Measuring financial inclusion: a multidimensional index[1]

Noelia Cámara, BBVA Research,
and David Tuesta, CAF- Bank of Development for Latin America

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[1] This paper was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

Measuring financial inclusion: a multidimensional index

Noelia Cámara[1] and David Tuesta[2]

Abstract

We use demand and supply-side information to create a composite index that measures the extent of financial inclusion at country level, for 137 developed and less-developed countries. We postulate that the degree of financial inclusion is determined by three dimensions: usage, barriers and access to the financial system. Let assume that a latent structure exists behind the covariation of a set of correlated indicators associated to the financial inclusion concept. It allows estimating a comprehensive measure of the degree of financial inclusion by assigning weights endogenously, with a two-stage Principal Component Analysis. Our composite index is easy to interpret and compute.

Keywords: net financial inclusion, underlying structure, inclusion barriers

JEL classification: C43, G21, O16

Contents

[1] Financial Inclusion Unit, BBVA Research Department (noelia.camara@bbva.com)

[2] CAF- Bank of Development for Latin America (DTUESTA@caf.com)

1. Introduction

Issues relating to financial inclusion are a subject of growing interest and one of the major socioeconomic challenges on the agendas of international institutions, policymakers, central banks, financial institutions and governments. The United Nations' declared objective of achieving universal financial access by 2020 is another example of financial inclusion being recognized as fundamental for economic growth and poverty alleviation. [3] The World Bank's latest estimates state that nearly half of the adult population in the world does not have a bank account in a formal financial institution. However, the concept of financial inclusion goes beyond single indicators, such as percentage of bank accounts and loans or number of automated teller machines (ATMs) and bank branches. In the literature, the attempts to measure financial inclusion through multidimensional indices are scarce and incomplete. To the best of our knowledge, literature lacks a comprehensive indicator that can bring together information on financial inclusion by using a statistically sound weighting methodology and takes into account both demand and supply-side information. Our study aims to fill this gap.

The major contribution of this paper is the construction of a multidimensional financial inclusion index covering 138 countries for the periods 2011 and 2014. The weights of the index are obtained from a two-stage Principal Component Analysis (PCA) for the estimation of a latent variable. First, we apply PCA to estimate the group of three sub-indices (i.e. dimensions) representative of financial inclusion. Second, we apply again PCA to estimate the overall financial inclusion index by using the previous sub-indices as causal variables. Our index improves existing financial inclusion indices in several ways. First, we use a parametric method that avoids the problem of weighting assignment. Second, we offer a harmonized measure of financial inclusion for a larger set of countries, 137 developed and less-developed countries, that allows comparisons across countries and over time. Finally, we provide a comprehensive definition of financial inclusion combining information from 20 indicators from both demand and supply-side data sets, and from two perspectives: banked and unbanked population. It is the first time that a composite index uses a demand-side data set at individual level to measure the level of financial inclusion across countries. We identify two problems in the current financial inclusion indices. First, existing attempts to build financial inclusion indices rely only on supply-side country level data and come up with inaccurate readings of financial inclusion due to bias generated by the existence of measurement errors in the usage indicators. Supply-side indicators, particularly the number of accounts or loans, can overestimate the inclusiveness of financial systems since one person can have more than one account or loan. It is a very common practice in developed countries. Second, assigning exogenous weights to indicators is often criticized for lack of scientific rigor because exogenous information is imposed.

The lack of a harmonized measure that includes multidimensional information to define financial inclusion is a pitfall that confounds the understanding of several related problems. The multidimensional measurement of financial inclusion is important in several aspects. First, a measure that aggregates several indicators into a single index aids in summarizing the complex nature of financial inclusion and helps to monitor its evolution. A good index is better at extracting information. Second, a better measure of financial inclusion may allow us to study the link between financial

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[3] The Global Financial Development report for 2014, by the World Bank (2013), is the second report that focuses on the relevance of financial inclusion. It offers an overview of financial inclusion status and problems based on new evidence about financial sector policy. The Maya Declaration is another example that evidences the importance of financial inclusion. It consists of a set of measurable commitments by developing countries' governments to enhance financial inclusion. There are more than 90 countries in the agreement and they represent more than 75 per cent of the unbanked population. Finally, the G20 also express its interest in promoting financial inclusion in non-G20 countries through the Global Partnership for Financial Inclusion (GPFI). This platform, officially launched in Seoul in 2010, recognizes financial inclusion as one of the main pillars of the global development agenda endorsed in its Financial Inclusion Action Plan.

inclusion and other macroeconomic variables of interest (i.e. economic growth, financial stability, etc.). Third, information by dimension helps to better understand the problem of financial inclusion. It can be a useful tool for policy making and policy evaluation.

There are two commonly used approaches to constructing composite indices: non-parametric and parametric methods. The first ones assign the importance of indicators by choosing the weighs exogenously, based on researchers' intuition. There is evidence that indices are sensitive to subjective weight assignment, since a slight change in weights can alter the results dramatically (Lockwood, 2004). [4] Sarma (2008, 2012) and Chakravarty and Pal (2010) are examples of financial inclusion indices that apply this methodology to usage and access indicators from supply-side country level data sets. In contrast, parametric methods assign the importance of indicators (weights) in the overall index endogenously, based on the information structure of sample indicators. Specifically, through the covariation between the indicators related to the common structure. There are two parametric analyses commonly used for indexing: PCA and Common Factor Analysis. Amidzic *et al.* (2014) proposes a measure of financial inclusion based on a Common Factor Analysis. However, the indicators used to define financial inclusion only include limited supply-side information at country level. From an empirical point of view, PCA is preferred over Common Factor Analysis as an indexing strategy because it is not necessary to make assumptions on the raw data, such as selecting the underlying number of common factors (Steiger, 1979). This paper offers a multidimensional financial inclusion index with endogenous weights estimated by Principal Componets.

The rest of the paper is organized as follows. In section 2, we describe the data and the rationale for our chosen indicators as well as for the use of sub-indices that measure financial inclusion dimensions. Section 3 describes the methodology for constructing our composite index from multi-dimensional data. Section 4 discusses the results of the sub-indices as well as the composite financial inclusion index. Finally, Section 5 concludes.

2. Financial Inclusion Dimensions and Data Sources

How to measure financial inclusion is a topic of concern among researchers, governments and policy makers. To date, financial inclusion measurement has been mainly approached by the usage and access to the formal financial services by using supply-side aggregate data (e.g. Honohan (2007); Sarma (2008, 2012); Chakravarty and Pal (2010) and Amidzic *et al.* (2014)). However, the way supply-side information is collected is not precise to capture the extent of financial inclusion since it does not inform on the real population that is covered by access to the formal financial system or using financial services. In terms of access, a broad availability (i.e. more ATMs and bank branches) does not mean necessarily that a system is inclusive per se since the geo-location of points of service is unknown. In terms of usage, figures such as number of deposits are overestimated, especially in developed countries. These pitfalls should be solved by using additional information from the demand side when it comes to usage. There are only two studies that rely on demand-side data. The first one, developed by Demirgüç-Kunt and Klapper (2013 and 2015), focus on several financial inclusion-related indicators individually. [5] However, monitoring different indicators individually, although useful, does not offer a comprehensive understanding of the level of financial inclusion across countries. In the second study, Dabla-Norris *et al.* (2015) focuses on the Latin America and the Caribbean countries and builds on a previous version of our financial inclusion index by including a similar index for SMEs.

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[4]   There is also a problem with weight reassignment when new indicators are included into an existing index.

[5]   Didier and Schmuckler (2014) analyses individual indicators of the Enterprise Survey but they do not explore a composite indicator.

In brief, the few attempts to measure financial inclusion through composite indices are either limited in terms of countries or incomplete in terms of information and subject to methodological problems. In addition, current attempts also lack information on financial exclusion

We collate nine definitions for financial inclusion to stablish the dimension structure of our index. Accordingly, we define an inclusive financial system as one that maximizes usage and access, while minimizing involuntary financial exclusion. [6] Involuntary financial exclusion is measured by a set of barriers perceived by those individuals who do not participate in the formal financial system. It includes the barriers to financial inclusion through the obstacles perceived by people prevented from using formal financial services and it is considered a proxy for the quality of financial inclusion. Thus, we postulate that the degree of financial inclusion is determined by three dimensions: usage, barriers (i.e. quality) and access (Figure 1). These dimensions are, at the same time, determined by a set of 20 indicators including demand-side individual level indicators for the cases of usage and barriers, and supply-side country level indicators for access.

Combining information on the three dimensions is important since having access does not implies a straightforward usage as it is conditioned by other socio-economic factors such as income, regulatory framework or cultural habits that make individuals use these kinds of services in a particular manner. Access can be considered a necessary but not sufficient condition for measuring the inclusiveness of a financial system. Likewise, we consider the use of formal financial services as an output of financial inclusion rather than a comprehensive measure of the inclusiveness of a financial system in itself. Our hypothesis is that focusing only on usage and access leads to limited measurement of financial inclusion because we do not have information about the quality conditions of the financial inclusion process or the number of financially excluded people. In this context, demand-side individual surveys that gather information on the perceived reasons why people fail to use formal financial services add significant information about the degree of inclusiveness of a financial system. Adding this information on the unbanked aims to assess financial inclusion by introducing the concept of "net financial inclusion". It approaches financial inclusion measurement from a double perspective. From the banked side, by measuring the actual use of formal financial services, namely, inclusion output of financial systems. And, from the unbanked, by incorporating the extent of excluded population in the financial inclusion assessment.

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[6]   For the CGAP financial inclusion means that all working age adults have effective access to credit, savings, payments and insurance from formal service providers. Effective access involves convenient and responsible service delivery, at a cost affordable to the customer and sustainable for the provider with the result that financially excluded customers use formal financial services rather than existing informal options.
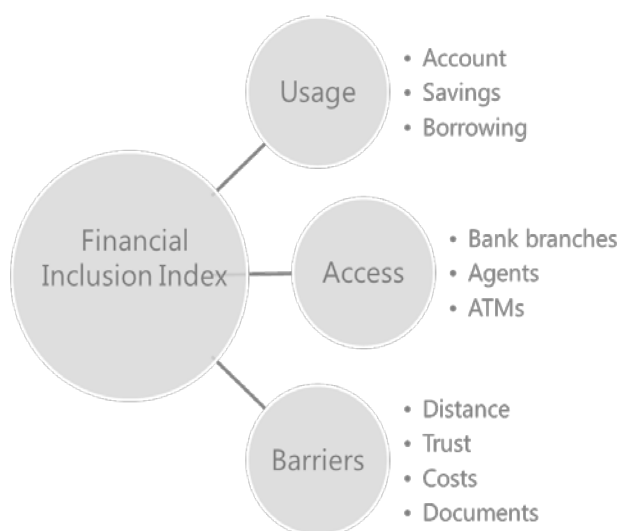
Source: Own elaboration

To compute the index, we take advantage of the largest demand-side harmonized dataset at individual level, the World Bank's Global Findex (2011 ad 2014). It offers a homogeneous measure of indicators for individuals' use of financial products across economies. This survey collects information about 150,000 nationally representative and randomly selected adults from 140 countries in 2011 and 137 in 2014, around the world. Data available at individual, rather than household, level is also an advantage that improves accuracy and comparability of the analyses. This database fills an important gap in the financial inclusion data landscape. We also use supply-side aggregate data on access from the International Monetary Fund's Financial Access Survey (2015). This is a source of supply-side data that offers information on an unbalanced panel of 189 countries, covering the period 2004-2015.

