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Impact of some Macroeconomic Variables on Tax Revenue in Nigeria

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ABSTRACT

The knowledge of the relationship between tax revenue and the interplay of macroeconomic factors is necessary to maximize the gains of the proposed elimination of non-tariff barriers by the African Union. This study was carried out to investigate the impact of trade liberalization and six macroeconomic variables on tax revenue in Nigeria from 1981-2019, using the autoregressive distributed lag (ARDL) approach to cointegration and the Error Correction Model (ECM). The unrestricted error-correction model was specified in the study by modifying ARDL model. Total tax and domestic tax revenues were predicted by trade liberalization and most macroeconomic variables examined. A unit increase in trade liberalization triggered an increase of 3% in both total and domestic tax revenues when all other variables in the model were held constant. The results of ECM showed that short run and long run equilibrium were present in the system. The macroeconomic variables found to be predictors of both domestic and external tax revenues are share of petroleum and mining in GDP, foreign direct investment, share of agriculture in GDP, per capita income, exchange rate and inflation rate. These are therefore important to explain tax revenue in Nigeria. The key policy recommendation for improved and sustained tax revenue is to embark on comprehensive trade liberalization policies as well as regulate changes in macroeconomic variables.

Keywords: Trade liberalization, Total tax revenue, Domestic Tax revenue, Error correction model

INTRODUCTION

Taxation is an age long event (Amahalu and Ezechukwu, 2017). Tax is a compulsory charge imposed by a public authority on the income and properties of individuals and companies as stipulated by the government Decree, Acts or Laws irrespective of the exact amount of service of the payer in return (Omotosho, 2001; Okeke et al., 2018). Tax is defined by the Institute of Chartered accountants of Nigeria (2006) and Chartered Institute of Taxation of Nigeria (2002) as an enforced contribution of money to government pursuant to a defined authorized legislation. Tax could be levied directly on personal or corporate income (called a direct tax) or levied on the price of a good or service (indirect tax) (Worlu and Nkoro, 2012). Tax is one of the most important sources of public revenue which a government uses to provide social and welfare services and also to achieve national macroeconomic objectives especially in the areas of fiscal and monetary policies. Every corporate organization is therefore expected to pay taxes as one of its responsibilities to the society. Taxation aims to finance government expenditure and to redistribute wealth which translates to financing development of the country (Ola, 2001; Jhingan, 2004, Musgrave and Musgrave, 2004; Bhartia, 2009; Ordu and Anele, 2015).

The use of tax as an instrument of social engineering is to stimulate general and/or sectoral economic growth (Sanni, 2007). Generally, the maximization of tax revenue is incompatible with the maximization of Gross Domestic Product (GDP) (Ma, 2001). While it was argued by Ergete and Bev (2012), James and Robert (2006), Ma (2001) and Peden (1991) that higher taxes reduce economic growth, Feng and Suyono (2014) in their findings reported that tax could have both positive and negative effects on the economy. The sustainability of revenues from tax has been greatly affected by tax evasion, which is an illegal non-payment or underpayment of tax. The regional economic outlook of the International Monetary Fund (IMF) (2018) reported that Nigeria, the Africa's most-populous

nation and largest economy, with a population of about 200 million people, has the lowest tax-to-GDP ratio among Sub-Saharan countries, with tax to GDP ratio of 5.9 percent compared to 24.7 percent for South Africa (Herbert *et al*., 2018). Effectively combating the scourge of tax evasion requires deeper understanding of the factors influencing the taxpayer's decision in tax matters, and then to quantify it in order to know its magnitude and its range in public finances (Angour and Nmili, 2019). Apart from being an essential fiscal policy tool and one of the primary sources of public revenue across the world, studies reveal the interaction effects of taxation play a pivotal role in the economy (Nwaorgu *et al*., 2016).

The relationship between tax revenue and the interplay of macroeconomic factors has received considerable research attentions over the years especially because correct knowledge of factors affecting tax revenue does not only facilitate proper economic and fiscal planning but also promotes economic growth and development.The global economic cooperation has led to trade openness or reduction and removal of barriers to free trade and the World Trade Organization (2013) has reported this as one of the major factors that have influenced the growth in world trade. One of the major factors that influence tax revenue istrade liberalization and this has frequently been at the center of an economic development strategy in Sub-Saharan Africa. Trade liberalization has been known to be associated with the reduction, removal and elimination of taxes on goods and services (including tariffs and import duties) as well as relaxing thequantitative barriers which may be accompanied or supported by currency devaluation and domestic tax reform (Mehdi *et al.*, 2014).

