Lafia Journal of Economics and Management Sciences: Volume 6, Issue 2; 2021
ISSN: 2550-732X
Published by Department of Economics, Federal University of Lafia, Nigeria

Composite Measure of Financial Inclusion in Nigeria: A Principal Component Analysis Approach

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Abstract
Owing to gaps in the literature regarding the dearth of a robust and an all-inclusive measurement of Financial Inclusion (FI), this study constructed an all-inclusive index for measuring FI in Nigeria. Adopting the use of the PCA as an indexing mechanism, the study condenses 22 selected aggregate indicators into a single comprehensive static that can serve as a measurement of financial inclusion. The selected indicators comprises not only indicators germane to the banking sector, which has become traditional in other studies but advances its investigation to include the contribution of previously neglected indicators that captures other sub-sectors (like Insurance and Mortgage) and financial markets (like Stock market) that constitutes the financial system. In a two-stage PCA analysis, the results indicate that the non-bank sectors contribute more to the supply of financial services in Nigeria than the banking sector. The results also suggest that the demand for financial services in urban centres outmatches that of the more populated rural areas. Generally, the results indicate a slow and sluggish rise in Financial Inclusion for the duration of the study. The study recommends that policies and programmes designed to increasing availability of points of service in rural settings should be pursued in order to fast track the actualization of financial inclusion goals.

Keywords: Financial Inclusion, Financial Inclusion Index, Principal Component Analysis
JEL Classification: C38, E52, E58, G28

1. Introduction

The literature on measuring Financial Inclusion (FI) can be considered novel due to the recent discovery and realization of the immense importance and significance of FI in the economy at both the macro and micro levels. Consequently, the policy drive and goal by the international community cum national governments to achieve a greater level of FI has intensified since the advent of the 21st century. Measuring the level of FI has become imperative for economists and policy makers alike because it is regarded as the best way to assess progress made in

light of several international and domestic initiatives, programs, reforms and policies established to improve it. Currently, there is no globally unified method of measuring FI. As such, several researchers like Korynski and Pytkowska (2016); Piñeyro (2013) and Sarma (2008) have devised innovative methods for measuring FI.

Several international and national efforts are underway to measuring FI. In Nigeria however, the primary data source for measuring the level of FI is the Access to Financial Services in Nigeria Survey, a national representative survey conducted every two years by the Enhancing Financial Innovation and Access (EFInA). According to the 2017 Annual Report on National Financial Inclusion Strategy (NFIS), the overall Financial Inclusion Rate (FIR) comprising adults who patronize both formal and informal financial services stands at 58.4% (Financial Inclusion Secretariat, 2018). While several methods exist for measuring FI, the survey approach is amongst the most effective. However, they are not without a few problems as studies like Atkinson and Messy (2013) maintain that such national measures are currently patchy and lack comparability.

In addition, other studies like Fadun (2014) argue that surveys tend to focus on specific geographic areas like urban centres where banks and other financial service providers congregate. In Nigeria however, the poor, disadvantaged and other vulnerable groups reside in rural areas (Abideen, Huq & Mydin, 2012; Hussaini & Imo, 2018). Banks and other financial institutions are known to either have very few branches in such rural settings or are reluctant to give financial service to rural dwellers (Ajide, 2013; Muritala & Fasanya, 2013; Ene & Inemesit, 2015). As such, surveys neglect and excludes the specific group/metric that proffers a good representation of financial exclusion in the country.

Alternative to the survey approach is the use of aggregate indicators (secondary data) of financial inclusion to gauging the level of FI. National Central Banks has over the years collected a cache of financial data as part of their supervisory duties for regulated institutions and can thus be a good source of information at the national level (Triki & Faye, 2013). A salient advantage that aggregate indicators of FI possesses over the survey approach is the high frequency, timeliness and limited costs with which such data can be collected over time (Beck, 2016). However, the researchers observe that, in Nigeria, a myriad of studies employ the use of either a single indicator or a few numbers of indicators in measuring FI. Some examples of such indicators are; number of banks, number of bank accounts per adult, number of branches per 1000km, number of ATM's per 1000km, total bank deposits to GDP and average size of loans to GDP per capita to serve as proxies of FI.

The use of such indicators captures only a limited aspect/dimension of FI and their use not only lead to a misrepresentation of FI but also yield misleading and biased results (Chattopadhyay, 2011; Laha & Kuri, 2011b; Sethy, 2016; Yorulmaz, 2013). In addition, commonly selected indicators, especially at the international level denote mostly the banking sector and lack the sectoral and compositional representation of financial systems (Charkravarty & Pal, 2010). Consequently, extant literature not only show that efforts aimed at measuring financial inclusion through multidimensional indices are scarce but also disclose that the indicators used in measuring FI are not comprehensive as they neglect some important aspects of FI (Sethy, 2016).

