Economics Bulletin

Volume 41, Issue 3

Measuring financial inclusion in African countries

Désiré Avom
University of Yaoundé 2 (Soa), CEREG

Chrysost Bangaké
University of Artois, Lille Economie et Management (LEM), Arras, F-62000, France

Hermann Ndoya
University of Dschang, Laboratoire de Recherche en Economie Fondamentale et Appliquée (LAREFA)

Abstract

There is no consensus in the literature on how to measure financial inclusion. Previous studies mainly rely on supply-side information to measure the extent of financial inclusion. We contribute to this literature by using a newly created index of overall financial inclusion for 37 African countries for the periods 2011, 2014 and 2017. Our measure comprises four dimensions: access, penetration, usage and barriers. Furthermore, we apply a two-stage principal component analysis (PCA) to assign weight to the dimensions. The proposed index is robust and comparable across countries. It is highly correlated with macroeconomic variables such as GDP per capita, education, institutional quality and consumption.

Citation: Désiré Avom and Chrysost Bangaké and Hermann Ndoya, (2021) "Measuring financial inclusion in African countries", *Economics Bulletin*, Vol. 41 No. 3 pp. 867-881
Contact: Désiré Avom - davom99@gmail.com, Chrysost Bangaké - chrysost.bangake@univ-artois.fr, Hermann Ndoya - hermannondoya@gmail.com.
Submitted: June 23, 2020. **Published:** July 18, 2021.

1. Introduction

Financial inclusion, defined as the proportion of individuals and firms that use financial services, has become a subject of considerable interest among policy makers, researchers, and other stakeholders. The heightened interest reflects a better understanding of the importance of financial inclusion for economic and social development. This indicates a growing recognition that access to financial services has a critical role in reducing extreme poverty, boosting shared prosperity, and supporting inclusive and sustainable development. In this regard, in Seoul in 2010, the issue of financial inclusion was addressed in the context of the Sustainable Development Agenda of the United Nations Development Programme. There are 17 newly proposed sustainable development goals (SDGs) and their achievement relies on public as well as private financing from industrial countries. Financial inclusion has been recognized as a catalyst for 7 of the 17 SDGs, including poverty reduction; and employment of women.

While this topic is highly interesting and has clear implications for developing countries, existing academic studies on the measure of financial inclusion have failed to reach a consensus. Previous studies have mainly relied on supply-side information to measure the extent of financial inclusion. For example, Honohan (2008) measured financial inclusion as the proportion of the adult population in an economy with a bank account in a formal financial institution. However, such a definition ignores other important aspects of financial inclusion, such as access, affordability, quality and usage of the financial system (Demirguc-Kunt and Klapper, 2012; Camara and Tuesta, 2014). To overcome these problems, many recent studies have attempted to provide a more comprehensible definition of financial inclusion and to construct more relevant indicators (Sarma, 2008; Chakravarty et al, 2010; Gupta et al, 2012; Sarma, 2015; Goel and Sharma, 2017). Unfortunately, these studies suffer from many shortcomings. As Camara and Tuesta (2014) mentioned "existing attempts to build financial inclusion indices rely only on supply country level data and come up with inaccurate reading of financial inclusion due to the existence of measurement errors in the usage indicators. Supply-side indicators can overestimate the inclusiveness of finance system" (p.3). Furthermore, these studies assign exogenous weights to financial inclusion indicators.

To solve these problems, Camara and Tuesta (2014) proposed a multidimensional financial inclusion index covering eighty-two countries for 2011. The weights assigned to the three dimensions (usage, barriers and access) are determined endogenously by using a two-stage principal component analysis (PCA)[1]. More recently, Nguyen (2020) used this approach to construct a composite index for forty-one developing countries. Our study is part of this tradition insofar as it draws on the work by Camara and Tuesta (2014), but it differs in several ways. The first novelty of this paper is that we focus solely on African countries because households in these countries are often unable to resort to financial markets to smooth out their revenue. Moreover, in sub-Saharan Africa, 80% of the adult population has no access to basic financial services, and only 34% have an account in a formal financial institution (CGAP, 2011; Demirguc-Kunt et al, 2015). The issue of financial inclusion is much more acute in Africa than elsewhere. To the best of our knowledge, there are no empirical studies that tackle the measurement of financial inclusion in Africa. This study tries to fill this gap. As a second novelty, we introduce mobile money in the analysis when building our multidimensional index. With the exception of the work by Nguyen (2020), previous have ignored this aspect. It is now widely accepted that advances in technology, especially mobile phones have revolutionized

[1] Amidžić et al (2014) constructed a financial inclusion indicator based on common factor analysis. Unfortunately, one drawback of this approach is that it requires assumptions on the raw data, such as selection of the underlying number of common factors (Steiger, 1979). Furthermore, common factor analysis reduces a set of variables to a smaller number of factors and, therefore, does not fully utilize data for all variables for each country.

financial services provision and introduced new models of serving the poor in African countries. In Kenya, for example, the M-Pesa service has enabled the rapid development of mobile money, with a coverage rate of almost 78% of the population (Economist Intelligence Unit, 2016). This is also the case in Uganda and Tanzania where mobile money has enabled rural people to save their farm income and carry out their transactions safely without being limited by distance or cost. As a third novelty, unlike the works by Nguyen (2020); and Camara and Tuesta (2014), which used three dimensions to measure the extent of financial inclusion, our index has four dimensions: access, penetration, usage and barriers. In this regard, we integrate the variables on demand and supply side information and consider three years; 2011, 2014 and 2017. This allows us to analyze the evolution of the index and the contribution of some key variables in different countries. As a fourth novelty, and for robustness checks, we perform multivariate regressions of our index on macro variables and briefly discuss the result.

The rest of the paper is organized as follows: Section 2 presents the framework. Section 3 outlines our methodology and data. Section 4 presents the results, while Section 5 highlights the main conclusions and policy implications for African countries.

2. Framework

2.1 Definition of financial inclusion

How to measure financial inclusion is a question that is attracting increasing attention. However, empirical studies on the measure of financial inclusion have failed to reach a consensus[2]. The lack of a harmonized measure that collects multidimensional information to define financial inclusion makes this task difficult. The recent financial inclusion index proposed by Camara and Tuesta (2014) addresses this problem by constructing a comprehensive measure that combines demand and supply-side information. According to these authors, financial inclusion can be defined as the phenomenon of maximizing usage and access to financial services while minimizing involuntary exclusion[3].

Thus, the Alliance for Financial Inclusion (2013), taking into account access (availability and physical proximity of financial services), usage (frequent and regular usage of financial services) and quality, defines financial inclusion as access to and usage of formal financial services at affordable cost by all segments of the population to satisfy their needs.

