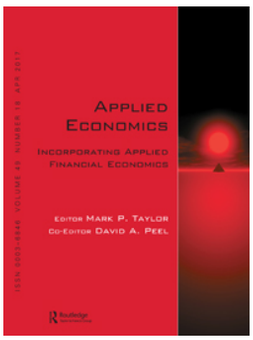

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Financial inclusion: measurement, spatial effects and influencing factors

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ABSTRACT

Using the index of financial inclusion and the World Bank Global Findex database, this study measures the level of financial inclusion across countries. The results reveal a geographical spatial aggregation distribution in which developed European and North American countries enjoy higher levels of financial inclusion than the less developed countries of Africa and most of Asia. Accordingly, our spatial analysis proves our hypothesis and reveals dependence and aggregation effects among countries. Then, we employ spatial econometric research to identify those factors significantly associated with financial inclusion. The results show that an individual's income, education and use of communications equipment are important factors that explain the level of financial inclusion, while financial depth and banking health status are the main determinants. Building an inclusive financial system is an important means for most countries to achieve the Millennium Development Goals.

KEYWORDS

Financial inclusion; financial inclusion index; international comparison; spatial econometrics

JEL CLASSIFICATION

G21; O16; O50

I. Introduction

Finance has developed dramatically since its inception, becoming more diversified, and more international – as well as more exclusive. Leyshon, French and Signoretta (2008) show that financial exclusion refers to those processes by which individuals and households face difficulties in accessing financial services and it amplifies geographical differences in levels of income and economic development. Meanwhile, Carbó, Gardener and Molyneux (2005) define financial exclusion as the inability (however induced) of some societal groups to access the financial system, particularly the barriers to accessing credit. Despite the difference in the definition of financial exclusion, it is generally acknowledged that the 'exclusive financial system' prevents poor and disadvantaged social groups from accessing finance, leading to uneven financial development.

Even worse, financial exclusion aggravates income inequality, harms social stability and disrupts the goal of social development in most countries. Nonetheless, according to the World Bank,[1] 39.3% of adults in the world in 2014 did not have an account at a formal financial institution. Moreover, even in high-income economies, the percentage is 9.6%; it reaches 77.7% in low-income economies. In other words, more than 2.8 billion adults in the world do not have a formal bank account, most of whom in developing economies.

In contrast to financial exclusion, the notion of 'financial inclusion or inclusive financing' is emerging simultaneously with the awareness that the lives of the poor should be improved. In recent years, financial inclusion has gained increasing prominence as a policy objective, catching the attention of policymakers. The UN designated 2005 as the International Year of Microcredit, highlighting its concerns for the underprivileged and fostering inclusive financial sectors. Later in 2009, in partnership with certain banks and other financial institutions, the UNDP began a project aiming to increase the financial inclusion of the poor by developing appropriate financial products for them and increasing the awareness of available financial services, while also strengthening financial literacy, particularly among women.

At the G20 Seoul Summit in 2010, a Financial Inclusion Action Plan was endorsed, calling for the launch of the Global Partnership for Financial Inclusion (GPFI) as a mechanism to further the G20's work on financial inclusion. In 2014, the agenda was updated by reviewing GPFI progress,

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[1]Source: The series 'account at a financial institution (% age 15+)' in the Global Financial Inclusion Database (Global Findex) from the World Bank

revising certain ongoing actions, adopting new appropriate actions and establishing how to track and monitor progress against these actions in the future.

Several countries have taken detailed measures to promote financial inclusion. Beginning in 2007, M-PESA in Kenya, one of the earliest success stories in the mobile phone-based delivery of financial services, successfully granted access to financial services to a large number of unbanked residents, particularly in the realm of small remittances. Similar examples exist in other countries, such as G-Cash in the Philippines, Celpay in Zambia and MTN in South Africa. The United Kingdom established the Financial Inclusion Taskforce to support the government in ensuring access financial services. These programs all increased potential access to finance for many previously financially excluded people.

Most scholars take a scientific approach to this subject to understand exactly how the development of financial inclusion works in practice. Arora (2014) measures the extent of financial access in developed and developing countries using data from the World Bank. Demirguc-Kunt and Klapper (2012) research adults' behaviour in terms of savings, credit and payment and risk management based on data from 148 countries. Meanwhile, several researchers use survey data in their research; Fungáčová and Weill (2015) analyse financial inclusion in China using individual data from a 2011 survey and find that financial inclusion is associated with individual characteristics. Conversely, Swamy (2014) focuses on the relationship between financial inclusion, gender and economic development by using a household survey from India. Corrado and Corrado (2015) use detailed data from the *Life in Transition Survey* undertaken in Europe during the 2008–2010 global crisis and show that the likelihood of financial inclusion depends on households' social, economic and demographic characteristics. However, little work to date has identified financial inclusion by country characteristics or analysed its determinants from a spatial perspective.

Based on this background, this study attempts to measure financial inclusion across the globe, to examine the details of the relationship between financial inclusion and economic development, and to reveal which factors significantly influence financial inclusion. The highlights of this article are as follows: (1) improvements in measuring financial inclusion, (2) the use of spatial econometrics to reveal the potential spillover effect among countries and (3) the proposal of feasible ways to enhance the extent of financial inclusion.

