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# A Co-integration Analysis of Trade Openness, Financial Deepening and Infrastructure in Nigeria

Eke O. Patrick[1*]
[1]*Department of Banking & Finance, Lagos State University, Ojo, Lagos, Nigeria;*

***Abstract***
*This paper employed an augmented Toda-Yamamoto multivariate technique to examine the co-integrating relationship between trade openness and financial deepening in Nigeria, with complimentary influence on infrastructure, inflation, bank competitiveness, and exchange rate. The study obtained data from the Central Bank of Nigeria and the World Bank from 1980 to 2017. The study upholds the growth-led finance hypothesis, while the reverse causality is not; trade openness drives infrastructure. Secondly, 'Romer hypothesis' is upheld, that is, openness is an antidote to long-term inflation. Government should promote full trade and financial sector liberalization, commit resources to financial and trade institutions development and infrastructural development.*

***Keywords****: Financial deepening, Nigeria, Trade openness*
***JEL Code****: G20, O55, F36*

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## I. Introduction

There is growing concern among policy makers, global economic and financial institutions, and investors on matters of internationalization of global economies. The proposition is that the extent of trade openness may create more and wider platform for demand for finance in the domestic economy and the external sector, towards accelerated economic growth, and on-towards a virtuous cycle of trade openness-finance linkage[1]. In 2008, the World Bank and the Organization of Economic Cooperation and Development (OECD) sought to establish conditions precedent to consistent economic advancement in 13 selected global leading economies, most of which were of East-Asia region since 1945. The findings uncovered potently that openness to trade was among five pragmatic approaches to economic convergence. Effects of trade openness have been noted to amount to substantial proportion of the GDP in many of the resource-endowed economies. In a forward and backward sectoral economic linkage framework, a functional financial system remains supply-source to growth[2,3].

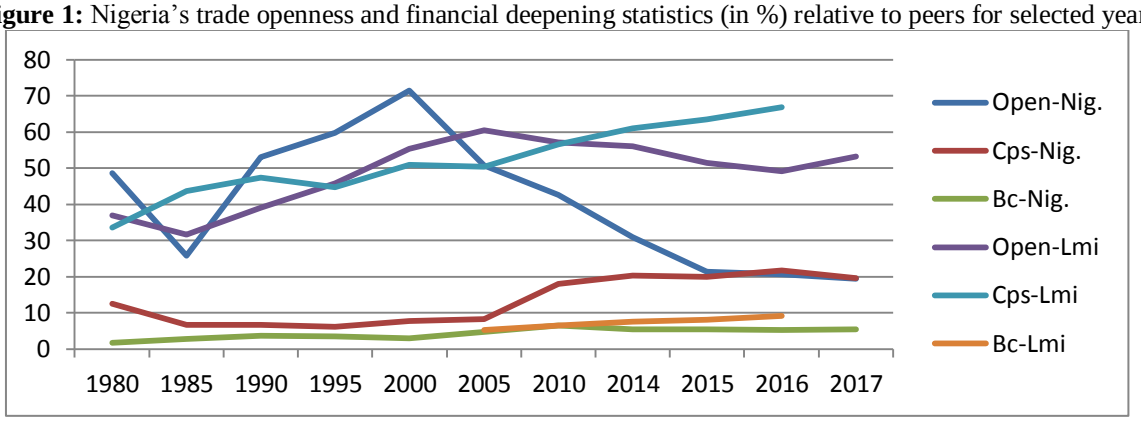
Given abundant and diverse resources endowment across countries and regions, the economics of openness to trade and financial development may have been under-examined at single country-level studies. Rather cross-country and cross- regional studies are common in the literature. Country-level study could inform how openness to trade would be a veritable platform for the exploitation, manufacturing and development of the vast African natural resources[4,5], as growth-retarding macroeconomic variables such as poor infrastructure, inflation and unemployment are becoming intractable in African economies. In many countries the financial and economic performances are symbiotic. However, many developing economies are trapped in vicious cycle of poor financial performance and poor economic performance nexus [6,7]. On the linkage between the two variables, broad, deep and diverse channels of relationship are being examined through different methods on how openness to trade can unlock the potentials of financial deepening from demand and supply angles and otherwise.

Recently, [8]examined the short and long-term impact of trade openness on financial development, using recently introduced trade openness index in a panel setting in 43 countries from 1996 to 2014. The study revealed that trade openness is associated with financial development in the long term, while the impact may be negative in the short term. The interrelationship between financial development and economic growth in the context of trade openness in 21 sub-Sahara African economies from 1965-2008, was examined in [7], using different dimensions of financial development. The study [7] , found limited evidence for finance led trade openness, only in 5 out of the 21 economies, that is, Burundi, Malawi, Niger, Senegal, and Sudan. Earlier, [9] find same evidence for Gabon, Kenya, Nigeria and Sierra Leone that are part of [7]sample. In contrast, in [7], the null hypothesis of trade openness led financial development hypothesis was not rejected only in Gabon, which is in line with the findings in this paper for Nigeria, when finance depth is examined from credit to private sector. Examined from liquidity perspective *M2r* and *M3r* and trade openness have neutral relationships.

Similarly, [10]examine the argument whether financial development and trade openness are complements or substitutes. The paper used pooled mean group (PMG) estimator in an autoregressive distributive lag (ARDL) of [11] to study the long and short-run relationships between financial development and trade openness in 87 OECD and non-OECD countries from 1960-2005. The paper finds both international trade and financial development as long-run growth enhancing, while in the short-run, it is of negative effects. However, the disaggregated study into OECD and non-OECD economies reveals that the null hypothesis for non-OECD is not rejected, while it is rejected in OECD economies.

