# TRADE OPENNESS AND INDUSTRIAL OUTPUT GROWTH IN NIGERIA

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## ABSTRACT
The study assessed trade openness and industrial output growth in Nigeria spanning the period of 1986 to 2019. Using the new trade theory as theoretical premise, the study sought to determine the whether trade openness causes industrial output growth in Nigeria. To do this, the study used the Toda-Yamamoto (T-Y) causality procedure. Using Nigeria's industrial output as proxy for industrial output growth and trade-to-GDP ratio as proxy for trade openness, findings from the T-Y estimation revealed that there was no causal relationship between trade openness and industrial output growth in the country. Thus, the study concluded that trade openness did not cause industrial output growth in Nigeria for the period under analysis. To ensure that trade openness leads to industrial output growth, the study recommends that trade in the country would have to be further opened up so as to allow for import discipline which would drive competition and promote the growth of Nigeria's industrial sector.

**Keyword:** Trade openness, Trade liberalization, Industrial output, Toda-Yamamoto causality.
**JEL Classification:** F10, F43, L60

## 1. INTRODUCTION
International trade has broadened the opportunities available to countries for expanding economic activities, including attaining industrial development. As globalization expands, trade has increasingly become vital for any successful dynamic modern economy. The process of trade assists production across boundaries, resulting in productive gains that accelerates economic expansion (Ajayi & Araoye, 2019). Since different technologies or allocations of resources are needed for efficient production of various kinds of traded goods and services, in addition to differing preferences for these commodities across countries, international trade provides the structure through which countries can expand their range of available industrial goods and services (Belloumi & Alshehry, 2020; Iyoboyi, Sabitu & Okereke, 2020).

Nigeria, like other developing countries has implemented several trade policies over the years. Recognizing the benefits of free trade, Nigeria in the 1980's made important changes in trade policy, targeted at reducing and removing previous restrictive trade policies and barriers, and fostering export activities. The Structural Adjustment Programme (SAP) of the era led to export promotion strategies using trade liberalization for the purpose of aiding effective domestic resource allocation and production of output. Furthermore, the SAP was intended to increase efficiency and improvement in productivity, leading to additional investments in industries with identified comparative advantage, so as to aid resource allocation and increase output and innovations in export oriented industries. This emphasis on industrial expansion, follows Ehikioya's (2020) submission that industrial growth is vital to attaining economic expansion.

Spurring industrial growth and economic expansion through the gains from a liberalized and open trade is vital. The need for industrial development is important because it remains a driver of structural change and long-run growth since it guarantees higher productivity growth and technological advancement than other sectors of the economy, while also aiding technological spillovers. Additionally, Umoh and Effiong (2013) consented that countries that neglect industrial growth, depend on primary exports which is subject to long-run deterioration of their terms of trade. Furthermore, Stensnes (2006) argued that free trade promotes efficiency through the division of labor and redistribution of productive activities across countries, thereby moving the world economy towards the international production possibility frontier.

Despite the arguments in favor of free trade, Omoke and Opuala-Charles (2021) noted that the relationship between free trade and productivity is ambiguous. They maintained that if specialization promoted by trade, channels domestic resources to sectors that enjoys increasing returns to scale, then growth may be enhanced. However, a technologically backward country may risk specializing in non-dynamic industries and lose out on these benefits, resulting in adverse effects on growth. Additionally, Bhagwati (2008) opined that an immiserizing growth condition can occur if expansion in exports causes the prices for the country's export goods to deteriorate enough to make it worse off with the increase in production. Available literatures do not offer clear predictions of the relationship between openness and growth, essentially, the relationship remains an empirical one, thereby justifying this study in Nigeria. The study particularly notes that, more than three decades after liberalizing trade, Nigeria still remains undeveloped and unindustrialized, informing the central problem of this study. Consequently, this study seeks to provide empirical evidence of the causal relationship between trade openness and industrial output growth in the country.

