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Measuring financial inclusion

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Abstract

Using a distance-based approach, this paper proposes an index of financial inclusion (IFI) – a measure of inclusiveness of a financial system that incorporates information on various dimensions of financial inclusion in a single number lying between 0 and 1. The proposed index is easy to compute and is comparable across economies and over time. It is unit-free, monotonous and homogeneous.

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1. Introduction

An important question in the emerging literature on financial inclusion (FI) relates to how it should be measured. Some studies have measured FI by simply measuring the proportion of adult population/households (of an economy) having a bank account (See, e.g., Honohan, 2008). However, such a measure ignores some important aspects of an inclusive financial system, such as quality and usage of the financial services. Studies have shown that merely having bank accounts may not imply financial inclusion if people do not use the accounts due to limitations such as remoteness, cost of transactions, psychological barriers and so on (see, e.g., Diniz et al. 2011, Kempson et al. 2004). A measure based on proportion of adults with a bank account effectively quantifies only one aspect of FI, viz., financial penetration, and ignores other important aspects, such as availability, affordability, quality and usage of financial system that together form an inclusive financial system.

An alternate approach, adopted by policy makers, involves the use a variety of indicators reflecting different aspects of FI such as penetration, availability and usage of the banking systems. Some such indicators are number of bank accounts (per 1000 adult persons), number of bank branches and ATMs (per million people), volume of bank credit and deposit as ratios of GDP etc. Alliance of Financial Inclusion (AFI), a global network of financial sector regulators, has recently developed, on similar lines, a set of financial inclusion indicators (AFI 2011).

These indicators do provide useful information on various aspects of FI. However, when used individually, they may provide incomplete information on the extent of FI in an economy. Table I provides an example.

TABLE I: *Financial inclusion indicators for select countries, 2010*

Country	*No. of bank A/C (per 1000 adults)*	*No. of Bank Branches (per 100,000 adults)*	*Credit/GDP (%)*	*Deposit/GDP(%)*
Czech Republic	1141.6	22.5	84.7	91.4
India	1066	22.5	43.4	58.4
Lebanon	916.5	31.6	79.9	281.4
Malaysia	2275.7	22.2	114.9	149.5
Qatar	769.8	23.4	67.5	64.3
Romania	1324.2	33.9	40.7	34.5
Thailand	1802.2	19.2	125.1	106

Source: *FAS (2012), IMF*

Taking the examples of, say, Malaysia and Lebanon from Table I, we can see that in the first and the third indicators, Malaysia ranks above Lebanon, while in the second and the fourth indicators, Malaysia ranks below Lebanon. Thus, these individual indicators do not convey in clear terms whether Malaysia is more financially inclusive than Lebanon or vice versa. Each individual indicator provides information only on one particular aspect of FI.

Thus, a comprehensive measure that combines information on all aspects (or dimensions) of FI into a single number is useful. In addition, such a measure should be mathematically robust, easy to compute and comparable across economies and over time.

In this paper we propose an index of financial inclusion (IFI) on these lines.[1] In Section 2, we review basic premises for construction of a comprehensive measure of financial inclusion and discuss pros and cons of several possible methodologies. Then, in Section 3, we present the IFI. We describe the IFI methodology in Section 3.1., followed by an illustrative example in Section 3.2. The illustrative example also outlines some conceptual and practical challenges of defining various dimensions of financial inclusion.

2. Conceptual issues in developing an IFI

Suppose that there are n quantifiable dimensions of an inclusive financial system, denoted by d_1, d_2,..,d_n.[2] A comprehensive, meaningful and mathematically robust IFI should then be considered as a function of n variables with domain in the n-dimensional real space ($\mathbb{R}_+^n$) and co-domain in the one dimensional real space ($\mathbb{R}_+$). The IFI can be defined as

$$\text{IFI}\ (d_1,d_2,\ldots d_n):\ \mathbb{R}_+^n \rightarrow \mathbb{R}_+$$

The IFI thus constructed is a multidimensional measure, incorporating information on various dimensions (aspects) of financial inclusion in a single number. In order that this measure is easy to interpret and useful for comparison across economies and over time, we need to ensure that it satisfies the following desirable properties:

1. Unit free measure: The IFI should be a unit free measure so that we can compare values across countries and time.

2. Boundedness: For an easy interpretation of its values, the IFI should be a bounded function. In other words, it should be bounded below by a number that characterizes the least inclusive system and bounded above by a number that characterizes the most inclusive system. For example, simple and easy to understand lower and upper bounds could be 0 and 1 respectively. With these bounds, IFI has its domain in $\mathbb{R}_+^n$ but co-domain as [0,1], a subset of $\mathbb{R}_+$.