2.1 Usage

To assess the extent of usage of the formal financial services by individuals, we try to proxy the utility derived of using such services by considering the use of different products: holding at least one active financial product that allows making and receive payments and storage money, having a savings account and having a loan in a formal financial institution. Taking advantage of the information in the Global Findex data set, we can measure the usage dimension of formal financial services.

We built the indicator to account for people using at least one formal financial service that allows making and receive payments and storage money by adding information from several questions in the Global Findex. We consider as formal financial service users for this indicator the percentage of respondents who report having an account (by themselves or together with someone else) at a bank or another type of financial institution. Account at a financial institution includes respondents who report having an account at a bank or at another type of financial institution, such as a credit union, microfinance institution, cooperative, or the post office (if applicable), or having a debit card in their own name. It includes an additional 2.77 percent and 2.04, for 2014 and 2011 respectively, of respondents who report not having any of the previous products but receive wages, government

transfers, or payments for agricultural products into an account at a financial institution in the past 12 months; pay utility bills or school fees from an account at a financial institution in the past 12 months; or receive wages or government transfers into a card in the past 12 months. Often, these individuals are not aware that they have a bank account. [7] In addition, we consider as banked those individuals who reported not having a bank account because someone else in the family already has one. They are contemplated as indirect users of formal financial services. [8] Finally, in order to account only for active financial products, we define dormant accounts and subtract them from the usage indicator by removing the percentage of respondents with an account at a bank or another type of financial institution who report neither a deposit into nor a withdrawal from their account in the past 12 months. The savings and loan indicators represent the percentage of adult population that saves and has a loan in a formal financial institution respectively. The upper panel in Table 1 shows descriptive statistics of the indicators that we use to measure usage dimension, for 2014. For all the demand-side indicators, data is aggregated at country level by computing the proportion of individuals in each category and then applying the weighting scheme corresponding to the sample in each country.

2.2 Barriers

The barriers to financial inclusion, perceived by unbanked individuals, provide information about the obstacles that prevent them from using formal financial services. This information offers an additional angle to assess the extent of financial inclusion since it offers the number of financially excluded individuals and the reasons perceived by these individuals for being excluded from the formal financial system. There are two types of financial exclusion: voluntary or self-exclusion and involuntary. If we treat financial inclusion as a behavioral issue, individuals need to decide whether to participate in the formal financial system given their budget constraints and utility function. One possibility is that some individuals do not have a demand for formal financial services, leading them to self- exclusion because of cultural reasons, lack of money or just because they are not aware of the benefits of these types of services. This choice can be shaped by imperfect information about the utility of financial services for managing risk, savings for the future and affordability of different investments such as education or buying a house. However, exclusion can also be due to other market imperfections such as the lack of access to financial services or an inappropriate product range that does not satisfy people's needs. The latter obstacles that hinder financial inclusion may be associated with the category of involuntary exclusion so that people cannot satisfy their demand.

In order to measure the degree of inclusiveness of financial systems, from the unbanked perspective, we take into account only the information about barriers that represent involuntary exclusion such as distance, lack of the necessary documentation, affordability and lack of trust in the formal financial system. The question about perceived barriers is formulated in the Global Findex questionnaire in such a way that individuals can choose multiple reasons for their not having a bank account.

According to the Global Findex data set, almost 20 percent and 16, for 2011 and 2014 respectively, of the unbanked population cites distance as one of the reasons that prevents them from having an account. This reason is observed more frequently in developing countries where access points are remote. Documentation requirements are also cited as a perceived barrier for financial inclusion by almost 20 percent of the unbanked in 2011 and 19 percent in 2014. Affordability is the second most

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[7] Since we want to compute and index including both developed and less-developed countries we cannot take into account the usage of financial services for enterprises due to the lack of harmonized information for developed countries. This information is only available for less-developed countries in the World Bank's Enterprise Survey.

[8] We do not consider people with insurance since this information is only available for less-developed countries.

cited obstacle for financial inclusion, after only lack of money, and prevented 25 percent of the unbanked from using formal financial services in 2011 (same figure for 2014). Finally, the lack of trust in the financial system is cited by 13 percent of adults in 2011 and 10 percent in 2014. All these variables are introduced in our analysis in their negative form so that the fewer people reporting the barrier, the greater the inclusiveness of the financial system.

2.3 Access

Access to formal financial services represents the possibility for individuals to use them. However, greater access does not necessarily imply a higher level of financial inclusion. There is a threshold for access since, when it reaches a certain level, a marginal increase does not necessarily generate a financial inclusion increase. It may enhance frequency in the use of financial services, by improving intensive margin of usage but does not necessarily increase extensive margin, in terms of higher percentages of accounts held or any other financial service. However, greater access is expected to foster financial inclusion when access levels are below the threshold, via greater availability, if financial services meet the needs of the population. Also, when increasing access is generated from different financial companies, more intense competition may increase the consumption of financial services via prices too, even above the threshold.

We construct the access dimension with supply-side data at country level from three basic indicators: automated teller machines (ATMs) (per 100,000 adults), commercial bank branches (per 100,000 adults) and banking agents (per 100,000 adults). Banking agents, also known as banking correspondents, are non-financial commercial establishments that offer basic financial services under the name of a financial services provider, facilitating access points to the formal financial system. The establishments are spread across diverse sectors (grocery shops, gas stations, postal services, pharmacies, etc.), as long as they are brick-and-mortar stores whose core business involves managing cash. In its most basic form, banking correspondents carry out only transactional operations (cash in, cash out) and payments but, in many cases, they have evolved as a distribution channel for the banks 'credit, saving and insurance products Cámara et al. (2015). [9]

This three indicators account for the physical points of services offered by the institutions belonging the formal financial system such as commercial banks, credit unions, saving and credit cooperatives, deposit-taking microfinance and other deposit takers (savings and loan associations, building societies, rural banks and agricultural banks, post office giro institutions, post office savings banks, savings banks, and money market funds). Information on ATMs and bank branches is collected by financial services providers though the International Monetary Fund's Financial Access Survey (FAS). Data on banking agents are gathered by Cámara et al. (2015). [10]

Since banking agents do not exist in all the countries, we add up banking agents to the number of bank branches in order to not to bias the analysis. Thus, we use a single indicator which contains information of the number of bank branches and banking agents together. Although banking agents play an important role in enhancing access, distance is still one of the reasons why people do not participate in the formal financial system. In 2014 perceived distance as a barrier for financial inclusion

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[9]   The key difference with respect to other financial channels such as in-store branches or kiosks is that, in the banking correspondent business model, financial services are provided by the employees of the commercial establishment itself, not by the bank´s employees or machines. This outsourcing strategy leads to an improvement in efficiency for banks that makes it sustainable to focus on low-income clients with costly efficient access channels.

[10]   Data on adult population come from the World Development Indicators provided by the World Bank.

decreased by 5 percent on average but it decreases for the group of developed countries. [11] Both technology and regulation are contributing greatly to extend availability of access points. However, these advances might not be perceived with the same intensity by financially excluded people in the developing world yet.

Descriptive Statistics

Table 1

Variable	Obs.	Mean	Std. Dev	Min	Max
Usage					
Account	137	61.00	27.00	8.00	100
Loan	137	11.60	5.15	1.31	26.43
Savings	137	24.46	16.85	0.90	68.84
Access					
ATMs/100,000 pop.	137	56.18	52.46	0.49	270.13
Branches and agents /100,000 pop.	137	20.82	17.91	0.66	89.73
Barriers					
Distance	137	17.06	11.65	0.00	49.16
Affordability	137	26.32	14.59	0.00	59.81
Documentation	137	18.60	11.98	0.00	49.47
Lack of trust	137	18.83	12.10	0.00	57.45
Source: Own elaboration					

3. Principal Component Analysis as an Indexing Strategy

Financial inclusion is an unobservable concept which cannot be measured quantitatively in a straightforward way. However this variable is supposed to be determined by the interaction of a number of causal variables. We assume that behind a set of correlated variables we can find an underlying latent structure that can be identified with a latent variable as is the case of financial inclusion. Two important issues arise in the estimate of any latent variable: the selection of relevant causal variables and the estimation of parameters (weights). Regarding the first issue, it is not possible to apply standard reduction of information criterion approaches for the selection of variables. For the second, since financial inclusion is unobserved, standard regression techniques are also unfeasible to estimate the parameters. The weight assignment to the indicators or sub-indices is critical to maximize the information from a data set included in an index. A good composite index should comprise important information from all the indicators, but not be strongly biased towards one or more of these indicators. Thus, we seek to determine the best weighted combination of indicators that define our underlying structure by applying two-stage principal components methodology to estimate the degree of financial inclusion as an indexing strategy.

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[11]   Distance is a problem that affects mainly less-developed countries. In developed countries, the proportion of the unbanked who perceive distance as a problem is only 10 per cent.

Measuring financial inclusion: a multidimensional index

Our dataset contains causal variables which summarize the information for the degree of financial inclusion. As explained in the previous section, each causal variable relates to different dimensions that define financial inclusion. The purpose of dividing the overall set of indicators into three sub-indices is twofold. On the one hand, the three sub-indices have a meaning so, we get additional disaggregated information that is also useful for policy making. On the other hand, for methodological purposes, since the sub-indices contain highly correlated indicators within dimension, we estimate the sub-indices first, rather than estimating the overall index directly by picking all the indicators at the same time. This is a preferred strategy because it avoids weight's biases towards indicators which exhibit the highest correlation (Mishra, 2007). We minimize this problem by applying two-stage PCA (Nagar and Basu, 2004). In the first stage, we estimate the three sub-indices: usage, barriers and access, which defined financial inclusion. In the second stage, we estimate the weights for each dimension and the overall financial inclusion index by using the dimensions as explanatory variables. Regarding the number of variables included in our index, PCA is robust to redundant information.

Let consider that the latent variable financial inclusion is linearly determined as follows:

$$FI_i = \omega_1 Y_i^u + \omega_2 Y_i^b + \omega_3 Y_i^a + e_i \qquad (1)$$

where subscript i denotes the country, and (Y_i^u, Y_i^b, Y_i^a) capture the usage, barriers and access dimension respectively. Thus, the total variation in financial inclusion is represented by two orthogonal parts: variation due to causal variables and variation due to error term (e_i). If the model is well specified, including an adequate number of explanatory variables, $E(e) = 0$ and the variance of the error term should be relatively small compared to the variance of the latent variable, financial inclusion. Thus, we can reasonably assume that the total variation in financial inclusion can be largely explained by the variation in the causal variables.