## 2. LITERATURE REVIEW

### 2.1 Theoretical Literature

**2.1.1 Classical Trade Theory:** The evolution of the classical trade theory followed the theories of Smith (1776) and Ricardo (1817) that argue in support of free trade as a channel for countries to attain production efficiency. At the core of Smith's (1776) theory of absolute advantage is the labor theory of value, which states that the value of a commodity is a function of the amount of labor expended in its production. Accordingly, a liberalized trade promotes international division of labor, enabling nations to concentrate production only on goods they produce most cheaply. Cost differences therefore govern the international movement of goods. Ricardo (1817) on the other hand, emphasized comparative cost differences in the technology of production rather than absolute cost differences among nations as basis for trade. Ricardo's (1817) theory argued that international trade could occur where comparative costs differences exist, stating that a country would benefit if it specialized in the production of goods with relatively better advantage, and to obtain other commodities through trade. In support, Cains and Sliwa (2008) and Anjande et al. (2020) noted that such specialization would result in improvements in production efficiency as cost effective methods of production are adopted. The implication of both theories is that productivity in an economy is to increase through trade liberalization.

**2.1.2 Neoclassical Trade Theory:** First developed by Marshall (1879), the Neoclassical trade theory unlike in Ricardo's theory of comparative advantage, explains why trade could still be beneficial even if the technology between countries was identical. Following Zang (2008), the theory posited that patterns of trade are determined simultaneously by differences in factor

endowments, technologies, and the tastes of trading countries. Contrasting the classical theory that primarily considered the supply side (cost) factors relating to trade, the Neoclassical trade theory held that the utility of a commodity was also important, therefore, preferences accounts for the existence of trade among nations even if their factor endowments and technologies are completely similar. Thus, productivity will be improved upon with increased trade liberalization provided that any one factor such as taste, technologies, or factor endowments differ among trading nations.

**2.1.3 The New Trade Theory:** The new trade theory was developed following the findings from the studies of Balassa (1967), and that of Grubel and Lloyd (1975), where contrary to the principles of the traditional trade theories, it was established that intra-industry trade took place. It contends that a large portion of intra-industry trade occurred with few costs of adjustment. Consequently, the new trade theory emerged in an attempt to describe why intra-industry trade is possible. The first contribution was from the work of Krugman (1979), where he argued that trade could occur within imperfect markets, and that trade results from economies of scale instead of differences in technology or factor endowments, and even product differentiation. Here, increasing returns to scale makes it possible for firms to lower their average costs as they increase production, and product differentiation allows firms to produce and export their unique variety to other countries. Additionally, Sunday, Oluwatoyin, and Olasupo (2020) noted that industrial cluster holds immense spillover effect on firm productivity, allowing them to benefit from the wealth of knowledge and other positive spill overs.

Later development of the new trade theory such as the work of Melitz (2003), incorporated firm heterogeneity in addition to the assumptions of economies of scale, differentiated products, and imperfect competition. The new trade theory therefor argue that trade can occur even if economies have similar tastes, technology, and factor endowments, thereby improving the productivity of firms. Accordingly, measures aimed at liberalizing trade will not only ensure that individuals are offered a wider range of choices, thereby increasing competition among firms, but also, it results in a mutual growth in productivity of firms in the different economies.

## 2.2. Empirical Review

A number of studies have explored the relationship between trade openness and industrial output growth. This empirical review explored related studies covering studies in Nigeria, Africa and outside the continent.

Tsaurai (2021) explored the determinants of trade openness in transitional economies. The study employed a panel data analysis, comprising of the dynamic generalized methods of moments (GMM), fixed effects, pooled ordinary least squares (OLS), and random effects on a panel data-set spanning 2000 to 2018. Findings from the study revealed that human capital development, the interaction between Foreign Direct Investment (FDI) and human capital development, economic growth and mining sector growth were found to have a significant positive impact on trade openness in transitional economies. These variables were important determinants of trade openness.

Kpoghul, Okpe and Anjande (2020) investigated the tripartite relationship between trade openness, foreign direct investment and the performance of the Nigerian economy. The study used an annual time series data-set covering 1970 to 2018 for within sample forecast and a five-year out-of-sample forecast, spanning 2019 to 2023 were used under four policy scenarios in line with the Economic Recovery and Growth Plan (ERGP) in Nigeria. Findings revealed that trade openness attracts FDI and they affect macroeconomic performance in Nigeria through direct and indirect channels. The

results established that increased trade openness, FDI, government expenditure and broad money supply would bring about increase in private investment, real consumption, outputs of oil and non-oil sectors, significant increase in non-oil exports, and government revenues.