The Nigerian government in recent decades has engaged in the search for the appropriate policy strategy to stimulate tax revenue and boost the revenue profile of the government (Saibu and Sinbo, 2013). In analyzing macroeconomic determinants of tax revenue in Nigeria using time series data from 1970 – 2011, Saibu and Sinbo (2013) deployed the autoregressive distributed lag (ARDL) method to establish both the long run and short run relationship among the variables, namely, tax revenue, trade openness, official exchange rate, inflation, real GDP and the ratio of external debt to GDP. Results showed that trade liberalization policy had positive effect on tax revenue contrary to expectation. Also, the growth rate of economic activity impacted positively on tax revenue in Nigeria while exchange rate depreciation and inflation rate were found to have negative effect on tax revenue.

Kwanashie *et al*. (1998) examined the impact of exchange rate and trade liberalization policies on Nigerian non-oil exports for the period 1986-1992. The findings showed that prices (relative and absolute) of export products rose sharply but the expansion was not sustainable. Besides, foreign prices of the commodities contracted over the period, suggesting that the rise in domestic prices might be due to the monotonic and rapid depreciation of the exchange rate of the naira. In a related study in Pakistan, Sumera *et al.* (2012) deployed econometric methods to estimate the impact of various factors on trade taxes and tax revenues. Results showed that exchange rate and population were negatively related to tax revenue, while trade openness, trade share and GDP showed a positive relationship with tax revenue. Tanzi (1992) in his study found that the share of agriculture in GDP may have an inverse influence on the tax share from both the demand and supply point of view. That is, as the share of agriculture in GDP increased, the amount of money collected as tax revenue decreased. This finding is supported by Gupta, (2007) who found that tax revenue is negatively correlated with share of agriculture in GDP. However, the relationship between share of agriculture in GDP and tax revenue may be positive in countries with large share of agricultural products in total exports (Agbeyegbe *et al*., 2006). Inflation indicates the quality and stability of a country's macroeconomic policies and can affect a

country's tax revenue. Generally, it has a negative effect on a country's tax performance as it reduces the purchasing power of people and tax collection (McMahon and Schmidt-Hebbel, 2000). Exchange rate and share of foreign direct investment in GDP are also exogenous determinants of tax revenue. However, their relationship with tax revenue alongside trade liberalization has not been adequately explored in Nigeria. The current study therefore aims to fill this gap by investigating the relationship between tax revenue and some microeconomic variables with emphasis on trade liberalization proxied by trade openness in Nigeria using time series analysis

MATERIAL AND METHODS

Data

Annual time series data on Nigeria's tax revenue, trade openness and six macroeconomic variables from 1981 – 2019 were obtained from secondary sources shown in the Appendix. There were three dependent variables in this study, namely, total tax revenue, domestic tax revenue and external tax revenue. Trade liberalization was the independent variable of interest while the six macroeconomic variables, viz exchange rate, inflation rate, per capita income, foreign direct investment, share of agriculture in GDP and share of petroleum and mining in GDP were used as control variables in this study. Measurement indicators of all the variables are presented in the Appendix.

Model Specification

Three models are considered in this study:

Model I: Examining the relationship between total tax revenue and trade liberalization alongside other macroeconomic variables.

Model II: Examining the relationship between domestic tax revenue and trade liberalization alongside other macroeconomic variables.

Model III: Examining the relationship between external tax revenue and trade liberalization alongside other macroeconomic variables.

An ARDL regression model (Pesaran et al, 2001) in its generalized form was specified as follows:

$$Y_t = \mu + \sigma t + \emptyset_1 Y_{t-1} + \ldots + \emptyset_p Y_{t-p} + \beta_0 X_t + \beta_1 X_{t-1} + \cdots + \beta_q X_{t-q} + \varepsilon_t, \quad (1)$$

Where μ, t, and ε_t are intercept, time trend and white noise error term respectively, X_t and Y_t are stationary variables. The above model is called an autoregressive-distributed lag model of order p in the autoregressive component and of order q in the distributed lag; this is often written as ARDL (p, q), or alternatively ADL (p, q).