A common point of discussion in the literature that is attributed to the success of openness-finance nexus in diverse economies is that both policy variables (finance and trade openness) provide the capacity and broader insights for nations to harness gains of globalization, human capital development, governance effectiveness and quality infrastructure[7,12]. These factors have in turn facilitated trade and global financial system [12]. However, for Nigeria, despite policies on economic liberalization and integration into the global market which was accelerated in 1986 with the structural adjustment programme, Nigeria's account on trade and financial development do not seem encouraging when its outcomes are compared to average of her peers in the World Bank low-middle income *(LMI)* grouping as represented in figure **1** below from 2005 to 2017. Presented in table **1** below are the trends showing trade openness (open) and credit to private sector *(Cps)* and bank competitiveness *(Bc)* for Nigeria relative to global low-middle income *(LMI)* peers, extracted from the World Bank data-base from 1980 to 2017. While Nigeria's record on financial development indicators was below her global competitors from 1980s, her openness to trade started to decline from 70 percent in year 2000 to 20 percent in 2015 relative to peers, then remaining at same level through to 2017.

**Figure 1:** Nigeria's trade openness and financial deepening statistics (in %) relative to peers for selected years




**Sources:** *the author. Data was sourced from the Central Bank of Nigeria statistical Bulletins from 2007 to 2017. LMI means Lower-middle income countries, which Nigeria is currently ranked by the World Bank; sourced from the World Development Indicators at: data.worldbank.org.* – indicates not available

While much work is ongoing on the wider context of financial development and trade openness, this study is limited to financial depth aspect of financial development, that is, financial liquidity and credit to firms effects[12] (Levine, 2004). Being a dynamic study, the explanatory variables studied include openness to trade *(Open)*, narrow money *(M2)*, broad money *(M3)*, bank competitiveness *(Bc)*, level of infrastructure *(Infra)*, measured by grossed fixed capital formation ratio, and inflation rate *(infl)*. Unique to this country-specific study, on Nigeria, a top largest economy in Africa is the adoption of an augmented Toda-Yamamoto technique and use of two different measures of financial deepening to further the trade openness-finance growth nexus debate.

The two different measures of financial deepening are- the liquidity approach- by narrow money (M2) ratio to Gdp, and broad money (M3) ratio to Gdp, while credit approach is by credit to private sector (Cps) ratio to Gdp from 1980 to 2017. The study also departs from previous papers by including some other measures of financial deepening peculiar to financial system challenged developing economies like Nigeria, such as ratio of bank branches, exchange rate, and inflation rate with the argument that openness to trade may moderate the challenges of liquidity, credit to private sector, financial competitiveness, and exchange rate depreciation.

Given the financial system challenges and the openness-financial development literature analysed at the introductory section, this study seeks to expand the country-level literature by examining the following research questions: to what extent does openness to trade impact financial deepening in Nigeria? and why would there exist relationship between trade openness, infrastructure and inflation in Nigeria. The hypotheses proposed thereon are that openness to trade does not significantly impact financial deepening in Nigeria; secondly, openness to trade does not significantly impact infrastructure in Nigeria; and finally trade openness does not significantly impact inflation in Nigeria.

## II. Review of relevant literature

The argument on international trade openness-growth nexus is pervasive; centers on exploitation of comparative advantage of economies, and how trade policies or its outcomes promote efficiency and competitiveness, economic growth and economic welfare, and by extension financial system development[13,14,8]. To strengthen the world trade integration and globalization, global economic policy making bodies such as the World Trade Organization (WTO) are becoming more dominant over domestic trade policies in developing countries, towards braking trade barrier. Their slogan has been that trade openness remains key to developing countries' quest to catch-up. Lately, complimentary research provides substantial evidence on country and cross-country positive nexus between trade openness and economic growth [15,10].

Toward effective national economic planning, Harrod, Domar, and Kaldor, demonstrates the importance of investment and foreign multiplier as co-determinants of long-run economic growth[16]. Particularly, in developing economies, given right reforms, right structure and institutions, openness to trade could promote much needed knowledge, technological transfer and technical progress [17], as they are disadvantaged in long-term industrial development competitiveness. For instance, policies that hinder capital flows across countries are often promoted by Central Banks in some economies to shield their capital markets, which freer trade pursuit, would decelerate.

Developing countries are characterized by small-sized domestic finance market that has largely contributed to low inducement to invest in capital goods, of which openness to global trade may widen the market, improve income and savings quality and assist to decelerate investment apathy. Limited openness to trade policies in developing countries is being attributed to their vicious cycle of poverty and international income inequality relative to advanced economies[18].

Plethora of evidences of how openness to trade can transform financial development through diverse demand and supply channels is reviewed in[8]. On the supply side, openness to trade could limit the adverse effects of group interest of a bank-based monopolistic financial market in African economies, by encouraging the development of diverse financial and quasi-financial institutions and products for competitiveness[19]. Furthermore, by trade openness allied institutions such as the telecommunication can help open up the financial market and deepen access to finance, particularly in the area of digital finance. On demand side, trade openness can create credit finance in products and services that may meet the interest of firms that would further deepen the financial system.

As globalization instrument, trade openness pursuit for financial deepening may similarly promote financial inclusiveness and assist in reduction in income inequality gap. In a comparative study of India and Brazil, [20]reveals that trade openness increases regional income inequality in India relative to Brazil. The underlying factor attributed is that trade encourages disparity of economic activities in Brazil than in India. In the review of openness and income inequality in both developed and other developing economies [21]found that openness has both positive and negative effects on inequality. Trade openness tends to narrow inequality among developing countries relative to the developed economies, while its impact on income inequality within developing economies is unclear.