3.1 First Stage PCA

The first stage estimates the dimensions, that is, the three unobserved endogenous variables Y_i^u, Y_i^b, Y_i^a and the parameters in the following equation system:

$$Y_i^u = \beta_1 account_i + \beta_2 savings_i + \beta_3 loan_i + u_i \qquad (2)$$

$$Y_i^b = \theta_1 distance_i + \theta_2 affordability_i + \theta_3 documents_i + \theta_4 trust_i + \epsilon_i \qquad (3)$$

$$Y_i^a = \gamma_1 ATM_{popi} + \gamma_2 branch_{popi} + v_i \qquad (4)$$

where account is a variable that represents the individuals who have at least one of the financial products described in section 2.1, and savings and loan represent individuals who save and have a loan in the formal financial system. Hence, the three dimensions are also indices that we estimate by principal components as linear functions of the explanatory variables described in Table 1. Note that the endogenous variables are unobserved so we need to estimate them jointly with the unknown parameters: β, θ and γ. Let $Rp, (pxp)$ be the correlation matrix of the p standardize indicators for each dimension. We denote $\lambda j (j = 1, \ldots, p)$ as the $j - th$ eigenvalue, subscript j refers to the number of principal components that also coincides with the number of indicators or sub-indices, p. $\varphi j (px1)$ is the eigenvector of the correlation matrix. We assume that $\lambda 1 > \lambda 2 > \ldots > \lambda p$ and denote $P_k (k = 1, \ldots, p)$ as the $k - th$ principal component. We get the corresponding estimator of each dimension according to the following weighted averages:

$$Y_i^u = \frac{\sum_{j,k=1}^{p} \lambda_j^u P_{ki}^u}{\sum_{j=1}^{p} \lambda_j^u} \qquad (5)$$

$$Y_i^b = \frac{\sum_{j,k=1}^{p} \lambda_j^b P_{ki}^b}{\sum_{j=1}^{p} \lambda_j^b} \qquad (6)$$

$$Y_i^a = \frac{\sum_{j,k=1}^{p} \lambda_j^a P_{ki}^a}{\sum_{j=1}^{p} \lambda_j^a} \qquad (7)$$

where $P_k = X\lambda_j \lambda_j$ represents the variance of the $k - th$ principal component (weights) and X is the indicators matrix. The weights given to each component are decreasing, so that the larger proportion of the variation in each dimension is explained by the first principal component and so on. Following this order, the $p - th$ principal component is a linear combination of the indicators that accounts for the smallest variance. In brief, this method represents a p-dimensional dataset of correlated variables by p orthogonal principal components, with the first principal component explaining the largest amount of information from the initial data. One issue using principal component analysis is to decide how many components to retain. Although a common practice is to replace the whole set of causal variables by only the first few principal components, which account for a substantial proportion of the total variation in all the sample variables, we consider as many components as the number of explanatory variables. Our concern is to estimate accurately financial inclusion rather than reducing the data dimensionality so, we avoid discarding information that could affect our estimates.

3.2 Second Stage PCA

The second stage of the principal component analysis computes the overall financial inclusion index by replacing Y_i^u, Y_i^b and Y_i^a in $Eq.(1)$ and applying a similar procedure to that described in the first stage (to estimate the vectors of parameters λ). This produces the following estimator of the financial inclusion index:

$$FI_i = \frac{\sum_{j,k=1}^{p} \lambda_j \ P_{ki}}{\sum_{j=1}^{p} \lambda_j} \qquad (8)$$

The highest weight, λ_1, is attached to the first principal component because it accounts for the largest proportion of the total variation in all causal variables. Similarly, the second highest weight, λ_2, is attached to the second principal component and so on. After some straightforward algebra, we can write each component, Pk of (8) as a linear combination of the three sub-indices ($p = 3$) and the eigenvectors of the respective correlation matrices represented by φ:

$$P_{1i} = \varphi_{11} Y_i^u + \varphi_{12} Y_i^b + \varphi_{13} Y_i^a \qquad (9)$$
$$P_{2i} = \varphi_{21} Y_i^u + \varphi_{22} Y_i^b + \varphi_{23} Y_i^a \qquad (10)$$
$$P_{3i} = \varphi_{31} Y_i^u + \varphi_{32} Y_i^b + \varphi_{33} Y_i^a \qquad (11)$$

so that the financial inclusion index can be expressed as:

$$FI_i = \frac{\sum_{j=1}^{3} \lambda_j \left(\varphi_{j1} Y_i^u + \varphi_{j2} Y_i^b + \varphi_{j3} Y_i^a \right)}{\sum_{j=1}^{3} \lambda_j} \qquad (12)$$

Rearranging terms, we can express the overall financial inclusion index as a weighted average of the dimensions as in Eq. (1). The parameters ω_k are the relative weights (importance) of each dimension in the final index, which are computed as: [12]

$$\omega_i = \frac{\sum_{j=1}^{3} \lambda_j \, \varphi_{jk}}{\sum_{j=1}^{3} \lambda_j}, k = 1, 2, 3. \qquad (13)$$

4. Results

In this section, we present the estimated financial inclusion indices for 137 developed and less-developed countries (see Table A1 in the appendix) by two-stage PCA for the years 2011 and 2014. The correlation matrix for the causal variables used to measure financial inclusion is reported in Table 2.

4.1 Financial Inclusion Dimensions

In the first stage, we compute the weights for the causal variables for each sub-index and estimate the latent variables: usage, barriers and access that represent the dimensions of the financial inclusion index. Since we construct the sub-indices as weighted averages of the principal components, it is possible to gather the coefficients for each causal variable. These weights are derived by Eqs. $(2 - 4)$ and normalized such that their sum is 1.

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[12]   In general the sum of the weights expressed by the formula above does not necessarily have to equal 1 due to the fact that principal component methodology normalizes the mode of each eigenvector to 1. The weights therefore could be very close to but not always equal to 1.

Correlation Matrix

Table 2

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Account	1	-	-	-	-	-	-	-	-	-	-
Loan	0.53	1	-	-	-	-	-	-	-	-	-
Savings	0.81	0.57	1	-	-	-	-	-	-	-	-
ATMs/100,000 pop.	0.68	0.33	0.54	1	-	-	-	-	-	-	-
Branches/100,000 pop.	0.55	0.25	0.31	0.56	1	-	-	-	-	-	-
ATMs/1,000 Km2	0.35	0.11	0.34	0.60	0.20	1	-	-	-	-	-
Branches/1,000 Km2	0.44	0.00	0.35	0.45	0.56	0.64	1	-	-	-	-
Distance	-0.45	-0.25	-0.27	-0.39	-0.43	-0.21	-0.40	1	-	-	-
High cost	-0.43	-0.29	-0.28	-0.34	-0.26	-0.26	-0.30	0.55	1	-	-
Documentation	-0.31	-0.23	-0.16	-0.31	-0.28	-0.05	-0.13	0.49	0.39	1	-
Lack of trust	-0.18	-0.05	-0.30	0.01	0.08	-0.21	-0.26	0.03	0.31	-0.07	1

Source: Own elaboration

Notes: Total Pearson correlations for 2014 data

With regard to the weighting scheme, we observe that the contributions of the different indicators barely change over time. For simplicity we only refer to the weights for 2014. For the usage dimension, the indicator for loans has the highest weight (0.40), followed by having an account (0.33) and savings (0.27) (see upper panel of Table 3). It is important to notice that although the weights are not evenly distributed, none of the indicators is dominant; this is a desirable condition for an index. For the access dimension, the ratios of ATMs have higher weight (0.61) than the bank branches and agents (0.39, see middle panel of Table 3). It is because ATMs are highly present in more mature markets so differences across countries are larger. [13] Finally, the lower panel of Table 3 shows the weights for the indicators in the barriers dimension. For the first three indicators (distance, affordability and documentation), the weights are also very similar, at 0.21, 0.25 and 0.25 respectively, and there only very small changes over time. Lack of trust is the most important indicator in defining the barriers dimension, with a weight close to 0.30.

Principal Components Estimates

Table 3

Usage		Usage			
Variable	P C1	P C2	P C3	P C4	norm. weight
Account	0.5968	-0.4551	0.6608	-	0.33
Loan	0.5126	0.8499	0.1223	-	0.40
Savings	0.6172	-0.2658	-0.7041	-	0.27
Eigenvalues	2.2617	0.5579	0.1804	-	
Access					
Variable	P C1	P C2	P C3	P C4	norm. weight
ATMs per 100,000 pop.	0.5204	0.0368	0.7283	-0.4443	0.61
Branches per 100,000 pop.	0.4546	0.7461	-0.0687	0.4816	0.39
Eigenvalues	2.5050	0.8044	0.5530	0.1377	
Barriers					
Variable	P C1	P C2	P C3	P C4	norm. weight
Distance	0.5198	-0.3481	-0.2594	0.7358	0.21
Affordability	0.5357	-0.0126	-0.5986	-0.5955	0.25
Documentation	0.5184	-0.3407	0.7373	-0.2676	0.25
Trust	0.4172	0.8733	0.1757	0.1803	0.29
Eigenvalues	3.1286	0.5854	0.1501	0.1358	

Source: Own elaboration.

Notes: The weights are normalized to sum 1. Figures refer to 2014 data

[13] For a robustness check, we also include branches and ATMs ratios per square kilometre. However, similar access indicators related to population are more powerful in measuring access since correlation with the rest of the indicators is much higher.

Since weights are obtained from the information in the principal components and the corresponding eigenvalues, it is worth studying the composition of these components to understand the structure of our estimated indices. Table 4 shows, in a cumulative way and by dimensions, the amount of the total variance explained by the different components. For the usage dimension, we observe that the first component, which contains 75% of the total information in this dimension (see Table 4) has an even contribution of the three indicators: account, loan and savings. This suggests that these three indicators measure the same latent structure. However, only the indicator referring to loans adds extra information through the second component. It might indicate that having a loan also represents a stage of greater financial inclusion since most people who have a loan already have another financial product, such as a bank account or pay-roll account. [14] As a result, having a loan may be an accurate indicator to identify more consolidated stages of financial inclusion. When defining the access dimension, as shown in the middle panel of Table 3, we again find an even contribution of the two indicators to the first principal component since the coefficients in the eigenvector for this component are similar. Finally, for the barriers dimension, we also find that the four indicators contribute evenly to the first component, which accounts for almost 80 per cent of the total variation in the data. Distance, affordability and documentation have their highest loadings in the first component. Although lack of trust contributes to the first component, it has its highest weight in the second component, which indicates that this variable also adds extra information, in a different structure, from the first component. Lack of trust is a structural variable that can be related to not only idiosyncratic financial system issues (efficiency of financial institutions, financial stability, episodes of bank failures, etc.) but also to broader issues beyond the financial markets, such as governance, cultural norms, economic crises or macroeconomic variables such as inflation.

Cumulative Variance Explained by Components

Table 4

Components	Cumulative Variance
Usage	
P C1	0.7539
P C2	0.9399
P C3	1
Access	
P C1	0.6262
P C2	0.8273
P C3	0.9656
P C4	1
Barriers	
P C1	0.7822
P C2	0.9285
P C3	0.9660
P C4	1

Source: Own elaboration

Notes: Figures refer to 2014 data

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[14] People who start to use formal financial services by having a loan, although they might exist, should be a very small minority.

Table 5 shows the list of countries ranked by the degree of usage, access and barriers. [15] For a more intuitive interpretation, the sub-indices are normalized to be between 0 and 1, where 1 indicates the best relative position in the dimension related to financial inclusion and 0 the worse. The computation of the sub-indices to estimate the dimensions can be useful information for policy-makers and governments when designing financial inclusion strategies. The idea is that policy-makers can obtain useful information to design interventions by using the information provided by weights in such a way that optimize financial inclusion strategies.

4.2 Multidimensional Financial Inclusion Index

In the second stage, we apply PCA on the three sub-indices (usage, access and barriers) to compute their weights in the overall index. Table 6 presents the composition of the principal components and the normalized weights for each dimension or sub-index, for 2014. Results are similar for 2011. The last column shows that PCA assigns the highest weight to access (0.42), followed by usage with a weight of 0.30 and barriers at 0.28. Thus, this information reveals that access is the most important dimension for explaining the degree of financial inclusion. Supply of formal financial services contributes more than number of users to explain the latent structure behind our pool of indicators, i.e. the degree of financial inclusion. It can be explained because access represents a necessary, but not sufficient condition, for using formal financial services.