To examine the relationship between the dependent variables (total tax revenue, domestic tax revenue and external tax revenue) and the independent variable (trade liberalization) including the six control variables (exchange rate, inflation rate, per capita income, foreign direct investment, share of agriculture in GDP and share of petroleum and mining in GDP), the following three autoregressive distributed lag models were specified as

$$\boldsymbol{TTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \, TTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i \, AGSGDP_{t-i}$$

$$+ \sum_{i=0}^{\cdot} \varphi_i \, AGSGDP_{t-i} + \sum_{i=0}^{\cdot} \delta_i \, PCI_{t-i} + \sum_{i=0}^{\cdot} \lambda_i \, FDISGDP_{t-i} + \sum_{i=0}^{\cdot} \psi_i \, PNMSGDP_{t-i} + \varepsilon_t \quad (2)$$

$$\boldsymbol{DTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \, DTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i \, AGSGDP_{t-i}$$

$$+\sum_{i=0}^{q4}\varphi_i\, AGSGDP_{t-i}+\sum_{i=0}^{q5}\delta_i\, PCI_{t-i}+\sum_{i=0}^{q6}\lambda_i\, FDISGDP_{t-i}+\sum_{i=0}^{q7}\psi_i\, PNMSGDP_{t-i}+\varepsilon_t \quad (3)$$

$$\boldsymbol{EXTGDP_t}=\alpha_0+\sum_{i=1}^{p}\beta_i\, EXTGDP_{t-i}+\sum_{i=0}^{q1}\Phi_i\, TROPENS_{t-i}+\sum_{i=0}^{q2}\gamma_i\, INFR_{t-i}+\sum_{i=0}^{q3}\emptyset_i\, EXR_{t-i}+\sum_{i=0}^{q4}\varphi_i\, AGSGDP_{t-i}$$
$$+\sum_{i=0}^{q4}\varphi_i\, AGSGDP_{t-i}+\sum_{i=0}^{q5}\delta_i\, PCI_{t-i}+\sum_{i=0}^{q6}\lambda_i\, FDISGDP_{t-i}+\sum_{i=0}^{q7}\psi_i\, PNMSGDP_{t-i}+\varepsilon_t \quad (4)$$

where:

$TTGDP_t$ = Total Tax Revenue at time t, measured as ratio of total tax revenue to GDP (current prices) in percentage.

$DTGDP_t$ = Domestic Tax Revenue at time t, measured as ratio of sum of Domestic (Direct & Indirect) Tax Revenue to GDP (current prices) in percentage.

$EXTDGP_t$ = External Tax Revenue at time t, measured as ratio of customs and excise duties to GDP (current prices) in percentage.

$TROPENS_t$ = Trade openness at time t, measured as ratio of sum of export and import to GDP, which is a constant.

$INFR_t$ = Inflation rateat time t, measured in percentage.

EXR_t = Exchange rate at time t, measured in percentage.

$AGSGDP_t$ = Share of agriculture in GDPat time t, measured as ratio of Agriculture to GDP (constant) in percentage.

PCI_t = Level of economic development at time t, measured by Real GDP per Capita.

$FDISDGP_t$ = Foreign Direct Investment at time t, measured as ratio of Net inflow of FDI to GDP in percentage.

$PNMSGDP_t$ = Share of mining and petroleum in GDPat time t, measured as Ratio of Mining and Petroleum to GDP (constant) in percentage.

α_0= Intercept.

ε_t= Error term.

In order to determine the degree of stationarity, a unit root testing was carried out through the Augmented Dickey-Fuller (1981) (ADF) test which is applied to the model given as

$$\Delta y_t=\alpha+\beta t+\gamma y_{t-1}+\delta_1\Delta y_{t-1}+\cdots+\delta_{p-1}\Delta y_{t-p+1}+\varepsilon_t \quad (5)$$

where: α is a constant, β is the coefficient on a time trend and p is the lag order of the autoregressive process. Imposing the constraints α = 0 and β = 0 corresponds to modelling a random walk and using the constraint β = 0 corresponds to modelling a random walk with a drift.

