CENTRAL BANK AUTONOMY AND STOCK MARKET INDEX IN NIGERIA: AN ARDL APPROACH TO CO-INTEGRATION AND TYDL GRANGER-CAUSALITY TESTS

BY

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Background of the Study

- The central banks as monetary authorities of their countries are empowered with the mandate of formulation and application of monetary policy.
- The role of central banks universally, therefore, involves achieving and sustaining price stability, issuance of legal tender and preservation of all-encompassing, safe and steady financial system.
- The Central Bank of Nigeria functions includes the regulation and supervision of the nation’s financial system

- The success story from German Bundesbank autonomy granted in 1957 opened up the trend to granting of autonomy to most central banks around as from the 1990s.
- Central bank autonomy is the freedom of central banks to carry out their functions (monetary policy functions) with little or no interference from the politicians or the government.
- Information is needed by both the investors are operators in the stock market to take decisions

- The theoretical background for central bank autonomy is linked with the ground-breaking works of Kydland and Prescot (1977) and Barro and Gordon (1983) on time-inconsistency and inflation bias problems of monetary policy under a discretionary environment
- Rogoff (1985) suggested that to solve these problems, monetary policy formulation should be left to an autonomous monetary authority with defined rules and regulations

Statement of the research problem

- From 1958 when the law establishing Central Bank of Nigeria was enacted till now, the legal backing of the bank has gone through seven amendments
- Each of these amendments grant different forms of autonomy to the bank
- These amendments through the years also impacted the macroeconomic and other economic variables differently

- Studies on the impact of central bank autonomy on macroeconomic variables had largely be on the developed countries.
- Few studies considered developing countries in the existing literature.
- There is diverse, contradictory and inconclusive empirical evidence about the effects of central bank autonomy on macroeconomic efficiency.
- There exist therefore a need for further consideration.

- Coupled with this, central bank autonomy and stock market index is an area that has not been adequately covered in the literature.
- This study intends filling this gap in literature
- This study investigated the impact of central bank autonomy on stock market index in Nigeria.
- An Effective Central Bank Autonomy index is constructed for this purpose.

Study objective

- Construction of Central Bank Autonomy Index based Ahsan, Skully and Wickramanayake (2008) for Nigeria with a modification in this study.

- This study considered the impact of central bank autonomy on the stock market index of Nigeria from 1985 to 2018.

- To also considered the interactions of other macroeconomic determinants with stock market index.

Review of literature

- In the ground-breaking paper by Kydland and Prescott (1977), followed by Barro and Gordon (1983), the time-inconsistency issue occurs when what is supposed to be paramount is no longer sufficient for any future date when that duration eventually comes.
- As an antidote to time-inconsistency problem that engender inflation bias, Rogoff (1985) proposed that central bank should be separated from political interference so as to restrict politically oriented monetary policy shocks and reduce inflationary expectations.

- According to Davis, Fujiwara and Wang (2018), whenever a problem of time consistency arises, discretionary policies that cause inconsistency in the first place are obviously superior to any form of policy guidelines.
- Rogoff (1985) then argues that time inconsistency occurs as the government has motivations to generate economic growth through surprised inflation.

Methods and Results

- This study used Autoregressive Distributed-Lag (ARDL) bound testing approach to co-integration. This estimation technique addresses the endogeneity problems inherent in most other estimations techniques (Pesaran and Shin, 2001)
- The ARDL approach to cointegration will be supported with Toda-Yamamoto and Dolado-Lutkepohl approach to Granger causality analysis

- Annual time series data from 1985 to 2018 obtained from the World Bank Development indicators (2019) and Central Bank of Nigeria Statistical Bulletins (2019) is used.

