A8)

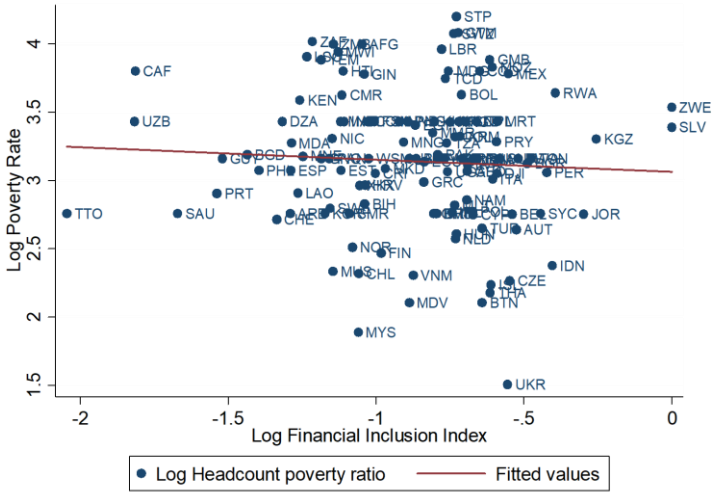

Figure no. 6 – Poverty and financial inclusion
Source: author compilation

In Table no. 6, we present the regression results of the impact of financial inclusion on poverty. For our full sample, high income, upper middle income, lower middle income, and low-income countries.

The estimates reveal that there is a robust relationship between financial inclusion and poverty reduction for the full sample, as well as high-income, upper middle income, lower middle income, and low-income countries. Across our samples, financial inclusion has a negative influence on the poverty rate. This suggests that financial services improve the life standards of people in all countries. This finding is consistent with Omar and Inaba (2020), Park and Mercado (2018) and Churchill and Marisetty (2020). Our findings enhance the results of previous studies on the negative relationship between education and poverty rates for the full sample. But for other samples the relation is unconfirmed. This result is appropriate with the view that education decreases poverty as it provides people skills to integrate the labor market and consequently to earn an income.

On another side, our findings suggest that income distribution is positively correlated with poverty in all our samples except in low-income countries, as well as a fair distribution of national wealth reduces poverty. In addition, inflation has no effect on poverty for all our samples, excluding high-income countries that have a negative relationship between inflation and poverty, and it is consistent with the work of Omar and Inaba (2020). Last but not least the association between financial inclusion and per capita income has a significant and positive correlation with poverty for our full sample. Butt for high income, upper middle

income, lower middle income, and low-income samples, the correlation is not significant. This finding is consistent with Park and Mercado (2018). This confirms that associating financial inclusion with a higher income level probably contributes to reduce poverty rates.

Table no. 6 – Impact of financial inclusion on poverty

Variables	Full Sample	High income	Upper middle income	Lower middle income	Low income
Financial Inclusion	-0.018*	-0.020	0.169	-0.096	0.244
	[-2.69]	[-0.13]	[0.37]	[-0.43]	[0.54]
Income distribution	1.000***	0.578	0.875*	1.521***	-0.442
	[5.00]	[1.41]	[1.82]	[0.83]	[-0.55]
Inflation	0.038	-0.081	0.053	0.000	0.031
	[1.02]	[-1.47]	[0.60]	[0.00]	[0.26]
Education	-0.464***	-0.172	-0.322	-0.369	0.193
Completion	[-2.40]	[-0.26]	[-0.67]	[-0.68]	[0.52]
Bank claims growth	-0.029	0.061	-0.056	-0.055	-0.075
	[-0.78]	[1.00]	[-0.68]	[-0.78]	[-0.55]
Rule of law	-0.000	0.000	-0.002	0.001442	-0.001
	[-0.24]	[0.28]	[-0.70]	[0.37]	[-0.22]
GNI*Financial	-0.105***	-0.047	-0.054	-0.047	-0.239
inclusion	[-3.64]	[-0.56]	[-0.46]	[-0.69]	[-0.88]
Constant	2.400**	1.827	2.06	-0.299	6.301
	[2.02]	[0.54]	[0.60]	[-0.09]	[1.32]
Observations	122	32	38	38	14
R-squared	0.512	0.274	0.243	0.401	0.338

Notes: Values in brackets are t-stat. ***, ** and * refer to significance at 1%, 5% and 10%, respectively.
Source: authors' estimates.