In terms of the principal component structure, we observe that the first and most important component, accounting for 76 per cent of the total variation in the data (see Table 7), has an even contribution of the three dimensions. As explained previously, this has to hold to ensure that the three dimensions measure the same latent structure which is interpreted as the degree of financial inclusion. [16] Moreover, unlike usage and barriers, access allocates part of its information in the second component, so this dimension not only contributes to the overall index through the first principal component, but also adds extra information through the second component and gains importance in explaining the overall index.

The first column of Table 8 shows the ranking position of countries according to their scores in the financial inclusion index in 2014, from the highest to the lowest score. The third column represents the ranking variations, from 2011 to 2014. As expected, developed countries have the most inclusive financial systems. The first quarter of the ranking (positions 1 to 40) corresponds to developed countries with few exceptions such as Brazil (4), Mongolia (20), Bangladesh (22), Colombia (36) and Thailand (39). This group of low-income countries outperforms other middle income countries and even some high-income countries. Brazil exhibits one of the best performances in the table. A factor that contributes to this success is related to the important role that the public sector takes in the financial system. The existence of social support programs, sponsored by the government through the formal financial system, generates usage of formal financial services for a vulnerable part of the population.

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[15]   Using two-stage PCA, we can compute indices by countries as well as aggregated by regions. Due to space limitations, we report the county-based analysis only.

[16]   Tables 4 and 7 show that, in most of the cases, only the first component explains more than 75 per cent of the causal variables' total variation (except for the access dimension that explains 62 per cent). Thus, the strategy of taking only the first principal component may be a good approximation for estimating the dimensions and the degree of financial inclusion as well.

Ranking of Countries by Dimension

Table 5

Usage		Access		Barriers	
Country	rank	Country	rank	Country	rank
Israel	1	Bangladesh	1	Norway	1
Sweden	2	Brazil	2	Sweden	2
Norway	3	Korea, Rep.	3	United Kingdom	3
Singapore	4	Colombia	4	Denmark	4
New Zealand	5	Peru	5	Netherlands	5
Mauritius	6	Russian Federation	6	Australia	6
Japan	7	Canada	7	France	7
France	8	Portugal	8	Japan	8
Luxembourg	9	United States	9	New Zealand	9
Denmark	10	Australia	10	Canada	10
United Kingdom	11	Chile	11	Finland	11
Finland	12	Spain	12	Belgium	12
Canada	13	Luxembourg	13	Switzerland	13
Australia	14	United Kingdom	14	Austria	14
Germany	15	Croatia	15	Singapore	15
Netherlands	16	Japan	16	Spain	16
Belgium	17	Costa Rica	17	Estonia	17
Mongolia	18	Austria	18	Malta	18
Austria	19	Slovenia	19	Ireland	19
United States	20	Israel	20	Germany	20
Ireland	21	Italy	21	Mongolia	21
Hong Kong SAR, China	22	Bulgaria	22	Korea, Rep.	22
Korea, Rep.	23	France	23	Luxembourg	23
Sri Lanka	24	Switzerland	24	Mauritius	24
Switzerland	25	Mongolia	25	Sri Lanka	25
Chile	26	Germany	26	Slovenia	26
Spain	27	Ireland	27	Greece	27
Slovak Republic	28	Belgium	28	Hong Kong SAR, China	28
Malta	29	Thailand	29	Latvia	29
Estonia	30	Estonia	30	Jordan	30
Latvia	31	New Zealand	31	Israel	31
Uruguay	32	Latvia	32	Croatia	32
Poland	33	Slovak Republic	33	Serbia	33
Slovenia	34	Ecuador	34	United States	34
Czech Republic	35	Poland	35	Lebanon	35
Croatia	36	Montenegro	36	China	36
Brazil	37	Lithuania	37	Thailand	37
Italy	38	Turkey	38	Cyprus	38
Bosnia and Herzegovina	39	Czech Republic	39	Ethiopia	39
Greece	40	China	40	United Arab Emirates	40
Cyprus	41	Hungary	41	Italy	41
Ecuador	42	Kazakhstan	42	Portugal	42
Portugal	43	Ukraine	43	Algeria	43
United Arab Emirates	44	South Africa	44	Kuwait	44
Lithuania	45	Greece	45	Venezuela, RB	45
China	46	Guatemala	46	Bosnia and Herzegovina	46
Thailand	47	Mexico	47	Brazil	47
Hungary	48	Romania	48	Vietnam	48
Bulgaria	49	Serbia	49	Poland	49
Kuwait	50	Pakistan	50	Macedonia, FYR	50
Malaysia	51	Malta	51	Belarus	51
Costa Rica	52	Cyprus	52	Czech Republic	52
Montenegro	53	Belarus	53	Tunisia	53
Macedonia, FYR	54	Saudi Arabia	54	Slovak Republic	54
Lebanon	55	Georgia	55	Costa Rica	55
Serbia	56	Panama	56	Lithuania	56

Ranking of Countries by Dimension

Table 5 cont

Usage		Access		Barriers	
Country	rank	Country	rank	Country	rank
Russian Federation	57	Denmark	57	Bhutan	57
Bolivia	58	Armenia	58	Saudi Arabia	58
Argentina	59	Bosnia and Herzegovina	59	Malaysia	59
Jamaica	60	Malaysia	60	Dominican Republic	60
Bhutan	61	Macedonia, FYR	61	Montenegro	61
Saudi Arabia	62	Kuwait	62	Hungary	62
Belarus	63	United Arab Emirates	63	Rwanda	63
South Africa	64	Argentina	64	Russian Federation	64
Dominican Republic	65	Lebanon	65	Myanmar	65
Turkey	66	Hong Kong SAR, China	66	Georgia	66
Namibia	67	Venezuela, RB	67	Jamaica	67
Romania	68	Singapore	68	Bulgaria	68
Venezuela, RB	69	Mauritius	69	Romania	69
Kazakhstan	70	Namibia	70	South Africa	70
Georgia	71	Netherlands	71	Kazakhstan	71
El Salvador	72	Belize	72	Uruguay	72
Colombia	73	Uruguay	73	India	73
Botswana	74	Gabon	74	Namibia	74
Ukraine	75	Indonesia	75	Kosovo	75
Kosovo	76	Sweden	76	Argentina	76
Kenya	77	Norway	77	West Bank and Gaza	77
Peru	78	Azerbaijan	78	Belize	78
Belize	79	Kosovo	79	Sudan	79
Rwanda	80	Albania	80	Nigeria	80
Panama	81	Honduras	81	Ecuador	81
Nigeria	82	Egypt, Arab Rep.	82	Yemen, Rep.	82
Guatemala	83	Dominican Republic	83	Colombia	83
Azerbaijan	84	India	84	Nepal	84
Indonesia	85	Jordan	85	Chile	85
Vietnam	86	Bolivia	86	Ghana	86
Algeria	87	Moldova	87	Bangladesh	87
India	88	Finland	88	Indonesia	88
Mexico	89	Botswana	89	Kenya	89
Honduras	90	El Salvador	90	Panama	90
Jordan	91	Philippines	91	Burundi	91
Nepal	92	Jamaica	92	Egypt, Arab Rep.	92
Ghana	93	Nicaragua	93	Zambia	93
Myanmar	94	Uzbekistan	94	Uzbekistan	94
Armenia	95	Tunisia	95	Albania	95
Nicaragua	96	Kenya	96	Mali	96
Bangladesh	97	Bhutan	97	Cote d'Ivoire	97
Gabon	98	Rwanda	98	Botswana	98
Tunisia	99	Angola	99	Azerbaijan	99
Albania	100	Sri Lanka	100	Zimbabwe	100
Angola	101	Kyrgyz Republic	101	Mauritania	101
Uganda	102	Zimbabwe	102	Pakistan	102
Philippines	103	West Bank and Gaza	103	Kyrgyz Republic	103
Cambodia	104	Vietnam	104	Burkina Faso	104
Kyrgyz Republic	105	Nigeria	105	Gabon	105
Mauritania	106	Cambodia	106	Bolivia	106
Zambia	107	Algeria	107	Ukraine	107
Ethiopia	108	Nepal	108	Benin	108
Uzbekistan	109	Tajikistan	109	Armenia	109
West Bank and Gaza	110	Zambia	110	Malawi	110
Moldova	111	Ghana	111	Moldova	111
Benin	112	Mauritania	112	Madagascar	112
Egypt, Arab Rep.	113	Sudan	113	Honduras	113

Ranking of Countries by Dimension

Table 5 cont

Usage		Access		Barriers	
Country	rank	Country	rank	Country	rank
Egypt, Arab Rep.	113	Sudan	113	Honduras	113
Togo	114	Cote d'Ivoire	114	Haiti	114
Congo, Rep.	115	Tanzania	115	Mexico	115
Tanzania	116	Mali	116	Cameroon	116
Sudan	117	Togo	117	Turkey	117
Malawi	118	Malawi	118	El Salvador	118
Burkina Faso	119	Senegal	119	Guatemala	119
Haiti	120	Benin	120	Congo, Rep.	120
Zimbabwe	121	Congo, Rep.	121	Angola	121
Cote d'Ivoire	122	Uganda	122	Uganda	122
Tajikistan	123	Iraq	123	Togo	123
Sierra Leone	124	Yemen, Rep.	124	Chad	124
Senegal	125	Burundi	125	Guinea	125
Cameroon	126	Cameroon	126	Sierra Leone	126
Afghanistan	127	Burkina Faso	127	Tajikistan	127
Congo, Dem. Rep.	128	Myanmar	128	Nicaragua	128
Mali	129	Madagascar	129	Peru	129
Iraq	130	Haiti	130	Senegal	130
Chad	131	Guinea	131	Tanzania	131
Pakistan	132	Ethiopia	132	Philippines	132
Burundi	133	Afghanistan	133	Iraq	133
Guinea	134	Sierra Leone	134	Congo, Dem. Rep.	134
Madagascar	135	Niger	135	Afghanistan	135
Yemen, Rep.	136	Congo, Dem. Rep.	136	Niger	136
Niger	137	Chad	137	Cambodia	137

Source: Own elaboration

Notes: Rankings are assigned according to the scores in each dimension of the financial inclusion index for 2014 data. Ranking for 2011 is available upon request.

Such way of facilitating money transfers is running in Brazil, Bangladesh, Mongolia and Thailand. [17] Most importantly, Brazil has a huge banking agent network, pioneering in Latin America. The same also happens with Bangladesh. Finally the role of state-owned banks, with the mandate of fostering financial inclusion, is also an important driver. The second quarter of the ranking, down to the position 40 to 80 is made up mostly of the Eastern European middle-income countries and some Asian (Sri Lanka, China, United Arab Emirates, etc.) and fewer Latin American countries (Costa Rica, Ecuador, Venezuela, Peru and Argentina, most of them below the 60th position).

The remaining positions after these two groups (81 to 137, less than the second half of the ranking) consist of a heterogeneous group that includes countries from Latin America, Asia and all the African countries in the sample except South Africa (63). The last ten countries, at the bottom of the ranking, are low-income African countries. Most African countries in our sample perform poorly in financial inclusion terms, with the only exceptions being South Africa, Nigeria (85) and Kenia (89). Given the relevance of the access dimension in the financial inclusion index, the low levels of financial

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[17]   Moreover, for Mongolia, the high level of financial inclusion may be due in large part to universal cash hand-outs from the government's Human Development Fund as well as pensions, health insurance and student tuition payments. Around 50% of all bank account holders over the age of 15 cite receiving government payments as the most common use for a bank account, according to the Global Findex database.

inclusion in some African countries should improve by including data on e-money outlets, belonging telecommunication companies, since this business model is widespread in the region. This argument does not apply to Latin American countries since e-money is provided by companies that belong the formal financial system.