Model Specification

- The implicit equation is:

SMI=*f(GDPPCGR,TOT,FDI,TRAOPEN,INTRP,TBR, ECBA,INFL).....(1)*

where SMI= Stock Market Index
GDPPCGR = GDP per capita growth rate
TOT=Term of Trade
FDI=Foreign Direct Investment as a percentage of GDP
TRAOPEN= Trade openness
INTRP= Interest rate spread
TBR = Treasury bills rate (short time interest rate)
ECBA= Effective Central Bank Autonomy Index
INFL = Inflation Rate

The Augmented Version of Equation (1)

$$\Delta SMI_t = \alpha_0 + \sum_{i=1}^{a} \alpha_{1i} \Delta SMI_{t-1} + \sum_{i=0}^{b} \alpha_{2i} \Delta GDPPCGR_{t-1} + \sum_{i=0}^{c} \alpha_{3i} \Delta TOT_{3i} + \sum_{i=0}^{d} \alpha_{4i} \Delta FDI_{4I} +$$

$$\sum_{i=0}^{e} \alpha_{5i} \Delta TRADEOPEN_{t-1} + \sum_{i=0}^{f} \alpha_{6i} \Delta INTRP_{t-1} + \sum_{i=0}^{g} \alpha_{7i} \Delta TBR_{t-1} + \sum_{i=0}^{h} \alpha_{8i} \Delta INFL_{t-1} + \sum_{i=0}^{i} \alpha_{9i} ECBA_{t-1}$$

$$+ \Omega_i SMI_{t-1} + \Omega_i GDPPCGR + \Omega_i TOT_{t-1} + \Omega_i FDI_{t-1} + \Omega_i TRADEOPEN_{t-1} + \Omega_i INTRP_{t-1}$$

$$+ \Omega_i TBR_{t-1} + \Omega_i INFL_{t-1} + \Omega_i ECBA_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

- The parameters Ωi, where i= 1, 2, 3,4,5,6,7,8,9 are the corresponding long run multipliers, where the parameters α1 – α9 are the short-run dynamic coefficients of the underlying ARDL model.

Unit Root Test

Stationarity of all variables in levels					Stationarity of all variables in 1st Difference			
	ADF		PP		ADF		PP	
Variables	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend
LNSMI	-2.656 (0.092)	-0.827 (0.953)	-2.877 (0.059)	-0.542 (0.976)	-4.172* (0.003)	-5.709* (0.000)	-4.203* (0.003)	-6.299* (0.000)
GDPPCGR	-3.906* (0.005)	3.878** (0.025)	-3.837* (0.006)	-3.813** (0.028)	-	-	-	-
ECBA	-1.472 (0.534)	-2.389 (0.378)	-1.474 (0.534)	-2.481 (0.335)	-6.258* (0.000)	-6.129* (0.000)	-6.406 (0.000)	-6.273 (0.000)
FDI	-4.184** (0.012)	-4.003* (0.004)	-3.991** (0.019)	-3.906* (0.005)	-	-	-	-
INFL	-2.113 (0.241)	-2.849 (0.194)	-2.684 (0.088)	-2.878 (0.182)	-3.26** (0.029)	-4.03** (0.021)	-6.716* (0.000)	-6.322* (0.000)
INTSP	-3.128 (0.034)	-3.033 (0.140)	-3.900 (0.005)	-2.773 (0.217)	-6.154* (0.000)	-6.518* (0.000)	-7.035* (0.000)	-10.73* (0.000)
TBR	-2.73*** (0.081)	-3.57** (0.049)	-2.70*** (0.085)	-3.41*** (0.069)	-	-	-	-
TOT	-1.334 (0.602)	-3.093 (0.125)	-1.384 (0.578)	-3.148 (0.112)	-6.015* (0.000)	-5.887* (0.000)	-6.391* (0.000)	-6.23* (0.000)
TRADEOPEN	-3.111 (0.035)	-2.898 (0.176)	-3.028 (0.043)	-2.752 (0.224)	-7.027* (0.000)	-7.241* (0.000)	-11.26* (0.000)	-11.26* (0.000)

Source: Author's calculation using E-view 9 (2020)
Note: *statistically stationary at 1%, **statistically stationary at 5% and *** statistically significant at 10%.