4.4 Impact of financial inclusion on income inequality

In this final section, we test the role of financial inclusion in coping with income inequality. We look forward to confirm the argument that a higher level of financial inclusion probably reduces income inequality, for the reason that people with low income can have access to financial services and subsequently increases their income. Yet, the relationship between financial inclusion and income inequality is not clear in Figure no. 7.

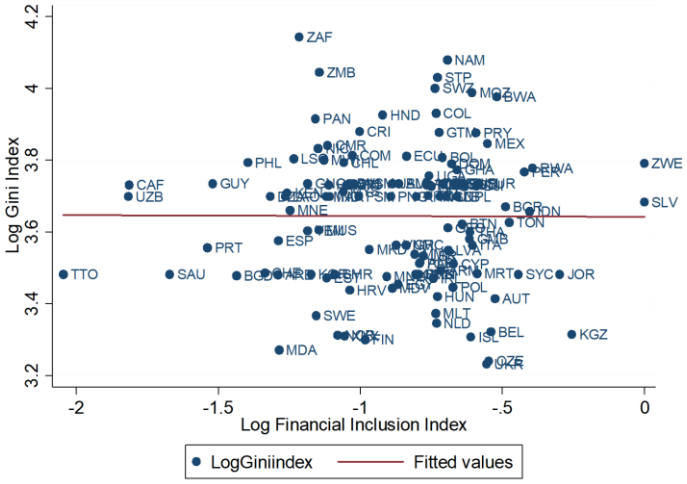

Figure no. 7 - Income inequality and financial inclusion
Source: author compilation

For examining this relationship, we take into consideration various control variables as inflation, primary education completion, bank claims growth, GDP growth, rule of law, and lastly the combination between financial inclusion and poverty rate (see Table no. A8). Table no. 7 presents our results on the impact of financial inclusion on income inequality for the full sample, high income, upper middle income, lower middle income, and low-income samples.

Table no. 7 - Impact of financial inclusion on income inequality

Variables	Full sample	High income	Upper middle income	Lower middle income	Low income
Financial Inclusion	-0.041	-0.290**	-0.093	-0.149*	0.080
	[-0.78]	[-2.43]	[-0.61]	[-1.68]	[0.63]
Inflation	0.020	0.017	0.075	-0.034	-0.010
	[1.25]	[0.59]	[2.40]	[-0.90]	[-0.32]
Education completion	-0.063	-0.302	0.024	-0.319	-0.240*
	[-0.77]	[-0.85]	[0.15]	[-1.54]	[-2.30]
Bank claims growth	0.043***	-0.023*	0.018	0.078	0.074
	[2.481]	[-0.68]	[0.62]	[2.87]	[2.05]
GDP growth	-0.001	0.050	-0.045	-0.112	0.090***
	[-0.053]	[1.09]	[-1.08]	[-1.93]	[4.33]
Rule of law	-0.002***	-0.001	-0.001	-0.001	-0.004**
	[-2.542]	[-1.23]	[-0.82]	[-0.66]	[-2.95]
Poverty*Financial inclusion	0.131***	0.218**	0.095	0.108	0.131
	[4.399]	[2.08]	[1.57]	[2.44]	[1.20]
Constant	3.612***	4.249**	3.331***	4.852***	4.437***
	[8.711]	[2.57]	[3.79]	[5.11]	[8.65]
Observations	122	32	38	38	14
R-squared	0.317	0.344	0.437	0.384	0.797

Notes: Values in brackets are t-stat. ***, ** and * refer to significance at 1%, 5% and 10%, respectively
Source: author compilation