Principal Component Estimates

Financial Inclusion Index

Table 6

Variable	P C1	P C2	P C3	norm. weight
Usage	0.5775	-0.5758	0.5787	0.39
Access	0.5437	0.8001	0.2535	0.42
Barriers	0.609	-0.1682	-0.7752	0.28
Eigenvalues	2.2805	0.4855	0.2339	

Source: Own elaboration

Notes: The weights are normalized to sum 1. Figures refer to 2014 data

Cumulative Variance Explained by Components

Financial Inclusion Index

Table 7

Components	Cumulative variance
PC1	0.7602
PC2	0.9220
PC3	1

Source: Own elaboration

Notes: Figures refer to 2014 data.

5. Conclusions and Policy Recommendations

Financial inclusion is an essential ingredient of economic development and poverty reduction and it can also be a way of preventing social exclusion. A person's right to use formal financial services, to prevent exclusion, must be a priority. However, efforts to measure financial inclusion are scarce and incomplete. Financial inclusion is a multidimensional concept that cannot be captured accurately with single indicators, but is determined by a much larger set of indicators than the few considered in existing works. The nature of the financial systems is complex and heterogeneous. An inclusive financial system needs particularly to encourage usage of financial services on the part of society's most vulnerable groups; that is, those most affected by obstacles to financial inclusion.

Existing financial inclusion composite indices are questionable since they choose arbitrary weights. This paper proposes a two-stage PCA to measure the extent of financial inclusion for a country or region. This methodology is statistically sound for index construction and robust to high dimensional data. We measure financial inclusion through a composite index for 137 countries by using 20 causal

variables as financial inclusion determinants for 2011 and 2014. This index is comparable across countries and over time. Specifically, our index poses that the degree of financial inclusion is determined by the maximization of usage and access to formal financial services, as well as by the minimization of obstacles causing involuntary exclusion. Demand-side information to assess the usage and barriers dimensions is key in determining the degree of financial inclusion. The dimension of usage measures financial inclusion from the banked perspective, and barriers do so from the perspective of the unbanked. Including information of financially excluded people helps to reveal a comprehensive picture of the extent of financial system inclusiveness. Our major contribution is twofold. First, we use a parametric method, robust to redundant information, to determine the contribution of each indicator to our financial inclusion index. It has the advantage of not employing any exogenous, subjective information. Second, we build a comprehensive index that includes both demand- and supply-side information.

As shown by our estimates, access is the most important dimension for determining the level of financial inclusion. It represents a necessary but not sufficient condition for using formal financial services. However, due to data constraints, we are not able to measure access to the formal financial system in a comprehensive way. We only measure physical access. Although remarkable effort has been done in the last five years in terms of data production (i.e. availability and quality), there exist important limitations. For instance, the traditional indicators used to measure access are currently incomplete. New technology adopted by the financial sector goes beyond the traditional banking access measured by number of physical access points. New mobile banking developments and the use of financial services on the internet open up new channels for accessing formal financial services that, under certain circumstances, overcome the distance as a barrier for access. Measuring these new channels is not straightforward because of the lack of homogeneous measures for a wide range of countries. [18] Although we cannot get an accurate proxy to take into account the new access channels, we do include information on mobile and internet banking in the usage dimension. Efforts in such direction yield relevant improvements on the analysis of financial inclusion's causes and consequences.

Despite of this caveat, the creation of such an index is useful to shed some light on the determinants of financial inclusion as well as its contribution to economic growth and development. Our index is easy to interpret and compute. We believe that more granular information on the different dimensions, in the form of disaggregated data by product, usage frequency and geo-locate information on access points, world be useful for a more accurate assessment of financial inclusion that leads policy recommendations.

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[18]   The bias introduced for omitting this information might be different for developed countries and less-developed countries. We cannot quantify this bias but we have some intuitive information about its direction. Although the lack of data to measure financial service access via internet and smart phone underestimates access more for developed countries than for less-developed countries, the effect on financial inclusion may be larger for less-developed countries than for developed countries. The latter have greater access levels and, as such, increases in access may have a larger effect on less-developed countries that start from lower levels. Likewise, less-developed countries benefit more from banking correspondents as well as from basic mobile phones.

Financial Inclusion Index Country Ranking, 2014

Table 8

Rank/137	Country	Δ	Rank/137	Country	Δ	Rank/137	Country	Δ
1	Israel	32	47	Lithuania	-7	93	Nepal	-1
2	Korea, Rep	3	48	Bosnia and Herz.	3	94	Armenia	-6
3	Canada	5	49	Bulgaria	-4	95	Albania	-18
4	Brazil	17	50	Serbia	-4	96	Ghana	7
5	Japan	8	51	UAE	-1	97	Mexico	-6
6	Australia	-5	52	Lebanon	3	98	Guatemala	-26
7	United Kingdom	9	53	Montenegro	-4	99	Egypt, Arab Rep.	-18
8	Sweden	16	54	Kuwait	-20	100	Gabon	11
9	Luxembourg	-6	55	Hungary	-16	101	Sudan	24
10	Norway	N/A	56	Uruguay	2	102	Pakistan	-5
11	New Zealand	-1	57	Ecuador	4	103	Uzbekistan	-20
12	France	-7	58	Macedonia	-6	104	Zambia	10
13	Singapore	-10	59	Belarus	-3	105	El Salvador	-3
14	United States	1	60	Malaysia	-7	106	Honduras	-12
15	Spain	-7	61	Saudi Arabia	1	107	Yemen, Rep	0
16	Germany	2	62	Venezuela	4	108	Kyrgyz Rep.	8
17	Austria	3	63	South Africa	5	109	Moldova	-3
18	Belgium	1	64	Kazakhstan	-1	110	Zimbabwe	-11
19	Mauritius	13	65	Romania	-6	111	Mauritania	N/A
20	Mongolia	11	66	Georgia	5	112	Côte d'Ivoire	N/A
21	Denmark	0	67	Jordan	6	113	Burundi	1
22	Bangladesh	42	68	Peru	11	114	Mali	6
23	Ireland	-12	69	Bhutan	N/A	115	Benin	11
24	Switzerland	N/A	70	Argentina	5	116	Angola	-16
25	Portugal	-17	71	Dominican Rep.	0	117	Burkina Faso	0
26	Finland	-1	72	Jamaica	-7	118	Malawi	-11
27	Croatia	-3	73	Namibia	N/A	119	Nicaragua	-17
28	Netherlands	-1	74	Vietnam	10	120	Uganda	10
29	Slovenia	-12	75	Algeria	4	121	Madagascar	11
30	Estonia	-1	76	Kosovo	-5	122	Haiti	N/A
31	Chile	23	77	Belize	N/A	123	Congo, Rep	-11
32	Russia	11	78	Tunisia	9	124	Cameroon	-2
33	Latvia	-5	79	Rwanda	14	125	Philippines	-5
34	Hong Kong	8	80	India	-2	126	Togo	-1
35	Italy	-5	81	Panama	18	127	Tajikistan	-1
36	Colombia	21	82	Ethiopia	N/A	128	Sierra Leone	4
37	Malta	-23	83	Ukraine	1	129	Chad	6
38	Slovak Rep.	-1	84	Indonesia	28	130	Guinea	-6
39	Thailand	-8	85	Nigeria	24	131	Tanzania	-1
40	Poland	4	86	Turkey	-22	132	Senegal	-3
41	Sri Lanka	6	87	Myanmar	N/A	133	Iraq	-10
42	Greece	-6	88	Bolivia	5	134	Congo, Dem. Rep.	0
43	Costa Rica	-2	89	Kenya	7	135	Afghanistan	1
44	Czech Rep.	-6	90	Botswana	18	136	Niger	1
45	China	3	91	Azerbaijan	-1	137	Cambodia	-30
46	Cyprus	-33	92	W. Bank and Gaza	-6			

Source: Own elaboration

Notes: Positive (negative) numbers represents an improvement (deterioration) in financial inclusion's relative position between 2011 and 2140

Appendix

Countries

Table A1

Afghanistan	Gabon	New Zealand
Albania	Georgia	Nicaragua
Algeria	Germany	Niger
Angola	Ghana	Nigeria
Argentina	Greece	Norway
Armenia	Guatemala	Pakistan
Australia	Guinea	Panama
Austria	Haiti	Peru
Azerbaijan	Honduras	Philippines
Bangladesh	Hong Kong SAR, China	Poland
Belarus	Hungary	Portugal
Belgium	India	Romania
Belize	Indonesia	Russian Federation
Benin	Iraq	Rwanda
Bhutan	Ireland	Saudi Arabia
Bolivia	Israel	Senegal
Bosnia and Herzegovina	Italy	Serbia
Botswana	Jamaica	Sierra Leone
Brazil	Japan	Singapore
Bulgaria	Jordan	Slovak Republic
Burkina Faso	Kazakhstan	Slovenia
Burundi	Kenya	South Africa
Cambodia	Korea, Rep0.	Spain
Cameroon	Kosovo	Sri Lanka
Canada	Kuwait	Sudan
Chad	Kyrgyz Republic	Sweden
Chile	Latvia	Switzerland
China	Lebanon	Tajikistan
Colombia	Lithuania	Tanzania
Congo, Dem0. Rep0.	Luxembourg	Thailand
Congo, Rep0.	Macedonia, FYR	Togo
Costa Rica	Madagascar	Tunisia
Cte d'Ivoire	Malawi	Turkey
Croatia	Malaysia	Uganda
Cyprus	Mali	Ukraine
Czech Republic	Malta	United Arab Emirates
Denmark	Mauritania	United Kingdom
Dominican Republic	Mauritius	United States
Ecuador	Mexico	Uruguay
Egypt, Arab Rep0.	Moldova	Uzbekistan
El Salvador	Mongolia	Venezuela, RB
Estonia	Montenegro	Vietnam
Ethiopia	Myanmar	West Bank and Gaza
Finland	Namibia	Yemen, Rep0.
France	Nepal	Zambia
	Netherlands	Zimbabwe

Source: Own elaboration

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Bank of Morocco – CEMLA – IFC Satellite Seminar at the ISI World Statistics Congress on *"Financial Inclusion"*

Marrakech, Morocco, 14 July 2017

Measuring financial inclusion: a multidimensional index[1]

Noelia Cámara, BBVA Research,

and David Tuesta, CAF- Bank of Development for Latin America

Measuring Financial Inclusion: A Multidimensional Index

Noelia Camara(BBVA Research)
David Tuesta (CAF- Bank of Development for Latin America)
Bank Al-Maghrib – CEMLA – IFC Satellite Seminar
on Financial Inclusion
Morocco, July 2017

Outline

1. Motivation

2. Contribution

3. Data

4. Econometric Strategy

5. Empirical results

6. Financial inclusion and geography

7. Conclusions

1. Motivation: The challenge of measuring the unobserved

- The use of formal financial services enhances **economic growth** and welfare (Bencivenga y Smith, 1991 RES; Rajan y Zingales, 1998 AER; Beck *et al.*, 2000 JoFE; Levine *et al.*, 2000 JoME; Townsend and Ueda, 2006 RES; Ergungor, 2010 JoMCB)

- Financial inclusion as well as income, health or home is a **basic ingredient for individuals' welfare**

- While the importance of financial inclusion is well-established, there is **no formal consensus** on its measurement

1. Motivation

- **Individual indicators**: + demand-side data (Demirguç-Kunt and Klapper, 2013)

- **Composite indices**:
  - **Non-parametric** methods: +supply-side data (Sarma, 2008, 2012 and Chakravarty and Pal 2010). They assign the importance of indicators by choosing the **weighs exogenously**

