

Banking Consolidation and Financial Deepening in Nigeria

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Abstract

One of the dramatic changes in the banking industry in Nigeria over the past two decades was banks consolidation which assumed to have improved bank performance as a result of robust financial deepening. In line with the above the study examined the impact of financial deepening on post banking consolidation in Nigeria. Using data collected from Central Bank of Nigeria and World Bank database from 1981 to 2018 the study employed Johansen cointegration, Error Correction Model (ECM) and Granger causality test methods of analyses to ascertain both the long and short run relationships among the variables. The result revealed that both the short and long run relationships confirmed the importance of financial deepening as a suitable strategy for banks consolidation. The ECM value of -0.34 which is statistically significant provides an indication of a satisfactory speed of adjustment which translates that about 34 percent of the errors are corrected in each period. The study concludes that strong financial deepening in Nigeria has aided banking sector consolidation which invariably improved banks' performance tremendously. The study therefore recommended among others that banks should be more aggressive in their profit drive in boosting financial deepening so as to reap the benefit of post consolidation epoch.

Keywords: *Banking system; Financial deepening; Banks consolidation; Banks performance Regulatory framework*

JEL Classification: *E58; G01; G21; G34*

Introduction

The Nigerian banking industry being a dynamic one, plays important role in the economy, has witnessed a lot of changes overtime that have resulted into frequent changes in government financial policies which affect inter alia, capitalization, liquidity, credit extension, organizational structure, qualification and experience of bank personnel etc. Prior to 1986, the financial system was under financial repression (Central Bank of Nigeria, 2003). The introduction of Structural Adjustment programme (SAP) in 1986 which was aimed at increasing competition and promoting efficient intermediation brought about freeing of interest rates, lifting of credit ceiling, the introduction of Open Market Operation (OMO), led to the increase in number of banks. This prompted the government to introduce a deposit insurance scheme with the promulgation of Nigerian Deposit Insurance Corporation (NDIC) Decree 22 of 1988, the prudential guidelines for banks and the creation of Central Bank of Nigeria (CNB) and BOFID Decree 24 and 25 of 1991 respectively.

The phenomenal growth in the number of banks in Nigeria from 41 in 1986 to 119 by April 1991 forced the CBN to place an embargo on licensing of new banks. Also, coupled with the distress and failure experienced by the banking industry from 8 in 1990 as the number of banks adjudged as technically insolvent rose to 28 in 1993 and by December 1995, the number had risen to 50. These occurred as a result of the general poor state of the financial sector, which was characterized by liquidity problem, internal structural weaknesses such as inadequate capital, poor assets quality, bad management etc.

With the introduction of the Universal Banking (UB) in 2001, Sanusi (2012a) was of the opinion that adoption of UB in Nigeria, like in other countries where UB has been in operation, would encourage the emergence of large banking groups and financial conglomerates which offer not only financial services but enhance international competition. Reverse is the case, because the dynamic role played by the banking industry in an economy is such that all other sectors of the economy is affected by its actions and inaction, therefore, any defect in the performance of the industry will always has a catastrophic effect in the economy.

Considering the magnitude and importance of this industry, it becomes imperative that everything should be done to guarantee its survival and growth, but it is quite worrisome that with operators in the industry the monetary clear way out of the doldrums is a little far. This informed the CBN on July 6, 2004, to introduce a major reform programme that was expected to transform the banking sector, which was the minimum capital base of N25billion for Deposit Money Banks (DMBs) effective from December 31, 2005 (Donwa and Odia, 2010; Donwa and Odia, 2011; and Bebeji, 2013). The banks were expected to shore up their capital through the injection of fresh funds where applicable, but were most importantly encouraged to enter into merger/acquisition arrangements without relatively smaller banks, thus taking the advantages of economies of scale to reduce cost of doing business and enhance their competitiveness locally and internationally.

The programme has resulted in the shrinkage of the number of banks from 89 to 25 through merger/acquisition involving 76 banks which altogether account for 93.5% of the deposit share of the market. Apart from resolving the distressed, the capitalization of the 25 banks that have emerged was the first phase and many challenges that lied ahead as a result of consolidation reduced the number to 24 in 2005 (Assaf, Barros and Ibiowie, 2011). The regulatory framework and capacity were also beefed up to ensure that the objectives of the reform to support the real sector of the economy are achieved.