Control variables are the same as control variables in the model presented in Table no. 6, with an exception for income distribution that was replaced by the association between poverty and financial inclusion. Our findings indicate that there is no correlation between the level of financial inclusion and income inequality, excluding the high-income and lower-middle-income level countries that have a significant and negative correlation. However, our findings in Table no. 6 indicated that financial inclusion reduces poverty for all our samples, but it seems that the effect of poverty reduction is not limited to lower-income level. This corroborates the argument that financial inclusion must be enlarged proportionally for poor people (Park & Mercado, 2018). In addition, Table no. 7 shows that growth in bank claims is correlated with income inequality for the full sample and high-income countries. This suggests that people with a low-income level are probably in a bad relationship with banks. The rule of law in our model is significantly correlated with income inequality only for the full sample and low-income countries. This enhances the argument that the quality of institutions and the trust in authorities can reduce income inequality. Lastly, the interaction between poverty rate and financial inclusion is significant and positively correlated with income inequality for both the full and high-income sample. This confirms that for decreasing income inequality, policymakers should focus their actions on decreasing poverty and facilitating financial services access.

5. CONCLUSIONS

In this paper, we tried to contribute to the determination of factors that influence financial inclusion and to examine the impact of financial inclusion on poverty and income inequality. For this reason, primary we constructed our financial inclusion index for 122 economies, including 32 from high-income, 38 from upper middle income,38 from lower middle income, and 14 from low-income countries. We have included in our financial inclusion index various dimensions such as Penetration, Availability, and Usage. We used the two-stage PCA method recommended by Cámara and Tuesta (2017), and we utilized annual data (2014-2019). The PCA method is considered a good method because it maximizes the dimensions of our financial inclusion index. Similar to Park and Mercado (2018), our financial inclusion index shows the same ranking for our selected countries.

By using this index, then we examine the crucial determinants that affect financial inclusion. The results show that for the full sample, rule of law, age dependency ratio, population density significantly impact financial inclusion. Particularly, countries with a high rule of law, and age dependency ratio significantly have higher financial inclusion; while countries with higher population density have lower financial inclusion. The estimates reveal that rule of law and age dependency ratio are the main determinants for financial inclusion in the full sample. However, we find population negatively affects the level of financial inclusion. These results are partially consistent for the high income, upper middle income, lower middle income, and low-income samples, only the rule of law is the determinant of financial inclusion.

For the Impact of financial inclusion on poverty reduction, this study enhances the results of previous studies on the negative relationship between education and poverty rates for the full sample. But for other samples the relation is unconfirmed. This result is appropriate with the view that education decreases poverty as it provides people skills to integrate the labor market and consequently to earn an income. On another side, our findings suggest that income distribution is positively correlated with poverty in all our samples except in low-income

countries. And a fair distribution of national wealth reduces poverty. In addition, inflation has no effect on poverty for all our samples, excluding high income countries that have a negative relationship between inflation and poverty. The association between financial inclusion and per capita income has a significant and positive correlation with poverty for our full sample. Butt for high income, upper middle income, lower middle income, and low-income samples, the correlation is not significant. This confirms that associating financial inclusion with a higher income level probably contributes to reduce poverty rates.

Concerning the Impact of financial inclusion on income inequality, our findings indicate that there is no correlation between the level of financial inclusion and income inequality, excluding the high-income and lower-middle-income level countries that have a significant and negative correlation. In addition, growth in bank claims is correlated with income inequality for the full sample and high-income countries. This suggests that people with a low-income level are probably in a bad relationship with banks. The rule of law in our model is significantly correlated with income inequality only for the full sample and low-income countries. The interaction between poverty rate and financial inclusion is significant and positively correlated with income inequality for both the full and high-income sample.

Overall, and based on our findings, this study offers some patterns to the policymakers at several levels. First, this study helps to measure financial inclusion and its relationship with macroeconomic variables such as rule of law, age dependency ratio, and population size that have high policy implications for many economies, especially for countries with a high aging population. Providing pensions for this population may enlarge access to financial services and consequently alleviating poverty. Second, the establishment of good governance throughout the enforcement of institutions and regulations mechanisms will automatically increase the level of financial inclusion for a large number of populations. Lastly, our results corroborate the findings of the scientific community on the strong relationship between financial inclusion and poverty alleviation. So, if policymakers want to reduce poverty they must enlarge and make easier financial access for all segments of the population. In this perspective, enhancing the role of microfinance especially in low- and middle-income countries may help to include a large segment of the population in the banking sphere.