3. Monotonicity: The IFI should be an increasing function of its dimensions; higher achievements in any given dimension, ceteris paribus, should give rise to higher values of the IFI.

4. Homogeniety: If each dimension in the IFI is changed by a constant amount, then it should not change the value of the IFI. This is also known as scale invariance property of an index. In mathematical words, the IFI should be a homogeneous function of degree zero.

Now, given d_1, d_2,….d_n ,the construction of an IFI essentially boils down to aggregating these dimensions in a meaningful manner, so as to satisfy the above desirable properties. There are several ways in which we can think of aggregating the dimensions. One way is to combine the dimensions by taking an average, either arithmetic or geometric. These average based indexes would satisfy all the above desirable properties; however, they would suffer from the 'perfect substitutability' assumption. In averages, whether arithmetic or geometric, the affect of an

[1] The IFI presented here is modified and improved over the attempts made in previous versions (e.g. Sarma, 2008; Sarma and Pais, 2011).

[2] In the illustrative example in Section 3.2, we consider three basic dimensions, viz., banking penetration, availability and usage of banking system.

increase in one dimension can be nullified by an equal (in case of arithmetic average) and proportionate (in case of geometric average) reduction in another dimension. This is called perfect substitutability; an index that suffers from this does not measure the actual impact of increase in one dimension and (equal/proportionate) and decrease in another. Another way to construct an index could be to use a principal component analysis (PCA), a statistical method for computing a linear combination of the dimensions where weights are computed so as to retain the variance-covariance structure of the dimensions. Though much in fashion amongst econometricians and data-miners, the PCA is hardly useful for constructing an index for measuring FI due to the fact that in such an index, we are concerned about capturing the levels (i.e., the first moments) of the achievements in various dimensions and not in the variance-covariance of the dimensions that measures second moments.[3] Further, PCA based indexes will only ensure multidimensionality and will not necessarily satisfy other desirable properties listed above.

In this paper, we use a 'distance-based' approach for constructing the IFI. In this distance based method, the IFI is computed as an average distance from an ideal and a worst outcome. Here, we construct IFI in such a manner that high value of IFI would indicate low distance from the ideal and high distance from the worst outcome. Thus it has an easy and meaningful interpretation. We conceptualize the IFI in the next section.

3. Index of Financial Inclusion (IFI)

Suppose that there are n-dimensions of an inclusive financial system. Then, a point in the n-dimensional Euclidean space can be used to indicate a country's achievements in these dimensions. In the same space, we can identify two points - one that indicates the worst achievement (zero financial inclusion) and one that indicates the best achievement (highest financial inclusion). Given these two reference points, a country's level of financial inclusion will be measured by how far the country's achievement point is from these reference points. In the following subsections, we present the methodology in details.

3.1. Methodology

The first step is to compute a country's achievement in each dimension of financial inclusion, using a dimension index. The dimension index d_i, is computed by the formula **(1).**[4] A weight w_i such that $0 \leq w_i \leq 1$ is attached to the dimension i, indicating the relative importance of the dimension i in quantifying the inclusiveness of a financial system.

$$d_i = w_i \frac{A_i - m_i}{M_i - m_i} \qquad \textbf{(1)}$$

where

w_i = weight attached to the dimension i, $0 \leq w_i \leq 1$

A_i = actual value of dimension i

[3] PCA can be a useful framework when one is trying to make an index that exploit the variance-covariance of many variables, say a measure of risk or crisis where volatility and co-movements may be of concern.

[4] This formula is similar to that of UNDP's dimension index formula for Human Development Index (HDI).

m_i = lower bound on dimension i, fixed by some pre-specified rule.

M_i = upper bound on dimension i, fixed by some pre-specified rule.