Result of Bound Test Approach to Co-integration

Level of Significance $(\alpha\%)$	Critical value		F-calculated / Computed F-statistic
	Lower bound I(0)	Upper bound I(1)	
10	1.95	3.06	**2.600685**
5	**2.22**	**3.39**	
2.5	2.48	3.7	
1	2.79	4.1	

Source: Author's calculation with E-view 9 (2020)

Estimated Short-run Dynamics

Estimated Short Run Dynamics Results for the Selected ARDL Model (1, 2, 2, 2, 2, 1, 2, 2, 0)

Regressand: SMI				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ECBA)	7.423382	4.108029	1.807042	0.1042
D(ECBA(-1))	-11.576765	5.107209	-2.266750	0.0496
D(FDI)	0.025641	0.053977	0.475028	0.6461
D(FDI(-1))	0.096177	0.050597	1.900830	0.0898
D(GDPPCGR)	-0.001795	0.020190	-0.088899	0.9311
D(INFL)	0.002634	0.004058	0.649007	0.5325
D(INTSP)	-0.017992	0.052085	-0.345423	0.7377
D(INTSP(-1))	-0.109710	0.050497	-2.172620	0.0579
D(TBR)	-0.003088	0.015374	-0.200851	0.8453
D(TBR(-1))	-0.034073	0.019083	-1.785561	0.1078
D(TOT)	0.005609	0.002404	2.332938	0.0445
D(TOT(-1))	-0.006229	0.002556	-2.437340	0.0375
D(TROP)	0.018117	0.009555	1.896063	0.0905
D(TROP(-1))	0.015508	0.010741	1.443872	0.1827
CointEq(-1)	-0.136890	0.082583	-1.657596	0.1318
Cointeq = LNSMI - (-4.1654*ECBA + 0.0976*FDI + 0.1218*GDPPCGR +				
0.0192*INFL + 0.4782*INTSP + 0.1391*TBR + 0.0198*TOT + 0.0028				
*TROP + 4.4613)				

Panel B: Goodness-of-Fit-measures		
R^2	0.995782	
Adjusted R^2	0.985471	
F-statistic	96.57467	
Prob(F-statistic)	0.000000	
Durbin-Watson stat	2.973569	
Panel C: Diagnostic Statistical Checking		
	Test Statistics	**Probability**
Breusch- Godfrey serial correlation LM test	2.139788	0.3430
Breusch-Pagan-Godfrey test for heteroskedasticity	9.771254	0.5511
Jacque-Bera normality test	1.097866	0.5776
ARCH test for heteroscedasticity	0.892069	0.3449
Ramsey RESET specification test	0.530133	0.4873

Source: Author's calculation using E-view 9 (2020)

Estimates of long-run Granger causality based on TYDL approach

	Sources of causality								
ependent variable	**Ln SMI**	**GDPPCGR**	**TOT**	**FDI**	**TROP**	**INTSP**	**TBR**	**INFL**	**ECBA**
LNSMI	-	3.7692	2.8014	4.9435***	0.7775	0.1970	1.3383	2.0873	0.3380
DPPCGR	0.0399	-	1.2781	2.9219	3.5009	2.0137	4.4722	0.7761	0.9904
TOT	1.4458	0.3839	-	0.1590	1.7109	0.0600	1.9789	0.4953	0.1929
FDI	0.0354	0.5480	0.8507	-	2.0519	5.0559***	3.5025	0.7198	1.7233
TROP	0.8625	2.0330	0.3605	0.3201	-	3.5162	0.5760	0.5369	1.4440
INTSP	0.4349	3.2851	1.0193	1.3429	1.3878	-	0.7606	1.2207	3.2764
TBR	3.8659	0.3628	4.9797	0.4273	1.7026	0.0600	-	0.4953	0.1929
INFL	1.9032	6.6322**	4.5331	5.5191	0.4635	1.3101	6.7622**	-	4.0906
ECBA	1.5847	0.8915	2.7111	0.6418	0.2689	0.1078	3.5566	0.0932	-

Notes: ** and *** indicates that significance at 5% and 10% respectively.