**Empirical evidence**

The growth of evidence of economic and financial variables' nexus with trade openness in the literature is on the rise. In a panel granger-causality test study in eight countries in the West African Economic and Monetary Union (WAEMU) [22] examine the linkage between trade openness, financial depth, and economic growth from 1992 to 2013. Evidence from the study reveals that unidirectional causality runs from financial deepening to economic growth through trade openness. In a close study, [23] used monthly data in a structural VAR framework to examine the link between trade openness and monetary policy in Ghana from 2002 to 2017. The outcome reveals that trade openness aids the effectiveness of monetary policy to reduce inflation in Ghana. Furthermore, [24]examine how income level responds to monetary policy, exchange rate and trade openness in India. The study finds positive impact of trade openness on income and interest rate in the short-run, while no long-run impact on income was found. On openness-inflation nexus, [25]tested the Romer hypothesis[26], on the influence of trade openness on inflation in Pakistan from 1976 to 2010. The study's outcome however reveals that positive relationship existed between trade openness and inflation in Pakistan. Similarly, [27]examined the impact of trade openness on inflation in Thailand using [28] co-integration. The study found that the 1993 Romer hypothesis is upheld in the Thailand case.

## III. Theoretical Framework and Methodology

**Theoretical framework**

This study adopts an eclectic theoretical framework, using the Keynesians investment theory, the Kendol export-led growth and the Mundell-Flaming balance of payment IS-LM framework. Openness to trade aids both trade and capital flows across borders. [29] illustrates a Mundell-Flaming model that introduces balance

of payment equation into the standard IS-LM framework. The current account part of the balance of payment equation is presented implicitly as:

$$X\text{-}M = NX(\varepsilon, Y, Y^f) \quad (1)$$

Where $\varepsilon$ is the real exchange rate, $Y$ is domestic aggregate income, and $Y^f$ is global income. The assumption is that net-export *(NX)* would be boosted as ε increases, if foreign goods would be relatively expensive, and also, given that $Y$ and $Yf$ are expected to increase simultaneously. Micro-level consumption preference is held constant, since increase in $Y$ in developing economies may have positive and negative effects through its impact on increased consumption and imports respectively[29] . Introducing the IS into the framework and recognizing the impact of $\varepsilon$ and $Y^f$ in the current account, the model equation becomes:

$$Y = E(Y, r, G, \varepsilon, Y^f) \quad (2)$$

Where $G$ is government expenditure. Given that the behavior of domestic and foreign interest rates, $r$ and $rf$ impact the financial system, $r$ might respond to balance of payment situation via capital and current accounts, then the monetary policy rule is introduced as:

$$M/P = L(r,Y), \qquad L_r < 0; \quad L_Y > 0 \quad (3)$$

Since in an open trade economy, balanced current account may not be optimal, the capital account section would depend on the real interest differentials between the home and world interest rate, i.e. $r–rf$. Incorporating the capital account *(CA)*, in an imperfectly capital mobility economy, the current account will assume the function *CA (r-rf)*, and then the balance of payment equation becomes:

$$NX(\varepsilon, Y, Yf) + CA(r - rf) = 0 \quad (4)$$

**Data issues**

The study employed time-series secondary data, obtained from the Central Bank of Nigeria Statistical Bulletin and World Bank's World Development indicators (WDI) database. The data spans 38 years from 1980 to 2017. In terms of population size (Nigeria currently ranks as the seventh most populated country in the World), in trade and economic size (Africa's largest economy) and political influence in the African continental free trade area (AfCFTA), evidence from the Nigeria's study may summarize Africa's socio-economic phenomena. Table **1** below presents the description of types and sources of data employed in the study.

**Table 1**: Variable descriptions, sources and justifications

| Variable description | Source/Measurement/Proxies | Literature justification |
|---|---|---|
| M2r= Money supply ratio | Secondary/Central Bank of Nigeria Statistical Bureau/ Broad money relative to GDP | [23,25,24] |
| M3r= Money supply | Secondary/Central Bank of Nigeria Statistical Bureau/ M2 plus long term deposits relative to GDP | [23,25,24] |
| CPS = Credit to private sector | Secondary/ Central Bank of Nigeria Statistical Bureau; | [30] |
| Open= export plus import relative to GDP | Secondary/ Central Bank of Nigeria statistical bulletin/maximum | [22,25] |
| Exr= Exchange rate | Secondary/ Central Bank of Nigeria Statistical Bulletin/ Average annual | [25,31] |
| Bc= Bank Competitiveness ratio | Secondary/World Bank/Commercial bank branch per 100,000 adults | [32, 30] |
| Infra=Infrastructure | Secondary/ Gross fixed capital formation/ Central Bank of Nigeria Statistical Bulletin | [33] |
| Infl= inflation rate | Secondary/Central Bank of Nigeria/ | [25,34] |

**Sources**: Compiled by the author

**Estimation technique**

A dynamic relationship between trade openness and financial deepening is assumed, explored via an augmented Toda-Yamamoto (ATY) technique. The technique [35]discusses long run regression, by extending granger-causality methodology to handle causal relation models in a VAR environment involving non-uniform level of stationarity. The summarized specification of the original[35] framework for $Y_t$ and $X_t$ series stated with panel notation are presented below:

$$Y_t = a + \sum_{j=1}^{m+d} \phi_j Y_{t-j} + \sum_{k=1}^{n+d} \varpi_k X_{t-j} + \varepsilon_{Yt} \quad (5)$$

$$X_t = a + \sum_{j=1}^{m+d} \varphi_j X_{t-1} + \sum_{k=1}^{n+d} \delta_k Y_{t-1} + \varepsilon_{Xt} \quad (6)$$

Where d represents maximum order of integration of the variable in the system, m and n are optimal lag of $Y_t$ and $X_t$. The random error $\varepsilon$ is assumed white noised. This study extends the *TY* dynamic long run form by introducing short run innovation. The model adopts modified Wald test, whose statistics for *Y* equation is presented below:

$$F = \frac{(Rss_{RY} - Rss_{UY})/K}{Rss_{UY}/(N-K)} \quad (7)$$

Where *K* represents the number of estimated coefficient. Using the F-test and Chi-squared statistics, the null hypothesis of no co-integration relationship is defined as: $H_0 = \delta_1 = \delta_2 = 0$ against alternative hypothesis that $H1 \neq \delta_1 \neq \delta_2 \neq 0$ of the presence of co-integration.