2.2 Dimensions and variables of financial inclusion

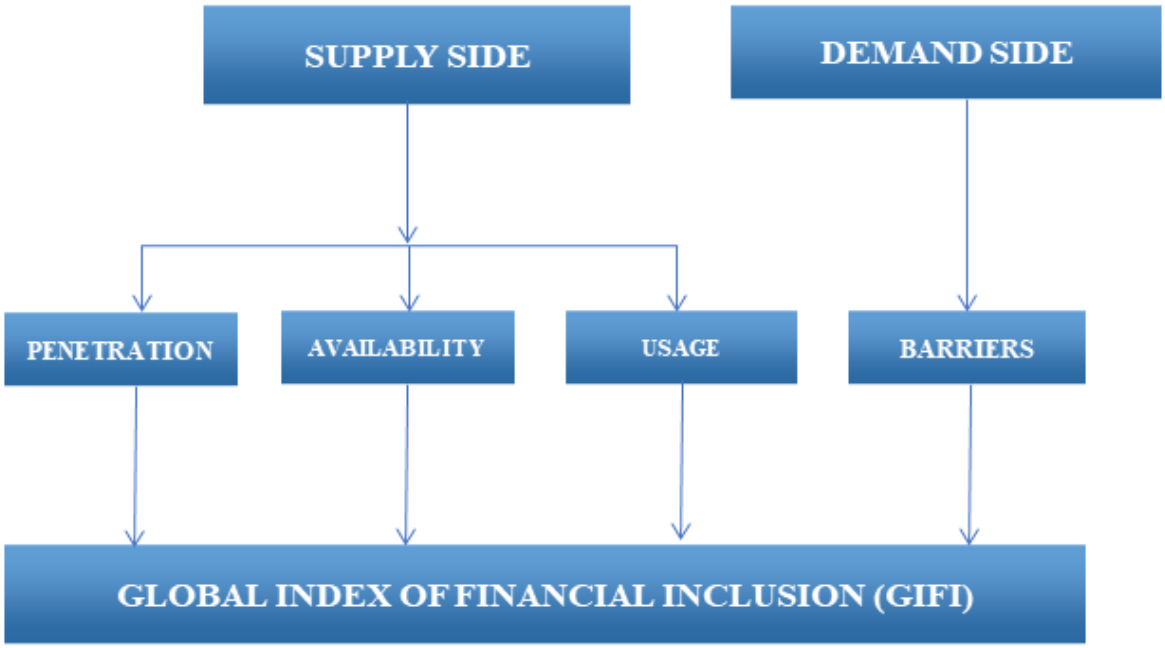
This subsection outlines the methods used to construct a multidimensional index of financial inclusion. This multidimensional approach is motivated by the notion that the inclusiveness of a financial system should be evaluated along several pertinent dimensions. Our financial inclusion index is in line with Camara and Tuesta's approach, but it deviates from their index in at least two ways. First, while the degree of financial inclusion is determined by three dimensions (usage, barriers and access) in their work, we propose a more relevant index that incorporates a sufficient number of variables. Specifically, we postulate that the degree of financial inclusion is determined by four dimensions: penetration, availability, usage and

[2] For example, Honohan (2008) measured financial inclusion as the proportion of the adult population in an economy with a bank account in a formal financial institution. Sarma (2008) defined financial inclusion as a process that ensures the ease of access, availability and usage of the formal financial system for all members of an economy.

[3] Involuntary financial exclusion is measured by a set of barriers perceived by those individuals who do not participate in the formal financial system.

barriers. Second, our index takes into account mobile financial services. The global structure of our index can be seen as in Figure 1.

Figure 1: Global structure of the financial inclusion index



Source: The authors

Dimension 1 (D1): Bank penetration

In this study, we measure bank penetration using two variables: demographic penetration measured by automated teller machines (ATMs) per 100000 people and commercial banks per 100000 people, and geographic penetration, measured by the number of commercial banks and ATMs per 1000 km². ATMs are computerized telecommunications devices that provide clients of a financial institution with access to financial transactions in a public place. ATMs are widely used and are practical in the sense that they are easily accessible and operate even beyond brick-and-mortar banks hours. Commercial bank branches are retail locations of resident commercial banks and other resident banks that function as commercial banks. We obtain data from the Financial Access Survey, which is compiled and published by the International Monetary Fund (IMF).

Dimension 2 (D2): Availability of financial products and services

This dimension captures formal financial services. The main idea is that banks and other financial institutions in the market should make available to individuals and businesses a wide range of formal financial services so that they can choose the financial product or service that suits them and their financial means. The variables used are: the proportion of adults with an account in a formal institution, the possession of a bank card (debit and/or credit), and the

proportion of adults with a mobile account. We obtain data from the World Bank's Global Findex database[4].

Dimension 3 (D3): Usage of financial products and services

We also consider usage important in measuring the level of financial inclusion in an economy because it takes into consideration the actual activities that take place within accounts. It is argued that simply being in possession of a bank account is not enough for an inclusive system because it is also imperative that banking services be adequately utilized. We consider several forms of utilization in this case: savings in a formal institution, withdrawals from a formal financial institution, loans from a formal financial institution, use of digital payments (making or receiving payments), and life and nonlife insurance policies. The data used come from the Global Findex Database and the Global Financial Development Database (GFDD) for insurance.

Dimension 4 (D4): Barriers to access and usage of financial products and services:

Many individuals are excluded from the conventional financial system. According to Global Findex 2017, nearly 1.7 billion people remain unbanked worldwide. The reasons often put forward are: the cost of services, distance, lack of trust, lack of necessary documentation, lack of financial means, and cultural and religious reasons. All these constitute barriers to the access to and use of financial products (Demirguc-Kunt and Klapper, 2012). This is the case in African countries. Therefore, we look at barriers to access and usage of financial products as a fourth dimension because they matter. These barriers can lead to voluntary exclusion of individuals (self-exclusion) or involuntary exclusion linked to market imperfections. In this work, we consider involuntary exclusion: cost, distance, documentation, trust and lack of funding. This information is collected from the Global Findex database.

3. Methodological approach and data

We closely follow the approach developed by Nagar and Basu (2002) and Camara and Tuesta (2014) who used PCA to weight socioeconomic indicators through the latent variable. This methodology has recently been used by Nguyen (2020). The main advantage of this method is that it considers all the information contained in each variable used in the construction of the index. The index is separately derived for each of the three years.

The first step uses PCA to estimate each of the four dimensions (penetration, availability, usage and barriers) as linear functions of the explanatory variables which are indicators included in each dimension, as described in Section 2. The weights are assigned to each indicator included in the construction of the dimension indices according to their respective contributions. The second stage uses PCA again to compute the overall financial inclusion index by applying a similar procedure to that described in the first stage. In this stage the overall financial inclusion index is estimated as a linear function of dimension indices and any dimension is weighted according to its contribution to the construction of the overall index[5].

[4]We also specify in this dimension separate indicators considering account in order to include in our index people with more than one account, because we note that many people have a mobile account, an account with a financial institution (bank, microfinance provider, cooperative) or both.