In a similar study, Emerenini and Ohadinma (2018) examined the impact of trade liberalization on the manufacturing sector of the country for the period of 1980 to 2016. Using annual time series data, the study employed the Error Correction Model (ECM) to analyze the data. The empirical analysis used manufacturing sector output as the dependent variable while trade openness, exchange rate, volume of exports and imports, and balance of payment were the independent variables. Findings from the ECM result showed that the effect of trade openness, exports and balance of payment had negative impacts on manufacturing output, however, exchange rate and imports exerted positive impact on manufacturing output with only imports and exports being significant. The study revealed that trade liberalization policy has not significantly improved the growth of the Nigerian manufacturing sector noting that trade has not been completely liberalized.

Similarly, Adamu and Doğan (2017) examined the long and short-run relationship between trade openness and industrial production in Nigeria using a quarterly time series data, spanning 1986:Q1-2008:Q4. The study used the Auto-Regressive Distributed Lag model (ARDL) and the Toda-Yamamoto (T-Y) causality procedure on the variables of industrial production index, trade openness, nominal exchange rate, and inflation rate. The ARDL result indicated that trade openness had a significant and positive impact on industrial production both in the long and short-run. Equally, the result of the T-Y procedure showed that there was a one-way causation, running from trade openness to industrial production in the country.

Also in Nigeria, Ojeyinka and Adegboye (2017) assessed the impact of trade liberalization on the performance of the Nigerian economy, with reference to the agricultural and manufacturing sectors of the economy between 1981 and 2014 using annual time series data. The Generalized Method of Moment (GMM) technique was used on the variables comprising outputs from the manufacturing and agricultural sectors, trade openness, and exchange rate. Findings showed a significant positive impact of trade liberalization on the output of the agricultural sector while a negative and significant relationship was recorded between trade liberalization and manufacturing output in Nigeria, suggesting a poor manufacturing base in comparison to Nigeria's trading partners.

Chibuzo (2017) investigated trade openness and manufacturing sector growth in Nigeria using an annual time series data-set spanning 1982 to 2015. The study used the Multiple regression analysis on the variables of manufacturing output, trade openness, investment, production index, and exchange rate. The study found that trade openness was statistically significant, production index positively affected manufacturing output growth, while investment growth and exchange rate had an inverse relationship with manufacturing output. The findings revealed that although the policy of trade liberalization enhances the productivity of the manufacturing sector in Nigeria, its impact was relatively low, and this could be attributed to the weak technological base and low level of capacity utilization.

Furthermore, Akims (2017) analyzed the effects of trade liberalization on the performance of the manufacturing sector in Nigeria making use of a quarterly firm-level data from the survey of manufacturing industries in Nigeria for the period of 2008:Q1 to 2010:Q4. The data for the study reported information for firms in organized cohorts based on their location, industry activity and size characteristics in the country. Appropriate panel fixed effects and random effects estimation techniques were carried out for the empirical analysis. Findings of the study indicated that whereas

import impedes productivity, export however enhanced productivity, thus, measures aimed at encouraging exports would be relatively more effective in improving productivity. Also, findings revealed that higher productivity does not influence the decision on whether or not a firm would participate in exports, but higher productivity increases the share of exports in total sales for firms that are already participating in foreign trade. In addition, the results provide some evidence in favor of the import discipline effect of trade liberalization thereby supporting the notion that trade liberalization provides a channel through which the competitiveness of firms in Nigeria's manufacturing industry can be improved upon.

Additionally, Ebenyi, Nwanosike, Uzoechina and Ishiwu (2017) examined the impact of trade liberalization on manufacturing value-added in Nigeria using an annual time series data-set covering the period of 1970 to 2014. The study employed the ARDL model to carry out its estimation. Variables used in the analysis were manufacturing output, trade openness, nominal exchange rate, interest rate, and capital formation (gross domestic savings). Findings from the study revealed that trade openness had a positive impact on manufacturing output, it was however not significant. The study noted that the heavy reliance of the Nigerian manufacturing firms on imported machinery and equipment is reflected in the country's weak manufacturing base. The study further revealed that the high cost of production in the country has limited the gains from trade liberalization, which is in favor of Nigeria's trading partners.