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ANNEXES

Table no. A1 – Description of variables and sources

Variables	Description	Data sources
Financial Inclusion Index (FII)	Computed with PCA method based on Penetration, Availability and Usage.	
Penetration		FAS-IMF
Deposit accounts (DPaccounts)	Number of deposit accounts with commercial banks per 1,000 adults	
Mobile money accounts (MBaccounts)	Number of registered mobile money accounts per 1,000 adults	
Availability		FAS-IMF
Branches	Number of commercial banks, credit union per 100,000 adults	
ATMs	Number of Automated Teller Machines (ATMs) per 100,000 adults	
Mobile money agents	Number of registered mobile money agent outlets per 100,000 adults	
Usage		FAS-IMF
Deposit	Outstanding deposits with commercial banks, (% of GDP)	
Loans	Outstanding loans from commercial banks, (% of GDP)	
Mobile money transactions (MBGDP)	Value of mobile money transactions (% of GDP)	
GNI per capita (GNI)	GNI per capita is the gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population.	WDI
Rule of law (LAW)	Rule of Law Index is a quantitative assessment tool designed by the World Justice Project to offer a detailed and comprehensive picture of the extent to which countries adhere to the rule of law in practice. Where 1 signifies the highest score and 0 signifies the lowest score.	WDI
Dependency Ratio (DEP)	Age dependency ratio is the ratio of dependents-people younger than 15 or older than 64-to the working-age population--those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population.	WDI
Population Density (POP)	Population density is midyear population divided by land area in square kilometers.	
Education Completion (EDU)	Primary completion rate, is the number of new entrants (enrollments minus repeaters) in the last grade of primary education, regardless of age, divided by the population.	WDI
Literacy (LIT)	The 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.	WDI
Income Distribution (INC)	Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. The Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	WDI
Inflation (INF)	Inflation, as measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	WDI
Poverty (POV)	The national poverty headcount ratio is the percentage of the population living below the national poverty line.	WDI
Bank claims growth (BAN)	Claims on the private sector include gross credit from the financial system to individuals, enterprises, non-financial	WDI
GDP growth (GDPG)	The annual percentage growth rate of GDP at market prices is based on constant local currency.	WDI

Table no. A2 – List of countries

High income countries	Upper middle income countries	Lower middle income countries	Low income countries
United Arab Emirates	Albania	Bangladesh	Afghanistan
Austria	Argentina	Bolivia	Central African Republic
Belgium	Armenia	Bhutan	Congo, Dem. Rep.
Bahamas, The	Azerbaijan	Cameroon	Guinea
Brunei Darussalam	Bulgaria	Comoros	Gambia, The
Switzerland	Bosnia and Herzegovina	Djibouti	Haiti
Chile	Belize	Algeria	Liberia
Cyprus	Botswana	Egypt, Arab Rep.	Madagascar
Czech Republic	Colombia	Micronesia, Fed. Sts.	Mozambique
Spain	Costa Rica	Ghana	Malawi
Estonia	Dominican Republic	Honduras	Rwanda
Finland	Ecuador	India	Chad
Greece	Fiji	Kenya	Uganda
Croatia	Georgia	Kyrgyz Republic	Yemen, Rep.
Hungary	Equatorial Guinea	Cambodia	
Iceland	Guatemala	Lao PDR	
Jordan	Guyana	Lesotho	
Korea, Rep.	Indonesia	Morocco	
Latvia	Ireland	Moldova	
Malta	Italy	Myanmar	
Mauritius	Jamaica	Mongolia	
Netherlands	Japan	Mauritania	
Norway	Lebanon	Nicaragua	
Oman	Maldives	Nepal	
Panama	Mexico	Pakistan	
Poland	North Macedonia	Philippines	
Portugal	Montenegro	Papua New Guinea	
Saudi Arabia	Malaysia	Solomon Islands	
San Marino	Namibia	El Salvador	
Sweden	Peru	Sao Tome and Principe	
Seychelles	Paraguay	Eswatini	
Trinidad and Tobago	Suriname	Tanzania	
	Thailand	Ukraine	
	Tonga	Uzbekistan	
	Turkey	Vietnam	
	Samoa	Vanuatu	
	Kosovo	Zambia	
	South Africa	Zimbabwe	