Formula **(1)** ensures that $0 \leq d_i \leq w_i$. The higher the value of d_i, higher is the country's achievement in dimension i. If n dimensions of financial inclusion are considered, then, a country's achievements in these dimensions will be represented by a point X = $(d_1,d_2,d_3,\ldots,d_n)$ on the n-dimensional space. In the n-dimensional space, the point O = (*0*, 0, 0,…,0) represents the point indicating the worst situation (zero achievement) while the point W = $(w_1, w_2,\ldots..w_n)$ represents an ideal situation indicating the highest achievement in all dimensions. The location of the achievement point X vis-à-vis the worst point O and the ideal point W will together determine a country's level of FI. An inclusive financial system will have an achievement point close to W and away from O. In our proposed IFI, we use a simple average of the normalized Euclidian distance between X and O (denoted by X_1, formula **(2)**) and the normalized inverse Euclidian distance between X and W (denoted by X_2, formula **(3)**).

$$X_1 = \frac{\sqrt{d_1^{\,2} + d_2^{\,2} + .. + d_n^{\,2}}}{\sqrt{(w_1^{\,2} + w_2^{\,2} + \ldots + w_n^{\,2})}} \qquad \textbf{(2)}$$

$$X_2 = 1 - \frac{\sqrt{(w_1 - d_1)^2 + (w_2 - d_2)^2 + .. + (w_n - d_n)^2}}{\sqrt{(w_1^{\,2} + w_2^{\,2} + \ldots + w_n^{\,2})}} \qquad \textbf{(3)}$$

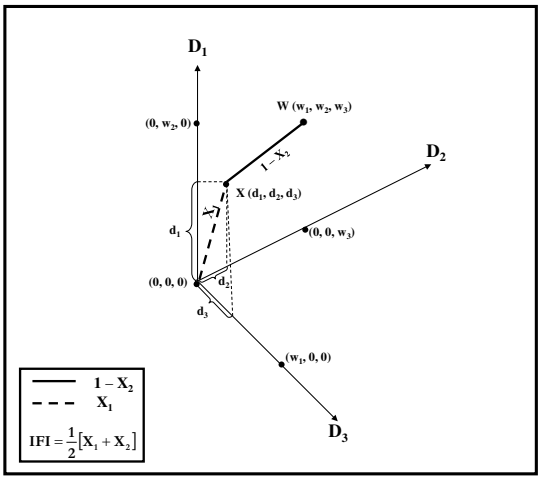
$$IFI = \frac{1}{2}\left[X_1 + X_2\right] \qquad \textbf{(4)}$$

As a special case, when all dimensions are given equal weight $w_i = 1$, then the ideal point is W = (1,1,1,…1) and the IFI formula is

$$IFI = \frac{1}{2}\left[\frac{\sqrt{d_1^2 + d_2^2 + \ldots + d_n^2}}{\sqrt{n}} + \left(1 - \frac{\sqrt{(1-d_1)^2 + (1-d_2)^2 + .. + (1-d_n)^2}}{\sqrt{n}}\right)\right] \qquad \textbf{(5)}$$

It is straightforward to verify that the IFI proposed here satisfies the desirable properties listed earlier. A graphical representation of a simple 3-dimensional IFI is given in Figure 1. Each dimension (D_1, D_2, and D_3) is represented by an axis in the three-dimensional space. The point W= (w_1,w_2,w_3) represents the (hypothetical) ideal point while the point O (0,0,0) is the point with least FI and a particular country's achievements in these dimensions is depicted by the point X=(d_1, d_2, d_3). A country that has an inclusive financial system should be closer to the ideal point W than a country that is less financially included. Similarly, a country with a more financially inclusive system should be farther away from the point O than a less inclusive country. An average of the normalized distance between O and X and the inverse normalized distance between W and X is the IFI of the country.

Figure 1: Graphical Explanation of a 3-dimensional IFI



3.2. Illustration of the IFI

To illustrate the above ideas, we have attempted to compute the IFI for different countries for the year 2009/2010, using data from the Financial Access Survey (FAS) database of IMF.[5] While computing the IFI, we have considered three basic dimensions of an inclusive financial system.[6] While presenting this illustrative example, we also outline few issues and challenges related to data availability in the next few subsections.

3.2.1. Dimension 1: Banking penetration

An inclusive financial system should penetrate widely amongst its users. The size of the 'banked' population, i.e. the proportion of people having a bank account is a measure of the banking penetration of the system. However, data on the number of 'banked' people is not readily available and in the absence of such data, we use number of deposit bank accounts per 1000 adult population as a proxy indicator of this dimension.