The remainder of this article is organized as follows: Section II reviews the related literature. Section III creates an index of financial inclusion (*IFI*) to measure financial inclusion. Section IV shows the measurement results and offers a discussion. Section V applies a spatial econometric model to illuminate the key factors associated with financial inclusion and presents the empirical results. Section VI concludes.

II. Literature review

There is growing literature addressing the definition of financial inclusion. The Financial Action Task Force defines financial inclusion as ensuring that financially excluded or underserved groups (such as low-income, rural and/or undocumented groups) have access to regulated financial services, which can help to strengthen the implementation of Anti-Money Laundering/Combating the Financing of Terrorism measures. The Consultative Group to Assist the Poor posits that financial inclusion means that low-income households and small enterprises have access to and can effectively use appropriate financial services. Furthermore, the sustainability of their rights to enjoy financial services should be guaranteed.

Meanwhile, in the broad sense, participants in financial markets include not just disadvantaged groups, but everyone in society. Financial inclusion is not simply the opposite of financial exclusion. It carries a more profound meaning. Demirguc-Kunt and Klapper (2012) define financial inclusion as those circumstances that feature broad access to financial services without either price or non-price barriers to their use. Chakravarty and Pal (2013) define it as the delivery of an economy's financial system to its members and, thus, consider it synonymous with banking inclusion.

Research has also attempted to determine how to measure financial inclusion. Beck, Demirguc-Kunt and Martinez Peria (2007) construct eight indicators to measure the outreach of finance: the number of branches and ATMs per capita and per square

kilometre, the number of loan and deposit accounts per capita, and the average loan and deposit sizes relative to GDP per capita. These indicators seem to be complete, but they yield the correct information if and only if they are used together. A single indicator means nothing and can sometimes even be incorrect. For instance, Sarma (2008) notes that Russia has a high number of bank accounts per capita but few bank branches. Thus, financial inclusion cannot be measured with individual indicators, as financial inclusion itself is multi-dimensional. Then, scholars have attempted to employ a multi-dimensional index to measure such inclusion by choosing indicators and dividing them into several dimensions, typically 'accessibility, availability and usage' (Sarma 2008). Chakravarty and Pal (2013) develop a calculation method for the financial inclusion index and use an axiomatic approach to measure financial inclusion, which allows the percentage contributions of different dimensions to be calculated. Gupte, Venkataramani and Gupta (2012) improve the quantity of dimensions and indicators by trying to involve all the indicators that other scholars have considered. These dimensions include 'outreach, usage, ease and cost of transaction'. Arora (2014) presents three different dimensions – 'outreach, ease and cost of transaction' – and in her research, financial inclusion is measured mainly in terms of transactions. Unlike Sarma and Chakravarty, Arora chooses a number of variables for each dimension, which expands the reach of the index.

III. Measure of financial inclusion

In this article, we agree with the connotation of financial inclusion in the broad sense and attempt to explain it more specifically. Financial inclusion means that everyone not only has access to financial services but also can enjoy various types of financial services, such as payment, deposits, credit etc. The measure of financial inclusion uses a more indicative approach with recapitulative dimensions and specific indicators. Moreover, to avoid correlations between dimensions (in Sarma (2008), 'accessibility' is similar to 'availability', which may cause multi-collinearity in the calculations), we also differentially weight every dimension and every indicator.

Access: This measure assesses the outreach of financial services. Because commercial banks take a leading role in providing access to finance, we measure access to finance mainly using the demographic penetration of the banking system.

Usage: This measure reflects the regularity and frequency with which customers use financial services. Indicators of this dimension are developed from payments, savings and borrowing, which are three key functions of finance.

Table 1 shows all the indicators considered in the index.

Table 1. Indicators of financial inclusion.

Dimension	Topic	Detailed indicators
Access	Account	Possession of a debit card (% age 15+)
		Account at a formal financial institution (% age 15+)
	Facilities	ATMs per 100,000 adults
		Branches of commercial banks per 100,000 adults
Usage	Payment	Checks used to make payments (% age 15+)
		Electronic payments used to make payments (% age 15+)
	Savings	Saved at a financial institution in the past year (% age 15+)
		Outstanding deposits with commercial banks (% of GDP)
	Borrowings	Loan from a financial institution in the past year (% age 15+)
		Outstanding loans with commercial banks (% of GDP)

ATM: automated teller machines.

We compute each indicator using the following formula:

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \tag{1}$$

where x_{ij} is the transformed value of indicator j in dimension I; A_{ij} is the actual value; M_{ij} and m_{ij} are the maximum and minimum of each indicator, respectively. After transformation, the value of each indicator lies between 0 and 1.

The *IFI* in dimension i is computed as follows:

$$IFI_i = 1 - \frac{\sqrt{w_{i1}^2(1-x_{i1})^2 + w_{i2}^2(1-x_{i2})^2 + \cdots + w_{\mathrm{in}}{}^2(1-x_{\mathrm{in}})^2}}{\sqrt{(w_{i1}^2 + w_{i2}^2 + \cdots + w_{\mathrm{in}}^2)}} \tag{2}$$

where x_{ij} is the transformed value ($0 \leq x_{ij} \leq 1$). w_{ij} stands for the weight of indicator j in dimension i. In contrast to those scholars who set weights subjectively (Sarma 2008; Chakravarty and Pal 2013), in this article, we compute the weight with an objective weighting method called the coefficient of variation (CV). CV was initially used in probability theory and statistics to measure the dispersion in a probability

distribution or frequency distribution and is defined as the ratio of the standard deviation σ to the mean value μ. Thus, the weight of each indicator is defined as the proportion of its CV to the sum of all indictors' CV numerically. That is,

$$w_{ij} = \frac{V_{ij}}{\sum_j V_{ij}} \tag{3}$$

where w_{ij} stands for the weight of indicator j in dimension i, and V_{ij} stands for the CV. Then, the final *IFI* is computed using the following formula:

$$IFI = 1 - \frac{\sqrt{{w_1}^2(1 - IFI_1)^2 + {w_2}^2(1 - IFI_2)^2}}{\sqrt{({w_1}^2 + {w_2}^2)}} \tag{4}$$

where w_1,$w_2$are the weight of dimension 1 (access) and 2 (usage), and the computation follows the CV method.