Since then, the sector has undergone remarkable changes over the years in terms of the number of institutions, structure of ownership as well as depth and breadth of operations. Despite the significant improvement in the sector, it is on record (Soludo, 2006; Olokoyo, 2012; Bebeji, 2013 and Kareem, Akinola and Oke, 2014) that the industry experienced high level of competition coupled with political instability and inconsistencies in policy implementation; thus, leading to a rapid decline on the level of profitability and financial performance of bank.

Most of the previous studies were more concerned about the performance analysis of banks after consolidation without taking into consideration some fundamental variables of financial deepening. So, this study contributed to existing empirical literature by estimating a more suitable dynamic model using financial deepening variables at aggregate level to examine the impact of financial deepening on bank consolidation in Nigeria.

The paper is divided into five Sections. Section 1 is introduction; section 2 deals with literature review while section 3 is methodology, section 4 contain analysis and section 5 is conclusion and recommendation.

Literature Review

The theories which are central to the analysis of this study are discussed as follows. The McKinnon-Shaw theory suggests that any distortion and limitation on the banking sector, such as interest rate controls, reserve and liquidity requirement, and government rationing of available credit to priority sectors, inhibit financial deepening mainly by depressing the interest rate (McKinnon, 1973; Shaw, 1973; Galbis, 1997; Mathiesun, 1980 and Capannelli, 2009). So, McKinnon and Shaw advocate for financial liberalization as a solution to end financial repression in emerging countries. Also, both McKinnon and Shaw model and endogenous growth models predicted that financial deepening depends on real income and real interest rate. The supply leading hypothesis suggests that financial deepening which promotes the existence and development of the financial markets brings about a higher level of savings and investment and enhance the efficiency of capital accumulation. The basis of this hypothesis is that, a well-functioning financial institutions can promote overall economic efficiency, create and expand capital accumulation, transfer resources from traditional (non-growth) sectors to the modern growth inducing sectors and also promote a competent entrepreneur response in these modern sectors of the economy. The demand-following hypothesis view is that resources should be allocated to more useful purposes in the early stages of growth rather than developing financial markets. Their assumption is that as the economy grows the demand for more financial services increases and thus leads to greater financial development (Onyemachi (2012).

The positive approach theory which involves private interest theory has its origins in the Chicago school which explicitly considers the design of banking regulation content and its structure (Hertog 2010). Private interest theory is a combination of public interest theory and neoclassical theory that occurred in response to the demands of interest groups struggling among themselves to maximize the incomes of their members' (Posner 1974). Rather than assuming the public interest, private interest theory assumes the interests of organized interest groups (such as banks or depositors). Applying private interest theory to the banking sector, Kane (1985, 1986) highlighting the interdependence between supervisors and the banking industry and addressing the question of whether banks should be regulated at all especially in order to reduce the risk interest groups such as depositors and investors. According to Kane (1985, 1986), the main objective of private interest theory is to prevail on the market for bank regulation regarding demand, which may affect how standards are organized. Another approach of private interest theory is Niskanen's theory of bureaucracy (1975) which basically explains the spread of regulation and over-regulation in the banking industry. Thus, regulatory authorities have an informational advantage over governments with respect to regulation. Based on this informational advantage, Niskanen (1975) suggests that the regulator will maximize utility by providing monetary or non-monetary incentives based on budget maximization; asymmetric information; and natural monopoly assumptions. The bank concentration theories are classified into pro-concentration and pro-de-concentration theories. Proponents of banking sector concentration argue that economies of scale drive bank mergers and acquisitions (increasing concentration), so that increased concentration goes hand-in-hand with efficiency improvements (Demirguc-Kunt and Levine, 2000). Proponents of concentration-stability argue that larger banks can diversify better so that banking systems characterized by a few large banks will be tended to be less fragile than banking systems with many small banks (Allen and Gale, 2003). Concentrated banking systems may also enhance profits and therefore lower bank fragility. High profits provide a buffer against adverse shocks and increase the franchise value of the bank, reducing incentives for bankers to take excessive risk. Furthermore, a few large banks are easier to monitor than many small banks, so that corporate control of banks will be more effective and the risks of contagion less pronounced in a concentrated banking system (Beck, Demirguc-Kunt and Levine, 2003). Proponents of banking sector de-concentration also argue that concentration will intensify market power and political influence of financial

conglomerates, prevent competition in and access to financial services, reduce efficiency, and destabilize financial systems as banks become too big to discipline and use their influence to shape banking regulations and policies (Demirguc-Kunt and Levine, 2000; Beck, Demirguc-Kunt and Levine, 2004; and Bank for International Settlements, 2001). While excessive competition may create an unstable banking environment, insufficient competition and contestability in the banking sector may breed inefficiencies.