Table no. A3 – Scoring Coefficients for orthogonal varimax rotation (weights)

Variable	Comp1	Unexplained
Penetration		
-zDaccounts	0.7071	0
-zMaccounts	0.7071	0
Availability		
-zBranches	-0.7021	0
-zATMs	0.7121	0
-zMagents	0.0012	0
Usage		
-zDeposit	0.6503	0
-zLoans	-0.7012	0
-zMBTransactions	0.2922	0

Table no. A4 – KMO test (first stage)

Variable	KMO
Penetration	**Overall (5.0000)**
-zDaccounts	0.5000
-zMaccounts	0.5000
Availability	**Overall (0.5057)**
-zBranches	0.5056
-zATMs	0.5054
-zMagents	0.5062
Usage	**Overall (0.5013**)
-zDeposit	0.5010
-zLoans	0.5009
-zMBTransactions	0.5061

Table no. A5 – FI dimensions of countries-First stage PCA

Country Name	Code	Penetration	Availability	Usage	Rank
San Marino	SMR	0,56	0,093582435	1	1
Korea, Rep,	KOR	0,8633071	0	0,499578791	2
Japan	JPN	0,827948085	0,151129626	0,546784754	3
Portugal	PRT	0,517633365	0,158083462	0,571421263	4
Iceland	ISL	0,876204834	0,397732272	0,550976223	5
Panama	PAN	1	0,438369661	0,506586836	6
Spain	ESP	0,484087314	0,316539007	0,620402482	7
Switzerland	CHE	0,566677255	0,3599018	0,581985006	8
Belgium	BEL	0,70183685	0,426675003	0,553927531	9
Bulgaria	BGR	0,2605665	0,240978659	0,597056027	10
Austria	AUT	0,412718907	0,148207174	0,482641214	11
Bahamas, The	BHS	0,430465939	0,278095439	0,533445085	12
Croatia	HRV	0,368822307	0,253953867	0,538193618	13
Malta	MLT	0,656412933	0,480011504	0,545152885	14
Turkey	TUR	0,481838664	0,269957892	0,49723558	15
Seychelles	SYC	0,236778619	0,315667784	0,593180741	16
Montenegro	MNE	0,248123942	0,278682218	0,563509374	17
Cyprus	CYP	0,5159337	0,496105391	0,574226413	18
Poland	POL	0,532222883	0,43261694	0,53341825	19
Italy	ITA	0,143346301	0,24157833	0,571547109	20
Mongolia	MNG	0,404931164	0,404790909	0,55716767	21
Ireland	IRL	0,323385432	0,256195424	0,505307469	22
Sweden	SWE	0,728499837	0,541797425	0,499284007	23
Georgia	GEO	0,276881233	0,287084871	0,536190914	24
Thailand	THA	0,255991309	0,216702519	0,485868866	25
Brunei Darussalam	BRN	0,495678866	0,416115773	0,50003983	26
Chile	CHL	0,57245587	0,479408931	0,498419431	27
Estonia	EST	0,533759341	0,431012686	0,481877413	28
Finland	FIN	0,537430274	0,528602106	0,530973837	29
North Macedonia	MKD	0,305729303	0,332326323	0,514546515	30
Latvia	LVA	0,507987338	0,454660323	0,493841076	31
Costa Rica	CRI	0,27309194	0,307031966	0,50426449	32
Peru	PER	0,223383996	0,203335373	0,466581688	33
Czech Republic	CZE	0,476187357	0,476361066	0,511506918	34
Liberia	LBR	0,161910892	0,68555006	0,737433508	35