Discussion of results

Unit Root testing

- TBR, FDI and GDPPCGR are stationary at levels, while the other variables (lnSMI, TOT, INTSP, TRADEOPEN, INFL and ECBA became stationary after the first differencing both under ADF and PP options.

- This depicts that the series have a combination of I (0) and I (1) which makes ARDL appropriate for estimation

- **Co-integration test and estimation of long-run relationship**
- The boundary test method was used to determine the existence of a long-term relationship between the variables of interest by conducting an F-test for the coefficients of the lagged-level variables of the model
- Pesaran and Shin (1995, 1998) suggested two critical values to evaluate the relationship (lower and upper bound) due to the limitations of the traditional Wald-test F-statistic

- The computed F-test is then compared with the critical values provided by Pesaran and Shin (1995, 1998) for the hypothesis test

- If the calculated F-statistic is less than the lower bound value, there is no long run association. On the contrary, the existence of a long-term relationship between the variables is suggested if the calculated F-statistics exceed the upper limit value

- There is an inconclusive long-run relation between the variables if the calculated F- statistics are between the lower bound and the upper bound.

- However, the error correction term would be a useful way to establish co-integration in the inconclusive cases after Kremers, Ercisson and Dolado (1992); Bannerjee, Dolado & Mestre (1998)

- The measured F-statistic (2.60) falls between the lower limit of (2.22) and the upper limit of (3.39) at a significant level of 5%. Therefore, there is an inconclusive long-run relationship between the variables.

- In the inconclusive cases, following Kremers, Ercission and Dolado (1992); Bannerjee, Dolado & Mestre (1998), the error correction term would be a useful means to establish cointegration.

- The error correction term (ECM) although negative, is not significant at 1% level, a pre-condition for long-run relationship.

- In essence, there exists no long-run relationship among the variables. As such, it is only the short-run dynamics that is estimated.

- The result reveals that the estimated coefficients of ECBA (-1), FDI (-1), INTRSP (-1), TRADEOPEN (-1), TOT and TOT (-) have a significant effect on SMI in Nigeria. CBA (-1) is at 5% significant level, FDI (-1) at 10% significant level, TRADEOPEN at 10% significant level, INTRSP (-1) at 10% significant level, TOT and TOT (-1) at 5% significant level.
- Central Bank Autonomy has a delayed negative relationship with Stock Market Index.

- Foreign Direct Investment one year lag has a positive relationship with Stock Market Index at 10% significant level.
- The terms of trade has a positive significant relationship with Stock Market Index, however, the one year lag of term of trade, has a negative but statistically significant impact on Stock Market Index all at 5% significant level.
- Trade openness only affected the Stock Market Index at a year lag. Interest rate spread has a negative significant relationship with Stock Market Index

- All other variables do not impact Stock Market Index in the short-run.
- About 99 per cent of the variation in stock market index is explained by explanatory variables included in the model.
- R-squared at 98.5 per cent is statistically significant at 1% level of significance implying that the model fits well since the explanatory variables are jointly significant at 1% level of significance.
- The model also passes all the other diagnostic tests.

- **Granger Causality Test (TYDL Approach)**
- Foreign Direct investment granger causes stock market index.
- Interest rate spread granger causes Foreign Direct Investment.
- The Gross domestic product per capital granger causes inflation
- Treasury bills rate (short term interest rate) granger causes inflation

Conclusion and Policy Recommendation

- Considering the importance of the stock market in the development of a nation, efforts should be made by the government to stimulate the macroeconomic variables to support the stock market in capital generation for economic growth and sustainability
- Firstly, the bank should improve the methodology used in forecasting inflation; this should be made more dynamic and all-encompassing and should be made transparent.
- Secondly, it should make use of monetary policy which is within the purview of the bank to enhance the diversification efforts of the Federal Government. Diversifying the economic is a sine qua non for economic prosperity of the economy
- The role that stock markets have to play in addressing the sustainability challenge, namely providing mechanisms for funding future sustainability needs could better be enhanced if the information required to spur such steady improvement is enhanced by monetary policy that are free from political pressure

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