Situating the study in other African countries, Fongang, Martial, Bergaly and Christian (2017) investigated the effect of trade openness on manufacturing growth in the Economic and Monetary Community of Central African (EMCCA) countries using an annual panel data-set covering the period from 1984 to 2014. The study employed a Panel Co-integration as well as a Dynamic Ordinary Least Square method to undertake its analysis. Variables used for the analysis were manufacturing output growth, trade openness, investment, and FDI. The results of the empirical analysis revealed a positive and significant effect of FDI and investment on manufacturing growth, as well as a weak effect of trade openness on manufacturing growth in EMCCA countries.

In a study conducted in Bangladesh, Ali, Alam and Islam (2016) studied the empirical relationship between trade openness, industrial value added and economic growth using annual time series data covering 1981 to 2015. As estimation technique, the study used the Multiple regression analysis and the Granger causality procedures. The model specification employed the variables of GDP, export, import, and industrial value added. The results from the empirical analysis indicated that imports had a negative relationship while exports positively influenced growth. The industrial value added also had a positive impact on growth. The Granger causality results showed a bidirectional causal relationship between export and growth as well as between export and industrial value added, indicating that trade liberalization causes industrial growth.

Extending the analysis to South Asian Association for Regional Cooperation (SAARC) countries, Tahir, Estrada, Khan and Afridi (2015) examined the impact of trade openness on the industrial sector development of member countries. Using a panel regression model, the study employed an annual panel data-set spanning the period of 1980 to 2013 for the selected six SAARC countries, namely, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. Variables used in the study were trade openness, industrial output ratio, investment, labor force, inflation, and education. Findings from the empirical analysis revealed that trade openness had a positive and significant impact on the growth of the industrial sector of the sampled countries. Other determinants such as education and investment also had a positive impact on the growth of industries in these countries.

Situating the study in Cameroon, Bongsha (2011) investigated the impact of trade liberalization on the manufacturing sector using annual time series data spanning 1980 to 2006. The study used the Multiple regression analysis and the Gravity model in its estimation. Variables in the Multiple regression were real exchange rate, manufacturing output, tariff rate, import, and export. Findings showed that reduction in protection (tariff) did not affect manufacturing positively. Furthermore, the result revealed that exchange rate and import is an important determinant of the performance of the manufacturing sector. The Gravity model was used to complement the single equation Multiple regression model. The main manufacturing performance indicator in the Gravity model was bilateral trade, and it was regressed with trade and other control variables like Gross Domestic Product (GDP), distance, tariffs, membership of regional trade agreement (RTA), common language and border, and colonial ties. Findings revealed that bilateral trade did not improve manufacturing performance despite trade liberalization. The results further revealed that membership of RTA and the reduction in tariffs (all indications of liberalization) did not positively influence bilateral trade in manufacturing. The distance variable and GDP variables equally did not influence bilateral trade in manufacturing.

In the review, inconsistency in time, country and methodology put up a barrier against a meaningful comparison among studies. However, the review revealed that majority of the related studies covered only the manufacturing sub-sector of the industrial sector, limiting the validity of their findings in generalizing for the industrial sector as a whole. Although Adamu and Doğan (2017) was an industrial based study in Nigeria, its scope however terminated in 2008. This study extends the analysis to 2019.

## 3. METHODOLOGY

### 3.1. Theoretical Framework

The new trade theory forms the theoretical framework of this study. Following Melitz's (2003) variant of the new trade theory which emphasized firm heterogeneity in addition to the assumptions of economies of scale, differentiated products and imperfect competition, open trade is considered a mechanism for reallocations between firms in an industry. The reduction or elimination of barriers to free trade would result to the reallocation of market share in the direction of more productive firms from less productive ones whereas firms with the least productivity will exit the market. This process would result in increases to average industry productivity, alongside growth in the market share of the most productive firms. In addition to improved productivity, Melitz (2003) argued that higher productive firms self-select into export markets, further strengthening industrial expansion.

At the core of the new trade theory is the assumption that open trade causes productivity and industrial expansion. Consequently, this assumption was adopted in the present study, to provide the framework in assessing whether trade openness leads to increases in productivity of firms operating in Nigeria's industrial sector.