3.2.2. Dimension 2: Availability

In the present index, we use data on the number of bank branches and the number of ATMs per 100,000 adults to measure the availability dimension. Two separate indexes are calculated for bank branches and ATMs. Then, a weighted average of these two indexes, using 2/3rd weight for bank branch index and 1/3rd weight for ATM index is considered as the index for the availability dimension.[7]

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[5] The data were extracted from www.fas.imf.org., last accessed in February 2012. Data for Bulgaria, Colombia, Greece, Jordan and Maldives were obtained from their respective Central Banks. Data for a few countries were obtained from BIS. If data for a country is not available for 2010 but is available for 2009, then the IFI is computed for 2009 for that country.

[6] The choice of these dimensions is largely motivated by the availability of relevant and consistent data for as many countries as possible. More dimensions to the IFI can be added as and when cross country data on other aspects (quality, affordability etc.) of FI are available.

[7] An analysis of the data on ATM-to-Branch ratios for years 2004-2010 indicates that the average ratio of ATM-to-branch is 2.13. Thus, it can be assumed that on an average, the services provided by a 2.13 ATM is

3.2.3. Dimension 3: Usage

Utilization of an inclusive banking system can be in many forms – credit, deposit, payments, remittances, transfer etc. So, the usage dimension should include measures on all these different forms of utilization. However, cross country comparable data on payments, remittances and transfers are not available till date. Hence, in incorporating the usage dimension in the present index, we consider only two basic services of the banking system – credit and deposit. We use the data on volume of credit to the private sector and deposit mobilized from the private sector as proportion of the country's GDP to measure this dimension.[8]

3.2.4. Choices of m_i, M_i and w_i

Computation of the IFI requires a-priori fixing the values of M_i (upper bound) and m_i (lower bound) for each dimension. While one can safely choose 0 as the lower bound for all the dimensions discussed above, it is not as straightforward in the case of the upper bound of a dimension, since theoretically it is not possible to arrive at a 'maximum' or even an 'optimum' benchmark of achievement for many dimensions of FI. While the empirically observed highest value of a dimension can be considered as an upper bound, this can potentially distort the scale of the index if the empirically observed highest value is an outlier, as this would amount to comparing all countries against excessively high benchmarks. In order to avoid excessive upper bounds, we use the empirically observed 90th percentile of the distribution of the values of a dimension as the upper bound for the dimension.[9] If a country has a dimension value higher than these upper bounds, then it is set equal to the upper bound.

As for the choice of w_i, all the three dimensions considered here are equally important for an inclusive financial system therefore all of them should get an equal weight =1. However, in this illustrative example, the availability and usage dimensions are quantified only partially, due to lack of data on important indicators that characterize these dimensions completely. For example, many countries have moved towards telephonic/electronic banking, thus reducing the importance of physical bank outlets. Hence, using data only on physical outlets (bank branches and ATMs) can give an incomplete picture of the availability of banking services. Similarly, data on credit and deposit only partially depict the usage of the financial system as other services, such as payments, transfers and remittances are not included due to unavailability of appropriate data. Taking this into consideration, in the present IFI, we give relatively less weights to these dimensions. Thus, in the present index, the weight for banking penetration is 1 and the weight for availability and usage dimensions is 0.5 each.[10]

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equivalent to that provided by a branch, though typically a branch provides some services that an ATM does not. Thus, branch index gets 2/3 and the ATM index gets 1/3 weightage in the availability index.

[8] In the literature on the role of finance in economic development, the credit to GDP and deposit to GDP ratios indicate what is known as "financial depth". In this literature, indicators of financial depth provide a measure of the contribution of the financial system in economic activities. Here, however, we are using similar ratios to indicate the volume of credit and deposit mobilized by the banking system of a country (vis-à-vis its GDP) as a measure of the extent of the usage of the banking system.

[9] The 90th percentile values are obtained by using data from FAS (IMF) on various dimensions covering the period 2004-2010. The upper bound for ATM is fixed at 2 times the upper bound for the branches, as the average ATM-to-branch ratio is found to be 2.13.

[10] These weights were decided based on discussion with banking sector experts and academicians. When appropriate data on all dimensions are available, these weights can be revised accordingly.