Umar (2009) described consolidation as the reduction in the number of banks with a simultaneous increase in size and concentration of consolidated entities in the sector. The general consensus described consolidation as a policy strategy designed to enhance commercial banks' performance through an increase in their capital base either by means of mergers, recapitalization or by means of absorption (Bebeji, 2013; Osuji and Okoli, 2013; Bebeji, Dogarawa and Sabari, 2014). Banks consolidation is motivated by innovations in technology, deregulation of financial services, enhancing intermediation, increased emphasis on shareholder value as well as privatization and international competition (Berger, Demsetz and Strahan 1999; IMF 2001; Aregbeyen and Olufemi (2011)). Banking sector consolidation has been the major policy instrument being adopted in correcting deficiencies in the financial sector as well as accelerating the rate of growth in the sector. This makes the economic rationale for domestic consolidation indisputable. Adebajju and Olokoyo (2008) observed that the main aim of banking sector reforms and recapitalization was to correct perceived or impending banking sector crises and subsequent failures. They stated further that banking crisis can be triggered by weakness in banking system characterized by persistent illiquidity, insolvency, undercapitalization, high level of non-performing loans and weak corporate governance, among others. In the same vein, Uchendu (2005) was of the opinion that the reforms in the banking sector emanated due to the backdrop of banking crisis as a result of highly undercapitalization of deposit money banks; weakness in the regulatory and supervisory framework; weak management practices; and the tolerance of deficiencies in the corporate governance behaviour of banks. According to Akpan, (2009) the immediate challenges the banks faced after consolidation exercise were to maximizing returns and optimizing profitability because they were required to significantly increase their level of returns and at the same time manage costs. These can only be realized through robust financial deepening which offers innovative products and services to the marketplace including new ways of delivering them.

Financial deepening is the ability of financial institutions to effectively mobilize savings for investments because the growth of domestic savings provides the real structure for the creation of diversified financial claims. Generally, financial deepening entails an increased ratio of money supply to Gross Domestic Product (Christian, 2013). It includes the aggregate or wide range of financial assets that are available in the economy. In line with this Hammilton and Godwin (2013) defined financial deepening as an increase in the supply of financial assets in the economy. Also, Osinsanwo (2013) describes financial deepening as increased financial services geared to all levels of the society. So, financial deepening involves the establishment and expansion of institutions, instruments and growth process. This informed Onyemachi (2012) to define financial deepening as an effort aimed at developing the financial system that is evident in increased financial instrument/assets in the financial markets-money and capital markets, leading to the expansion of the real sector of the economy. In the nutshell, the various definitions of financial deepening based on the most classic and practical indicator reflects the share of money supply to GDP which is the ratio of M2/GDP.

Empirical evidence on the effects of bank consolidation has mix results based on each country market characteristics and regulations (Focarelli, Panetta, and Salleo, 2002; Vander Venet, 2002). Generally, in US there is no strong evidence on the benefit of consolidation, but with a mixed results from Europe (Carbo and Humphrey, 2004; Cavallo and Rossi, 2001; Diaz, Garcia, and Sanfilippo, 2004; Esho, 2001; Sathye, 2001). As for Asian countries the conclusions are also mixed and vary with the period analysed by some authors (Drake and Hall, 2003). Also, the

study by Ritu, Pablo, David and Raul (2004) reported a strong positive and significant effect of bank consolidation on bank performance, which implies that bank return increases with consolidation. In addition, the study of Usman (2008) shows that bank consolidation has no significant impact on both bank profitability and efficiency. Furthermore, the results of Barros and Caporale (2012) study indicated that the Nigerian banking sector has benefited from the consolidation process. Similarly, in Nigeria Sanni, Ebo and Adereti (2012) reported a positive significant difference between earnings per share of nine banks in their bank consolidation study. In the same vein, Adegbaaju and Olokoyo (2008) found a positive and significant relationship between recapitalization and profitability (ROA and ROE) but a negative and significant relationship with yield on earning asset (YEA). More so, Olayinka and Farouk (2014); Jeroh and Okoye (2015) results show that consolidation has significant and positive impact on the performance of banks in Nigeria. Finally, Olawumi, Lateef and Oladeji (2017) examined financial deepening and bank performance in Nigeria and their results show that financial deepening has positive and significant relationship with bank performance in Nigeria. From most of the empirical studies reviewed, evidence has shown that there is no study that examined the nexus between bank consolidations and financial deepening especially in Nigeria. So, there is need to carry out the study of this nature.