IV. Measurement results

Primary results

The data for the *IFI* are cross-national and come mainly from the 2011 World Bank Global Financial Inclusion Database. Several countries dropped out as a result of missing values. Before calculating the *IFI*, the data were winsorized at the 97 quantile. In other words, we set the 97 quantile rather than the real value as the maximum value (M_{ij}) of each indicator because some statistical values are extremely high, which would damage comparability. For instance, imagine a group of numbers: 100, 10, 5, 5, 3, 2, 1. The value will become 1, 0.09, 0.04, 0.04, 0.02, 0.01, 0 after transformation without winsorization. One of these is much larger than the other numbers. However, if we set the 97 quantile as the maximum value, then the group of numbers after transformation will become 1, 1, 0.44, 0.44, 0.22, 0.11, 0, which becomes more comparable. Thus, we must lose 3% of the value to handle the distorting influence of the extreme value.

Table 2 shows the *IFI* for 127 countries and their rankings.[2] Among all countries, the 10 highest ranking are Australia, Canada, New Zealand, the United States, Ireland, France, the United Kingdom, Portugal, the Republic of Korea and Cyprus, most of which are European countries. Cyprus, an island country in Europe, ranks number 10 on the list because it has a high-income per capita and substantial financial development even though its land area and total GDP are small. It has the highest score for the indicators 'Outstanding deposits/loans with commercial banks', and commercial bank branches per capita are also higher than in other countries. BRICS (Brazil, Russia, India, China and South Africa), as the largest emerging economies, have close mid-range ranking positions. They have similar *IFI* scores but differ in their score structures. Brazil, Russia and South Africa have much higher scores in the *Access* dimension than in the *Usage* dimension. As one of the pioneering countries to develop branchless banks (McKay and Pickens 2010), India has successfully broadened financial services usage through non-bank banks, which is why its score in the *Usage* dimension is higher than its score in the *Access* dimension, which is measured mainly by banking indicators. Moreover, Brazil scores 0.436 for the *Access* dimension but only 0.186 for the *Usage* dimension, as do Russia and South Africa. China is more balanced, with scores of 0.267 and 0.212 for these two dimensions, respectively. India is an exception. Its score for the *Access* dimension is only 0.127, while its score for the *Usage* dimension is higher (0.153). The other middle rankings are occupied by Central Asia, Central and South American regions, whereas the bottom is occupied mainly by African countries. Most African countries have a low score for each indicator and dimension, showing that the development of financial inclusion in that region lags far behind.

According to the measurement results, developed countries generally have higher *IFI* scores and show strong aggregation geographically (see Figure 1). Thus, we inquire whether spatial spillover effects exist for financial inclusion. We hypothesize that there is a spatial spillover effect that aggravates the aggregation and difference in the distribution of financial inclusion. This study then conducts a spatial data analysis to verify our hypothesis.

[2]Due to limited space, we do not list the results for each indicator and dimension.

Table 2. Measuring the *IFI* results, 2011.