The implementation of Autoregressive Distributed Lag (ARDL)/Bounds testing for estimating the long-run relationships required three basic steps. The first step is to examine the existence of long-run relationships among all the variables in the model. The second step involved estimating long run relationship coefficients with respect to cointegration relations estimated in first step and the third step was estimating short run dynamic coefficients through error correction modelling.

In order to test the existence of long-run relationship between the variables, there was need to formulate an unrestricted error-correction model (ECM), which is a particular type of ARDL model, as proposed by Pesaran and Shin (1995) and Pesaran, Shin and Smith, (2001).

In this study, the unrestricted error-correction model wasspecified by modifying the three ARDL models specified in (2), (3) and (4).

$$\Delta \boldsymbol{TTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta TTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, \Delta TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, \Delta EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i \, \Delta AGSGDP_{t-i}$$

$$+ \sum_{i=0}^{\iota} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0}^{} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0}^{} \psi_i \, \Delta PNMSGDP_{t-i} + \theta_1 TTGDP_{t-1} + \theta_2 TROPNES_{t-1}$$

$$+\theta_3 INFR_{t-1}\theta_4 + EXR_{t-1} + \theta_5 AGSGDP_{t-1} + \theta_6 PCI_{t-1} + \theta_7 FDISGDP_{t-1} + \theta_8 PNMSGDP_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta \boldsymbol{DTGDP_t} = \alpha_0 + \sum \beta_i \, \Delta DTGDP_{t-i} + \sum \Phi_i \, \Delta TROPENS_{t-i} + \sum \gamma_i \, \Delta INFR_{t-i} + \sum \emptyset_i \, \Delta EXR_{t-i}$$

$$+ \sum_{i=0}^{q5} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0}^{q6} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0}^{q7} \psi_i \, \Delta PNMSGDP_{t-i} + \theta_1 DTGDP_{t-1} + \theta_2 TROPNES_{t-1}$$

$$+\theta_3 INFR_{t-1} + \theta_4 EXR_{t-1} + \theta_5 AGSGDP_{t-1} + \theta_6 PCI_{t-1} + \theta_7 FDISGDP_{t-1} + \theta_8 PNMSGDP_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta \boldsymbol{EXTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta EXTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, \Delta TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta INFR_{t-i}$$

$$+ \sum_{i=0} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0} \psi_i \, \Delta PNMSGDP_{t-i} + \theta_1 EXTGDP_{t-1} + \theta_2 TROPNES_{t-1} +$$

$$\theta_3 INFR_{t-1} + \theta_4 EXR_{t-1} + \theta_5 AGSGDP_{t-1} + \theta_6 PCI_{t-1} + \theta_7 FDISGDP_{t-1} + \theta_8 PNMSGDP_{t-1} + \varepsilon_t \quad (8)$$

where:

TTGDP, DTGDP and EXTGDP are the dependent variables while TROPENS, INFR, EXR, AGSGDP, PCI, FDISGDP and PNMSGDP are the explanatory variables. The optimal lag selection in the above models was based on theAkaike Information Criterion(AIC), Schwarz Criterion(SC) (also known as Bayesian Information Criterion(BIC)), and Hannan-Quinn Information Criterion(HQIC).

After establishing the existence of long-run relationship in equation (6, 7 & 8), we went on to the second step where we estimated the long-run coefficients based on the ARDL (p_1, q_1 q_2 q_3 q_4 q_5 q_6 q_7) model.

$$\boldsymbol{TTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \theta_1 TTGDP_{t-i} + \sum_{i=0}^{q1} \theta_2 TROPENS_{t-i} + \sum_{i=0}^{q2} \theta_3 INFR_{t-i} + \sum_{i=0}^{q3} \theta_4 EXR_{t-i} + \sum_{i=0}^{q4} \theta_5 AGSGDP_{t-i} + \sum_{i=0}^{q5} \theta_6 PCI_{t-i} + \sum_{i=0}^{q6} \theta_7 FDISGDP_{t-i} + \sum_{i=0}^{q7} \theta_8 PNMSGDP_{t-i} + \varepsilon_t \quad (9)$$