**Model specification**

The model underlying this study is presented implicitly in linear model form as follows:

$$Y_t = f(\alpha_1, X_{1t}^{\beta_1}, X_{2t}^{\beta_2}, X_{3t}^{\beta_3}, \ldots, \varepsilon_t) \quad (8)$$

Where $Y_t$ stand for financial deepening, comprised of money supply ratio to Gdp *(M2r)* and credit finance to private sector *(cps)* studied independently; $X_1$ is openness *(Open)*, and $X_2$ is exchange rate *(Exr)*; $X_3$, bank competitiveness *(Bc)*, $X_4$ is physical infrastructure *(infra)*, and $X_5$ is inflation rate *(Infl)* a substitute for nominal interest, by Fischer's rule [36,37]. The implicit form is further presented as follows:

$$(M2r_t, M3r, Cps_t) = f(Open_t, Exr_t, Bc_t, Infra_t, Infl_t) \quad (9)$$
$$\qquad\qquad +\quad -\quad +\quad +\quad -$$

Other variables critical to openness-finance nexus in the short and long-terms are governance effectiveness and quality of legal institution, which are not treated for data limitation. The signs underneath are the *a priori* expectations. In explicit form, and by applying the log transformation process on equation **9**, the model becomes:

$$InM2r_t, InM3r_t, InCps_t = \alpha_1 + \theta_1 InOpen_{1t} + \delta_2 InExr_{2t} + \xi_3 InBc_{3t} + \beta_4 InInfra_{4t} + \gamma_5 InInfl_{5t} + \varepsilon_t \quad (10)$$

Therefore, in dynamic structure form the study looks forward to the powers of trade openness *(Open)*, exchange rate (*Exr*), bank competitiveness *(bc)*, physical infrastructure *(Infra)*, inflation rate (*infr)*, to impact money supply ratio *(M2r)* and credit to private sector *(Cps)*. Following [38]categorization this study adopts financial deepening as measure of financial development, due to its liquidity effects, and substitute for economic growth. In line with dynamism of variable relations, this study treats the seven variables as endogenous, as presented in equations 11 to 18 below. In explicit form, following [39]on the dynamic linkage of Global hedged funds and traditional financial assets, the dynamic multivariate panel Granger-VAR system is presented as follows in equations 11 to 18:

$$\Delta M2r_t = \alpha_1 + \sum_{j=1}^{P} \theta_{1j} \Delta Open_{t-j} + \sum_{j=1}^{P} \delta_{1j} \Delta Exr_{t-j} + \sum_{j=1}^{P} \psi_{1j} \Delta M2r_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{1j} \Delta Cps_{t-j} + \varepsilon_{1t}, \quad (11)$$

$$\Delta M3r_t = \alpha_2 + \sum_{j=1}^{P} \theta_{2j} \Delta Open_{t-j} + \sum_{j=1}^{P} \delta_{2j} \Delta Exr_{t-j} + \sum_{j=1}^{P} \varsigma_{2j} \Delta M3r_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{2j} \Delta Cps_{t-j} + \varepsilon_{2t}, \quad (12)$$

$$\Delta Cps_t = \alpha_3 + \sum_{j=1}^{P} \theta_{3j} \Delta Open_{t-j} + \sum_{j=1}^{P} \delta_{3j} \Delta Exr_{t-j} + \sum_{j=1}^{P} \gamma_{3j} \Delta Infra_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{3j} \Delta Cps_{t-j} + \varepsilon_{3t}, \quad (13)$$

$$\Delta Open_t = \alpha_4 + \sum_{j=1}^{P} \theta_{4j} \Delta Open_{t-j} + \sum_{j=1}^{P} \psi_{4j} \Delta M2r_{t-j} + \sum_{j=1}^{P} \delta_{4j} \Delta Exr_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{4j} \Delta Cps_{t-j} + \varepsilon_{4t}, \quad (14)$$

$$\Delta Exr_t = \alpha_5 + \sum_{j=1}^{P} \theta_{5j} \Delta Open_{t-j} + \sum_{j=1}^{P} \psi_{5j} \Delta M2r_{t-j} + \sum_{j=1}^{P} \delta_{5j} \Delta Exr_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{5j} \Delta Cps_{t-j} + \varepsilon_{5t}, \quad (15)$$

$$\Delta Bc_t = \alpha_6 + \sum_{j=1}^{P} \theta_{6j} \Delta Open_{t-j} + \sum_{j=1}^{P} \psi_{6j} \Delta M2r_{t-j} + \sum_{j=1}^{P} \xi_{6j} \Delta Bc_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{6j} \Delta Cps_{t-j} + \varepsilon_{6t}, \quad (16)$$

$$\Delta Infra_t = \alpha_7 + \sum_{j=1}^{P} \theta_{7j} \Delta Open_{t-j} + \sum_{j=1}^{P} \theta_{7j} \Delta M\ 2r_{t-j} + \sum_{j=1}^{P} \gamma_{7j} \Delta Infra_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{7j} \Delta Cps_{t-j} + \varepsilon_{7t}, \quad (17)$$

$$\Delta Infl_t = \alpha_8 + \sum_{j=1}^{P} \theta_{8j} \Delta Open_{t-j} + \sum_{j=1}^{P} \theta_{8j} \Delta M\ 2r_{t-j} + \sum_{j=1}^{P} \beta_{8j} \Delta Infl_{t-j} + \ldots + \sum_{j=1}^{P} \phi_{8j} \Delta Cps_{t-j} + \varepsilon_{8t}, \quad (18)$$