Country Name	Code	Penetration	Availability	Usage	Rank
Fiji	FJI	0,407125493	0,392650293	0,48357291	36
Namibia	NAM	0,28371171	0,297960666	0,479230702	37
Samoa	WSM	0,25688098	0,341898295	0,511707015	38
Jordan	JOR	0,3425244	0,390931745	0,495827176	39
Bosnia and Herzegovina	BIH	0,184534452	0,34868148	0,532925374	40
Armenia	ARM	0,207461311	0,333738105	0,512561992	41
United Arab Emirates	ARE	0,415723195	0,451930504	0,491592811	42
Guatemala	GTM	0,224583183	0,393817066	0,532744324	43
Saudi Arabia	SAU	0,407454499	0,424500344	0,474402642	44
Hungary	HUN	0,407573087	0,459899576	0,492801261	45
Netherlands	NLD	0,455391769	0,498407253	0,493218825	46
Colombia	COL	0,250201119	0,351873712	0,492521254	47
Mauritius	MUS	0,246120628	0,376293895	0,506950407	48
South Africa	ZAF	0,185246872	0,282518601	0,477643939	49
Indonesia	IDN	0,230817096	0,348751616	0,49144053	50
Argentina	ARG	0,248247573	0,349558264	0,481281428	51
Malaysia	MYS	0,237862247	0,364155551	0,488935815	52
Trinidad and Tobago	TTO	0,447811975	0,508477398	0,483617107	53
Tonga	TON	0,219267309	0,415553393	0,519480127	54
Suriname	SUR	0,248861333	0,36269505	0,476746111	55
Azerbaijan	AZE	0,301044017	0,400998201	0,475527385	56
Lebanon	LBN	0,17795579	0,401009917	0,515364771	57
Albania	ALB	0,168430733	0,388488193	0,505031	58
Oman	OMN	0,400352541	0,542927889	0,497362112	59
Botswana	BWA	0,3108339	0,418002393	0,462750716	60
Belize	BLZ	0,15324733	0,385124859	0,503701713	61
Kosovo	XKX	0,198725934	0,410032112	0,496681992	62
Norway	NOR	0,40874366	0,51556664	0,470322786	63
Mexico	MEX	0,133333602	0,3414963	0,481781416	64
Dominican Republic	DOM	0,161363605	0,390560678	0,477629537	65
Greece	GRC	0,681777619	0,849780599	0,523103034	66
Bolivia	BOL	0,157464253	0,556955255	0,552284922	67
Ecuador	ECU	0,160660869	0,417738431	0,474510841	68
Ukraine	UKR	0,398774038	0,406364221	0,371273421	69
Jamaica	JAM	0,135317198	0,404937709	0,464808251	70
Maldives	MDV	0,143467235	0,441357092	0,481030146	71
Paraguay	PRY	0,15141386	0,421377024	0,463576789	72
Moldova	MDA	0,276080572	0,536186815	0,469313773	73
Guyana	GUY	0,100255352	0,422763198	0,46798904	74
Mauritania	MRT	0,017287863	0,463435317	0,49532439	75
Equatorial Guinea	GNQ	0,100001786	0,469097966	0,457772621	76
Congo, Dem, Rep,	COD	0,148422951	0,503369957	0,446998683	77
Eswatini	SWZ	0,179566601	0,557683047	0,462338891	78
Uzbekistan	UZB	0,212600774	0,602481022	0,463111257	79
Comoros	COM	0,010679029	0,44368013	0,45397262	80
Haiti	HTI	0,028159518	0,460642356	0,451614312	81
Bhutan	BTN	0,25333226	0,564888646	0,420218963	82
Gambia, The	GMB	0,039482269	0,498281146	0,466136174	83
Afghanistan	AFG	0,018282866	0,457226356	0,448618681	84
Vanuatu	VUT	0,177292245	0,546144939	0,431024977	85
Central African Republic	CAF	0	0,45373922	0,448352658	86