Country	*IFI*	Rank	Country	*IFI*	Rank	Country	*IFI*	Rank
Australia	0.7483	1	Bulgaria	0.2669	44	Uruguay	0.1337	87
Canada	0.7232	2	Macedonia, FYR	0.2597	45	Honduras	0.1274	88
New Zealand	0.7012	3	Russian Federation	0.2568	46	Bolivia	0.1243	89
United States	0.6870	4	Saudi Arabia	0.2566	47	Nigeria	0.1183	90
Ireland	0.6610	5	Costa Rica	0.2522	48	Paraguay	0.1159	91
France	0.6512	6	Lebanon	0.2485	49	Ghana	0.1118	92
United Kingdom	0.6402	7	South Africa	0.2458	50	El Salvador	0.1118	93
Portugal	0.6311	8	Morocco	0.2396	51	Philippines	0.1103	94
Korea, Rep.	0.6119	9	Chile	0.2358	52	Armenia	0.1102	95
Cyprus	0.5979	10	China	0.2350	53	Indonesia	0.1069	96
Malta	0.5896	11	Montenegro	0.2332	54	Nepal	0.1050	97
Luxembourg	0.5638	12	Panama	0.2173	55	Djibouti	0.0894	98
Denmark	0.5438	13	Romania	0.2153	56	Zambia	0.0890	99
Belgium	0.5290	14	Turkey	0.2145	57	Liberia	0.0858	100
Israel	0.5220	15	Venezuela, RB	0.2127	58	Haiti	0.0845	101
Spain	0.4991	16	Bosnia and Herzegovina	0.2115	59	Azerbaijan	0.0839	102
Netherlands	0.4818	17	Angola	0.2087	60	Rwanda	0.0813	103
Slovenia	0.4628	18	Ukraine	0.1918	61	Comoros	0.0793	104
Italy	0.4464	19	Jamaica	0.1910	62	Uganda	0.0784	105
Estonia	0.4449	20	Belarus	0.1889	63	Nicaragua	0.0778	106
Sweden	0.4363	21	Ecuador	0.1859	64	Lesotho	0.0767	107
Germany	0.4242	22	Kosovo	0.1770	65	Tanzania	0.0758	108
United Arab Emirates	0.4128	23	Jordan	0.1740	66	Gabon	0.0693	109
Finland	0.4032	24	Guatemala	0.1734	67	Sierra Leone	0.0685	110
Croatia	0.3990	25	Albania	0.1734	68	Malawi	0.0653	111
Japan	0.3967	26	Kazakhstan	0.1724	69	Iraq	0.0583	112
Latvia	0.3936	27	Moldova	0.1672	70	Pakistan	0.0568	113
Iran, Islamic Rep.	0.3857	28	Sri Lanka	0.1647	71	Cambodia	0.0544	114
Czech Republic	0.3831	29	Kenya	0.1639	72	Chad	0.0460	115
Qatar	0.3739	30	Mozambique	0.1613	73	Mali	0.0449	116
Austria	0.3701	31	Swaziland	0.1556	74	Cameroon	0.0421	117
Kuwait	0.3551	32	Colombia	0.1549	75	Kyrgyz Republic	0.0394	118
Mauritius	0.3512	33	Tunisia	0.1542	76	Sudan	0.0391	119
Slovak Republic	0.3418	34	Peru	0.1508	77	Congo, Rep.	0.0349	120
Mongolia	0.3243	35	Bangladesh	0.1507	78	Tajikistan	0.0337	121
Greece	0.3105	36	Mexico	0.1498	79	Burundi	0.0306	122
Poland	0.3061	37	India	0.1426	80	Afghanistan	0.0302	123
Hungary	0.2987	38	Dominican Republic	0.1420	81	Madagascar	0.0208	124
Malaysia	0.2863	39	Georgia	0.1398	82	Yemen, Rep.	0.0162	125
Trinidad and Tobago	0.2797	40	Algeria	0.1386	83	Congo, Dem. Rep.	0.0107	126
Brazil	0.2789	41	Vietnam	0.1380	84	Central African Republic	0.0088	127
Serbia	0.2771	42	Argentina	0.1366	85			
Thailand	0.2745	43	Botswana	0.1351	86			

Source: Computed from World Bank Global Findex Database.
IFI: index of financial inclusion.

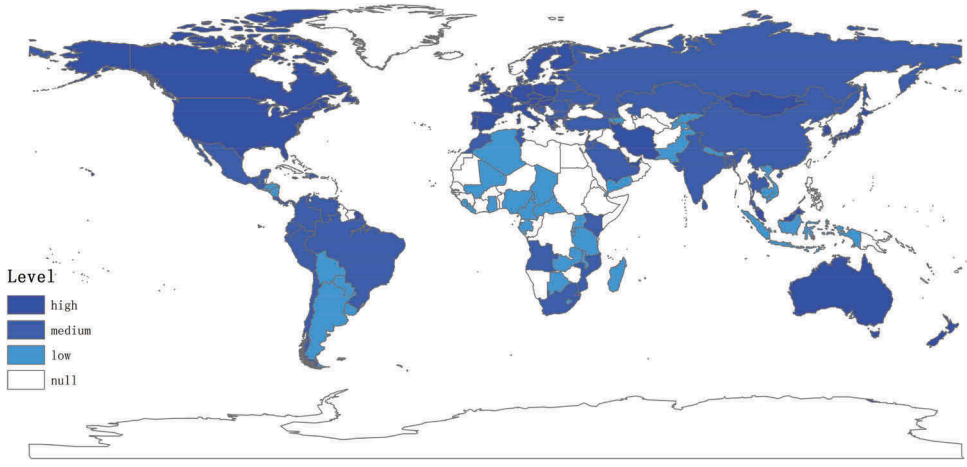

Figure 1. *IFI* distribution map.

Spillover effect – spatial autocorrelation

Mainstream economic theories assume homogeneity in space and thus fail to consider correlations among adjacent districts. This assumption contradicts reality, as resources such as labour, capital and technology are by no means distributed in a balanced fashion. Spatial autocorrelation reflects dependence between spatially organized observational units . If there are similarities in the distribution of observations in adjacent areas, positive spatial autocorrelation is present. Otherwise, there is negative spatial autocorrelation. It is easy to comprehend substantive spillover phenomena, such as knowledge spill overs and trade and migration flows, when spatial autocorrelation is considered. Previous research offers many techniques for handling spatial interaction, particularly in measuring autocorrelation. As with autocorrelation coefficient ρ in time series (AR-type), there are several measures of spatial autocorrelation, and one of the more familiar measures is Moran's I coefficient(Moran 1950).

$$\text{Moran's } I = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(Y_i - \bar{Y})(Y_j - \bar{Y})}{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}\sum_{i=1}^{n}(Y_i - \bar{Y})^2} \tag{5}$$

where n is the number of spatial units indexed by i and j, Y stands for the variable of interest and $\bar{Y} = (1/n)\sum_{i=1}^{n} Y_i$ is the average value of Y_i. W_{ij} is an element of a matrix of spatial weights and is generally a binary value.

$$W_{ij} = \begin{cases} 1 & \text{if District } i \text{ adjoins District } j \\ 0 & \text{if District } i \text{ doesn't adjoin District } j \end{cases} \tag{6}$$

where $i = 1,2,\ldots,n$; $j = 1,2,\ldots m$.