### 3.2. Data and Method of Analysis

Secondary data was employed for the study. It used annual time series data, spanning the period of 1986 to 2019. Data for trade openness was gotten from the World Bank data base of 2019, while data for industrial output was sourced from the 2019 Annual CBN statistical bulletin. To determine whether trade openness causes industrial output growth in Nigeria, the study used the Toda-Yamamoto (T-Y) causality procedure.

Following Toda and Yamamoto (1995), the justification for using the T-Y approach stems from the fact that it helps in overcoming the problem of asymptotic critical values when causality tests are done in the presence of non-stationarity or no co-integration. As such, the T-Y test minimizes the risks associated with the possibility of a wrongly identified order of integration. Similarly, the approach is applicable for any arbitrary levels of integration for the variables.

### 3.3. Model Specification

The model specification adapted the model of Adamu and Doğan (2017). The study thus used the variables of industrial output growth and trade openness to carry out its analysis. Consequently, the causal model specification for the T-Y procedure is given in Equations 1 and 2;

$$IOG_t = \alpha_0 + \sum_{i=1}^{k} \varphi_{1i} IOG_{t-1} + \sum_{j=k+1}^{k+d\max} \varphi_{2j} IOG_{t-j} + \sum_{i=1}^{k} \lambda_{1i} TOP_{t-1} + \sum_{j=k+1}^{k+d\max} \lambda_{2j} TOP_{t-j} + \varepsilon_{1t} \quad (1)$$

$$TOP_t = \beta_0 + \sum_{i=1}^{k} \phi_{1i} TOP_{t-1} + \sum_{j=k+1}^{k+d\max} \phi_{2j} TOP_{t-j} + \sum_{i=1}^{k} \varpi_{1i} IOG_{t-1} + \sum_{j=k+1}^{k+d\max} \varpi_{2j} IOG_{t-j} + \varepsilon_{1t} \quad (2)$$

where, $\alpha_0$ and $\beta_0$ are the intercepts; $\varphi$, $\lambda$ $\phi$ and $\varpi$ are the parameters of the model; $\varepsilon_t$ represents the residuals of models; *k* denotes the optimal lag length; *dmax* is the maximum order of integration suspected to occur in the system; *IOG* represents industrial output growth (proxied by industrial output), while *TOP* represents trade openness (proxied by the sum of exports and imports of goods and services measured as a share of GDP).

### 3.4. Estimation Procedure

The empirical analysis for the study begins by giving the descriptive statistics of the data-sets. It summarizes the basic statistical features of the data under consideration by providing a historical background for the behavior of the data distribution.

The first step for the T-Y test involves the testing of the time series to determine the maximum order of integration (*dmax*) of the variables in the system. This was done using the Augmented Dickey Fuller (ADF) and the Kwaitkowski, Phillips, Schmidt and Shin (KPSS) unit root tests developed by Dickey and Fuller (1979) and Kwiatkowski et al. (1992) respectively. For the case of the ADF test, the null hypothesis is non-stationarity, while for the KPSS, the null hypothesis is that of stationarity.

The next step is the determination of the optimal lag length (*k*). The *k* is always unknown and has to be obtained from the VAR estimation of the variables in their levels. In the econometric literature, a number of selection criteria have been proposed that can be used to determine the optimal lag order. The criteria considered in this study are the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC), and the Hannan-Quinn Criterion (HQC).

The last stage involves testing for causality. The causality test is done by using the Modified Wald procedure in the VAR system, where the optimal lag length is equal to $k + d\max$ . The Modified Wald test has an asymptotic chi-square distribution with *k* degrees of freedom in the limit when a $VAR(k + d\max)$ is estimated. The causality between two variables can be described as unidirectional, bidirectional or no causality considering these decision rules; unidirectional causality occurs when either null hypothesis is rejected, bidirectional causality exists when both null are rejected, and no causality exists if neither null hypothesis is rejected.

As post-estimation tests, the study carried out the VAR Residual Serial Correlation LM test to test for serial correlation and used the Inverse roots of AR characteristic polynomial to test for the stability of the model.