Country Name	Code	Penetration	Availability	Usage	Rank
Myanmar	MMR	0,024884521	0,482671347	0,453671348	87
Nicaragua	NIC	0,12508648	0,611295597	0,473671417	88
Sao Tome and Principe	STP	0,196421773	0,605773526	0,438249179	89
India	IND	0,252681096	0,608331469	0,408814343	90
Honduras	HND	0,194304372	0,598469718	0,424883887	91
Chad	TCD	0,007626252	0,510452914	0,447962759	92
El Salvador	SLV	0,185444033	0,566159511	0,406930604	93
Madagascar	MDG	0,048190906	0,49879297	0,423366562	94
Mozambique	MOZ	0,096042439	0,542557901	0,424025951	95
Zambia	ZMB	0,208347007	0,67682509	0,445601554	96
Morocco	MAR	0,097498169	0,591604502	0,442048307	97
Nepal	NPL	0,112859594	0,678081	0,481427381	98
Solomon Islands	SLB	0,079498639	0,468095204	0,377841113	99
Pakistan	PAK	0,071487485	0,59159103	0,446726404	100
Kyrgyz Republic	KGZ	0,176418422	0,573138843	0,389033033	101
Vietnam	VNM	0,193205964	0,600817671	0,391679432	102
Ghana	GHA	0,260559268	0,639194858	0,386037653	103
Yemen, Rep,	YEM	0,084059155	0,598766185	0,419745392	104
Lesotho	LSO	0,184127012	0,680135612	0,416090773	105
Micronesia, Fed, Sts,	FSM	0,133554159	0,628764409	0,402904018	106
Kenya	KEN	0,392601135	0,78635176	0,382991702	107
Lao PDR	LAO	0,152057004	0,609903476	0,378491376	108
Malawi	MWI	0,108083512	0,662185596	0,414722289	109
Egypt, Arab Rep,	EGY	0,081294442	0,7344585	0,462903522	110
Algeria	DZA	0,149134197	0,639823054	0,384856439	111
Djibouti	DJI	0,113595444	0,635968622	0,385826174	112
Cameroon	CMR	0,068304948	0,676632989	0,418115706	113
Papua New Guinea	PNG	0,055868817	0,646690832	0,384052978	114
Bangladesh	BGD	0,156140175	0,830611094	0,430048005	115
Guinea	GIN	0,062637531	0,732619841	0,385386373	116
Philippines	PHL	0,100533085	0,407206179	0,18945246	117
Rwanda	RWA	0,254357821	0,988289404	0,403632328	118
Cambodia	KHM	0,059366911	0,524689415	0,192506094	119
Uganda	UGA	0,223661729	0,852562198	0,304746242	120
Tanzania	TZA	0,330805626	1	0,293639098	121
Zimbabwe	ZWE	0,267537402	0,763020494	0	122

Table no. A6 – Scoring Coefficients for orthogonal varimax rotation (weights)

Variable	Comp1	Unexplained
-zPenetration	0.5049	0
-zAvailability	-0.5951	0
-zUsage	0.6252	0

Table no. A7 – KMO test (Second stage)

Variable	Overall (0.6164)
-zPenetration	0.7162
-zAvailability	0.6027
-zUsage	0.5845

Table no. A8 – Multicollinearity test

	FII	GNI	LAW	DEP	POP	EDU	LIT	INC	INF	POV	BAN	GDPG
FII	1.000											
GNI	-0.061	1.000										
LAW	0.595***	0.009	1.000									
DEP	0.021	-0.335***	-0.041	1.000								
POP	-0.054	0.130	-0.018	-0.009	1.000							
EDU	0.023	0.313***	0.030	-0.664***	0.102	1.000						
LIT	0.084	0.385***	0.146	-0.654***	0.089	0.689***	1.000					
INC	-0.054	-0.465***	-0.165*	0.397***	-0.09	-0.25***	-0.176*	1.000				
INF	0.050	-0.245***	-0.077	0.190**	-0.06	-0.128	-0.238***	0.157*	1.000			
POV	-0.088	-0.454***	-0.19**	0.671***	-0.07	-0.50***	-0.564***	0.57***	0.277***	1.000		
BAN	-0.009	-0.151*	0.052**	-0.003	-0.05	0.139	0.064	0.142	0.212**	0.029	1.000	
GDPG	0.099	-0.143	0.077	0.023	-0.10	0.084	-0.065	0.002	-0.137	-0.05	0.29***	1.000

Notes

[1] https://www.gpfi.org/data (Accessed : 13 February 2022).

[2] https://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.gsma.com%2Fmobileeconomy%2Fwpcontent%2Fuploads%2F2020%2F06%2FGSMA_MobileEconomy_2020_AsiaPacific.pdf&clen=5668877&chunk=true (Accessed : 13 February 2022).

[3] The normalized value of e_i for variable E in the i[th] row is calculated as:

$$Normalized\ (e_i) = \frac{e_i - E_{min}}{E_{max} - E_{min}}$$

where

E_{min} = the minimum value for variable E

E_{max} = the maximum value for variable E

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