The expected value of Moran's I lies between −1 and 1. The −1/+1 value represents two extreme circumstances: perfect dispersion or perfect correlation. A zero value indicates a random spatial pattern. According to the measurement results of *IFI*, we computed the Moran's I coefficient and got the result equals to 0.5266 with a z value 7.0214, showing a significant positive autocorrelation of *IFI* countries at the 1% level. In addition, Figure 2 shows a scatter plot of Moran's I coefficients, divided into four quadrants. Thirty-one countries are found in the first quadrant, which means that they have a high *IFI* score and are surrounded by other high-scoring countries. However, 58 countries show the opposite – less developed financial inclusion and low-scoring neighbours – and are found in the third quadrant. The second quadrant includes eight countries that, despite having high-scoring neighbours, do not perform well themselves in financial inclusion. Points in the fourth quadrant (10 in total) represent countries that stand out from their neighbours. The other points lying on the axis are those with no neighbours on the map as a result of missing values or isolation (as in the case of Australia).

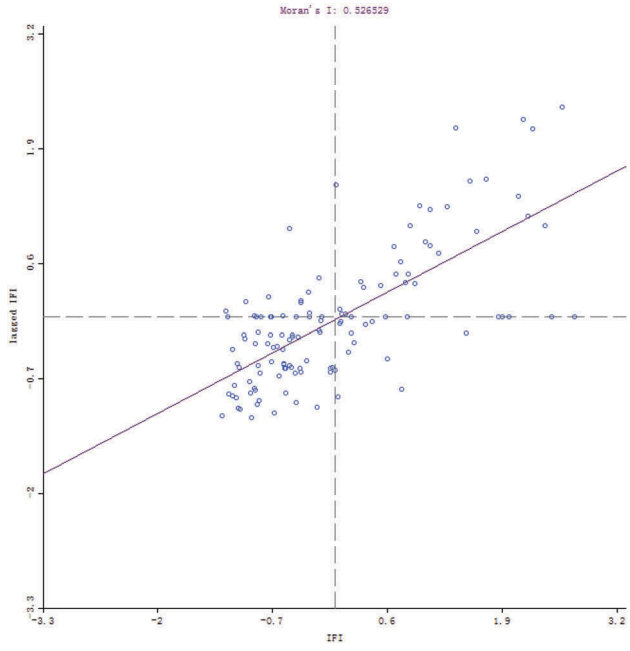

Figure 2. Scatter plot of Moran's *I* coefficients.

Whether the Moran's I coefficient or the distribution of the scatter, the results show a significant positive autocorrelation among *IFI* countries. In other words, if one country has high financial inclusion, it will influence its neighbour countries through a spillover effect.

Aggregation effect – spatial heterogeneity

Figure 3 shows the cluster map of *IFI* countries. According to this figure, the spatial distribution of financial inclusion shows the character of regional aggregation, that is heterogeneity in financial inclusion. This figure shows those countries whose spatial

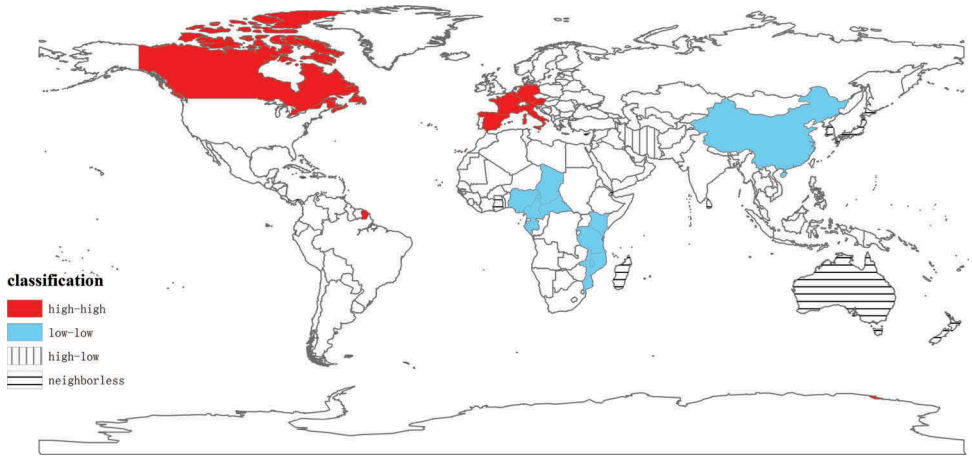

Figure 3. LISA cluster map.

relationship[3] is statistically significant, and Figure 3 focuses more on the local results in the spatial relation. In detail, the Western European countries and Canada (whose colour is red) belong to the high-accumulation areas (HH), which means that they have a high financial inclusion along with their neighbours, and the coordination is significant at the 1% level. Most African countries and China belong to the low-accumulation areas (LL). In those areas, the development of financial inclusion is badly lagging. Iran is a special case, as it has a high *IFI* score (0.3857, rank 28) even though its neighbours do not perform well in terms of financial inclusion. For instance, Iraq scores only 0.0583 and ranks 112 in the world.