Where: $\theta, \varsigma, \delta, \psi, \phi, \xi, \beta, and\ \gamma$ are unknown parameters; $\alpha_{1-8}$ are constant terms; $\varepsilon_t$ is the residual, white noise (idiosyncratic) compliant for each equation. In addition, the VECM framework that allows for multiple co-integrating vectors, with each explanatory variable bearing its *speed-of-adjustment* parameter can be represented as:

$$\Delta Y_t = \alpha + \sum_{1=i}^{p} \Gamma_i \Delta Y_{t-i} + \Pi e_{t-i} + \varepsilon_t \quad (19)$$

$$\Gamma = \tau\beta' \quad (20)$$

Where *Y* represents vector of variables listed in 11-18; $\tau$ represents a matrix of speed of adjustment parameters, $\beta$ represents matrix of co-integrating vectors, $\varepsilon$ is vector of error terms.

## IV. Results and Implication of Findings

**Time series analysis**

**Unit root test**

Presented below in table **2** is the unit root test statistics. Three variables- the *lm2r, lcps,* and *linfl* are level stationary while *lopenness, linfra, lexrt,* and *linfra* are first differenced stationary. The *lm3r* series produce mixed result as the Augmented Dickey-Fuller (ADF) technique reveals it as level variable, while the Phillips-Perron (PP) reveals it as first difference variable. The non-uniform stationary properties of the variables studied suggest the use TY methodology for long-run co-integration and regression analysis.

**Table 2:** Unit root

| Methods | Augmented Dickey-Fuller Test | | | Phillips-Perron Test | | | |
|---|---|---|---|---|---|---|---|
| Variables | 1Test statistics | Prob. value | Stationary@ | 1Test statistics | Prob. value | Stationary @ | Remark |
| Lmr2 | -7.0011 | 0.0000*** | I(0) | -6.1790 | 0.0000*** | I(0) | stationary |
| Lm3r | -3.5368 | 0.0000** | I(0) | -8.1575 | 0.0000*** | I(1) | Mixed |
| Lcps | -3.5407 | 0.0000*** | I(0) | -3.5565 | 0.0000*** | I(0) | stationary |
| Lopenness | -7.8425 | 0.0000*** | I(1) | -7.8425 | 0.0000*** | I(1) | differenced |
| Linfra | -6.2946 | 0.0000*** | I(1) | -6.2939 | 0.0000*** | I(1) | differenced |
| Linfl | -3.7824 | 0.0289** | I(0) | -3.6210 | 0.0416** | I(0) | stationary |
| Lexr | -6.3532 | 0.0000*** | I(1) | -6.3620 | 0.0000*** | I(1) | Differenced |
| Lbc | -5.2813 | 0.0007*** | I(1) | -5.2963 | 0.0006*** | I(1) | Differenced |

**Source:** By the researcher. *,**,*** denotes 0.1, 0.05, and 0.01 levels of significance respectively. [1]Test is for constant and trend models.

**Summary statistics**

One significant item in the summary statistics presented in table **3** is the Jarque-Bera test statistics that reveals that all eight variables- M2r,M3r, Cps, Open, Infra, Infl, Exrt, and Bc are normally distributed, which indicates that the study fails to reject the null hypothesis of normal distribution of each of the series. It implies that the inferential t-statistics and F- statistics thereof may be valid.

**Table 3**: Summary table

| Statistics | M2r | M3r | Cps | Open | Infra | Infl | Exr | Bc |
|---|---|---|---|---|---|---|---|---|
| Mean | 14.9566 | 24.1732 | 11.2109 | 49.4292 | 19.4433 | 19.2355 | 86.1830 | 4.0137 |
| Median | 12.6931 | 21.9260 | 8.2093 | 51.7710 | 6.3115 | 12.5500 | 84.5500 | 3.6925 |
| Max. | 30.4237 | 43.2600 | 23.0760 | 81.8130 | 85.7500 | 72.8000 | 305.000 | 6.5611 |
| Mini. | 9.1516 | 13.2310 | 5.9172 | 19.5340 | 2.0170 | 5.4000 | 0.5464 | 1.7656 |
| J. B. Stat. | 3.9460 | 0.2718 | 5.6215 | 3.9273 | 4.0651 | 3.5694 | 5.5902 | 0.5345 |
| Prob. value | 0.1390 | 0.8729 | 0.0602 | 0.1403 | 0.1310 | 0.1678 | 0.0611 | 0.7655 |
| Obser. | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 |

**Source:** By the author.

**Lag length order**

While the Schwarz criteria restricted the regression to lag order one, all the other criterion maximized the lag at two (2), hence lag order 2 informed the extent of restrictions used in the TY regression presented below in table **4**. Lag order 2 is therefore incorporated into the TY framework for the augmented short-run and long-run regression.

**Table 4**: Lag selection order

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -73.1600 | NA | 1.25e-08 | 4.5088 | 4.8607 | 4.6317 |
| 1 | 153.233 | 339.5908 | 1.65e-12 | -4.5129 | -1.3459* | -3.4076 |
| 2 | 236.730 | 88.1353* | 9.83e-13* | -5.5961* | 0.3860 | -3.5082* |

**Source:** By the author: where LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion. * denotes lag order selected by the criterion.