  - **Parametric** methods (CFA): + supply-side data (Amidži´c *et al.*, 2014). The importance of indicators (weights) in the overall index are determined **endogenously**

2. This paper

- We present a country-level **multidimensional index** to measure the degree of inclusiveness of financial systems. It is comparable across countries and over time

- Our index uses **demand and supply-side** information of **banked and unbanked**

- **Weights** are **endogenously** determined

- Access and barriers measure the **degree of readiness** for financial inclusion while usage is considered as the **output**

3. Data

- **Demand-side**: Usage and Barriers - Global Findex (2011 and 2014)
  - The survey collects information about 150,000 nationally representative and randomly selected adults from 148 countries
  - Harmonized micro-data set

- **Supply-side**: Access
  - Financial Access Survey (2011 and 2014): Annual data collected by country authorities
  - Data on banking correspondents : Camara *et al.*, (2015)

3. Data: Index structure

- Our index covers 140 and 137 countries for 2011 and 2014, respectively

- It summarizes the information of **20 FI-related indicators** in an efficient way

- We define an inclusive financial system as one that maximizes usage and access, while minimizing involuntary financial exclusion
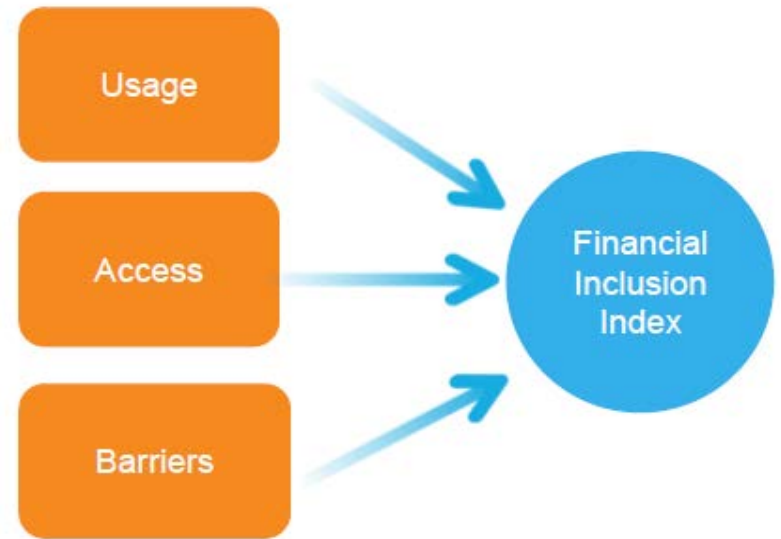
3. Data: Usage

- Account: adjusted number of account/card holders in a formal financial institution or post office over the total population: **corrected by dormant accounts/cards**

- **Savings**:

$$Saving_i = \frac{formal\ savings_i}{informal\ savings_i}$$

- **Loans**:

$$Loan_i = \frac{formal\ loans_i}{informal\ loans_i}$$

3. Data: barriers

- **Trust**: percentage of unbanked who do not have a bank account because they do not trust the formal financial system

- **Affordability**: percentage of unbanked who do not have a bank account because they perceive them to be too expensive

- **Distance**: percentage of unbanked who do not have a bank account because they perceive that access points are too far away

- **Documents**: percentage of unbanked who do not have a bank account because they perceive that lack the necessary documents

3. Data: access

- Access points:

  - **Access points with a human interaction**: Number of commercial bank branches and banking correspondents (per 100,000 adults)

  - **Access points with a machine interaction:** ATMs (per 100,000 adults)

4. Econometric strategy

- We assume that behind our set of correlated variables, we can find an **underlying structure** that can be identified with a latent variable that represents FI

- We need to estimate at the same time the parameters and the latent variable. **Standard regression techniques are unfeasible** for these purposes

- **Two-step PCA**

4. Econometric strategy

- **First step**: estimation of the three dimensions(usage, access and barriers)

$$Y_{ui} = \beta_1\ account_i + \beta_2 savings_i + \beta_3 loan_i + u_i$$

$$Y_{ai} = \gamma_1\ personal\ access\ point_i + \gamma_2 \mathrm{ATM}_i + v_i$$

$$Y_{bi} = \alpha_1 distance_i + \alpha_2 affordability_i + \alpha_3 documents_i + \alpha_4 trust_i + e_i$$

i: denotes the country, $(Y_u Y_a Y_b)$ is the dimension's vector where the subscripts u, a and b denote the dimensions

4. Econometric strategy

- **Second step**: estimate of the dimension weights and the overall FI index (dimensions are the explanatory variables)

$$MIFI_i = \theta_1 Y_{ui} + \theta_2 Y_{ai} + \theta_3 Y_{bi} + \tau_i$$

5. Results: Financial inclusion growth 2011 - 2014

Rank	Country	Δ
1	Israel	+32
2	Korea, Rep.	+3
3	Canada	+5
4	Brazil	+17
5	Japan	+8
6	Australia	-5
7	United Kingdom	+9
8	Sweden	+16
9	Luxembourg	-6
10	Norway	N/A
11	New Zealand	-1
12	France	-7
13	Singapore	-10
14	United States	+1
15	Spain	-7
16	Germany	+2
17	Austria	+3
18	Belgium	+1
19	Mauritius	+13
20	Mongolia	+11
21	Denmark	0
22	Bangladesh	+42
23	Ireland	-12

Rank	Country	Δ
24	Switzerland	N/A
25	Portugal	-17
26	Finland	-1
27	Croatia	-3
28	Netherlands	-1
29	Slovenia	-12
30	Estonia	-1
31	Chile	+23
32	Russian Federation	+11
33	Latvia	-5
34	Hong Kong SAR, China	+8
35	Italy	-5
36	Colombia	+21
37	Malta	-23
38	Slovak Republic	-1
39	Thailand	-8
40	Poland	+4
41	Sri Lanka	+6
42	Greece	-6
43	Costa Rica	-2
44	Czech Republic	-6
45	China	+3
46	Cyprus	-33

| Rank	Country	Δ
47	Lithuania	-7
48	Bosnia and Herzegovina	+3
49	Bulgaria	-4
50	Serbia	-4
51	United Arab Emirates	-1
52	Lebanon	+3
53	Montenegro	-4
54	Kuwait	-20
55	Hungary	-16
56	Uruguay	+2
57	Ecuador	+4
58	Macedonia, FYR	-6
59	Belarus	-3
60	Malaysia	-7
61	Saudi Arabia	+1
62	Venezuela, RB	+4
63	South Africa	+5
64	Kazakhstan	-1
65	Romania	-6
66	Georgia	+5
67	Jordan	+6
68	Peru	+11
69	Bhutan	N/A

5. Results: Financial inclusion growth 2011 - 2014

| Rank	Country	Δ
70	Argentina	+5
71	Dominican Republic	0
72	Jamaica	-7
73	Namibia	N/A
74	Vietnam	+10
75	Algeria	+4
76	Kosovo	-5
77	Belize	N/A
78	Tunisia	+9
79	Rwanda	+14
80	India	-2
81	Panama	+18
82	Ethiopia	N/A
83	Ukraine	+1
84	Indonesia	+28
85	Nigeria	+24
86	Turkey	-22
87	Myanmar	N/A
88	Bolivia	+5
89	Kenya	+7
90	Botswana	+18
91	Azerbaijan	-1
92	West Bank and Gaza	-6

Rank	Country	Δ
93	Nepal	-1
94	Armenia	-6
95	Albania	-18
96	Ghana	+7
97	Mexico	-6
98	Guatemala	-26
99	Egypt, Arab Rep.	-18
100	Gabon	+11
101	Sudan	+24
102	Pakistan	-5
103	Uzbekistan	-20
104	Zambia	+10
105	El Salvador	-3
106	Honduras	-12
107	Yemen, Rep.	0
108	Kyrgyz Republic	+8
109	Moldova	-3
110	Zimbabwe	-11
111	Mauritania	N/A
112	Côte d'Ivoire	N/A
113	Burundi	+1
114	Mali	+6
115	Benin	+11

Rank	Country	Δ
116	Angola	-16
117	Burkina Faso	0
118	Malawi	-11
119	Nicaragua	-17
120	Uganda	+10
121	Madagascar	+11
122	Haiti	N/A
123	Congo, Rep.	-11
124	Cameroon	-2
125	Philippines	-5
126	Togo	-1
127	Tajikistan	-1
128	Sierra Leone	+4
129	Chad	+6
130	Guinea	-6
131	Tanzania	-1
132	Senegal	-3
133	Iraq	-10
134	Congo, Dem. Rep.	0
135	Afghanistan	+1
136	Niger	+1
137	Cambodia	-30