V. Factors associated with financial inclusion

Econometric models

Because the measurement results show significant autocorrelation and heterogeneity in the distribution of *IFI*, we aim to determine what factors lead to this phenomenon. However, many factors may be associated with it, for it includes two or more parties in the financial transactions, primarily demanders (people who have an account) and providers (financial institutions). Mediators such as the government and other organizations may also be involved. An optimal social environment will facilitate transactions and promote the development of financial inclusion. Thus, the social environment also matters. As a result, we aim to understand the association from different aspects. In the first regression, we focus on the demanders. The demander characteristics included in our regression include income, education and gender, which are likely to greatly impact the access to and usage of finance. The second regression attempts to determine the influencing factors from a banking aspect, such that the variables related to banking management, such as the capital asset ratio and non-performing loan ratio, are considered. In the third regression, we pay attention to the development of the social environment. By means of the three regressions, we, respectively, capture the factors associated with financial inclusion from the 'demanding, supplying and social environment' perspectives, which helps us to identify the key influencing factors. We do not combine three regressions because the data for some variables are not available for all countries. If we include all the variables in a single regression equation, the number of observations will dwindle to 36, which is too few to conduct an econometric analysis.

The dependent variable in each regression is a transformation of the *IFI* because the computation result of *IFI* lies between 0 and 1, which is easy to compare but is not appropriate for inclusion in the regression equation. Thus, before the regression, we apply the transformation as follows:

$$Y = \mathrm{Ln}\left(\frac{IFI}{1 - IFI}\right) \tag{7}$$

The transformed variable Y lies between $-\infty$ and $+\infty$. Considering the existence of spatial spillover and aggregation effects, the traditional OLS

[3]The relationship includes the spatial correlation between close countries and differences between distinct countries.

regression method may be biased. Thus, we prefer a spatial regression (including a spatial lagged model [SLM] and a spatial error model [SEM]). The spatial lagged regression equation is as follows:

$$Y = \lambda WY + \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \cdots + \alpha_n X_n + \varepsilon \quad (8)$$

where λWY is the spatial lagged term of the dependent variable Y, and X_i (i = 1,2,...,n) represents independent variable. α_i (i = 1,2,...,n) is the parameter to be estimated, and ε is the random error term.

Finally, the spatial error regression equation is as follows:

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \cdots + \alpha_n X_n + \lambda W\xi + \varepsilon \quad (9)$$

where the error term is divided into two parts: $\lambda W\xi$ stands for the spatial error, and ε is the random error term.

The difference between Equations (7) and (8) is that in Equation (7), the dependent variable Y has a direct effect on its close neighbours. In other words, the development of financial inclusion in one place will directly influence places nearby. However, in Equation (8), the spatial influencing factor is included in the error term, which shows an indirect effect. Theoretically, it is difficult to tell which is better because there are two different ways to express the spatial factors. As a result, in the following analysis, we report the results of both a SLM and a SEM, and they serve as robustness tests for one another. We also conduct an OLS regression as a comparison.

Empirical results

Results of the regression on demand factors

Demand factors refer to the characteristics of people who need financial services, such as income, gender, education and so on. Studies have shown that financial access is strongly correlated with per capita income (Honohan 2008). Data from the household survey prove that people with higher income are more likely to be included in the financial system (Al-Hussainy et al. 2008).

With the development of information and communication technologies (ICT), the Internet (and the mobile Internet) plays a key role in the financial system by consolidating the impact of financial inclusion on economic growth (Andrianaivo and Kpodar 2011). Branchless banks that are based on ICT work in some African countries. People with phones or with other forms of access to the Internet can easily enjoy financial services; in other words, ICT makes them financially included.

Education is another factor associated with financial inclusion. Generally, well-educated people are welcomed by banks. Sarma and Pais (2011) use literacy as an indicator to proxy for education. We do the same and assume that literacy positively influences financial inclusion.

There is a debate regarding the influence of gender on financial inclusion. Because of their weak economic position, women are more likely to be excluded by financial institutions than men. However, highly developed financial inclusion allows all women to have access to finance.

To make a comparison, an OLS regression is also included in Table 3. As the result shows in

Table 3. The results of the regression of demand factors.

Variables	OLS (1)	OLS (2)	SLM (3)	SEM (4)
Income	0.4483*** (0.1376)	0.4138*** (0.1162)	0.4087*** (0.1277)	0.4514*** (0.1344)
Telephone	0.0219*** (0.0072)	0.0264*** (0.0073)	0.0264*** (0.0076)	0.0267*** (0.0076)
Internet	0.0067 (0.0054)	0.0105* (0.0056)	0.0088 (0.0056)	0.0076 (0.0056)
Gender	0.014 (0.0127)	0.0131 (0.0111)	0.0164 (0.0201)	0.0131 (0.0205)
Literacy	0.0009 (0.0081)	0.0816** (0.0406)	0.081*** (0.0297)	0.0739** (0.0308)
Literacy^2		−0.0006* (0.0003)	−0.0006*** (0.0002)	−0.0005** (0.0002)
Constant	−7.0199*** (1.6541)	−9.3820*** (1.8836)	−9.2758*** (1.8245)	−9.3368*** (1.91)
WY			0.1146* (0.0595)	
Wξ				0.1997 (0.1278)
Obs.	75	75	74	74
R^2	0.7035	0.7302	0.7440	0.7389

*, **, ***Denote statistical significance at the 10%, 5% and 1% levels, respectively. SEs are in parentheses under the robust estimates.