**Granger causality result**

The Granger-causality statistics is presented in table **5** below. Established in the vector autoregressive (VAR) framework, it provides preliminary investigation on the short-run relationships among the variables, and could assist to establish basis for variables' inclusion in the mode. In line with *a priori*, narrow money *(M2r)* and credit to private sector *(Cps)* significantly granger-causes trade openness, while the broad money *(M3r)* variable does not granger-cause trade openness in Nigeria. The formal result supports the well known finance-led growth hypothesis in Nigeria. More formally, bi-directional causal relations exist between trade openness and infrastructure *(Infra)*, which may provide evidence that in the Nigeria's case openness to trade and commerce cannot strive in the absence of infrastructures such as functional sea and airports, good roads network, security, etc. Similarly, in line with expectation of finance-growth nexus, credit to private sector *(Cps)* and infrastructure are bi-directionally causal; and exchange rate *(exr)*, and bank competitiveness *(Bc)* also granger-causes credit to private sector *(Cps)*.

**Table 5:** Pairwise Granger-causality tests @ lag 1

| Null hypothesis | Obser. | F. statistics | P. value |
|---|---|---|---|
| lopen does not Granger-cause lm2r | 37 | 0.0153 | 0.9021 |
| lm2r does not Granger-cause lopen | 37 | 3.0773 | 0.0884* |
| lopen does not Granger-cause lcps | 37 | 0.1191 | 0.7322 |
| lcps does not Granger-cause lopen | 37 | 4.3636 | 0.0443** |
| linfra does not Granger-cause lopen | 37 | 8.9974 | 0.0050*** |
| lopen does not Granger-cause linfra | 37 | 3.3685 | 0.0752* |
| linfra does not Granger-cause lcps | 37 | 5.4498 | 0.0256** |
| lcps does not Granger-cause linfra | 37 | 11.5187 | 0.0018*** |
| lexr does not Granger-cause lcps | 37 | 6.1342 | 0.0185** |
| lcps does not Granger-cause lexr | 37 | 0.0081 | 0.9288 |
| lbc does not Granger-cause lcps | 37 | 14.8079 | 0.0005*** |
| lcps does not Granger-cause lbc | 37 | 0.0477 | 0.8284 |
| lbc does not Granger-cause linfra | 37 | 5.6921 | 0.0228** |
| linfra does not Granger-cause lbc | 37 | 1.2046 | 0.2801 |
| lexr does not Granger-cause lm2r | 37 | 15.1167 | 0.0004*** |
| lm2r does not Granger-cause lexr | 37 | 0.0014 | 0.9707 |

Source: Computed by the author. *,**,*** indicates significant @ 0.1, 0.05 and 0.01 respectively.

**Regression results and analysis: Augmented Toda-Yamamoto**

**Diagnostic statistics: serial correlation test:** The model serial correlation test of the residual produces LM statistics of 36.1428, presented in table **6** below. In line with the null hypothesis of no serial correlation, the study using the p-value fails to reject the hypothesis that the model is free of serial correlation at the required P-Lag of 2.

**Table 6:** LM Serial correlation test

| Lag | Observation | LM Stat. | D.f | Probability |
|---|---|---|---|---|
| 1 | 37 | 83.1428 | 49 | 0.0017 |
| 2 | 37 | 36.6324 | 49 | 0.9039 |

**Source:** Computed by the author

**Residual heteroscedasticity test**

Presented in table **7** below is the residual heteroschedasticity test, no cross terms. The result, using the P-value suggests that the study fails to reject the null hypothesis which indicates that the residuals of the cross sections are homoschedastic.

**Table 7:** VAR residual heteroscedasticity test

| Observation | $\chi^2$ Stat. | D.f | Probability |
|---|---|---|---|
| 36 | 792.3751 | 784 | 0.4100 |

**Source:** By the author.

**Model stability test**

The test on the model stability reveals that the variables under study are centrally located within the unit circle of the autoregressive characteristic polynomial, which suggests absence of unit root. Hence, the condition for stability of the model for the study is meant. Complimenting this test is the short-run dynamic adjustment test. The negative short-term adjustment mechanism for each equation is significant, which indicates possible long-run equilibrium.

**Short-run (dynamic) effects**

The short and long term results are presented in Tables **8** and 9 below. In the short-run, all equations models produce the standard negative coefficients which reveal stability and convergence towards equilibrium within two years. Similarly, it indicates that the explanatories co-integrate with the dependent variable in the long-term equilibrium process. The exceptional adjustment rate value of above 100 percent speed recorded in the narrow money (*Lm2r*), credit-to-private sector *(Lcps)*, exchange rate (*Lexr*), infrastructure ratio *(linfra)* and inflation rate *(linfl)* is justified in the extant works of [40,41,42]. [41]reveal that the speed of adjustment process to equilibrium in a study on the demand for money in Fiji from 1970-2002 was 1.114 (-111.4 per cent). In a study on savings and investment relationship in Nigeria, [42]find that the speed of adjustment to equilibrium was -1.107 (-110.7 per cent). Similarly, [40] find that corporate bond issue equation has -1.009 speed of adjustment towards long-term equilibrium in thirteen (13) African economies.

**Table 8:** Short-run (dynamic) convergence results

| Dependent variable | Optimal lag order of explanatory variables | Coefficient: Short run residual | Std. error | Prob. | Outcome & Implication |
|---|---|---|---|---|---|
| Lm2r | 2 | -1.3478* | 0.6664 | 0.0613 | converge towards equilibrium |
| Lm3r | 2 | -0.9964 | 0.6932 | 0.1711 | converge towards equilibrium |
| Lcps | 2 | -1.3358*** | 0.3856 | 0.0035 | converge towards equilibrium |
| Lopen | 2 | -0.9701* | 0.5046 | 0.0737 | converge towards equilibrium |
| Lexr | 2 | -1.5816*** | 0.3177 | 0.0002 | converge towards equilibrium |
| Lbc | 2 | -0.8038* | 0.4534 | 0.0962 | converge towards equilibrium |
| Linfra | 2 | -1.5275*** | 0.3812 | 0.0011 | converge towards equilibrium |
| Linfl | 2 | -1.3269** | 0.4820 | 0.0148 | converge towards equilibrium |

**Source:** By the researcher. *, ** & *** denote 0.1, 0.05, 0.001 levels of significance respectively. The negative coefficient indicates convergence towards equilibrium that the joint influence of explanatory variables flow to the dependent variable in the long-term.