[5] To save space, we omit all definitions, notation, and equations from the paper. For more details on the methodology used, see the work of Camara and Tuesta (2014) and Nagar and Basu (2002).

We build three financial inclusion indices covering three years: 2011, 2014 and 2017. However, we do not use all the variables at once in every period. We gradually integrate them into the analysis. For example, we do not include the variables on the "mobile banking" for 2011 because of their unavailability and also exclude the variables explaining the "barriers" dimension. Likewise, for 2014, we include "Mobile Banking" variables but not those of the "barriers" dimension, given that they are not available. Finally, for 2017, all variables are included.

In this regard, we take advantage of the information in the World Bank's Findex database, the Global Financial Development Database (GFDD) and the Financial Access Survey (FAS). The sample contains 32 countries in 2011, 24 countries in 2014 and 2017. The choice of sample and period is dictated by data availability.

The descriptive statistics and the definitions of each variable are shown in Table A.11 and A.12 in the Appendix, respectively.

4. Results and discussion

4.1 Results of the first stage of PCA

In this first stage, we used PCA to obtain the weight and contribution of each variable to the calculation of the index for each dimension.

In dimension 1, which captures the penetration level, the most important variables are those capturing the demographic penetration of banks, i.e., the number of commercial banks per 100000 adults and the number of ATMs per 100000 adults. Both variables contribute nearly 52% to the construction of the index on this dimension, with the remaining 48% of the variables capturing geographical penetration. This means that population indicators provide better information than space indicators. On this dimension, in 2011, for example, Mauritius, South Africa and Botswana occupied the top three places with scores of 0.94, 0.37 and 0.19, respectively. The bottom-ranking countries were Guinea, the Central African Republic (CAR) and Chad, with scores of 0.01, 0.005 and 0.003 respectively (*see Appendix A.2*).

As far as the second dimension (availability of financial services) is concerned, it is important to note that the variables that make the largest contributions are mobile banking and having an account with a formal institution. They contribute 46% and 22%, respectively, to the construction of the dimension index for 2014. Considering mobile banking, Kenya was in first place in 2014 with a score of 0.85, compared to 0.50 for 2011, when it occupied fourth place (s*ee Appendices A.2 and A.3*).

It should be noted that mobile banking has enabled African countries to improve the supply of available financial services by increasing the penetration of banks and other financial institutions. With regard to the third dimension, which captures the level of usage of financial services, the variables nonlife insurance and withdrawal are those that contribute the most to the index on this dimension, with 26% and 22%, respectively. The top ranked countries are South Africa, Mauritius and Kenya with scores of 0.81, 0.76 and 0.63 respectively (*see Appendix A.3*).

Finally, lack of money, distance and documentation are the top indicators defining the barriers to access, with weights of 31%, 17% and 14%, respectively. The cost of financial services and lack of trust account for the remaining 38% (*see Appendix A.4*).

4.2 Results of the second stage of the PCA

In the second stage, we apply PCA on the four dimensions (penetration, availability, usage, and barriers) to compute their weights in the overall index. We observe that the usage and availability of financial services are the most important dimensions that contribute to the construction of the global index of financial inclusion in African countries. On the other hand, penetration of formal financial services and barriers contribute the least to the construction of the overall index. With all components taking together, the average level of financial inclusion steadily increased over the study period, from 0.18 in 2011; to 0.29 in 2017.

Table 1 shows the ranking of countries according to the value on our financial inclusion index in 2011.

Mauritius, South Africa and Kenya had the most inclusive financial systems in 2011. Niger occupies the last position with a score of 0.02. The top-ranked countries for 2011 are those with high levels of banking penetration, in contrast to those at the bottom of the ranking.

Table 1: Global index of financial inclusion (GIFI) in Africa 2011

Countries	GIFI	Rank	Countries	GIFI	Rank
Mauritius	0.89	**1**	Sierra Leone	0.13	**17**
South Africa	0.63	**2**	Cameroon	0.11	**18**
Kenya	0.38	**3**	Chad	0.11	**19**
Angola	0.38	**4**	Togo	0.10	**20**
Botswana	0.34	**5**	Congo	0.10	**21**
Rwanda	0.23	**6**	Senegal	0.09	**22**
Nigeria	0.22	**7**	Egypt	0.09	**23**
Lesotho	0.21	**8**	Benin	0.09	**24**
Zambia	0.20	**9**	Burkina-Faso	0.08	**25**
Ghana	0.20	**10**	Mali	0.07	**26**
Uganda	0.19	**11**	Burundi	0.06	**27**
Tanzania	0.18	**12**	Sudan	0.05	**28**
Malawi	0.16	**13**	Guinea	0.03	**29**
Gabon	0.15	**14**	Madagascar	0.03	**30**
Djibouti	0.15	**15**	CAF	0.02	**31**
Algeria	0.14	**16**	Niger	0.02	**32**

Note: This index is computed with three dimensions: penetration, availability and usage of financial products and services.

Considering the two mobile banking variables (digital payment volume and having a mobile money account), on average, African countries improved their level of financial inclusion by 8 points, from 0.18 to 0.26. These results are in line with the preceding works by Mialou et al (2017) who saw a similar evolution on their index of financial inclusion across time. However, we attribute the improvement in the average financial inclusion scores between 2011 and 2014 to mobile banking.

Table 2: Global index of financial inclusion in Africa 2014

Countries	GIFI	Rank	Countries	GIFI	Rank
Mauritius	0.74	**1**	Ivory Coast	0.22	**13**
South Africa	0.56	**2**	Zambia	0.21	**14**
Kenya	0.53	**3**	Senegal	0.18	**15**
Namibia	0.45	**4**	Congo	0.15	**16**
Botswana	0.41	**5**	Malawi	0.13	**17**
Uganda	0.35	**6**	Burkina-Faso	0.13	**18**
Rwanda	0.31	**7**	Mali	0.13	**19**
Tunisia	0.27	**8**	Benin	0.12	**20**
Nigeria	0.26	**9**	Cameroon	0.11	**21**
Ghana	0.24	**10**	Togo	0.11	**23**
Gabon	0.24	**11**	Egypt	0.11	**22**
Tanzania	0.23	**12**	Ethiopia	0.07	**24**

Note: This index is computed with three dimensions: penetration, availability and usage of financial services. However, unlike in 2011, we add two variables that capture mobile banking. Hence, the number of countries declines from 32 to 24.

Taking into account the indicators that capture the barriers to and usage of financial services, the overall index of financial inclusion in Africa improved from 0.26 in 2014 to 0.29 in 2017. These global financial inclusion scores are obtained by simply averaging the scores of countries in the sample. However, the top of the ranking has does not actually change. Table 3 shows that the scores of the highest ranked countries in 2014 fall, while those of poorly ranked countries in 2014, have instead increase.