Income: GNI per capita, after PPP (current international $); *telephone*: telephone lines (per 100 people); *Internet*: Internet users (per 100 people); *gender*: gender (% female of total); *literacy*: literacy rate (of adult people); *literacy*^{2}: the square of literacy; *WY*: the spatial lagged term of the dependent variable *Y*; *Wξ*: the spatial error term.

the second column, income and telephone ownership are significant and positively associated with financial inclusion. In particular, income's coefficient is very large. As one's income increases, his (her) likelihood of being accepted by financial institutions increases. Owning a telephone also plays an important role, having a coefficient of 0.0219 in the regression. Thus, to further determine whether access to the Internet, the gender variable and literacy are statistically significant, we also consider the marginal effect of education and, thus, add into the regression the square term of literacy; the result is shown in the third column. The coefficient reveals an inverted U-shaped relationship between literacy and financial inclusion. When literacy increases from a relatively low level, it will strongly boost financial inclusion. When the literacy ratio reaches a point (here, it is approximately 75%), the boosting effect will fade and disappear. In addition, in regression OLS (2), the Internet is significant at the 10% level.

SLM (3) presents the regression results of the SLM (Equation 7), and SEM (4) represents the spatial error model. Compared with OLS (2), there is no significant difference in the demand factors. However, in SLM (3), the spatial lagged term of the dependent variable *Y* is significant at 10%, showing a strong spatial relation across countries. The lagged coefficient is 0.1146. The result in SEM (4) is almost the same, but the error term is not significant.

Results of the regression on supply factors

As one of the main participants in the financial system, financial institutions have different current situations and development goals. One goal of financial institutions is the development of financial depth, which emphasizes the size of financial institutions and financial markets in the economy and may be correlated with financial inclusion.

Additionally, the current state of banking also plays a key role in determining whether to adopt an inclusive strategy. Two indicators of bank health are the capital to asset ratio (*CAR*) and non-performing loans to gross loans (NPL). Returns are a proxy for banks' return on assets. If the banks include the masses who were previously excluded, its NPL ratio will rise, and the return on assets will inevitably fall. The *H*-statistic is a measure to test competition in the banking market. As it increases, the intensity of competition increases, and people are more likely to be included.

As shown in Table 4, financial depth indeed is positively correlated with financial inclusion, as its coefficient is positively significant in each regression. In OLS (2), as we drop the 'depth' variable, the R^2 falls from 0.5919 to 0.3618. Apart from depth, only NPL is negatively significant in OLS (1), which is contrary to our expectations. In other words, if a bank is unhealthy, it will become more cautious and exclude some poor or disadvantaged groups. The literature demonstrates that poor groups are thus not responsible for high NPL.

SLM (3) shows the results of the SLM. The coefficient of depth is lower than OLS (1), but the coefficient of *ROA* is significant at the 10% level. As the financial system becomes more inclusive, the return on assets decreases, which explains why many financial institutions are exclusive. However, if all institutions exclude the poor, they will only harm themselves. We must find ways to balance inputs and costs. In addition, as we expected, the spatial correlation is positively significant. Neighbouring countries' development with respect to financial

Table 4. The results of the regression on supply factors.

Variables	OLS (1)	OLS (2)	SLM (3)	SEM (4)
Depth	0.0099*** (0.0017)		0.0077*** (0.0016)	0.0085*** (0.0017)
CAR	−0.0077 (−0.0261)	−0.0951*** (0.0314)	−0.0042 (0.0249)	−0.0198 (0.0266)
NPL	−0.0236* (0.0131)	−0.033** (0.0162)	−0.0346** (0.0138)	−0.0295** (0.0143)
H	−0.3762 (−0.3183)	−0.2453 (0.2769)	−0.4207 (0.2946)	−0.4871 (0.3011)
ROA	−0.0407 (0.0566)	−0.1511 (0.0908)	−0.0741* (0.0445)	−0.0459 (0.045)
Constant	−1.3361*** (0.459)	0.5018 (0.3083)	−0.8779** (0.4075)	−0.9877** (0.4217)
WY			0.2512*** (0.0915)	
Wξ				0.2115 (0.1327)
Obs.	65	73	64	64
R^2	0.5919	0.3618	0.6469	0.6185

*, **, ***Denote statistical significance at the 10%, 5% and 1% levels, respectively. SEs are in parentheses under the robust estimates.

Depth: Deposit money in bank assets to GDP (%); *CAR*: bank capital to total assets (%); *NPL*: bank non-performing loans to gross loans (%); *H*: *H*-statistic, a measure of the degree of competition in the banking market; *ROA*: bank return on assets (%, before tax); *WY*: the spatial lagged term of the dependent variable *Y*; *Wξ*: the spatial error term.

inclusion has a strong spillover effect, with a correlation coefficient of 0.2512. The error term in SEM (4) is not significant.

Results of the regression on social factors

Apart from demand (ordinary people) and supply (financial institutions) factors, financial inclusion is also associated with the social environment. If a country is very economically developed, its citizens will be rich and its financial sector will be well developed. In this case, the level of financial inclusion will be higher than in less developed economies. In addition, poverty, inequality and unemployment are the focus of policymakers' attention and play important roles in economic development. The level of financial inclusion may rise in response to both prosperity and declining inequalities and the unemployment ratio. Economic freedom represents the freedom of the social environment. Countries with free social environments tend to have high levels of financial inclusion.