Methodology

For the purpose of this study aggregate time series data of all the 24 post consolidation banks in Nigeria were sourced from the CBN statistical Bulletin and World Bank Database from 1981 to 2018. The study adds to the limited number of existing studies on banking consolidation (Adegbaaju and Olokoyo, 2008; Assaf, Barros and Ibiowie, 2011; Jeroh and Okoye, 2015) by estimating a more suitable dynamic model which included financial deepening variables. The study used Johansen cointegration, Error Correction Model (ECM) and Granger causality test methods of analyses to ascertain both the long and short run relationships among the variables. It is evident from the literature that financial deepening (FINDEEP) which serves as a linkage to welfare is a potential indicator for financial development (FD) and is determined by M2GDP ratio with other bank-characterizing variables such as loan to deposit ratio (LDR), lending rate (LR) and Banks Domestic credit to Private sector % of GDP (BDGP_GDP). Bank consolidation is proxy by bank performance which is measured by Gross Fixed Capital Formation (GFCF) of all the banks in the post consolidation era.

Estimation Techniques

For the purpose of this study co-integration test is conducted to confirm the existence of a long run linear relationship between time series variables. Johansen's methodology which uses two different test statistics namely the trace test statistic and the maximum Eigen-value test statistic was conducted to identify the number of cointegrating vectors,. The trace statistic tests the null hypothesis which states that the number of distinct cointegrating relationships is less than or equal to 'r' against the alternative hypothesis of more than 'r' cointegrating relationships, and is defined as:

$$\lambda_{\text{trace}}(r) = -T \sum_{j=r+1}^p \ln(1 - \hat{\lambda}_j) \quad (1)$$

Where:

$\hat{\lambda}_j$ = the eigenvalues; T = total number of observations.

The maximum Eigen-value statistic (maximum likelihood ratio) for testing the null hypothesis of at most 'r' cointegrating vectors against the alternative hypothesis of 'r+1' cointegrating vectors, is given by:

$$\lambda_{\text{max}}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1}). \quad (2)$$

Furthermore, granger causality test equations are stated as thus:

$$Y_t = \alpha_0 + \sum_{i=1}^n \alpha_i Y_{t-i} + \sum_{i=1}^n \alpha_{i+1} X_{t-i} + \mu_t \quad (3)$$

$$X_t = \beta_0 + \sum_{i=1}^n \beta_i X_{t-i} + \sum_{i=1}^n \beta_{i+1} Y_{t-i} + \eta_t \quad (4)$$

These two equations can be rewritten in this form:

$$X_t = \sum_{j=1}^m a_j X_{t-j} + \sum_{j=1}^m b_j Y_{t-j} + \varepsilon_t \quad (5)$$

$$Y_t = \sum_{j=1}^m c_j X_{t-j} + \sum_{j=1}^m d_j Y_{t-j} + \eta_t \quad (6)$$

If b_j is different than zero; Y_t causes X_t . On the other hand, if c_j is different than zero; X_t causes Y_t . The results of the Granger causality test can be interpreted in four different forms (Gujarati, 2004): If the coefficient of lagged variables X_t and Y_t are statistically insignificant, the independence will occur between variables. If the coefficient of lagged X_t is statistically significant in equation 5 (e.g. $a_j \neq 0$), while the coefficient of lagged Y_t is statistically insignificant in equation 6 (e.g. $d_j \neq 0$); there is unidirectional causality from X_t to Y_t . On the other hand, if coefficient of lagged X_t is statistically insignificant ($a_j=0$) in equation 5, while the coefficient of lagged Y_t is statistically significant in equation 6 (e.g. $d_j \neq 0$); there is unidirectional causality from Y_t to X_t . If both coefficients of lagged X_t and Y_t are significant, there is bilateral causality between both variables.