Table 3: global index of financial inclusion in Africa 2017

Countries	GIFI	Rank	Countries	GIFI	Rank
Mauritius	0.67	**1**	Mozambique	0.25	**13**
Namibia	0.55	**2**	Uganda	0.24	**14**
South Africa	0.45	**3**	Senegal	0.24	**15**
Kenya	0.4	**4**	Egypt	0.24	**16**
Botswana	0.35	**5**	Mali	0.22	**17**
Ghana	0.33	**6**	Ivory Coast	0.21	**18**
Morocco	0.32	**7**	Tanzania	0.21	**19**
Rwanda	0.29	**8**	Togo	0.2	**20**
Nigeria	0.27	**9**	Malawi	0.18	**21**
Zambia	0.26	**10**	Cameroon	0.18	**22**
Burkina-Faso	0.26	**11**	Benin	0.18	**23**
Tunisia	0.25	**12**	Congo	0.17	**24**

Note: This index has is with four dimensions: penetration, availability and use of financial services and barriers. As for 2014, we select 24 countries due to data availability. The barriers dimension comprises: cost, distance, trust, documentation and lack of money.

4.3 Preliminary stylized facts and multivariate assessment

To address the robustness of our financial inclusion index, we adopt two strategies. The first focuses on analyzing the correlation between our index and some variables of interest. Second, we consider multivariate regressions of the inclusion index on macro variables.

The most striking feature is the occurrence of positive and significant correlations between our financial inclusion index and most variables of interest. As Appendices A.5 and A.10 show, the correlation between our financial inclusion index and GDP per capita is high (0.87) and significant at the 1% level. This result supports the theoretical literature linking financial inclusion and economic growth (Beck et al., 2005; Demirguc-Kunt and Klapper, 2012; Delis, 2012).

Another variable of interest that may be correlated with financial inclusion is institutional quality. In this study, institutional quality is proxied by rule of law, which is scaled between -2.5 and +2.5, with a value close to +2.5 indicating a good institutional quality environment. We find a high and significant correlation (0.71) between the two variables (Appendices A.6 and A.10). Appendices A.8 and A.10 show a strong positive correlation (0,62) between financial inclusion and education[6].This result supports the theoretical literature linking financial inclusion and education (Honohan, 2008; Guerineau and Jacollin, 2014). We also correlate our index with the bank Zscore, an indicator of banking stability where a high value indicates high stability. We find a low and nonsignificant correlation (0.21) between financial inclusion and bank stability (Appendices A.7 and A.10). This result indicates that the stability of the banking market does not significantly affect financial inclusion. We finally correlate our financial inclusion index with consumption. In this study, we measure consumption by household final consumption expenditure. We find a high and significant correlation (0.71) between the two variables (Appendices A.9 and A.10). This result also supports the theoretical literature highlighting financial inclusion as a catalyst of household consumption.

Our second strategy consists of assessing the effects of financial inclusion on some macro variables (education, consumption, bank stability and economic growth) in African countries.

To parsimoniously assess these effects, we estimate the regression equation below:

$$Y_{i,2011-2017} = \alpha + \beta FI_{i,2011-2017} + \delta X_{i,2011-2017} + \varepsilon_i \qquad \textbf{(1)}$$

Where Y is the average value of education, consumption, bank stability and economic growth for 2011-2017. FI is the average value of the index of financial inclusion for 2011-2017. *X* is a vector of regressors including the average values of secondary education enrollment, total population, government expenditure, inflation and trade for 2011–2017.

For Equation 1 above, we limit the number of regressors included to avoid multicollinearity among the regressors. We run regressions between the average values of financial inclusion in 2011, 2014 and 2017 and the average values of growth, consumption, education and bank stability[7]. We also use robust standard errors to address potential heteroskedasticity.

The results are presented in Table 4 where columns (1) to (4) show the estimates of financial inclusion on education, consumption, bank stability and economic growth respectively.

[6] In this work, we use secondary school enrollment as a proxy of education.

[7] Another alternative was to perform the regressions for separate years. The results remain qualitatively similar.

Globally, the results show that countries with a high level of financial inclusion have significantly increased education, consumption, bank stability and economic growth.

Specifically, our results corroborate both theoretical and empirical works showing that greater financial inclusion significantly increases education (see, for example Arora, 2012), household consumption (Koomson et al, 2020) and economic growth. Furthermore, it contributes to greater banking stability (Ahamed and Mallick, 2017), which ultimately promotes economic growth (Van et al, 2019).

Table 4: Estimates of financial Inclusion on education, consumption, bank stability and economic growth.

	(1)	(2)	(3)	(4)
VARIABLES	**Education**	**Consumption**	**Economic Growth**	**Bank Stability**
Financial Inclusion	**0.1463*** **	**0.3785*** **	**0.3983*** **	**0.0424***
	(0.020)	**(0.028)**	**(0.038)**	**(0.024)**
Trade		0.4290***	0.5605***	
		(0.144)	(0.187)	
Inflation		-0.0219**	-0.0146	-0.0122*
		(0.010)	(0.012)	(0.007)
Government Expenditure	0.2156**			
	(0.095)			
Population	0.0661*			
	(0.035)			
GDP Growth				0.1209***
				(0.021)
Constant	1.8348**	4.0979***	3.9426***	2.8689***
	(0.775)	(0.621)	(0.777)	(0.164)
Fisher	20.47***	76.31***	54.58***	14.88***
R-squared	0.3077	0.5838	0.4936	0.2528
Observations	31	36	36	32

Notes: Dependent variables are average values of education, bank stability and consumption, and economic Growth for 2011, 2014 and 2017. The regressors use average values for the same period. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors are used for t-stats reported in brackets.

5. Conclusions

Financial inclusion is an important emerging topic and is considered a salient driver of economic development. Some researchers have cited financial inclusion as the panacea for combating poverty and most importantly the impetus for growth and development with respect to developing countries. However, existing composite indices of financial inclusion are incomplete or questionable. Drawing on Camara and Tuesta's (2014) work, we have developed an original index of financial inclusion using four dimensions: access, penetration, usage and barriers. Furthermore, we apply a two-stage principal component analysis (PCA) to assign weight to the dimensions. The proposed index is robust, and comparable across countries. It is highly correlated with macroeconomic variables such as GDP per capita, education, consumption, and institutional quality.

Given that our index is easy to compute, it can be used by policy makers and researchers to monitor the progress of financial inclusion initiatives in African countries.

References

Ahamed, M. M., & Mallick, S. K. (2019). Is financial inclusion good for bank stability? International evidence. *Journal of Economic Behavior& Organization*, *157*, 403-427.