Table 5 shows the regression results: GDP plays a key role in financial inclusion, with a significant coefficient 0.6919 in OLS (1). The other variables are not significant. In OLS (2), we remove the GDP variable, and the result is different: poverty is negatively significant at the 1% level, which indicates that alleviating poverty boosts financial inclusion. *EFI* is positively associated with financial inclusion, which verifies our hypothesis. We focus mainly on the SLM and SEM spatial regressions, which reveal that reduced poverty and the rise in economic freedom correspond with an increase in financial inclusion. The spatial error term is significant in SEM (4), showing that the correlation between neighbouring countries is more obvious than the spread effect from one country to another.

VI. Conclusion

In an exclusive financial system, many poor and disadvantaged groups cannot obtain access to finance, which harms society. Financial inclusion is the opposite of exclusion. In this article, we analyse financial inclusion from a broad perspective, considering it the process of ensuring everyone has access to financial services and to the use of finance in a wide and deep context. Using cross-country data from the World Bank, we propose an improved *IFI* to measure the level of financial inclusion across countries. The measurement results reveal a geographical spatial aggregation distribution: European and North American countries have a higher level of financial inclusion than African and most Asian countries.

Based on this distribution, our research applies the spatial econometric method to analyse the inner mechanism. We find simultaneous spillover and aggregation effects. The development of financial inclusion in one country has spillover effects on its neighbour, and close countries will influence one another, which leads to aggregation in regions. The computation of Moran's *I* coefficient and the LISA cluster map verify our analysis.

Then, spatial regression is conducted to determine which factors lead to the distribution in financial inclusion. We employ a regression from the three perspectives ('demand, supply and the social environment'), which denote the three key elements of the use of finance. For demand factors, one's

Table 5. The results of the regression on social factors.

Variables	OLS (1)	OLS (2)	SLM (3)	SEM (4)
GDP	0.6919*** (0.2006)			
Gini	−0.0044 (0.0076)	−0.0040 (0.0081)	−0.0026 (0.0087)	0.0015 (0.0093)
Unemployment	0.0064 (0.0095)	0.0082 (0.0117)	0.0070 (0.0143)	0.012 (0.0143)
Poverty	−0.0035 (0.0040)	−0.0185*** (0.0028)	−0.0187*** (0.0025)	−0.0210*** (0.0026)
EFI	0.013 (0.0108)	0.0318*** (0.010)	0.0279*** (0.0097)	0.0193* (0.0101)
Constant	−8.3279 (1.7417)	−2.5159*** (0.6837)	−2.1942*** (0.7207)	−1.8471** (0.7751)
WY			0.1150 (0.0763)	
Wξ				0.2901** (0.1241)
R^2	0.78	0.7121	0.7274	0.7391
Obs.	59	59	57	57

*, **, ***Denote statistical significance at the 10%, 5% and 1% levels, respectively. SEs are in parentheses under the robust estimates.

GDP: Logarithm of GDP per capita, after PPP (current international $); *Gini*: Gini coefficient, a measure of the degree of income inequality; *unemployment*: unemployment of the total labour force (%); *poverty*: poverty headcount ratio at $5 a day (PPP) (% of population); *EFI*: Index of Economic Freedom, an annual index created by The Heritage Foundation and The Wall Street Journal to measure the degree of economic freedom; *WY*: the spatial lagged term of the dependent variable *Y*; *Wξ*: the spatial error term.

income, education and the use of communications equipment are important factors explaining the level of financial inclusion. The main determinants of the supply factors are financial depth and banking health. Moreover, as a country becomes more developed, its poverty ratio lowers, its social economic environment becomes freer and its financial inclusion level increases. In each regression, the spatial effect is significant.

Our findings have several implications. First, as advocated by the United Nations, building an inclusive financial system is an important way to achieve the Millennium Development Goals and to resuscitate the worldwide economy. On the macro level, governments should play a positive role in developing financial inclusion by incorporating it into national development strategies; additionally, the relevant legislative and regulatory work should be improved to help with this achievement. On the meso-economic level, society should strengthen the construction of financial infrastructure devoted to reducing the cost of financial services and making them affordable to the poor. On the micro level, micro finance should be developed to improve financial inclusion.

Second, for countries that are not as progressive in terms of financial inclusion, the government should promote the opening of domestic financial markets to absorb the effects of the international development of financial inclusion. Global financial market synergy and linkage can help to better share the spatial spillover effects brought on by developed countries.

Third, according to the empirical results, increases in residents' income, better education and financial innovations based on ICT developments, such as mobile banking, branchless banking and improved financial institution management, can help to expand the breadth and depth of financial services and improve the level of financial inclusion.

Finally, every country should strengthen the exchange of experiences between countries through international financial organizations, such as the Alliance for Financial Inclusion and GPFI. These organizations must work together to develop financial inclusion.

Due to data availability limitations, we have only cross-sectional data for 1 year, which makes us unable to examine how financial inclusion changes when factors change. Moreover, in our research, we attempt to divide the sample into HH and LL to reveal what causes heterogeneity across countries. However, we must also acknowledge the lack of data for certain countries. Nevertheless, the econometric results provide us with an in-depth perspective on financial inclusion.

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