Against this backdrop, this paper is motivated to construct a comprehensive measure of FI by employing a wider range of indicators that captures not only the multi-dimensional aspect of FI, but also representative of the sub-sectoral and compositional aspects of FI in Nigeria. The Financial Inclusion Index (FII) represents as a single indicator that can be utilized to denote the level of financial inclusion for the Nigerian economy from 1992 to 2019. The remainder of this paper is structured as follows: 1. Introduction. 2. Literature Review. 3. Methodology. 4. Results and Discussion. 5. Conclusion and Recommendations.

2. Literature Review

2.1 Conceptual Clarifications

2.1.1 Dimensions of Financial Inclusion

The three dimensions of FI are Financial Access, Financial Usage and Financial Quality (Ondiege, 2015; Sethy, 2016). These three dimensions of FI are broad categories into which indicators can be grouped without being restrictive (Triki & Faye, 2013).

Financial Access (FA) other times referred to as the "supply-side" of FI because it involves financial institutions who are the providers/suppliers of financial services and products (Kama & Adigun, 2013). FA is basically the capacity to use financial services offered by formal financial houses.

Financial Use (FU) also referred to as "demand-side" of FI because it deals with individuals and firms that require the use of financial services and products. Financial use represents the regularity, frequency and duration of use of financial services over time (Oluyombo & Aina, 2014).

The literature on Financial Quality (FQ) has witnessed increased attention by economists and policy makers in recent times because it focuses on the barriers that limit the improvement of FI on both the

supply and demand sides. This study categorizes FQ into Supply and Demand side barriers (Atkinson & Messy, 2013; Beck, Demirgüç-Kunt & Martinez, 2008).

2.1.2 Sub-Sectoral and Compositional Aspects of Financial Inclusion

A broad range of quality financial services/products must include other sectors of the financial system and not limited to banking institutions. Non-banking services and products like pensions and insurance should be availed in order to promote the overall level of FI. Financial systems are also composed of two major components, which are financial institutions (like banks and insurance firms) and financial markets (like bond and equity markets) (Levine 2002).

2.2 Empirical Review

While pioneering efforts at constructing a Financial Inclusion Index (FII) was made by Beck and Torre (2006), most studies on constructing a FII are made for South-Asian countries like India and Bangladesh (Yorulmaz, 2013). The work of Sarma (2008) stands as a leading study in constructing an index of FI. The technique utilized in the study is similar to that employed by the United Nations Development Programme (UNDP) in constructing other renowned indexes. The study considers three dimensions to measuring the extent of FI. Depth (penetration) of access using the number of bank accounts per 1000 population as a proxy. Availability to measure proximity of access using number of bank branches and number of ATM's per 1000 population. Usage to measure the extent and frequency of use by the customers. Attaching equal weights to the various dimensions, the study categorizes countries based on the value of IFI, which ranges as high (for an index above 0.6), medium (for an index between 0.4-0.6) and low (for index below 0.4).

Chakravarty and Pal (2010) made a good argument for the importance of constructing an index of FI due to the different dimensions of banking services. The index relies on the axiomatic approach developed in the realm of human development. The study considers 6 indicators of FI which are; number of bank branches per 1,000 people and per 1,000 square kilometer, number of deposit account per 1,000 people, number of credit account per 1,000 people, deposit income ratio and credit income ratio. Ultimately, the index show that between 1991 to 2001 the level of FI decreased and between 2001 to 2007 the level of FI increased.

In another study, Chattopadhyay (2011) set out to examine the success of FI for the state of West Bengal. The author's methodology in

building an index of FI is similar to that used by Sarma. Like Sarma, the author first constructs an index for each dimension of FI. The study considers three basic dimensions of FI namely; Banking Penetration, Availability of banking services and Usage of banking services. The Index of FI reveal that, out of 23 states only 2 states have a high IFI with values above 0.5, 5 states have a medium IFI with values ranging from 0.3 to 0.5 and 16 states have a low IFI with values ranging between 0 and 0.3.

Laha and Kuri (2011a) in their study constructed separate composite indices for demand and supply side before constructing the overall IFI. The indicators selected for Supply-side dimensions are; number of accounts per 100 of adult population, number of bank branches per 100 adult population and credit and deposit as a proportion of NSDP. The indicators selected for Demand-side dimensions are; proportion of household having access to savings, credit and insurance. States with a IFI value below 0.2 are considered to have a low level of financial inclusion, those in between 0.2 to 0.5 a medium level, and those above 0.5 a high level. The study concludes that overall financial inclusion in urban areas is comparatively higher than rural India.