# 5. Empirical results
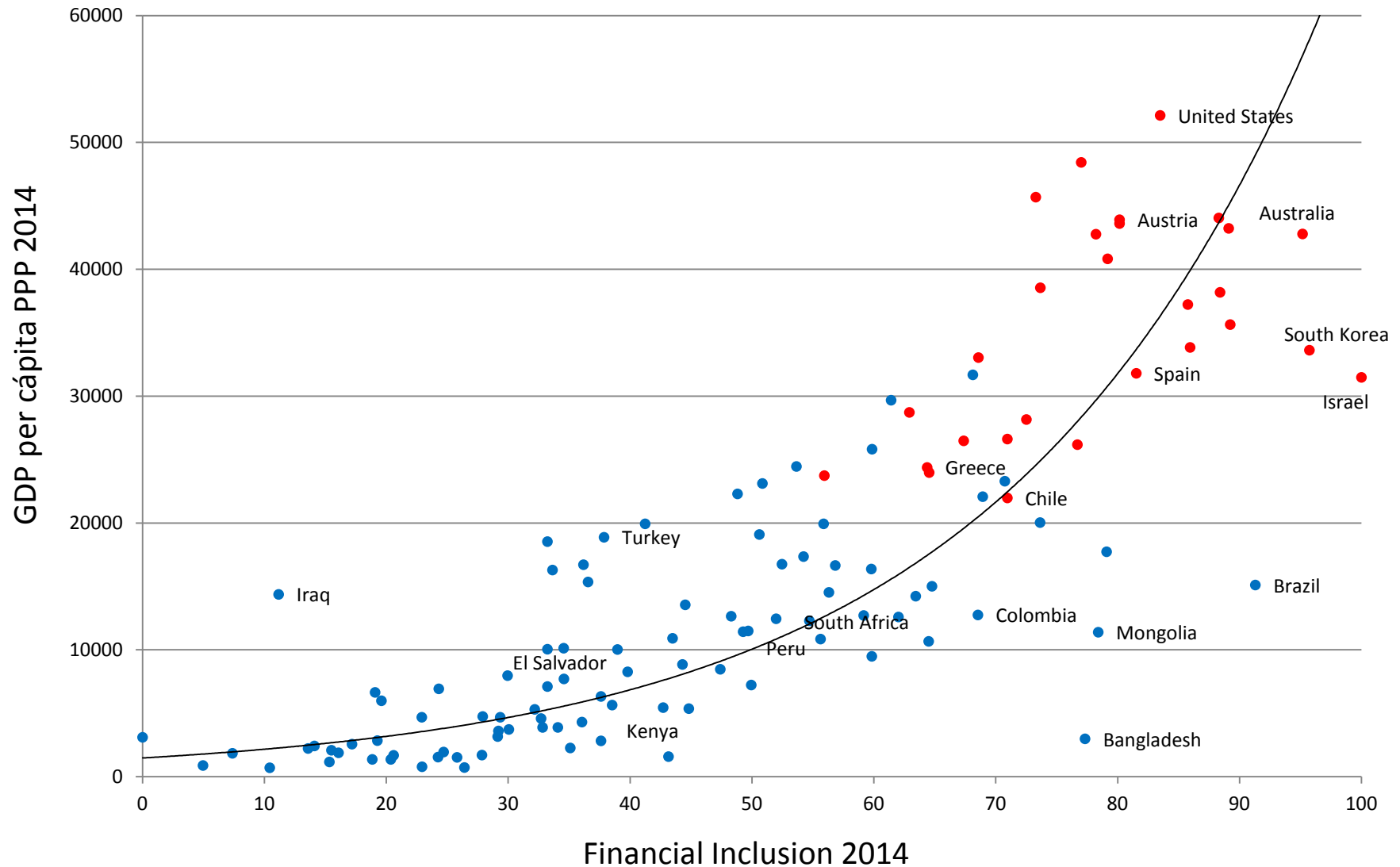
5. Empirical results
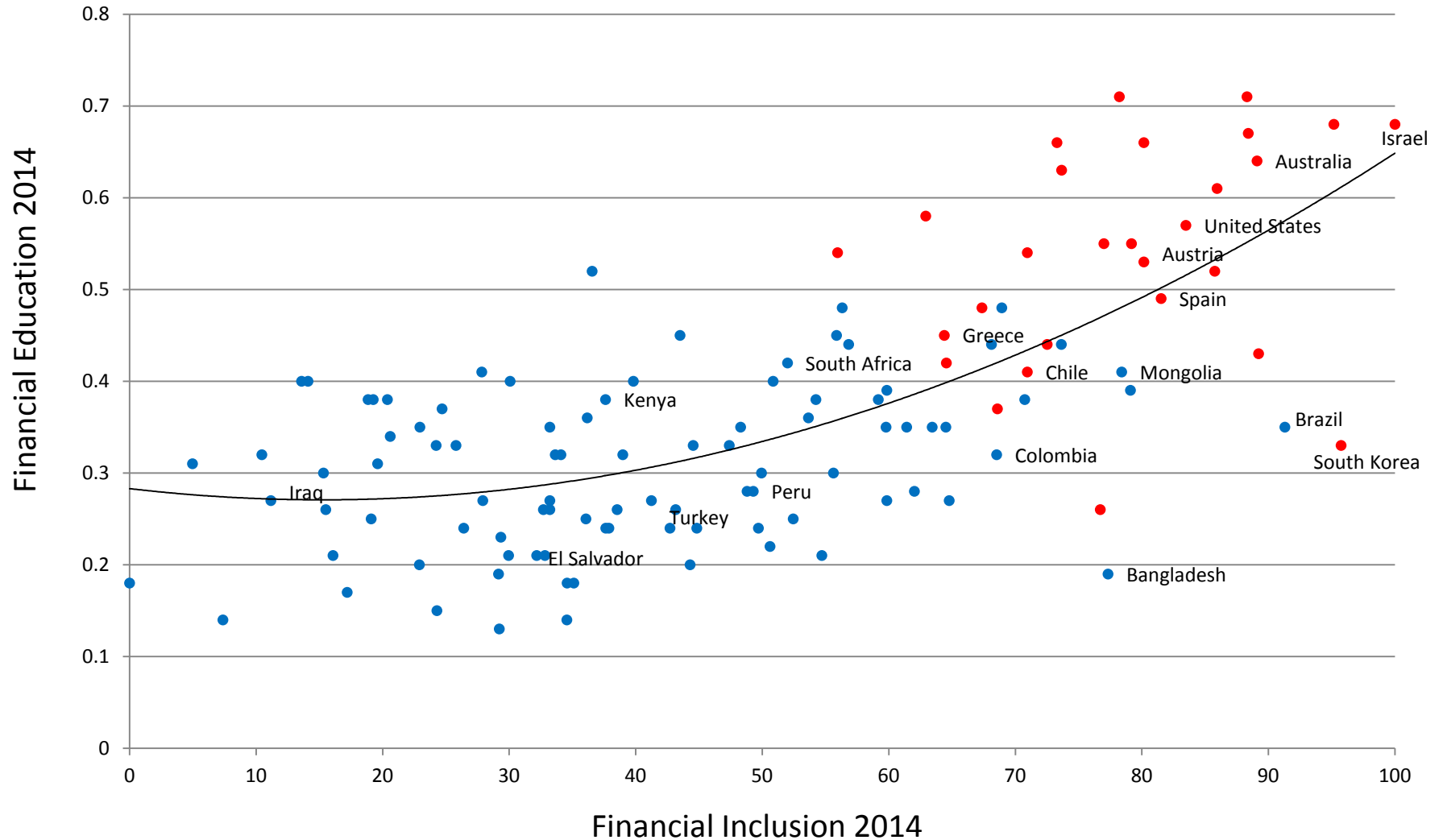
6. Geography and Financial Inclusion

- *Hypothesis*: **There is spatial autocorrelation between the level of financial inclusion in the country *i* and its neighbors**

- We find evidence in favor of our hypothesis of spatial dependence

- We introduce a weighting mechanism based on geo-position to control for spatial dependence when calculating the financial inclusion index
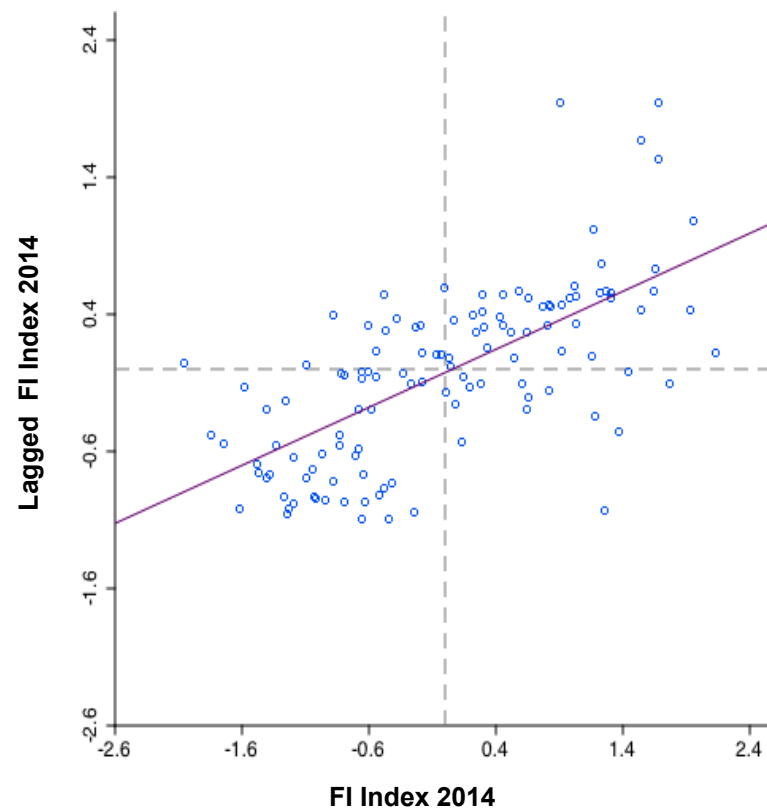
6. Geography and Financial Inclusion

Spatial autocorrelation
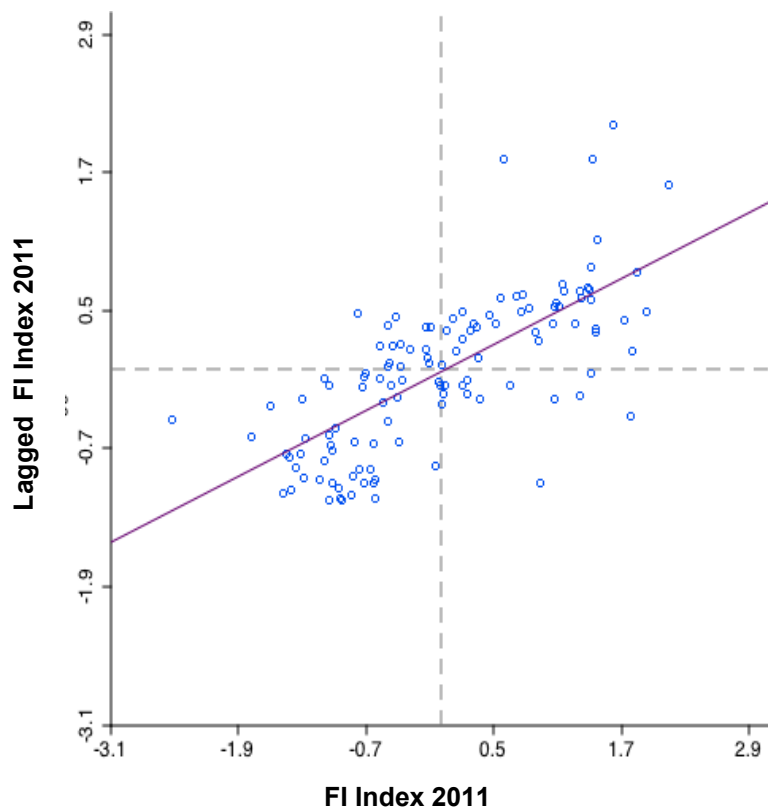
6. Geography and Financial Inclusion

2011

```
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set           : F.I.INDEX
Dependent Variable :     FI_2011  Number of Observations:  121
Mean dependent var :     54.386  Number of Variables   :    2
S.D. dependent var :    21.3322  Degrees of Freedom    :  119

R-squared          :    0.729789  F-statistic          :       321.397
Adjusted R-squared :    0.727518  Prob(F-statistic)    :  1.30815e-35
Sum squared residual:    14878.5  Log likelihood       :      -462.811
Sigma-square       :     125.03   Akaike info criterion :      929.621
S.E. of regression :    11.1817   Schwarz criterion    :      935.213
Sigma-square ML    :    122.963
S.E of regression ML:   11.0889
```

```
-----------------------------------------------------------------------
    Variable    Coefficient     Std.Error    t-Statistic  Probability
-----------------------------------------------------------------------
    CONSTANT      33.45656       1.547975      21.61311     0.00000
    GDP_2011     0.001388721   7.746297e-05    17.92754     0.00000
-----------------------------------------------------------------------
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : MATRIX WEIGHT.gwt
  (row-standardized weights)
TEST                        MI/DF      VALUE        PROB
Moran's I (error)          0.1293      3.6349      0.00028
Lagrange Multiplier (lag)     1       16.6609     0.00004
Robust LM (lag)               1        8.0443     0.00456
Lagrange Multiplier (error)   1        9.7801     0.00176
Robust LM (error)             1        1.1636     0.28072
Lagrange Multiplier (SARMA)   2       17.8245     0.00013
```

2014

```
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set           : F.I.INDEX
Dependent Variable :     FI_2014  Number of Observations:  121
Mean dependent var :     49.153  Number of Variables   :    2
S.D. dependent var :    23.7076  Degrees of Freedom    :  119

R-squared          :    0.673984  F-statistic          :       246.012
Adjusted R-squared :    0.671244  Prob(F-statistic)    :  9.65965e-31
Sum squared residual:    22171.8  Log likelihood       :      -486.944
Sigma-square       :     186.317  Akaike info criterion :      977.888
S.E. of regression :    13.6498   Schwarz criterion    :       983.48
Sigma-square ML    :    183.238
S.E of regression ML:   13.5365
```

```
-----------------------------------------------------------------------
    Variable    Coefficient     Std.Error    t-Statistic  Probability
-----------------------------------------------------------------------
    CONSTANT      26.05823       1.925583      13.53264     0.00000
    GDP_2014     0.001470589   9.375898e-05    15.68478     0.00000
-----------------------------------------------------------------------
DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : MATRIX WEIGHT.gwt
  (row-standardized weights)
TEST                        MI/DF      VALUE        PROB
Moran's I (error)          0.1088      3.1105      0.00187
Lagrange Multiplier (lag)     1        9.9491     0.00161
Robust LM (lag)               1        3.9091     0.04803
Lagrange Multiplier (error)   1        6.9357     0.00845
Robust LM (error)             1        0.8957     0.34395
Lagrange Multiplier (SARMA)   2       10.8447     0.00442
```