## 4. RESULTS AND DISCUSSION OF FINDINGS

### 4.1. Descriptive Statistics

The descriptive statistics on Table 1 provides the basic statistical features of the data-set under consideration

Table 1: *Descriptive Statistics*

| ***Statistics*** | ***IOG*** | ***TOP*** |
|---|---|---|
| Mean | 8582.160 | 35.23374 |
| Maximum | 39879.69 | 53.27796 |
| Minimum | 62.63000 | 9.135846 |
| Skewness | 1.303849 | -0.431258 |
| Kurtosis | 3.838478 | 2.924792 |
| Jarque-Bera | 10.62944 | 1.061918 |
| Probability | 0.004919 | 0.588041 |
| Observations | 34 | 34 |

**Source:** *Computed using E-views 10*

Given the mean values of each data, evidence of variations was observed in the data-set as shown by the difference between the minimum and maximum values of both distributions. The skewness of the data-set indicated that slight deviations from the mean was positively skewed for the *IOG* data, while *TOP* was negatively skewed. The kurtosis for *IOG* had a leptokurtic distribution indicating broader fluctuation in the distribution, while *TOP* had a mesokurtic distribution, indicating a normal distribution, which is further supported by the Jaque-Bera statistics. Although the Jaque-Bera statistics for *IOG* indicated a distribution that was not normally distributed, however, the study proceeded with the T-Y procedure since the multivariate framework does not necessarily require the normality assumption.

### 4.2. Unit Root Test

Considering the sensitivity of the Toda Yamamoto (T-Y) procedure to the order of integration of a data-set, the study conducted the Augmented Dickey-Fuller (ADF) test and the Kwaiatkowski, Phillips, Schmidt and Shin (KPSS) tests. Carrying out these two tests is considered reliable noting that the null hypotheses for both procedures are mirror opposites, i.e., while the ADF tests the null hypothesis for the presence of unit root, the KPSS procedure tests the converse. The results of both tests are presented on Table 2.

Both the ADF and the KPSS unit root tests showed similar order of integration. A confirmatory analysis of both the ADF and the KPSS procedures showed that *TOP* was stationary for both test procedures (i.e., at levels 1(0)). However, both the ADF and the KPSS test results indicated the presence of unit root for IOG at levels and first difference. IOG only became stationary after second differencing. To determine the maximum order of integration (*dmax*) of the variables in the system, the result of both test procedures were accepted. Consequently, the *dmax* for the T-Y procedure in this study was 2.

Table 2: *ADF & KPSS Unit Root Test Results*

| Variable | ADF Stat. | Order of Integration | KPSS Stat. | Order of Integration |
|---|---|---|---|---|
| *IOG* | -6.400731<br>(-2.981038) | 1(2) | 0.275000<br>(0.463000) | 1(2) |
| *TOP* | -3.600073<br>(-2.954021) | 1(0) | 0.222112<br>(0.463000) | 1(0) |

**Source:** *Computed using E-views 10*
Figures in parenthesis represents the critical values at the 5% level.

### 4.3. The Lag Length Selection Test

The first step in carrying out the T-Y estimation based on the Augmented VAR procedure requires selecting an optimal lag length. Consequently, the optimal lag length required for the estimation of the T-Y procedure is carried out as presented on Table 3. Analysis of the selection criteria showed that majority of the test criteria chose 2 lags. As such, the study adopted 2 lags in carrying out the T-Y estimation.

Table 3: *Optimal Lag Length Result*

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -411.7092 | NA | 8.44e+09 | 28.53167 | 28.62597 | 28.56120 |
| 1 | -355.9469 | 99.98769* | 2.38e+08 | 24.96185 | 25.24474* | 25.05045 |
| 2 | -350.4918 | 9.029121 | 2.16e+08* | 24.86150* | 25.33298 | 25.00916* |
| 3 | -347.8751 | 3.970144 | 2.41e+08 | 24.95690 | 25.61698 | 25.16363 |
| 4 | -346.3944 | 2.042302 | 2.93e+08 | 25.13065 | 25.97932 | 25.39644 |
| 5 | -341.5436 | 6.021657 | 2.87e+08 | 25.07198 | 26.10923 | 25.39683 |

**Source:** *Computed using E-views 10*
* indicates lag order selected by the criterion
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

### 4.4. Toda Yamamoto Result

The result of the T-Y causality test is presented on Table 4.