**Long-run causality results and analysis**

The Toda Yamamoto (TY) Granger-non causality long-run result is presented in table **10** below. Significantly *a priori* satisfied results were achieved at lag order 1. Unidirectional causality exists from trade openness to financial depth, while however the relationship between openness and liquidity is neutral. That is, openness to trade (*Open)*

positively and significantly drives financial deepening when measured by credit to private sector *(Cps)* (row 3); but does not significantly drives financial deepening and *vice- versa* when measured by liquidity, that is, narrow money *(M2r) (row1)* and broad money *(M3r) (row 2)*. It may imply that policy limitations to trade openness are having detrimental effects on financial depth when measured from liquidity perspective rather than credit to businesses in Nigeria. [9]also find that openness drives financial development only in Gabon out of 16 sub-Sahara African economies examined. Indeed in contract to trade openness and financial development potentials as revealed in many studies[43,44,19,7], evidences from studies on the link between trade openness and financial development in African economies have been unbalanced, particularly when trade openness stands as

substitute for growth and when it is complementary in the financial development-economic growth nexus enhancement[7,9,10].

In line with *a priori* openness to trade is found to significantly impact infrastructure ratio *(infra)* (row 5) and bank competitiveness *(bc) (row 8)* while the reverse causality were not achieved. Moreover, trade openness negatively and significantly impacts inflation rate *(infl) (row 7)* and exchange rate *(exr) (row 5)*. On the former, openness to trade could enhance improved trade infrastructures and allied economic infrastructures, such that the Nigerian current lackluste state of trade infrastructure may be transformed. In an open trading system investments in public transportation and port infrastructures would rapidly expand and be modernized. This process in-turn could transmit to more macroeconomic opportunities that would increase economic growth rate, leading to poverty reduction[45]. On the later, openness to trade, if pursued as policy trust would hold inflation down as cheaper commodities become available through competitiveness and entrepreneurship.

The outcome of negative trade openness- inflation nexus affirms the [26] hypothesis in Nigeria, that rising trade openness negatively impacts inflation. High and unstable inflationary regimes have been the concern of monetary authorities in Nigeria; and it transmits adverse social and economic consequences, particularly in the real sector of the economy, unhealthy to capital market growth, accentuating poverty and unemployment. Similarly, openness may improve exchange rate appreciation, particularly through export diversification strategy.

Finally, trade openness positively impacts bank competitiveness, another indicator of financial deepening in the VAR framework. It implies that openness to global trade may stimulate competitiveness can help to open the banking markets to varied players, instruments, products and technologies, particularly from advanced economies that may help deepen the financial system [32,30].

Thus, in response to the hypothesis tested, this study rejects the hypothesis that openness to trade does not significantly drive financial deepening in Nigeria in the short and long term. The complementary relationship of both variables is negated in the Nigerian case, which suggests weak financial deepening policies that could attract more external trade.

**Table 9:** Long-run causality result: augmented Toda-Yamamoto Granger (non-causality) approach @ lag 1.

| Null Hypothesis | Coeff. | Std error | X2 stat.(p.v) | F.stat. (p.v) | Causality flow? |
|---|---|---|---|---|---|
| lopen does not cause lm2r | 0.1822 | 0.1638 | 4.323(0.115) | 2.161(0.149) | no causality |
| lm2r does not cause lopen | -0.3377 | 0.4349 | 1.057(0.589) | 0.528(0.600) | |
| lopen does not cause lm3r | 0.0906 | 0.3160 | 3.484(0.17) | 1.74(0.208) | no causality |
| lm3r does not cause lopen | 0.4341 | 0.3657 | 2.717(0.257) | 1.358(0.287) | |
| lopen does not cause lcps | 0.1984 | 0.1317 | 10.360(0.00)*** | 5.180(0.019)** | yes: lopen→lcps |
| lcps does not cause lopen | 0.4455 | 0.3977 | 2.746(0.25) | 1.374(0.28) | |
| lopen does not cause lexr | -0.003 | 0.2711 | 6.243(0.004)*** | 3.122(0.073)* | yes: lopen→lexr |
| Lexr does not cause lopen | -0.184 | 0.1472 | 2.578(0.275) | 1.289(0.304) | |
| lopen does not cause linfra | 0.176 | 0.3609 | 7.637(0.002)*** | 3.818(0.045)** | yes: lopen→linfra |
| linfra does not cause lopen | -0.054 | 0.1475 | 1.663(0.23) | 3.4681(0.17) | |
| lopen does not cause linfl | -0.013 | 0.7019 | 5.605(0.061)** | 2.803(0.093)* | yes: lopen→linfl |
| linfl does not cause lopen | 0.058 | 0.0672 | 2.304(0.316) | 1.152(0.342) | |
| lopen does not cause lbc | 0.3200 | 0.0910 | 17.92(0.000)*** | 8.96(0.003)*** | yes: lopen→ lbc |
| lbc does not cause lopen | 1.0973 | 0.5361 | 4.194(0.122) | 2.096(0.157) | |

Source: Prepared by the author. * ,** and *** indicate 0.1, 0.05 and 0.01 levels of significance respectively; → denotes one-way causality/co-integration. Probability values (pv) are in parenthesis

**Long-Run Causality: Joint Statistics**

The Wald test result presented in Table **10** below reveals that aside from broad money *(M3r)* and infrastructure variables that are insignificant, the narrow money (*M2r)*, credit to private sector *(Cps)*, trade openness (Open), exchange rate *(exr)* and inflation rate (*infl)* equations are significant. The result suggests that primarily the long-term development of the *mr2, cps, open, exr, bc* and *infl* depends on respective models explanatory variables.