$$\boldsymbol{DTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \theta_1 DTGDP_{t-i} + \sum_{i=0}^{q1} \theta_2 TROPENS_{t-i} + \sum_{i=0}^{q2} \theta_3 INFR_{t-i} + \sum_{i=0}^{q3} \theta_4 EXR_{t-i} + \sum_{i=0}^{q4} \theta_5 AGSGDP_{t-i} + \sum_{i=0}^{q5} \theta_6 PCI_{t-i} + \sum_{i=0}^{q6} \theta_7 FDISGDP_{t-i} + \sum_{i=0}^{q7} \theta_8 PNMSGDP_{t-i} + \varepsilon_t \quad (10)$$

$$\boldsymbol{EXTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \theta_1 EXTGDP_{t-i} + \sum_{i=0}^{q1} \theta_2 TROPENS_{t-i} + \sum_{i=0}^{q2} \theta_3 INFR_{t-i} + \sum_{i=0}^{q3} \theta_4 EXR_{t-i} + \sum_{i=0}^{q4} \theta_5 AGSGDP_{t-i} + \sum_{i=0}^{q5} \theta_6 PCI_{t-i} + \sum_{i=0}^{q6} \theta_7 FDISGDP_{t-i} + \sum_{i=0}^{q7} \theta_8 PNMSGDP_{t-i} + \varepsilon_t \quad (11)$$

The optimal lag length selection for the ARDL (p_1, q_1 q_2 q_3 q_4 q_5 q_6 q_7) is also based on AIC, BIC and HQIC information criteria. In the third step, we estimated the short run dynamic coefficients through error correction model. The standard ECM was estimated as follows:

$$\Delta \boldsymbol{TTGDP_t} = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta TTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, \Delta TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, \Delta EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i \, \Delta AGSGDP_{t-i} + \sum_{i=0}^{q5} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0}^{q6} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0}^{q7} \psi_i \, \Delta PNMSGDP_{t-i} + \Omega ECT_{t-1} \quad \varepsilon_t \; (12)$$

$$\Delta DTGDP_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta DTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, \Delta TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, \Delta EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i \, \Delta AGSGDP_{t-i} + \sum_{i=0}^{q5} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0}^{q6} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0}^{q7} \psi_i \, \Delta PNMSGDP_{t-i} + \Omega ECT_{t-1} + \varepsilon_t \quad (13)$$

$$\Delta EXTGDP_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta EXTGDP_{t-i} + \sum_{i=0}^{q1} \Phi_i \, \Delta TROPENS_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta INFR_{t-i} + \sum_{i=0}^{q3} \emptyset_i \, \Delta EXR_{t-i} + \sum_{i=0}^{q4} \varphi_i + \sum_{i=0}^{q5} \delta_i \, \Delta PCI_{t-i} + \sum_{i=0}^{q6} \lambda_i \, \Delta FDISGDP_{t-i} + \sum_{i=0}^{q7} \psi_i \, \Delta PNMSGDP_{t-i} + \Omega ECT_{t-1} + \varepsilon_{t,} \quad (14)$$

Where: ECT_{t-1} is the error correction term lagged by one period, derived from the long-run models (Equation 6, 7 and 8); the parameter Ω measures the speed of adjustment towards long-run equilibrium and the coefficients $\beta_i, \Phi_i, \gamma_i, \emptyset_i, \varphi_i, \delta_i, \lambda_i and \psi_i$represent the short-run dynamics of the model.

RESULTS AND DISCUSSIONS

After estimating an appropriate version of the unrestricted ECM, the Lagrange Multiplier (LM) Test was performed to test the null hypothesis that the errors were serially independent as against the alternative that the errors were serially dependent. In addition to Lagrange Multiplier (LM) test, this study used the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests to determine the stability of the models. These tests were carried out to check the robustness of the model and to ensure that the models were dynamically stable. Finally, the White's (1980) test was performed to test the null hypothesis of no heteroscedasticity in the regression models.