Goel and Sharma (2017) construct a FII for India following the method pioneered by the UNDP. The study also considers three dimensions of FI. They are; Banking Penetration measured by the number of accounts (deposits and loans) per 1,000 people. Availability of Banking Services measured by the number of ATM's per 100,000 people, number of bank branches per 1,000 people and the number of scheduled commercial banks per 1,000 sq. km. Access to Insurance measured by the number of life insurance. The FII reveals that from 2005 to 2012, India was categorized as having a low Financial Inclusion Rate as the value of the FII ranged between 0 – 0.4. However, the index revealed that for 2013 there was an improvement as India was categorized as having a medium FIR as the FII value ranged between 0.4 - 0.6. The objective of FI was achieved for 2004 – 2005 as the FII value range between 0.6 – 1 and India was categorized as having a high FIR.

Cámara and Tuesta (2017) offered an alternative (PCA) approach to measuring FI in the literature. The main contribution of the paper is the construction of a multidimensional financial inclusion index covering 138 countries for the period of 2011 to 2014. The study postulates that the level of FI is ascertained by 3 dimensions of FI. They are; Usage, Barriers and Access. All three dimensions are represented by a total of 20 indicators used in building the index. The author presents the ranking position of countries according to their scores in FII in 2004 from the highest to the lowest. The rankings indicate that out of 137

countries, Nigeria is listed as ranking 85th with an improvement of 24 points between 2011 to 2014.

Nwidobie (2019) is the only study that attempts to build a FII for Nigeria using an alternative (PCA) approach. The study employed analysis of secondary data, which comprised 8 indicators to measure FI. They are; demand, time, saving and foreign deposits of Deposit Money Banks (DMB's), number of branches, deposit in rural branches, loan granted to customers in rural areas, volume of transactions via ATM, volume of transactions via mobile bank, volume of transactions via POS and volume of transactions via web pay. The result of the PCA reveals that the number of bank branches, with an Eigenvalue of 1.32 is the main determinant of FI in Nigeria. The study recommended monetary authorities to improve financial inclusion in Nigeria by focusing on the variables used in building the index.

The review of related literature discloses that a good number of studies in the literature employ indicators germane only to the banking sector for constructing an index of FI. While the banking industry is usually the most dominant sector in the financial system for most economies, with the advent of technology, other sectors (like the insurance and mortgage) and financial markets (like capital and bond markets) are increasing in size. As a break away from the norm, this study utilizes indicators that are representative of the multidimensional and compositional aspect of FI in building a comprehensive and robust index of FI.

3. Methodology

While the first step towards constructing a comprehensive FII is identifying essential indicators to be used, data availability would constitute its main challenge. According to Sarma (2008), Gupte et al., (2012) and Yorulmaz (2013) any index of FI should satisfy three basic criteria. First, the indicators selected in building the index should encompass as much dimensions and aspects of FI as possible. Second, the index should be easy to compute and thirdly, the index should be comparable across time and across countries. The table below contains a cross section of all indicators used in building the index as well as the sectors and dimensions they belong. In the exception of Real Interest Rate (RIR), which was sourced from World Development Indicators (WDI), all other indicators were sourced from various issues of the CBN Statistical Bulletin yearly publications.

Table 1: Selected Indicators for Financial Inclusion Index

FINANCIAL INCLUSION INDICATORS (SECONDARY DATA)					
COMPONENTS OF FINANCIAL SYSTEMS	SUB-SECTOR	FINANCIAL ACCESS (FINANCIAL ORGANIZATIONS)	FINANCIAL QUALITY (FINANCIAL AUTHORITIES)		FINANCIAL USAGE (INDIVIDUALS & FIRMS)
		SUPPLY SIDE	BARRIERS	AFFORDABILITY	DEMAND SIDE
FINANCIAL INSTITUTIONS	BANKING SECTOR	No. of Banks	Documentation Requirements for openning a bank account	Interest Rate	Commercial Bank Savings Deposit
		No. of Bank Branches		Prime Lending Rate	Commercial Bank Branch Deposit in Rural Areas
		No. of cheques cleared			Deposits in Micro-Finance Banks
		No. of Micro-F Banks	Location of commercial banks	Cost of Opening a bank account	Commercial Bank Branch Loans in Rural Areas
		No. of Development Banks			Commercial Bank Loans to SME's
			Processing time	Transfer charges	Commercial Bank Credit to Private Sector
	INSURANCE SECTOR	No. of Insurance companies	Location of firms	Cost of premiums	N/A
		No. Branches of Insurance firms	Documentation requirments		N/A
	MORTGAGE SECTOR	No. of Private Mortagage firms	Location of firms	Cost of mortgage premiums	Loans of Private Mortgage firms
		No. Branches of Mortgage firms	Documentation requirments		Fixed Deposits with Private Mortgage Firms
FINANCIAL MARKETS	CAPITAL MARKET	Total Volume of Equity	Documentation Requirement	Market Capitalization	No. of transactions @ NSE
	BOND MARKET	Issues of Treasury Bonds	Location of firms	Treasury Bill Rate	Total Subscriptions of Treasury Bills
		Bonds(Debentures)	Documentation requirments		