Both the disturbances u_{1t} and u_{2t} are assumed to be uncorrelated (Gujarati, 1995).

Model Specification

The study model is based on McKinnon and Shaw (1973) hypothesis which predicted that financial deepening promotes the existence and development of the financial markets that leads to a higher level of savings and investment which enhance the efficiency of capital accumulation in terms of capital formation. Thus, the estimated model in this study is stated as follows:

$$GFCF = f(FD) \quad (7)$$

By decomposing financial development (FD) into its various components, we rewrite equation (7) as follows:

$$GFCF = f(FINDEEP, LDR, BDCP_GDP, LR) \quad (8)$$

The function can also be represented in a log-linear econometric format thus:

$$\ln GFCF_t = \alpha + \alpha_1 \ln FINDEEP_t + \alpha_2 \ln LDR_t + \alpha_3 \ln BDCP_GDP_t + \alpha_4 \ln LR_t + \varepsilon_t \quad (9)$$

Furthermore, the Error Correction Model (ECM) can be stated as follows:

$$\begin{aligned} \Delta GFCF_{t-1} = & \sum_{i=1}^n \alpha_0 \Delta GFCF_{t-i} + \sum_{i=1}^n \alpha_1 \Delta FINDEEP_{t-i} + \sum_{i=1}^n \alpha_2 \Delta LDR_{t-i} \\ & + \sum_{i=1}^n \alpha_3 \Delta BDCP_GDP_{t-i} + \alpha_4 \sum_{i=1}^n \Delta LR_{t-i} + ECM_{t-1} + \varepsilon_{it} \end{aligned} \quad (10)$$

where Δ is the difference operator; n , is the numbers of lags, $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ are short run coefficients to be estimated, ECM_{t-i} represents the error correction term derived from the long-run co integration relationship and ε_{it} the serially uncorrelated error terms in equation.

Analysis of the Results

In the results of descriptive statistics in the Table 1 below the large differences between maximum and minimum values of the series revealed evidence of significant variation in the trends of the variables over the sample period. Only two variables (FINDEEP and LDR) are platykurtic in nature as their respective kurtosis values of about 2.14 and 2.82 are less than 3 but

the positive kurtosis indicates too few cases at the tail of the distribution. The Skewness coefficient indicates normal curves for all the variables with the values ranging between -3 and +3. Finally, the Jarque-Berra statistic rejected the null hypothesis of normal distribution for GCF_GDP and BDCP_GDP at 5 percent critical value while the null hypothesis of normal distribution for FINDEEP, LDR and LR were accepted because their probability values are higher than the critical value. This may have resulted from the problem of trended data, which were examined with the unit root analysis. Also, the results of correlation matrix in appendix 1 below indicate that GCF_GDP has a positive association with all the variables except LR. This implies that an increase in FINDEEP, BDCP_GDP and LDR increase Gross Fixed Capital Formation (GFCF) of all the banks in Nigeria in post consolidation era. While an increase in LR decreases GCF_GDP, which implies that an increase in lending rate in Nigeria reduces Gross Fixed Capital Formation (GFCF) of all the banks in Nigeria in post consolidation era. These results indicate that there is absence of multicollinearity among the predictor variables. In addition, in Table 2 below the results of unit root test indicate that all the variables are I(1) series. Therefore, there is justification to conduct cointegration and Granger causality tests among the variables of the study.

Table 1. Descriptive Statistics Results

	GCF_GDP	FINDEEP	BDCP_GDP	LDR	LR
Mean	12.64646	14.54595	14.98159	67.56081	17.59486
Median	12.09500	12.70000	13.49400	69.60000	17.58000
Maximum	34.02100	24.30000	38.34900	85.70000	29.80000
Minimum	2.002000	9.200000	8.693000	38.00000	7.750000
Std.Dev.	6.196861	4.563721	5.970382	12.49356	4.690745
Skewness	1.536342	0.827439	2.522312	-0.689486	0.189738
Kurtosis	6.290948	2.142170	9.785859	2.820209	3.572605
Jarque-Bera	31.25225	5.356505	110.2232	2.981415	0.727478
Probability	0.000000	0.068683	0.000000	0.225213	0.695073
Observations	37	37	37	37	37