Unit Root Test

The unit root test was conducted to determine the stationarity of the variables using the Augmented Dickey Fuller (ADF) test. Out of a total of the ten variables tested in this study, five variables were shown to be level stationary series I(0) at the 5 percent level of significance. These are total tax

revenue as a share of GDP (TTGDP), domestic tax revenue as a share of GDP (DTGDP), foreign direct investment as a share of GDP (FDI), inflation rate (INFR), share of petroleum and mining in GDP (PNMSGDP). The other five variables were stationary after first difference I(1). These are external tax revenue as a share of GDP (EXTGDP), trade openness (TROPNES), share of agriculture in GDP (AGSGDP), exchange rate (EXR), and per capita income (PCI). Details of the unit root test for each of the ten variables are given in Table 1

Table 1: ADF unit root test of order of integration

LEVEL VARIABLES	ADF STATISTIC	CRITICAL VALUE (5%)	REMARKS	1ST DIFFERENCE ADF STATISTIC	CRITICAL VALUE (5%)	INTEGRATION ORDER
DTGDP	-3.1817	-2.9484	Stationary	-	-	I(0)
FDI	-3.4884	-2.9484	Stationary	-	-	I(0)
INFR	-3.2701	-2.9511	Stationary	-	-	I(0)
PNMSGDP	-3.8149	-2.9484	Stationary	-	-	I(0)
TTGDP	-3.2568	-2.9484	Stationary	-	-	I(0)
AGSGDP	-	-	Non Stationary	-6.1078	-2.9540	I(1)
EXR	-	-	Non Stationary	-3.6494	-2.9511	I(1)
EXTGDP	-	-	Non Stationary	-6.7105	-2.9511	I(1)
PCI	-	-	Non Stationary	-4.9196	-2.9511	I(1)
TROPNES	-	-	Non Stationary	-8.1411	-2.9411	I(1)

ARDL Bounds Estimation

In line with Narayan (2005) and Pesaran *et al* (2001), the following decision rule has been applied in this study:

i. If computed F-statistics is less than lower bound critical values, the null hypothesis cannot be rejected that there is no long run relationship between variables

ii. If computed F-statistics is greater than the upper bound value, it could be claimed that variables used in the model are cointegrated.

iii. If computed F-statistic falls between the lower and upper bound values, then the test results are inconclusive.

As shown in Table 2, the F-statistic values for model I (4.2869) and model II (4.3689) are greater than the critical value of the upper bound, which is 3.39 in each case at the 5 percent level of significance. Therefore, in each case, we reject the null hypothesis and conclude that there exists a long run relationship between total tax revenue and trade liberalization along with the six macroeconomic variables and between domestic tax revenue and trade liberalization along with the six macroeconomic variables. However, for model III, F (1.6894) < p-value (3.39) at the 5% level of significance. We therefore do not reject the null hypothesis and hence conclude that there is no long-run relationship between external tax revenue and trade liberalization along with the six macroeconomic variables.

Long Run Estimates Based on AIC-ARDL (1, 0, 0, 1, 0, 0, 1, 1)

After confirming the existence of long-run cointegration relationship among the variables in models I and II, the long-run relationship between the variables in equations 9 and10 was estimated as specified in Table 3. The optimal ARDL (1, 0, 0, 1, 0, 0, 1, 1) model was selected by the AIC. For model I, the results indicated that the eight variables in aggregate were significant predictors

of total tax revenue in Nigeria. However, when the variables were examined to evaluate their individual contribution to the model, it was found that all of the variables except inflation rate (θ = -0.029, p = 0.5139) made a significant contribution to the model that predicted total tax revenue in Nigeria.

Table 2: Results of ARDL bounds test

	MODEL I (TTGDP)		**MODEL II (DTGDP)**		**MODEL III (EXTGDP)**	
Test Statistic	Value	K	Value	K	Value	k
F-statistic	4.286890	7	4.368867	7	1.689388	7
Critical Value Bounds						
	Model I		Model II		Model III	
Significance	I(0) Bound	I(1) Bound	I(0) Bound	I(1) Bound	I(0) Bound	I(1) Bound
10%	1.95	3.06	1.95	3.06	1.95	3.06
5%	2.22	3.39	2.22	3.39	2.22	3.39
2.5%	2.48	3.70	2.48	3.70	2.48	3.70
1%	2.79	4.10	2.79	4.10	2.79	4.10

Source: Author's Computation Extract from Eviews 9.0

For model II, the eight variables in aggregate were also significant predictors of domestic tax revenue in Nigeria. However, when the variables were examined to evaluate their individual contribution to the model, it was found that all of the variables except foreign direct investment (θ = -2.3026, p = 0.3629) made a significant contribution to the model that predicted domestic tax revenue in Nigeria. Results showed that no cointegration relationship existed between the variables in model III as shown in Table 3 and as earlier indicated in Table 2 where F (1.6894) < p - value (3.39) at the 5% level of significance.