Items highlighted in red indicate their unavailability and so not included in building the index.
Source: Authors Computation.

First Stage of PCA

We begin by specifying three different models that represents the separate dimensions and thereafter defining the variables. With an attempt to avoid bias, ten indicators make up each dimension in the exception of Financial Quality that suffers from lack of sufficient data and as a result consists of only three variables.

$$FA^h = \pi 1No.B + \pi 2No.BB + \pi 3No.CC + \pi 4No.MFB + \pi 5No.DB + \pi 6No.IC + \pi 7No.PMF + \pi 8TVE + \pi 9ITB + \pi 10BD + \tau i \quad \text{---------- 1}$$

Where FA stands for Financial Access, No.B is the Number of Banks, No.BB is the Number of Bank Branches, No.CC is the Number of Cheques Cleared, No.DB is the Number of Development Banks, No.IC means Number of Insurance Companies, No.PMF is the Number of Primary Mortgage Firms, TVE stands for Total Value of Equities, ITB is the Issues of Treasury Bonds, while BD means Bonds (Debentures).

$$FQ^S = \upsilon 1IR + \upsilon 2PLR + \upsilon 3TBR + \omega i \quad \text{---------- 2}$$

Where FQ stands for Financial Quality, IR is Interest Rate, PLR is Prime Lending Rate and TBR means Treasury Bill Rate.

$$FU^n = \acute{a}1CBSD + \acute{a}2CBBDR + \acute{a}3CBBLR + \acute{a}4CBL - SME + \acute{a}5CBCPS + \acute{a}6DMFB + \acute{a}7LPMF + \acute{a}8FDPMF + \acute{a}9No.T@NSE + \acute{a}10TSTB + \varphi i \quad \text{---------- 3}$$

Where FU stands for Financial Use, CBSD is Commercial Bank Savings Deposits, CBBDR is the Commercial Bank Branch Deposits in Rural Areas, CBBLR is Commercial Bank Branch Loans in Rural Areas, CBL-SME means Commercial Bank Loans to Small & Medium

Enterprises, CBCPS is Commercial Bank Credit to Private Sector, DMFB are Deposits in Micro-Finance Banks, LPMF stands for Loans in Primary Mortgage Firms, FDPMF is the Fixed Deposits in Private Mortgage Firms, No. T@NSE = Number of Transactions at the Nigerian Stock Exchange, while TSTB is the Total Subscriptions of Treasury Bonds.

The sub-indices are estimated by PCs as linear functions of the indicators described in table 1 above. The indicators are estimated jointly with the unknown parameters denoted as π, υ and ά. Let Rp, (pxp) be the correlation matrixes of the p standardize indicators for each dimension. Let j = 1,..., be denoted as the $j-th$ eigenvalue, then subscript j represents the number of PCs that also corresponds with the number of indicators, p. φj(px1) is the eigenvector of the correlation matrix. It is assumed that $\lambda 1 > \lambda 2 > ... > \lambda$p and denote ($k$ = 1,...,) as the $k-th$ PC. The corresponding estimator of each dimension according to the following weighted averages is arrived at:

$$FA^{h} = \frac{\Sigma_{j,k=1}^{p} = \lambda_j^h P_{ki}^h}{\Sigma_{j=1}^{p} = \lambda_j^h} ----4 \qquad FQ^{s} = \frac{\Sigma_{j,k=1}^{p} = \lambda_j^s P_{ki}^s}{\Sigma_{j=1}^{p} = \lambda_j^s} ---- 5$$

$$FU^{n} = \frac{\Sigma_{j,k=1}^{p} = \lambda_j^n P_{ki}^n}{\Sigma_{j=1}^{p} = \lambda_j^n} ----6$$

where $Pk = X\lambda j,\lambda j$ signifies the variance of the $k-th$ PC (weights) and X is the indicators matrix. The weights assigned to each component are decreasing, so that the larger proportion of the variation in each dimension is explained by the 1st PC and so on. Following this order, the $p-th$ PC is a linear combination of the variables that accounts for the least variance. In summary, this method represents a p-dimensional dataset of correlated variables by p orthogonal PCs, with the 1st PC explaining the largest amount of information from the initial data.