Alliance for Financial Inclusion (2013). Measuring financial inclusion core set of financial inclusion indicators. *Financial Inclusion Data Working Group (FIDWG).*

Amidžić G., Massara, A. and Mialou A., (2014), Assessing Countries'Financial Inclusion Standing—A new Composite Index, IMF Working Paper

Arora, R. U. (2012). Financial inclusion and human capital in developing Asia: The Australian connection. *Third World Quarterly*, *33*(1), 177-197.

Beck, T., Demirguc-Kunt, A., and Martinez Peria, M. S. (2005). *Reaching out: Access to and useof banking services across countries*. The World Bank.

Camara, N. and Tuesta, D. (2014). Measuring financial inclusion: A muldimensional index. *BBVAResearch Paper*, (14/26).

CGAP (2011). Advancing financial access for the world's poor.*Consultative Group to Assist the Poor, Washington, DC 20433 USA.*

Chakravarty, S. R., Pal, R., et al. (2010). Measuring financial inclusion: an axiomatic approach.*Mumbai: Indira Gandhi Institute of Development Research*.

Delis, M. D. (2012). Bank competition, financial reform, and institutions: The importance of beingdeveloped. *Journal of Development Economics*, 97(2):450–465.

Demirguc-Kunt, A. and Klapper, L. (2012). *Measuring financial inclusion: The global findex database*. The World Bank.

Demirguc-Kunt, A., Klapper, L., Singer, D., and Van Oudheusden, P. (2015). *The global findexdatabase 2014: Measuring financial inclusion around the world*. The World Bank

Economist Intelligence Unit, E. I. (2016). Global microscope 2016: the enabling environment forfinancial inclusion. *MIF/IDB, Accion and the Metlife Foundation. EIU, New York, NY.*

Guérineau, S. and Jacolin, L. (2014). L'inclusion financière en Afrique subsaharienne : faits styliséset déterminants. *Revue d'économie financière*, (4) :57–80.

Goel, S. and Sharma, R. (2017). Developing a financial inclusion index for India. *Procedia computer science*, 122:949–956.

Gupte, R., Venkataramani, B., and Gupta, D. (2012). Computation of financial inclusion index forIndia. *Procedia-Social and Behavioural Sciences*, 37:133–149.

Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal ofBanking& Finance*, 32(11):2493–2500.

Koomson, I., Villano, R. A., & Hadley, D. (2020). Effect of financial inclusion on poverty and vulnerability to poverty: Evidence using a multidimensional measure of financial inclusion. *Social Indicators Research*, 1-27.

Lockwood, B. (2001). *How Robust is the Foreign Policy/Kearney Index of Globalisation?* University of Warwick Coventry.

Mialou, A., Amidzic, G., &Massara, A. (2017). Assessing countries' financial inclusion standing—A new composite index. *Journal of Banking and Financial Economics*, (2 (8)).

Nagar, A. L. and Basu, S. R. (2002). Weighting socioeconomic indicators of human development:A latent variable approach. *STATISTICS TEXTBOOKS AND MONOGRAPHS*, 165:609–642.

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

Sarma, M. (2008). Index of financial inclusion (icrier working paper no. 215). *Retrieved from Indian Council for Research on International Economic Relations website: http://www. icrier. org/pdf/Working_Paper_215. pdf*.

Sarma, M. (2015). Measuring financial inclusion. *Economics Bulletin*, 35(1):604–611.

Steiger, J. H. (1979). The relation between external variables and common factors. *Psychometrika*, 44, 93-07.

Triki, T. and Faye, I. (2013). Financial inclusion in Africa.

Van, L. T. H., Vo, A. T., Nguyen, N. T., & Vo, D. H. (2019). Financial Inclusion and Economic Growth: An International Evidence. *EmergingMarkets Finance and Trade*, 1-25.

Appendix

A.1: List of countries

Country	**Code**	Country	**Code**
Algeria	**DZA**	Madagascar	**MAD**
Angola	**AGO**	Malawi	**MWI**
Benin	**BEN**	Mali	**MLI**
Botswana	**BWA**	Mauritius	**MUS**
Burundi	**BDI**	Morocco	**MAR**
Burkina Faso	**BFA**	Mozambique	**MOZ**
Cameroon	**CMR**	Namibia	**NAM**
Central Africa Republic	**CAF**	Niger	**NER**
Chad	**TCD**	Nigeria	**NGA**
Congo	**COG**	Rwanda	**RWA**
Djibouti	**DJI**	Senegal	**SEN**
Egypt	**EGY**	Sierra Leone	**SLE**
Ethiopia	**ETH**	South Africa	**ZAF**
Gabon	**GAB**	Sudan	**SDN**
Ghana	**GHA**	Tanzania	**TZA**
Guinea	**GIN**	Togo	**TOG**
Côte d'Ivoire	**CIV**	Tunisia	**TUN**
Kenya	**KEN**	Uganda	**UGA**
Lesotho	**LSO**	Zambia	**ZAM**

A.2: Index of financial inclusion in Africa by dimensions 2011

Countries	penetration	Rank	Disponibility	Rank	Usage	Rank
South Africa	0.37	**2**	0.68	**2**	0.83	**1**
Algeria	0.08	**11**	0.25	**8**	0.1	**26**
Angola	0.15	**5**	0.67	**3**	0.31	**8**
Burundi	0.04	**21**	0.03	**30**	0.11	**25**
Benin	0.05	**18**	0.05	**27**	0.16	**20**
Burkina-Faso	0.03	**22**	0.08	**23**	0.15	**22**
Botswana	0.19	**3**	0.45	**5**	0.36	**4**
Cameroon	0.02	**26**	0.10	**21**	0.21	**15**
Congo	0.03	**23**	0.15	**18**	0.14	**23**
Djibouti	0.07	**16**	0.17	**16**	0.20	**16**
Egypt	0.09	**8**	0.09	**22**	0.1	**27**
Gabon	0.09	**9**	0.18	**15**	0.17	**18**
Ghana	0.08	**10**	0.24	**9**	0.29	**10**
Guinea	0.01	**31**	0.06	**25**	0.04	**31**
Mauritius	0.94	**1**	0.97	**1**	0.75	**2**
Kenya	0.1	**7**	0.50	**4**	0.54	**3**
Lesotho	0.07	**15**	0.22	**10**	0.35	**7**
Madagascar	0.02	**27**	0.02	**31**	0.08	**28**
Mali	0.06	**17**	0.05	**28**	0.12	**24**
Malawi	0.02	**28**	0.15	**19**	0.30	**9**
Niger	0.007	**29**	0.008	**32**	0.06	**30**
Nigeria	0.15	**4**	0.26	**6**	0.24	**14**
CAF	0.005	**30**	0.02	**30**	0.047	**32**
Rwanda	0.11	**6**	0.22	**11**	0.35	**5**
Sudan	0.03	**24**	0.05	**26**	0.08	**29**
Senegal	0.07	**14**	0.04	**29**	0.16	**19**
Sierra Leone	0.03	**25**	0.13	**20**	0.25	**13**
Chad	0.0003	**32**	0.17	**17**	0.16	**21**
Togo	0.07	**13**	0.06	**24**	0.19	**17**
Tanzania	0.04	**19**	0.22	**13**	0.27	**11**
Uganda	0.04	**20**	0.18	**14**	0.34	**6**
Zambia	0.07	**12**	0.26	**7**	0.27	**12**