**Table 10:** Long-Run Causality Results: Joint Statistics Modified Wald Test

| Variables studied @ lag order P=2: lm2r, lm3r, lcps, lopen, lexr, linfra, linfl, lexr | $\chi^2$ Stat. | F. Stat. | P.value ($\chi^2$ Stat.) | P.value (F. Stat.) | Outcome: joint influence flow |
|---|---|---|---|---|---|
| Dependent variable: lm2r | 23.3047 | 1.9420 | 0.025** | 0.1124 | yes |
| Dependent variable: lm3r | 9.9563 | 1.6594 | 0.1265 | 0.1992 | no |
| Dependent variable: lcps | 59.646 | 4.9705 | 0.0000*** | 0.0023*** | yes |
| Dependent variable: lopen | 23.951 | 1.9959 | 0.1823 | 0.0837* | yes |
| Dependent variable: lexr | 65.427 | 5.4523 | 0.0000*** | 0.0014*** | yes |
| Dependent variable: linfra | 15.8731 | 1.3227 | 0.1971 | 0.3003 | no |
| Dependent variable: linfl | 5.2795 | 2.6397 | 0.0714* | 0.1042 | yes |

| | | | | | |
|---|---|---|---|---|---|
| Dependent variable: lbc | 38.7822 | 3.232 | 0.0000*** | 0.0184** | yes |

**Source:** By the author. * ,**and *** indicate 0.1, 0.05 and 0.01 levels of significance respectively

**Policy implications of findings**

The following implications are suggestive of the findings. Firstly, the notion that openness to trade and financial development comes naturally synonymous is not supported in this study, as the complementary bidirectional relationship of openness to trade and financial deepening[10,12] is not upheld. That financial deepening, using three financial indicators fail to drive trade openness, could be that financial and liquidity policies and products thereof are either inappropriate, few or non-existence to create sufficient liquidity and borrowing capacity needs to support trading. Secondly, it is found that openness to trade drives financial deepening when assessed from credit to private *(Cps)* sector. Perhaps, one of the greatest hindrances of private firms' growth in Nigeria is lack of financial capital for expansion and working capital for improved capacity utilization and employment[30]. Openness to trade may avail easy credit access to private firms to boost operations, capacities, and innovations.

Thirdly, trade openness is found to negatively drive exchange rate, which indicates that the current managed exchange rate policies of Nigerian government may be counter-productive, since it is not market driven and anti-free trade policy. This phenomenon may have made Nigeria become one of the most smuggling-prone economies globally[46]. Completely liberalized trading system may become the antidote to the depreciation of the exchange rate. The enormous potentials of openness to trade on all variables studied, one policy concern of Nigeria's trade history is the high preponderance to smuggling, which openness could resolve, of which the World Bank once estimated that the potential amount of goods smuggling through the Benin Republic border annually is $5 billion[47]. This amount would result to gains in revenue, under an open trade framework. Fourthly, trade openness is found to drive infrastructure growth, which suggests that currently, governments addressing the Nigeria's huge physical infrastructural deficits through debt finance may not be optimal. The impact of physical infrastructure on trade openness cannot be overemphasized. Trade openness may provide the mechanism for private-public partnership or outright concession of projects for trade infrastructural development, particularly rail, ports and access roads.

Fiftly, openness to trade is found to negatively and significantly drive inflation, thereby upholding the[26] hypothesis. The Nigerian inflation rate often in second digit may not be addressed by right policy pills by often hiking the monetary policy rates. Rather, the use of trade openness could improve competitiveness in the macroeconomy towards a better inflation management.

## V. Conclusion and Recommendations

In Nigeria's case the study produced mixed results. The short-run granger-causality study provide evidence that finance and growth are complimentary, the long-run Toda-Yamamoto technique however affirms the growth-led finance doctrine, as openness to trade is found to significantly drive financial deepening, measured by credit to firms. The study fails to uphold the complimentary relation from finance to growth hypothesis, as finance does not drive trade openness in the long-term.

To move forward, this paper recommends policies to boost openness to trade, as the regression result reveals that in the long-run trade openness significantly drives financial deepening, with complimentary drive for physical infrastructure, competitive exchange rate, inflation rate and bank competition. First, Nigerian government should review its trade policies to resolve all obstacle to freer trade liberalization, particularly as it is hoped to take full advantage of intra-Africa trade, by accenting to the African continental free trade treaty and world trade organization(WTO), with appropriate safeguards against unfair trade practices. However, government needs to diversify the nation's exports base to expand export revenues, and reduce exposure to commodity price shocks. Secondly, governments can leverage on openness to trade to develop allied and complimentary sectors in the trade industry such as trade infrastructures and branch banking that may expand the macroeconomy. Thirdly, openness to trade would assist to manage exchange rate crises. Openness could become potential sources of scarce forex supply for stabilizing the foreign exchange volatilities, which has remained suspect in the Nigeria macroeconomic crises. The uncertainty and volatility in the forex market often account for large variability among firms that are import dependent for rawmaterial; which freer trade policy would assist to ameliorate. Fourthly, openness to trade could provide resilience to undue price increases due to output shortage, hence an antidote to inflation. Government need to balance encourage productivity competitiveness of domestic firms and consumers' welfare. Finally, as one of largest economies in Africa, the Nigerian government should encourage African regional economic integration to take full advantage of openness.

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