Second-Stage of PCA

The second stage of the PCA combines all the separate dimensions into one. It then becomes possible to build a linear model of FII, which is determined as follows;

$$FII = w1FA^h + w2FQ^s + w3FU^n + \varepsilon i ----------7$$

The same procedure described in the first stage is again applied in the second stage. So that the FII can be expressed thus;

$$FI = \frac{\Sigma_{j=1}^{3} \lambda_j (\vartheta_{j1} FA_i^h + \vartheta_{j2} FQ_i^s + \vartheta_{j3} FU_i^n)}{\Sigma_{j=1}^{3} \lambda_j} ----------8$$

4. Data Presentation and Results

4.1 First Stage of PCA (Dimensions of FII)

The result of the First-stage PCA, which comprises the three dimensions is presented from 1992 – 2019. As mentioned in the previous section, for easy comprehension, the study will only discuss the Eigen values greater than 1.

4.1.1 Supply-Side Dimension

Table 2: PCA FII Supply-Side

Principal Components Analysis					
Computed using: Ordinary correlations					
Eigenvalues: (Sum = 10, Average = 1)					
Num. of PCs	**Value**	**Difference**	**Proportion**	**Cum. Value**	**Cum. Proportion**
PC1	6.304186	4.996692	0.6304	6.304186	0.6304
PC2	1.307494	0.466986	0.1307	7.61168	0.7612
PC3	0.840509	0.200065	0.0841	8.452189	0.8452
PC4	0.640444	0.168665	0.064	9.092633	0.9093
PC5	0.471779	0.193404	0.0472	9.564412	0.9564
PC6	0.278375	0.201513	0.0278	9.842786	0.9843
PC7	0.076861	0.024219	0.0077	9.919647	0.992
PC8	0.052643	0.032728	0.0053	9.97229	0.9972
PC9	0.019915	0.012119	0.002	9.992205	0.9992
PC10	0.007795	---	0.0008	10	1

Source: Authors Computation

Table 2 show that the first PC with an eigenvalue of 6.304 accounts for about 63% of the total variation in $FII_{SS.}$ While the second PC with an eigenvalue of 1.307 accounts for about 13% of the total variation in FII_{SS}. Together, they constitute 76% of the total variation in the Supply dimension of FI in Nigeria. Following the Kaisers criterion, only the first and second PC's will be further evaluated as the values of other PC's (from 3rd to 10th) are below one and they collectively account for only 24% of the remaining variation in FII_{SS}, which is negligible.

Table 3: FII_{SS} Variable Loadings (Weight)

Eigenvectors (loadings)/ Weights		
Variable	**PC 1**	**PC 2**
LNBONDS_DB	0.374629	0.106069
LNEQUITY_B	0.390495	0.070844
LNITB_B	0.345874	-0.13696
LNN_RIC	-0.26284	-0.22457
LNNO_BANKS	-0.31938	0.023489
LNNO_BB	0.375611	-0.00557
LNNO_CC	0.286312	-0.38591
LNNO_DB	0.315071	0.217216
LNNO_MFB	-0.02788	0.847167
LNNRPMI	-0.30552	0.012398

Source: Authors Computation

Table 3 reveals that in PC1, the variable/indicator with the largest loading for the supply dimension is Volume of Equity provided at the Nigerian Stock Exchange Market (NSE) with a weight of 0.39. The second largest loading is the Number of Bank Branches in Nigeria with 0.38. The third is Volume of Bonds on offer in the Bonds market with a weight of 0.37. The Issues of Treasury Bills, Number of Development Banks and Number of Cheques Cleared occupy the fourth, fifth and sixth positions with 0.34, 0.32 and 0.29 weights respectively. The remaining variables possess negative signs associated with their weights and indicate their insufficiency in the supply dimension. The seventh position is taken by Number of Microfinance banks with a weight of -0.03. The eighth is Number of Reporting Insurance Companies with a weight of -0.26 and ninth is Number of Primary Mortgage Firms with -0.31.