6. Geographical Proximity and Financial Inclusion

- A weighted method of principal component analysis (GWPCA) is computed to account for the proximity between countries

$$MIFI_i = \boldsymbol{\omega_1} \overline{Y}_{ij}^{u} + \boldsymbol{\omega_2} \overline{Y}_{ij}^{a} + \boldsymbol{\omega_3} \overline{Y}_{ij}^{b} + \boldsymbol{\epsilon_i}$$

- We use the Euclidean distance between the centroid of the countries and their geographic location. We obtain a value for each pair of coordinates

- Spatial weights are calibrated by introducing a specification of the distance that consider adjacent countries (located at 2,500 km)

6. Financial inclusion growth with spatial effects: 2011 - 2014

Rank	Country	Δ
1	Israel	+32
2	Korea, Rep.	+2
3	Canada	+5
4	Brazil	+14
5	Japan	+5
6	Sweden	+18
7	Norway	N/A
8	Australia	-6
9	United Kingdom	+7
10	Luxembourg	-6
11	Singapore	-8
12	New Zealand	-2
13	France	-7
14	United States	+6
15	Spain	-7
16	Germany	+2
17	Mauritius	+15
18	Austria	+3
19	Belgium	-2
20	Denmark	+2
21	Mongolia	+10
22	Ireland	-9
23	Switzerland	N/A

Rank	Country	Δ
24	Portugal	-16
25	Finland	0
26	Netherlands	+1
27	Chile	+26
28	Colombia	+23
29	Croatia	-5
30	Slovenia	-14
31	Estonia	-1
32	Hong Kong SAR, China	+10
33	Russian Federation	+11
34	Latvia	-6
35	Malta	-20
36	Italy	-5
37	Bangladesh	+28
38	Slovak Republic	-1
39	Sri Lanka	+9
40	Thailand	-11
41	Greece	-5
42	Poland	+1
43	Costa Rica	-3
44	Czech Republic	-6
45	China	+2
46	Cyprus	-33

Rank	Country	Δ
47	Bosnia and Herzegovina	+5
48	Lithuania	-7
49	United Arab Emirates	+1
50	Bulgaria	-5
51	Serbia	-5
52	Lebanon	+4
53	Kuwait	-19
54	Ecuador	+6
55	Montenegro	-6
56	Hungary	-17
57	Uruguay	+1
58	Macedonia, FYR	-4
59	Peru	+16
60	Belarus	-3
61	Malaysia	-6
62	Saudi Arabia	+1
63	Venezuela, RB	+4
64	South Africa	+4
65	Kazakhstan	-1
66	Romania	-7
67	Jordan	+5
68	Georgia	+3
69	Bhutan	N/A

6. Financial inclusion growth with spatial effects: 2011 - 2014

Rank	Country	Δ
70	Argentina	+5
71	Dominican Republic	0
72	Jamaica	-5
73	Namibia	N/A
74	Vietnam	+10
75	Algeria	+4
76	Kosovo	-5
77	Belize	N/A
78	Rwanda	+15
79	Tunisia	+9
80	India	+1
81	Ethiopia	N/A
82	Panama	+18
83	Ukraine	+1
84	Indonesia	+28
85	Nigeria	+24
86	Myanmar	N/A
87	Kenya	+9
88	Bolivia	+5
89	Turkey	-22
90	Botswana	+19
91	West Bank and Gaza	-5
92	Azerbaijan	-1

Rank	Country	Δ
93	Nepal	-1
94	Mexico	-6
95	Guatemala	-29
96	Albania	-18
97	Ghana	+6
98	Armenia	-9
99	Gabon	+13
100	Sudan	+25
101	Egypt, Arab Rep.	-20
102	Uzbekistan	-18
103	Pakistan	-6
104	Zambia	+10
105	Honduras	-11
106	El Salvador	-4
107	Yemen, Rep.	0
108	Kyrgyz Republic	+8
109	Zimbabwe	-10
110	Moldova	-4
111	Mauritania	N/A
112	Côte d'Ivoire	N/A
113	Burundi	0
114	Mali	+5
115	Benin	+11

Rank	Country	Δ
116	Burkina Faso	+1
117	Angola	-17
118	Nicaragua	-16
119	Malawi	-12
120	Uganda	+10
121	Madagascar	+11
122	Haiti	N/A
123	Congo, Rep.	-12
124	Cameroon	-3
125	Togo	0
126	Philippines	-4
127	Tajikistan	-1
128	Sierra Leone	+4
129	Guinea	-6
130	Chad	+5
131	Tanzania	-1
132	Senegal	-3
133	Iraq	-9
134	Congo, Dem. Rep.	0
135	Afghanistan	+1
136	Niger	+1
137	Cambodia	-30

5. PCA vs. GWPCA

Δ	Country	Δ	Country	Δ	Country	Δ	Country
-15	Bangladesh	-1	Chad	-1	Serbia	0	Haiti
+9	Peru	+1	Denmark	-1	Slovenia	0	India
+8	Colombia	-1	El Salvador	-1	South Africa	0	Indonesia
-4	Armenia	-1	Estonia	+1	Sudan	0	Iraq
+4	Chile	+1	Ethiopia	+1	Switzerland	0	Israel
+3	Ecuador	+1	Finland	-1	Thailand	0	Jamaica
+3	Guatemala	-1	France	+1	Togo	0	Japan
+3	Mexico	+1	Gabon	-1	Tunisia	0	Jordan
+3	Norway	-1	Ghana	-1	Uruguay	0	Korea, Rep.
-3	Turkey	+1	Greece	+1	Uzbekistan	0	Kosovo
-2	Australia	+1	Guinea	-1	Venezuela, RB	0	Kyrgyz Republic
-2	Croatia	+1	Honduras	+1	West Bank and Gaza	0	Lebanon
-2	Egypt, Arab Rep.	-1	Hungary	+1	Zimbabwe	0	Macedonia, FYR
-2	Georgia	+1	Ireland	0	Afghanistan	0	Madagascar
+2	Hong Kong SAR, China	-1	Italy	0	Algeria	0	Mali
+2	Kenya	-1	Kazakhstan	0	Argentina	0	Mauritania
+2	Malta	+1	Kuwait	0	Belize	0	Namibia
+2	Mauritius	-1	Latvia	0	Benin	0	Nepal
-2	Montenegro	-1	Lithuania	0	Bhutan	0	Niger
+2	Netherlands	-1	Luxembourg	0	Bolivia	0	Nigeria
-2	Poland	-1	Malawi	0	Botswana	0	Senegal
+2	Singapore	-1	Malaysia	0	Brazil	0	Sierra Leone
+2	Sri Lanka	-1	Moldova	0	Burundi	0	Slovak Republic
+2	Sweden	-1	Mongolia	0	Cambodia	0	Spain
+2	United Arab Emirates	+1	Myanmar	0	Cameroon	0	Tajikistan
-2	United Kingdom	-1	New Zealand	0	Canada	0	Tanzania
-1	Albania	+1	Nicaragua	0	China	0	Uganda
-1	Angola	-1	Pakistan	0	Congo, Dem. Rep.	0	Ukraine
-1	Austria	-1	Panama	0	Congo, Rep.	0	United States
-1	Azerbaijan	-1	Philippines	0	Costa Rica	0	Vietnam
-1	Belarus	+1	Portugal	0	Côte d'Ivoire	0	Yemen, Rep.
-1	Belgium	-1	Romania	0	Cyprus	0	Zambia
+1	Bosnia and Herzegovina	-1	Russian Federation	0	Czech Republic		
-1	Bulgaria	+1	Rwanda	0	Dominican Republic		
+1	Burkina Faso	-1	Saudi Arabia	0	Germany		

7. Conclusions

- We propose a **parametric index** to measure the degree of financial systems' inclusiveness. It is **comparable across countries and over time**. It is **easy to interpret**

- **Demand and supply information** is considered

- Our index has **desirable properties**: It comprises information from all the indicators but it is not strongly biased towards one or more indicators

- It accounts for the **dependence between countries' geo-position and financial inclusion**

- This financial inclusion index may help in **advising policy makers** though the financial inclusion diagnosis and potential market failures

Thank you!

noelia.camara@bbva.com

Appendices

TABLE 1

Variable	Obs	Mean	Std. Dev.	Min	Max
		DESCRIPTIVE STATISTICS			
		Usage			
Account	137	61.00	27.00	8.00	100
Loan	137	11.60	5.15	1.31	26.43
Savings	137	24.46	16.85	0.90	68.84
		Access			
ATMs/100,000 pop.	137	56.18	52.46	0.49	270.13
Branches/100,000 pop.	137	20.82	17.91	0.66	89.73
		Barriers			
Distance	137	17.06	11.65	0.00	49.16
Affordability	137	26.32	14.59	0.00	59.81
Documentation	137	18.60	11.98	0.00	49.47
Lack of trust	137	18.83	12.10	0.00	57.45

TABLE 3

PRINCIPAL COMPONENTS ESTIMATES

Usage

Variable	PC_1	PC_2	PC_3	PC_4	norm. weight
Account	0.5968	-0.4551	0.6608	-	0.33
Loan	0.5126	0.8499	0.1223	-	0.40
Savings	0.6172	-0.2658	-0.7041	-	0.27
Eigenvalues	2.2617	0.5579	0.1804	-	

Access

Variable	PC_1	PC_2	PC_3	PC_4	norm. weight
ATMs per 100,000 pop.	0.5204	0.0368	0.7283	-0.4443	0.61
Branches per 100,000 pop.	0.4546	0.7461	-0.0687	0.4816	0.49
Eigenvalues	2.5050	0.8044	0.5530	0.1377	

Barriers

Variable	PC_1	PC_2	PC_3	PC_4	norm. weight
Distance	0.5198	-0.3481	-0.2594	0.7358	0.21
Affordability	0.5357	-0.0126	-0.5986	-0.5955	0.25
Documentation	0.5184	-0.3407	0.7373	-0.2676	0.25
Trust	0.4172	0.8733	0.1757	0.1803	0.29
Eigenvalues	3.12863	0.585401	0.150115	0.135852	

Notes: The weights are normalised add up to 1

TABLE 4

Cumulative Variance Explained by Components

Components	Cumulative variance
Usage	
PC_1	0.7539
PC_2	0.9399
PC_3	1
Access	
PC_1	0.6262
PC_2	0.8273
PC_3	0.9656
PC_4	1
Barriers	
PC_1	0.7822
PC_2	0.9285
PC_3	0.9660
PC_4	1

TABLE 6

		PRINCIPAL COMPONENT ESTIMATES		
		Financial Inclusion Index		
Variable	PC_1	PC_2	PC_3	norm. weight
Usage	0.5775	-0.5758	0.5787	0.39
Access	0.5437	0.8001	0.2535	0.42
Barriers	0.609	-0.1682	-0.7752	0.28
Eigenvalues	2.28051	0.485501	0.233989	

Notes: The weights are normalised add up to 1