3.3. IFI for select countries: An illustrative example

Table I presents the IFI values computed for various countries for the year 2009/2010. These values indicate that different countries around the world are at different levels of financial inclusion, ranging from a low of 0.016 (for Chad) to 0.996 (for Luxembourg). These also indicate that, in general, high income countries tend to have high IFI values, barring some exceptions. The average IFI for these set of countries is 0.442 and median IFI is 0.393. In this sample of 90 countries, there are 31 countries which can be considered highly financially inclusive, with IFI$\geq$ 0.6. With IFI values ranging between 0.3 and 0.6, 27 countries can be placed in the medium-IFI categories and the rest 32 countries are poor achievers in financial inclusion, with their IFI being less than 0.3.

TABLE II: ***IFI values for various countries (2009/2010)***

Sl. No.	*Country*	*IFI*	*Sl. No.*	*Country*	*IFI*	*Sl. No.*	*Country*	*IFI*
1	Afghanistan	0.052	31	Georgia	0.272	61	Oman*	0.373
2	Algeria	0.316	32	Germany	0.713	62	Pakistan*	0.106
3	Angola	0.084	33	Greece	0.879	63	Peru	0.362
4	Argentina	0.252	34	Hungary	0.481	64	Philippines	0.258
5	Armenia	0.238	35	India	0.386	65	Poland	0.479
6	Austria*	0.891	36	Iraq*	0.059	66	Portugal	0.943
7	Azerbaijan	0.128	37	Ireland	0.881	67	Qatar	0.354
8	Bangladesh	0.401	38	Israel*	0.731	68	Romania	0.483
9	Belgium*	0.759	39	Italy	0.605	69	Russian Federation	0.781
10	Belize	0.597	40	Japan*	0.920	70	Rwanda*	0.125
11	Bosnia & Herzegovina	0.387	41	Jordan*	0.403	71	Saudi Arabia*	0.318
12	Botswana*	0.257	42	Kazakhstan	0.311	72	Seychelles	0.618
13	Brazil	0.354	43	Kenya*	0.172	73	Sierra Leone	0.079
14	Bulgaria	0.730	44	Korea, Republic of*	0.922	74	Singapore	0.736
15	Cambodia	0.087	45	Kosovo	0.293	75	Slovak Republic	0.695
16	Cameroon*	0.043	46	Kyrgyz Republic	0.080	76	Slovenia	0.616
17	Chad*	0.016	47	Latvia	0.587	77	South Africa	0.388
18	Chile	0.688	48	Lebanon	0.497	78	Spain	0.951
19	Colombia	0.397	49	Lesotho	0.114	79	Swaziland	0.217
20	Comoros	0.079	50	Lithuania	0.766	80	Syrian Arab Republic	0.123
21	Congo, Republic of*	0.024	51	Luxembourg	0.996	81	Tanzania*	0.076
22	Cyprus*	0.974	52	Madagascar	0.064	82	Thailand*	0.673
23	Czech Republic	0.463	53	Malaysia	0.791	83	Togo*	0.110
24	Djibouti*	0.245	54	Maldives	0.426	84	Tonga*	0.316
25	Equatorial Guinea*	0.104	55	Malta	0.887	85	Turkey*	0.438
26	Estonia	0.695	56	Mexico	0.430	86	Uganda	0.106
27	Ethiopia*	0.067	57	Moldova	0.438	87	Ukraine	0.717
28	Finland	0.835	58	Namibia*	0.371	88	United Kingdom	0.949
29	France	0.738	59	Netherlands	0.689	89	Uruguay	0.237
30	Gabon*	0.056	60	Norway	0.689	90	Uzbekistan	0.372

Note: * indicates that the IFI value is for 2009.

3. Conclusion

We have proposed an index of financial inclusion (IFI), a multidimensional measure of financial inclusion that captures information on various aspects of FI in a single number lying between 0 and 1. The IFI is easy to compute, has well defined bounds, is unit free, monotonous and scale invariant. The conceptual framework of the IFI is general, rendering it amenable to include a variety of dimensions, subject to availability of data. The IFI so defined, can be used to measure financial inclusion at different time points and at different levels of economic aggregation (village, province, state, nation and so on). It can be used by policy makers to monitor progress of FI initiatives and by academic community to investigate interesting hypotheses on inter-linkages between FI and income, inequality and so on.

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