The indicator with the lowest loading is Number of banks with a weight of -0.32. The obvious pattern here is that with the exception of Number of Bank branches, the indicators for other sub-sectors like the Capital and Bond Markets occupy the leading positions in the dimension of supply of FI. While other vital indicators that represent available points of service provided by Microfinance banks, Insurance firms, Mortgage firms and Banks are not only low but in the negative. The number of bank branches occupies the second highest weight probably because, the bank branches are located in urban centres of the 36 states in the country. This result goes in tandem with other studies that report that the number of bank branches in Nigeria is sufficient for supplying needed financial products and services in the country but currently they function under full capacity due to the fact that bank branches are scanty in rural areas. In PC2, the indicator with the highest weight is Number of Micro-finance Banks and suggests the importance of this indicator in increasing FII_{SS}.

4.1.2 Demand-Side Dimension

Table 4: PCA FII Demand-Side

Principal Components Analysis					
Computed using: Ordinary correlations					
Eigenvalues: (Sum = 10, Average = 1)					
Num. of PCs	**Value**	**Difference**	**Proportion**	**Cum. Value**	**Cum. Proportion**
PC1	7.113759	5.79501	0.7114	7.113759	0.7114
PC2	1.318749	0.667663	0.1319	8.432508	0.8433
PC3	0.651086	0.267807	0.0651	9.083594	0.9084
PC4	0.383279	0.11931	0.0383	9.466873	0.9467
PC5	0.263968	0.103899	0.0264	9.730842	0.9731
PC6	0.160069	0.098306	0.016	9.890911	0.9891
PC7	0.061763	0.029289	0.0062	9.952674	0.9953
PC8	0.032474	0.020015	0.0032	9.985148	0.9985
PC9	0.012459	0.010066	0.0012	9.997607	0.9998
PC10	0.002393	---	0.0002	10	1

Source: Authors Computation

Table 4 show that the PC1 has an eigenvalue of 7.114 accounts for about 71% of the total variation in $FII_{DD.}$ While the PC2 with an eigenvalue of 1.319 accounts for about 13% of the total variation in FII_{DD}. Together, they constitute 84% of the total variation in the Demand dimension of FI in Nigeria. Following the Kaisers criterion, only the 1st and 2nd PC's will be further evaluated as the values of other PC's (from 3rd to 10th) are below one and they collectively account for only 16% of the remaining variation in FII_{DD}, which is negligible.

Table 5: FII_{DD} Variable Loadings (Weight)

Eigenvectors (loadings)/Weights		
Variable	**PC 1**	**PC 2**
LNCBBDR_M	-0.09593	0.746065
LNCBBLR_M	0.293651	0.192391
LNCBCPS_M	0.36938	0.080397
LNCBLSME_M	-0.15297	0.577985
LNCBSD_PSD_B	0.364739	0.129724
LNDMFB_DST_M	0.362296	0.139587
LNFD_PMI_B	0.35307	-0.01637
LNLPMI_B	0.3655	-0.01882
LNNO_OF_TNSE	0.316998	-0.14086
LNTSTB_B	0.348847	0.095219

Source: Authors Computation

The PCA result in Table 5 discloses that a group of 5 indicators occupy the largest loadings for the demand dimension. They are are Commercial Bank Credit to Private Sector, Loans in Private Mortgage Institutions, Commercial Bank Savings Deposit, Deposits in Microfinance Banks and Fixed Deposits in Primary Mortgage Firms with weights of 0.369, 0.365, 0.364, 0.362 and 0.353. While the indicators with the lowest loadings are Total Subscriptions of Treasury Bills, Commercial Bank Branch Loans in Rural Areas, Commercial Bank Branch Deposits in Rural Areas and Commercial Bank Loans to Small and Medium Enterprises with weights of 0.348, 0.293, -0.095 and -0.152 respectively.

Here a familiar pattern appears as indicators representing demand for services for Credit by the private sector (Household, Individuals & Firms), Mortgage services, Commercial Bank Private Sector Deposits, Deposits in Microfinance Banks and Subscriptions of Treasury Bills, which are services offered in most urban centres lead the category of financial services in high demand. While the indicators representing demand for financial services in rural areas, which comprises Commercial Bank Branch Loans and Deposits in Rural Areas cum Commercial Bank Loan to Small and Medium Enterprises (SMEs)

occupy the lowest weights. Hence, the demand for financial services in urban centres is higher than the demand for financial services in rural areas.

4.1.3 Quality-Side Dimension

As stated in previous sections, difficulty in identifying essential indicators constitutes a crucial challenge in building an index of FI. This limitation is most prominent in the quality dimension due to the category of variables required. Due to lack of adequate data, only 3 indicators was selected from the Price barriers and none from the non-price barriers. The lack of sufficient data greatly hampers the quality dimension, as only indicators representing price barrier are available.