Table 3: Long run coefficients

VARIABLE	**MODEL I (TTGDP) COEFFICIENT**	***P*-VALUE**	**MODEL II (DTGDP) COEFFICIENT**	***p*-VALUE**	**MODEL III (EXTGDP) COEFFICIENT**	***p*-VALUE**
TROPNES	0.0263	0.039	0.0341	0.040	-	-
INFR	-0.0286	0.513	-0.025	0.020	-	-
EXR	0.0595	0.001	0.0632	0.000	-	-
AGSGDP	-0.6322	0.048	-0.5528	0.004	-	-
PCI	-0.0032	0.016	-0.0027	0.014	-	-
FDI	-2.8797	0.053	-2.3026	0.362	-	-
PNMSGDP	0.4373	0.049	0.3723	0.020	-	-
Constant	27.9778	0.001	22.6119	0.001		

Source: Author's Computation Extract from Eviews 9.0

Short Run estimates based on AIC-ARDL (1, 0, 0, 1, 0, 0, 1, 1) for Models I and II and based on VAR Lag Order Selection Criteria for Model III

The results are presented in Table 4. As observed from the table, the lagged error correction terms (ECM) for models I and II have negative coefficients (-0.9430 and-1.0199,

respectively) which are statistically significant at the 1% significance level. By these results, the variables measured in the first and second models are in each case significantly cointegrated and any disequilibrium produced by shocks of previous years would converge back to the long-run equilibrium in the current year at the speed of 94% and102%, respectively. The short-run coefficients in Table 4 account for short-run fluctuations not due to deviations from the long-run equilibrium. These results simply showed that in cases of short run shocks, our variables are likely to respond appropriately to equilibrium except in the case of external tax revenue. The results also imply that the variations in both total tax revenue and domestic tax revenue in Nigeria during the period under review were explained in the short-run by trade liberalization along with the other six variables examined in each case. These explain equations 12 and 13. For model III, after confirming that no cointegration relationship exists between the variables, we estimated the short run model using the VAR lag order selection criteria. Equation 14 therefore showed no statistical significance.

Table 4: Cointegration form

VARIABLE	MODEL I (TTGDP) COEFFICIENT	*p*-VALUE	MODEL II (DTGDP) COEFFICIENT	*p*-VALUE	MODEL III (EXTGDP) COEFFICIENT	*p*-VALUE
D(TROPNES)	0.0248	0.594	0.0348	0.004	0.0087	0.485
D(INFR)	-0.026	0.496	-0.0254	0.466	-0.0091	0.303
D(EXR)	0.0071	0.806	-0.0051	0.841	0.0027	0.793
D(AGSGDP)	-0.5963	0.073	-0.5638	0.036	-0.0231	0.741
D(PCI)	-0.0030	0.017	-0.0028	0.015	0.0002	0.711
D(FDI)	1.1245	0.661	1.0512	0.646	-0.1358	0.824
D(PNMSGDP)	-0.3876	0.529	-0.3330	0.544	0.0220	0.877
CointEq(-1)	-0.9429	0.000	-1.0198	0.000	-0.0740	0.632

Source: Author Computation extract from Eviews 9.0

Table 5: Breusch-Godfrey Serial Correlation LM Test

		MODEL I	
F-statistic	0.0721	Prob. F(2,19)	0.930
Obs*R-squared	0.2637	Prob. Chi-Square (2)	0.876
		MODEL II	
F-statistic	0.0312	Prob. F(2,19)	0.969
Obs*R-squared	0.1147	Prob. Chi-Square (2)	0.944

Heteroscedasticity Test Using the White Test

A White test for heteroscedasticity was carried out for models I and II. As observed from the results presented in Table 6, since the White test statistic is not larger than the critical Chi-square value and that each F (13,21) has a *p*-value greater than 0.05, we therefore do not have a problem with heteroscedasticity. We do not reject the null hypothesis and hence conclude that there is no heteroscedasticity in the estimated models.