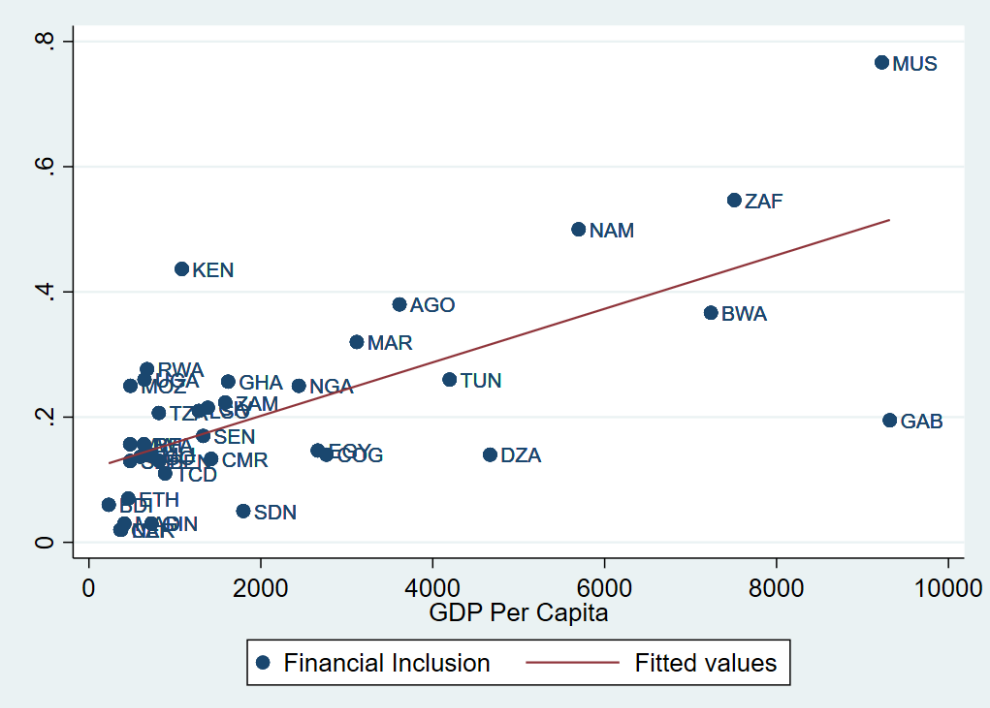
A.3: Index of financial in Africa inclusion by dimensions 2014

Countries	Penetration	Rank	Disponibility	Rank	Usage	Rank
South Africa	0.34	**2**	0.57	**2**	0.81	**1**
Benin	0.04	**17**	0.05	**19**	0.26	**17**
Burkina-Faso	0.02	**22**	0.05	**20**	0.29	**14**
Botswana	0.17	**6**	0.47	**5**	0.56	**5**
Ivory Coast	0.06	**14**	0.31	**8**	0.28	**15**
Cameroon	0.01	**23**	0.03	**24**	0.27	**16**
Congo	0.03	**20**	0.07	**18**	0.31	**13**
Egypt	0.08	**10**	0.04	**21**	0.20	**22**
Ethiopia	0.01	**24**	0.04	**22**	0.13	**24**
Gabon	0.13	**7**	0.21	**13**	0.37	**9**
Ghana	0.09	**9**	0.25	**11**	0.36	**11**
Mauritius	0.93	**1**	0.55	**2**	0.76	**2**
Kenya	0.08	**11**	0.85	**1**	0.63	**3**
Mali	0.05	**16**	0.13	**15**	0.18	**23**
Malawi	0.04	**18**	0.09	**16**	0.24	**18**
Namibia	0.30	**4**	0.45	**6**	0.57	**4**
Nigeria	0.13	**8**	0.26	**10**	0.37	**10**
Rwanda	0.24	**5**	0.29	**9**	0.39	**7**
Senegal	0.05	**15**	0.08	**17**	0.37	**8**
Togo	0.06	**13**	0.04	**23**	0.21	**20**
Tunisia	0.33	**3**	0.13	**14**	0.34	**12**
Tanzania	0.02	**21**	0.41	**7**	0.23	**19**
Uganda	0.03	**19**	0.47	**4**	0.50	**6**
Zambia	0.06	**12**	0.25	**12**	0.21	**21**

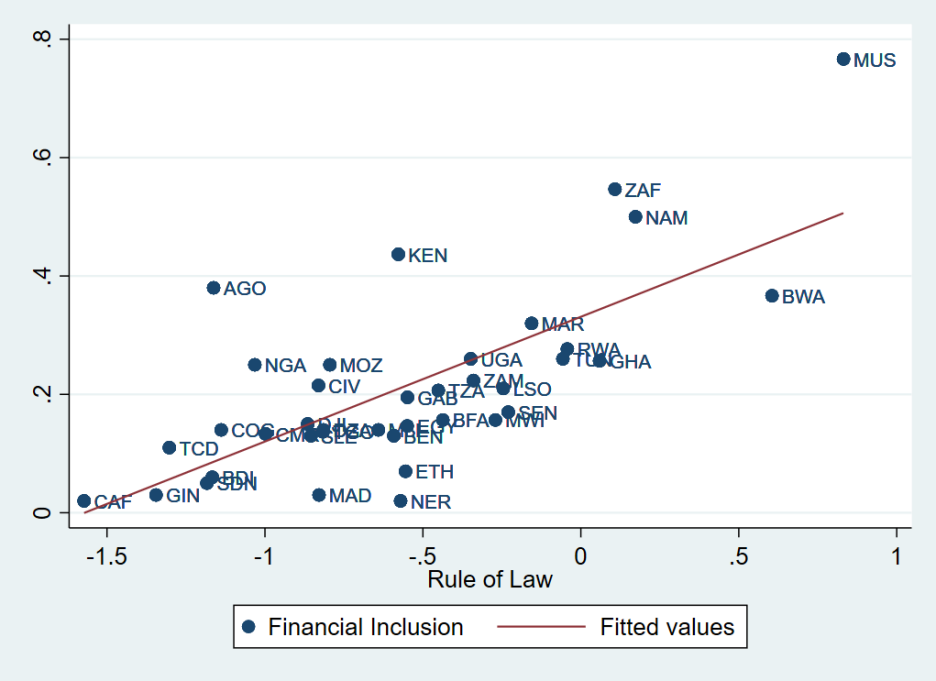
A.4: Index of financial in Africa inclusion by dimensions 2017