4.2 Trend of Supply-Side and Demand-Side Dimensions of FI

An advantage of the PCA as mentioned in previous sections is tracing the historical trend of FII from 1992 to 2019. The diagram below gives the trend of the from the first stage PCA and comprises the Financial Inclusion Demand side (FII_{DD}) and Supply side (FII_{SS})

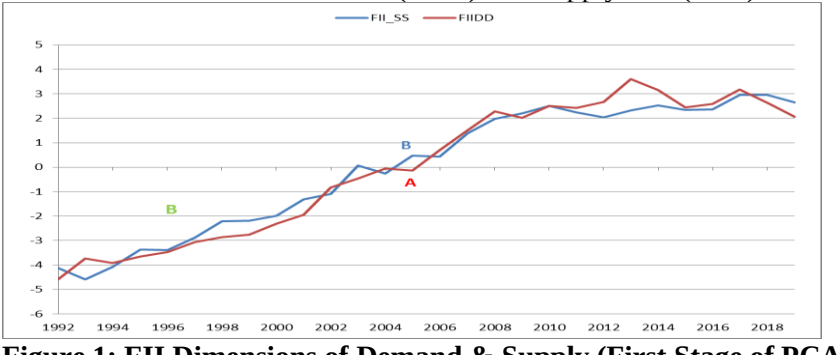

Figure 1: FII Dimensions of Demand & Supply (First Stage of PCA)
Source: Authors Computation

Figure 1 shows that there is a steady increase of both Demand and Supply dimensions of FI from 1992 to 2019. At points A & B, both dimensions reveal increased improvement after the 2004/05 Recapitalization policy. The graph show that the Supply dimension of FII is higher than the Demand dimension of FII.

4.3 Second- Stage of PCA (Financial Inclusion Index)

In the second stage, the PCA is applied on the PCs belonging to the three sub-indices (Demand, Supply & Quality) to calculate their respective weights in the final index.

Table 6: PCA FII

Principal Components Analysis					
Included observations: 28					
Computed using: Ordinary correlations					
Eigenvalues: (Sum = 3, Average = 1)					
Num. of PCs	Value	Difference	Proportion	Cum. Value	Cum. Proportion
PC1	2.604683	2.223656	0.8682	2.604683	0.8682
PC2	0.381027	0.366738	0.127	2.985711	0.9952
PC3	0.014289	---	0.0048	3	1

Source: Authors Computation

Table 6 shows that PC1, with an eigenvalue of 2.605 accounts for about 87% of the total variation in FII. While PCs 2 & 3 with eigenvalues of 0.381 and 0.014 accounts for about 14% of the total variation in FII. Employing the Kaisers criterion, only the 1st PC will be further evaluated as the values of other PC's are below one.

Table 7: FII Dimension Loading

PCA FII	
Variables	**PC 1**
FIIDD	0.597913
FIIQ	-0.52783
FIISS	0.60324

Source: Authors Computation

Table 7 discloses that in PC1, the Supply-side dimension possesses the highest loading with a weight of 0.603 and closely followed by the Demand-side dimension with a weight of 0.597. This suggests that Supply of financial services is slightly above the demand for it. Hampered by the lack of suitable data, the financial quality possesses a negative weight of only -0.527, which contributes little to Financial Inclusion in Nigeria.

4.3.1 Financial Inclusion Index in Nigeria 1992-2019

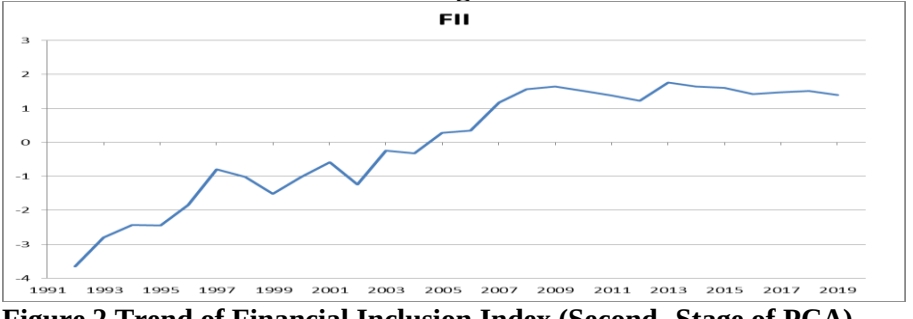

Figure 2 Trend of Financial Inclusion Index (Second- Stage of PCA)
Source: Authors Computation

Figure 2 reveals several important information and pattern based on different historical antecedents. The trajectory of FII suggests that overall FI in Nigeria has improved over the study scope, increasing from -3.65 in 1992 to 1.39 in 2019. However, despite this increase, the graph reveals that overall FII saw more improvement between 1992 and 2007/08 when the Global Financial Crisis hit. This may suggest an untested relationship between financial stability and financial inclusion that requires further investigation. The graph further reveals that while FII attained its highest in 2013 at 1.76 it has been on a downward trend since then.