Table 6: Heteroscedasticity test: white test

MODEL I			
F-statistic	0.3017	Prob. F(13,21)	0.9849
Obs*R-squared	5.5082	Prob. Chi-Square(13)	0.9622
Scaled explained SS	1.3750	Prob. Chi-Square(13)	1.0000
MODEL II			
F-statistic	0.3018	Prob. F(13,21)	0.9849
Obs*R-squared	5.5103	Prob. Chi-Square(13)	0.9622
Scaled explained SS	1.1591	Prob. Chi-Square(13)	1.0000

Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) Tests for Stability

In addition to the Lagrange Multiplier (LM) test performed above, the cumulative sum (CUSUM) of recursive residuals and cumulative sum of squares (CUSUMSQ) of recursive residuals tests were performed to investigate the stability of our models. The graphs of both CUSUM and CUSUMSQ (for both Model I and Model II indicate that there is no instability in the coefficients as the plots of the graphs are confined within the 5 per cent critical bounds of parameter stability, suggesting that all the coefficients of the estimated ARDL models are stable over the period under review (see Figures 1, 2, 3 & 4 below).

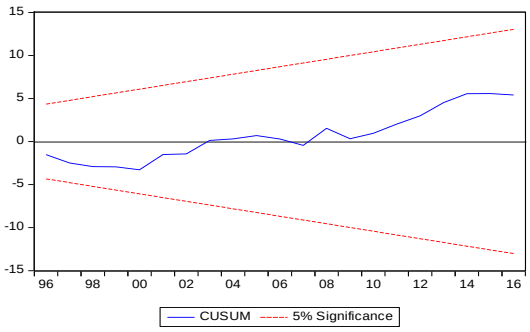

Figure 1: Graph of CUSUM showing stability (Model I)

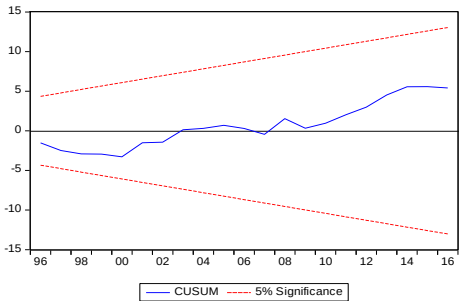

Figure 2: Graph of CUSUMSQ showing stability (Model I)

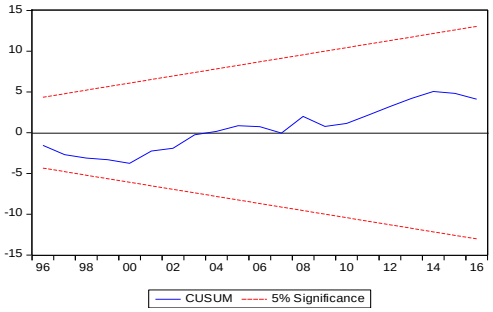

Figure 3: Graph of CUSUM showing sability (Model II)

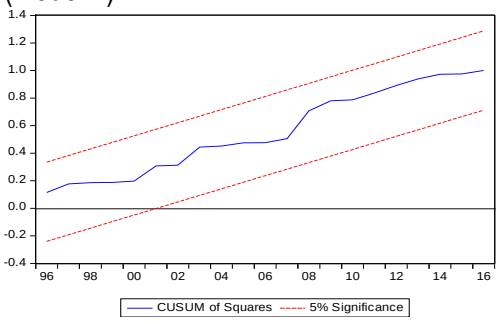

Figure 4: Graph of CUSUMSQ showing stability (Model II)

CONCLUSION

The study sought to ascertain the effect of trade openness on tax revenue performance in Nigeria. The findings indicated trade liberalization to be the main driver of both total and domestic tax revenues in Nigeria. For every unit increase in trade liberalization the gains in both total and domestic tax revenue rose by about 3 percent. However, trade liberalization and the macroeconomic variables were found to have no long and short run relationship with external tax revenue for the period under review. A number of reasons could be responsible for this and further research may be intended to investigate into this. As found in this study, except inflation rate, all other macroeconomic variables were found to predict total tax revenue, and except foreign direct investment, all other macroeconomic variables predicted domestic tax revenue.

In order to improve Nigeria's total and domestic tax revenues, this study suggests that trade liberalization policies may be implemented, while appropriately regulating key macroeconomic variables such as exchange rate, inflation rate, per capita income, foreign direct investment, share of agriculture in GDP and share of petroleum and mining in GDP.

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