Countries	Penetration	Rank	Disponibility	Rank	Usage	Rank	Barriers	Rank
South Africa	0.48	**3**	0.39	**4**	0.70	**1**	0.39	**10**
Benin	0.02	**21**	0.20	**17**	0.22	**23**	0.3	**3**
Burkina-Faso	0.007	**24**	0.27	**9**	0.32	**10**	0.46	**17**
Botswana	0.22	**6**	0.33	**7**	0.32	**11**	0.52	**20**
Ivory Coast	0.05	**14**	0.21	**14**	0.22	**22**	0.37	**8**
Cameroon	0.01	**22**	0.14	**20**	0.23	**17**	0.36	**7**
Congo	0.04	**18**	0.09	**23**	0.16	**24**	0.40	**13**
Egypt	0.10	**11**	0.12	**22**	0.23	**18**	0.53	**21**
Ghana	0.12	**8**	0.37	**5**	0.33	**9**	0.49	**18**
Mauritius	0.80	**1**	0.70	**2**	0.65	**2**	0.50	**19**
Kenya	0.07	**12**	0.64	**3**	0.63	**3**	0.31	**4**
Morocco	0.38	**4**	0.06	**24**	0.37	**7**	0.59	**24**
Mali	0.03	**20**	0.22	**13**	0.25	**15**	0.41	**15**
Malawi	0.03	**19**	0.14	**21**	0.25	**16**	0.37	**9**
Mozambique	0.05	**14**	0.29	**8**	0.23	**19**	0.40	**12**
Namibia	0.49	**2**	0.71	**1**	0.60	**4**	0.40	**11**
Nigeria	0.12	**9**	0.17	**19**	0.30	**12**	0.53	**22**
Rwanda	0.10	**10**	0.21	**16**	0.40	**6**	0.54	**23**
Senegal	0.04	**16**	0.23	**12**	0.22	**20**	0.45	**16**
Togo	0.04	**17**	0.21	**15**	0.22	**21**	0.33	**5**
Tunisia	0.36	**5**	0.18	**18**	0.43	**5**	0.13	**1**
Tanzania	0.20	**7**	0.26	**11**	0.28	**14**	0.35	**6**
Uganda	0.01	**23**	0.37	**6**	0.35	**8**	0.26	**2**
Zambia	0.06	**13**	0.27	**10**	0.29	**13**	0.41	**14**

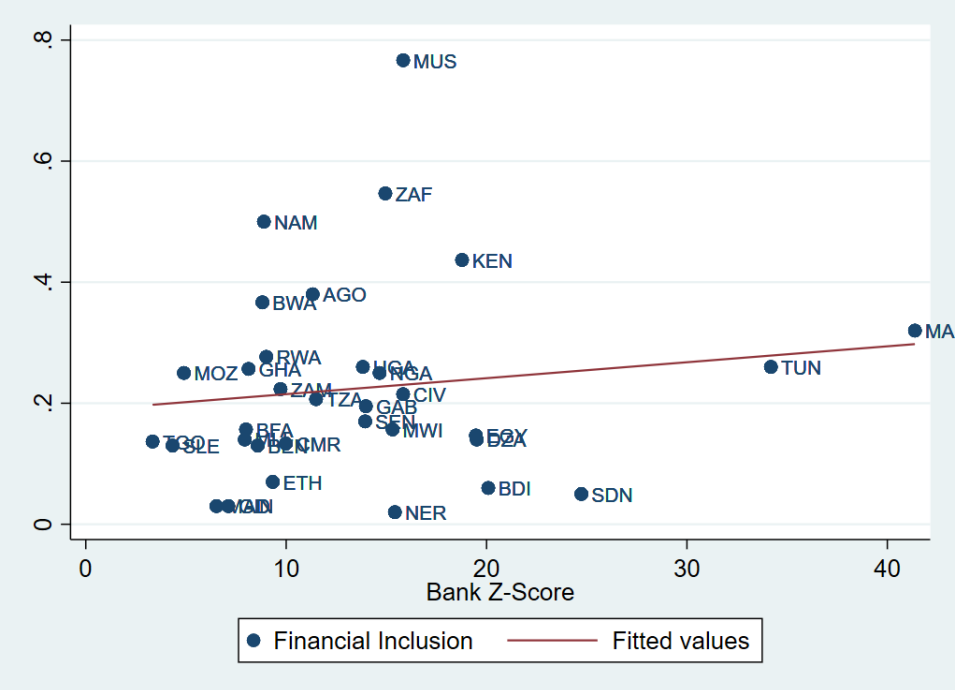
A.5: Financial inclusion and income



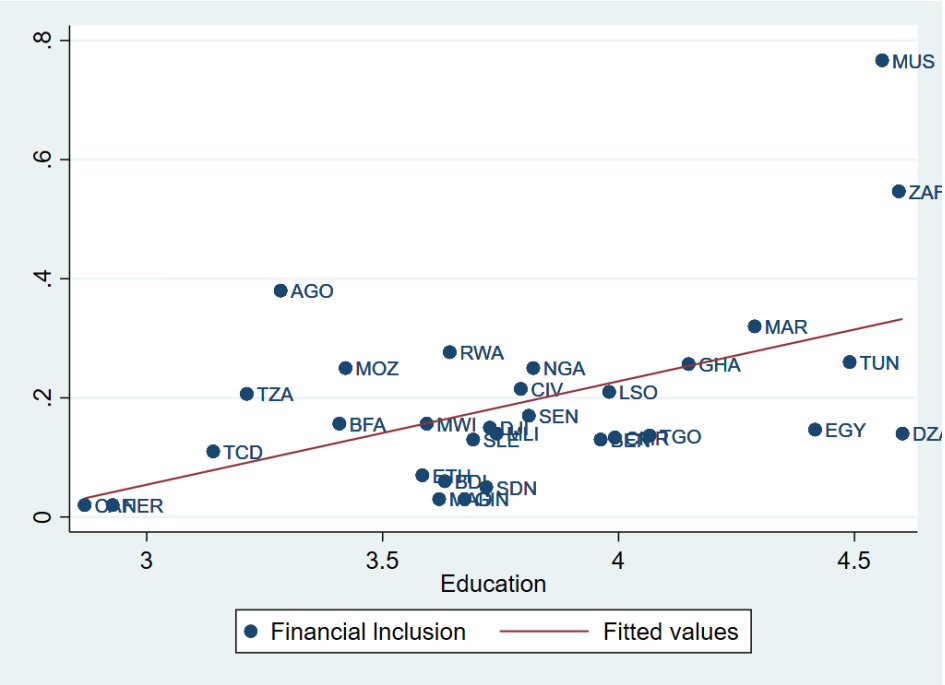
A.6: Financial inclusion and rule of law