Source: Author's Computation, 2018

Table 2. Unit Root Test Results

Variables	ADF Test Statistic	Critical Value of ADF	Order of integration	Remarks
GCF_GDP	-5.094058*	-3.632900	I(1)	Difference Stationary
FINDEEP	-5.618371*	-3.632900	I(1)	Difference Stationary
LDR	-5.733121*	-3.632900	I(1)	Difference Stationary
BDCP_GDP	-5.428762*	-3.632900	I(1)	Difference Stationary
LR	-5.904707*	-3.639407	I(1)	Difference Stationary

Source: Author's Computation, 2018

Cointegration Test and Error Correction Model

The appropriate lag length considered for the series in the computation of the cointegration test for long run relationship is lag 3 which is based on the minimum values of AIC criterion (see appendix 2). In the Table 3 below the Johansen-Juselius Cointegration test results show that there is cointegration among the variables since calculated trace and max-eigenvalue statistics are greater than critical value at 5% significance level. Therefore, this is a long run relationship among the variables. While the results in Table 4 below show that the expected negative sign of the ECM is highly significant. The ECM coefficient of -0.34117 suggests that deviation from the long-term path is corrected by around 34.11 percent over the following year. This means that the adjustment takes place very quickly. This singular feature made competition skewed among the players in the banking industry which also improves bank performance in post consolidation era.

Finally, the results of pairwise granger causality tests in Table 5 show that there is uni-directional causality between FINDEED & GCF_GDP; and LR & LDR. This implies that there is improvement in financial development (FD) as a result of high level of financial deepening in the post consolidation era.

Table 3. Johansen-Juselius Cointegration Tests

Hypothesized No. of CE(s)	Trace Statistic	Max-Eigen Statistic	Critical Values (5%)	
			Trace	Max-Eigen
$r = 0$	75.62324**	33.96621**	69.81889	33.87687
$r \leq 1$	41.65703	22.93635	47.85613	27.58434

Source: Author's Computation, 2018

Table 4. Error Correction Model Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.341170	0.087483	-3.899861	0.0005

Source: Author's Computation, 2018

Table 5. Pairwise Granger Causality Tests

Lags: 1				
Null Hypothesis:		Obs.	F-Statistic	Prob.
FINDEEP does not Granger Cause GCF GDP		36	5.11715	0.0304
LR does not Granger Cause LDR		36	7.17129	0.0115

Source: Author's Computation, 2018

Conclusion and Recommendations

Conclusion

The study examined the impact of financial deepening on post banking consolidation in Nigeria. In this study it was affirmed that financial deepening and other key variables such as loan to deposit ratio (LDR), lending rate (LR) and Banks Domestic credit to Private sector % of GDP (BDCP_GDP) are very crucial in determining the performance of banks in the post consolidation epoch in Nigeria. All these variables were found to be statistically significant. Also, all the variables under investigation have both long and short run relationships with bank consolidation. The study concludes that strong financial deepening in Nigeria has aided banking sector consolidation which invariably improved banks' performance tremendously. Despite the methodology used in this study, the results can still be biased because of several limitations such as manipulation of variables and data. Further researchers in this area of study may have to take into consideration the effect of second tier bank capital adequacy in Nigeria and other factors not considered in this study.

Recommendations

The study therefore made the following recommendations:

- o Banks should be more aggressive in their profit drive for improved financial deepening to reap the benefit of post consolidation epoch.
- o The Central Bank of Nigeria (CBN) should set and enforce guidelines that will make banks more aggressive in the pursuit of real sector lending.
- o Banks should invest largely in staff development in order to face the challenges in this post consolidation era.

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Appendix 1. Correlation Matrix Results

	GCF_GDP	FINDEEP	BDCP_GDP	LDR	LR
GCF_GDP	1.000000				
FINDEEP	0.088657	1.000000			
BDCP_GDP	0.062524	0.440661	1.000000		
LDR	0.179781	-0.153554	0.417385	1.000000	
LR	-0.520302	-0.010705	-0.263311	-0.303238	1.000000

Source: Author's Computation, 2018

Appendix 2. Lag Length Selection Criteria for Cointegration

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-511.1143	NA	10536616	30.35967	30.58413	30.43622
1	-437.3926	121.4240	611069.6	27.49368	28.84047*	27.95298*
2	-416.8058	27.85268	877161.9	27.75328	30.22240	28.59532
3	-379.1936	39.82476*	553698.2*	27.01139*	30.60282	28.23617

* indicates lag selection by the criteria

Source: Author's Computation, 2018