4.4 Robust Tests

In employing the PCA as a constructive tool, it would be expedient to verify or check the sampling adequacy of 22 variables selected for building the FII. The Kaiser Meyer Olkin (KMO) test and the Bartlett's test of sphericity (BTS) are among the frequent techniques employed in achieving this. The KMO and BTS test whether the variables in a correlation matrix are significantly different from an identity matrix. An identity matrix is when the diagonal values are 1 and the non-diagonal values are 0. This condition implies that the variables selected for building the index are completely unrelated and independent of each other, as such the use of PCA as an indexing tool would be unsuitable and inappropriate. Both tests are often used in parametric tests where the rejection of the null hypothesis of an identity matrix is an indication that the data are well suited for either the PCA or Factor Analysis.

H_0: Correlation matrix is an Identity Matrix (Null Hypothesis)
H_1: Correlation matrix is not an Identity Matric (Alternative Hypothesis)

Decision Rule

For the KMO, according to Kaiser and Rice (1974) the guidelines for ascertaining the KMO result is given thus;
In the 0.90s Marvelous
In the 0.80s Meritorious
In the 0.70s Middling
In the 0.60s Mediocre
In the 0.50s Miserable
Below 0.50 Unacceptable
For the BTS, when the P-Value of the BTS is lower than the critical value of 0.05, the null hypothesis can be rejected.

Table 8: Results of the KMO and BTS Tests

Table 8 KMO and Bartlett's Test	
Kaiser Meyer-Olkin Measure of Sampling Adequacy	0.681
Approx. Chi-Square	86.44
Bartlett's Test of Sphericity Df	3
Significance	0.000

Source: Authors Computation

Table 8 shows that the KMO result is 0.68 and the P-value of the BTS is 0.00. Hence, the null hypothesis is rejected and the alternative hypothesis that the correlation matrix is not an identity matrix is accepted. This implies that the variable in the correlation matrix are well suited for PCA.

5. Conclusion and Recommendations

The Supply-side dimension, the PCA results show that the supply of financial market services like the volume of equity, bonds, and treasury bills outstrip the supply of services offered by microfinance banks, insurance, mortgage and commercial banks. The results show that the supply of bank services offered by the main banks is very low. However, the supply of banking services offered by bank branches underscores the importance of bank branches in the Nigerian economy. The result also proves that previously neglected areas in the literature like the financial markets prove themselves to be the leading sectors that contribute more to financial supply in Nigeria. This implies that neglecting financial markets in constructing FII will portend misrepresentation of Financial Inclusion in Nigeria. From the PCA results, the study concludes that number of financial institutions is low and insufficient.

In the demand-side dimension, the indicators representing regularity and frequency of use of financial services in urban centres like Commercial Bank Credit to Private Sector, Loans in Private Mortgage Institutions, Commercial Bank Savings Deposit and Fixed Deposits in Primary Mortgage Firms are among the highest. On the other hand, indicators representing regularity and frequency of use of financial services in rural areas like Commercial Bank Branch Loans and Deposits in Rural Areas cum Commercial Bank Loan to Small and Medium Enterprises (SMEs) are very low. The result lends credence to the assertion that financial institutions are congregated in urban centres than rural areas. As such, there is little demand for financial services in rural areas.

Despite the increase of demand and supply dimensions of FI, the results suggest that both dimensions are not only low but also insufficient

in rural areas. Based on the results of the PCA analysis, this study concludes that the demand for financial services is higher in the urban centres than rural areas. Given some of the observed limitations associated with the survey method, the authors recommend the use of the parametric method, specifically the PCA as an indexing instrument in condensing selected aggregate indicators for measuring the level of financial inclusion for the Nigerian economy.

The study also recommends that government should encourage and facilitate the entry of more banks and bank branches into the NFS. This would increase the level of financial supply. Government through requisite agencies should encourage and adequately secure the financial markets in order to contribute to the supply of financial services. Conversely, encouraging banks to open more branches in rural areas will allow Nigerians residing in rural areas to be financially included.

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