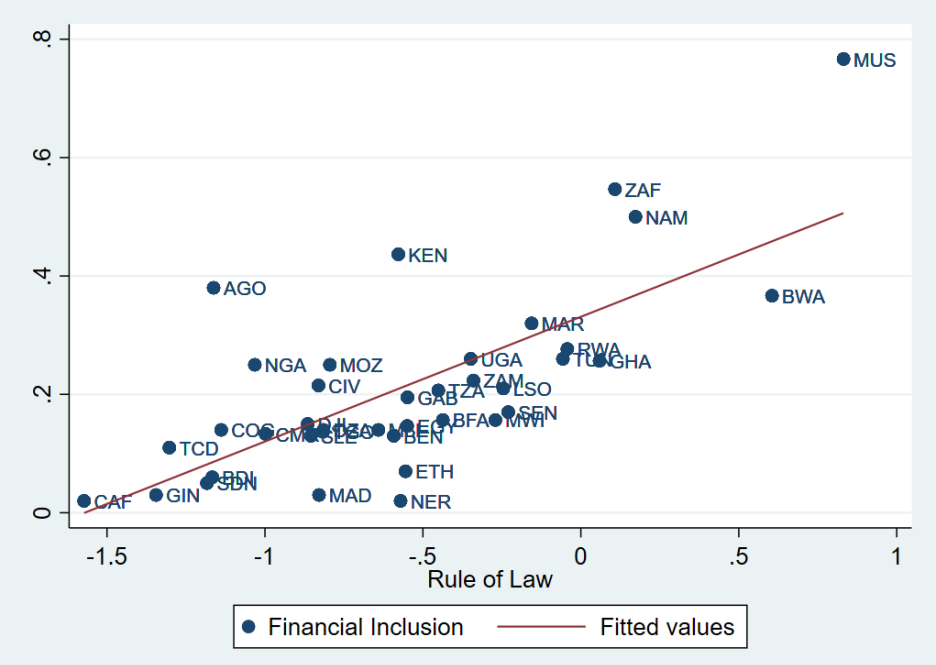
A.7: Financial inclusion and banking stability



A.8: Financial inclusion and education



A.9: Financial inclusion and rule of law



A.10: correlation matrix between financial inclusion and some variables of interest

	GIFI	Rule	GDP	Bank Zscore	Education	Consumption
GIFI	1					
Rule	0.711***	1				
GDP	0.874***	0.605***	1			
Bank Zscore	0.213	0.237	0.385*	1		
Education	0.622***	0.584***	0.803***	0.458***	1	
Consumption	0.800***	0.653***	0.847***	0.139	0.706***	1

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

A.11: Descriptive statistics

VARIABLES	N	Mean	Sd	Min	Max
Account	77	0.335	0.215	0.0152	0.898
Credit Card	77	0.165	0.164	0.00740	0.738
Debit Card	77	0.0412	0.0458	0	0.241
ATMs 1000 Km²	77	12.86	42.10	0.0240	224
ATMs 100,000	77	12.86	16.43	0.377	67.90
Banks 1000Km²	77	6.746	20.07	0.0341	112
Banks 100,000	77	6.162	5.404	0.679	24.50
Life Insurance	77	1.043	2.154	0.000800	10.70
Nonlife Insurance	77	0.814	0.543	0.00600	2.570
Savings	77	0.107	0.0651	0.00600	0.321
Withdrawal	48	0.655	0.115	0.393	0.880
Mobile Money account	48	0.182	0.169	0.000279	0.729
Digital Payments	48	0.328	0.185	0.0539	0.790
Distance	24	0.240	0.118	0.0350	0.535
Cost	24	0.288	0.133	0.112	0.709
Trust	24	0.250	0.0950	0.0763	0.429
Documentation	24	0.161	0.103	0.0278	0.552
Lack of Money	24	0.717	0.111	0.472	0.937
GDP Per Capita	111	2263.768	2507.909	213.4056	10199.91
Education	81	49.50391	22.79565	14.21728	101.7961
Rule of Law	114	-.5668979	.5371348	-1.731393	.912838
Bank Z-Score	83	14.06792	8.132279	3.33342	43.9962
Consumption	98	1396.292	1432.793	196.4096	7021.874
Population	114	2.69e+07	3.33e+07	865937	1.91e+08
Inflation	108	7.09633	7.678487	-3.704296	36.90664
Trade	111	71.53973	28.41844	19.45883	159.2039
Government Expenditure	111	15.12439	6.113664	4.370989	36.60414

A.12: Data Definition and Sources

Variables	Definitions	Sources
ATMs 100,000	Number of ATMs per 100,000 adults.	FAS
ATMs 1000 Km²	Number of ATMs per 1,000 km².	FAS
Banks 100,000	Number of commercial bank branches per 100,000 adults	FAS
Banks 1000 Km²	Number of commercial bank branches per 1,000 km².	FAS
Account	The percentage of respondents who report having an account at a bank or another type of financial institution.	Global Findex
Debit Card	The percentage of respondents who report having a debit card.	Global Findex
Credit Card	The percentage of respondents who report having a credit card.	Global Findex
Mobile money account	The percentage of respondents who report personally using a mobile money service in the past 12 months.	Global Findex
Savings	The percentage of respondents who report saving or setting aside any money at a bank or another type of financial institution in the past 12 months.	Global Findex
Withdrawal	Among respondents with a financial institution account, the percentage who report one or more withdrawals from their account in the past 12 months.	Global Findex
Digital Payments	The percentage of respondents who report using mobile money, a debit or credit card, or a mobile phone to make a payment from an account.	Global Findex
Life Insurance	Ratio of life insurance premium volume to GDP.	GFDD
Nonlife Insurance	Ratio of nonlife insurance premium volume to GDP.	GFDD
Cost	The percentage of respondents who report not having a financial institution account because financial services are too expensive.	Global Findex
Distance	The percentage of respondents who report not having a financial institution account because financial institutions are too far away.	Global Findex
Documentation	The percentage of respondents who report not having a financial institution account because they lack the documentation needed to open one.	Global Findex
Trust	The percentage of respondents who report not having a financial institution account because they do not trust financial institutions.	Global Findex
Lack of money	The percentage of respondents who report not having a financial institution account because they do not have enough money to use one.	Global Findex
GDP	Gross Domestic Product per Capita. Data are in constant 2010 U.S. dollars.	WDI
Education	Secondary school enrolment.	WDI
Rule of Law	It captures perceptions to which agent have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property right.	WGI
Bank Z-Score	It captures the probability of default of a country's commercial banking system.	GFDD
Consumption	It captures Household final consumption expenditure.	WDI
Population	It captures total population in a country.	WDI
Trade	It is the sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI
Inflation	It is measured by the consumer price index	WDI
Government Expenditure	It captures the general government final consumption expenditure	WDI

FAS = Financial Access Survey; WDI = World Development Indicators; GFDD = Global Financial Development Database; WGI = Worldwide Governance Indicators; WEF = World Economic Forum; ATM = Automatic Teller Machines.