Table 4: *Toda Yamamoto (T-Y) Test Result*

| Null hypothesis | Chi-sq | df. | Prob. | Remark |
|---|---|---|---|---|
| *Top* does not Granger Cause *IOG* | 0.877266 | 2 | 0.6449 | No Causality |
| *IOG* does not Granger Cause *TOP* | 4.774328 | 2 | 0.0919 | No Causality |

**Source:** *Computed using E-views 10*

The result of the T-Y test conducted at the 5% level indicates that there was no causal relationship existing between trade openness (*TOP*) and industrial output growth in Nigeria for the period under analysis. Trade openness for the period under consideration did not cause industrial output growth, suggesting that the degree of trade openness allowed in the country limited industrial output growth. This result is supported by the works of Emerenini and Ohadinma (2018) and that of Ojeyinka and Adegboye (2017) which alluded the result to the existence of several restrictive barriers despite the policy of trade liberalization, in addition to a weak industrial productive base weakening the country's industrial export.

### 4.5. Residual Diagnostic Test

To ensure model adequacy, the VAR residual serial correlation LM test and the AR Root were conducted.

### 4.5.1. Serial Correlation Test

The result of the VAR Residual Serial Correlation LM test is presented on Table 5. The result of the VAR residual serial correlation LM test led to the acceptance of the null hypothesis considering the probability values of the lags at the 5% level. As such, the study concluded that the T-Y model was free from serial correlation.

Table 5: *VAR Residual Serial Correlation LM Test Result*

Null hypothesis: No serial correlation at lag h

| Lag | LRE* stat | Df | Prob. | Rao F-stat | Df | Prob. |
|---|---|---|---|---|---|---|
| 1 | 1.580273 | 4 | 0.8123 | 0.392957 | (4, 40.0) | 0.8124 |
| 2 | 4.709469 | 4 | 0.3184 | 1.217221 | (4, 40.0) | 0.3187 |

Null hypothesis: No serial correlation at lags 1 to h

| Lag | LRE* stat | df | Prob. | Rao F-stat | Df | Prob. |
|---|---|---|---|---|---|---|
| 1 | 1.580273 | 4 | 0.8123 | 0.392957 | (4, 40.0) | 0.8124 |
| 2 | 11.21294 | 8 | 0.1899 | 1.498976 | (8, 36.0) | 0.1920 |

**Source:** *Computed using E-views 10*

### 4.5.2. Stability Test

The plot of the Inverse roots of AR characteristic polynomial used to test for the stability of the model is presented on Figure 1.

The Inverse roots of the AR characteristic polynomial graph on Figure 1 have roots with modulus which are less than one and they lie within the unit circle, indicating that the model is stable and the conclusions drawn thereof are also reliable. Therefore, the model satisfies the dynamic stability condition.

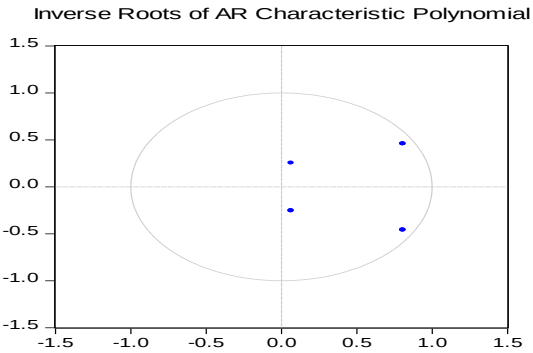


Figure 1: *AR Stability Graph*

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

### 5.1. Conclusion

In line with the finding of the Toda-Yamamoto (T-Y) procedure, the study concluded that there was no causal relationship between trade openness and industrial output growth in Nigeria. As such, trade openness does not cause industrial output growth in the country. It noted that the degree of trade openness limited industrial output growth. Supporting this conclusion were the studies by

Emerenini and Ohadinma (2018) and that of Ojeyinka and Adegboye (2017), alluding the result to the existence of several restrictive trade barriers and a weak industrial base.

### 5.2. Policy Recommendations

To ensure that trade openness leads to industrial output growth, the study in line with Kpoghul et al. (2020) and Akim (2017) recommended that trade openness in the country would have to be further expanded so as to allow for import discipline which would drive competition and promote the growth of Nigeria's industrial sector. Additionally, other determinants of trade openness such as human capital development as identified by Tsaurai (2021) should be developed to complement trade liberalization policy for industrial expansion.

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