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The Response of Aggregate Output to Taxes on Products in Nigeria

Ubong Edem Effiong[1], Alex Oisaozoje Iriabije[2], Nora Francis Inyang[3]

Abstract: The aim of this study was to examine how aggregate output responds to shocks in tax on products within the Nigerian economy. To capture such shocks, we utilized quarterly data from 2010Q1 to 2020Q4 which gives us a total of 44 observations. The data was analysed using *Granger Causality Test (GCT), Vector Autoregression (VAR), Impulse Response Function (INFs), Variance Decomposition (VD), and threshold regression.* From the GCT, it was discovered that a one-way causality runs from TAX to GDP thus supporting the fact that it is taxes that causes GDP and not the other way around. The VAR estimates revealed that GDP is strongly endogenous in predicting itself and TAX was also strongly exogenous in predicting GDP in the second period. The IRFs indicated that GDP respond negatively to shocks in TAX in the short-run; but responded positively to such innovations in the long-run. The VD captured the fact that GDP is strongly endogenous in the short-run while in the long-run, TAX also contributed significantly to the aggregate forecasting error variance in GDP. The optimal tax threshold in this study was estimated to be about 159.5774 billion. The paper concludes by asserting that proper fiscal policy that ensures sustainable taxation should be put in place to avoid the crowding out of domestic production.

Keywords: Aggregate Output; Tax on Products; Fiscal Policy; VAR; Nigeria.

JEL Classification: C22; E23; E62; H21; H32

1. Introduction

Taxation is meant to accumulate revenue for public expenditure, to redistribute income, stabilize the economy, overcome externalities, affect resource allocation, and to be supportive of economic progress. The goal of economically structured taxes is to fulfil desired fiscal policy objectives (allocation, redistribution, and stabilization) in the most efficient way possible, namely by reducing undesirable distortions, decreasing tax collecting costs, and boosting economic growth (Stoilova & Patonov, 2017).

The effectiveness of taxes, particularly the tax structure, is critical to achieving economic development and budgetary consolidation. Taxation, with the exception of lump sum taxes, produces distortions that have a detrimental influence on economic growth, according to economic theory. Considering a basic production function, it is clear that taxes may influence growth by influencing physical capital, human capital, and total factor productivity (Stoilova & Patonov, 2017). According to McBride (2012), corporate and personal income taxes are the most damaging to growth, whereas consumption, environmental, and property taxes are less so (OECD, 2008).

[1] Department of Economics, University of Uyo, Nigeria, Corresponding author: ubongeffiong3@gmail.com.
[2] Department of Economics, University of Uyo, Nigeria.
[3] Department of Economics, University of Uyo, Nigeria.

Taxation generates a predictable and reliable stream of cash that may be used to fund development goals. As a result, an effective and efficient tax system can help the government generate enough revenue to cover its estimated expenditures, meet the needs of the people, and meritoriously partake in the global economy, refining people's quality of life by providing access to education, enhanced healthcare supply, job opportunities, clean air, safe drinking water, and the security of life and property (Pfister, 2009).

Taxes on products in the Nigerian economy maintained a steady increase in the 1980s and rose sharply in the early 2000s. Such behaviour is presented in Figure 1 where the unit of measurement is in billions of naira.

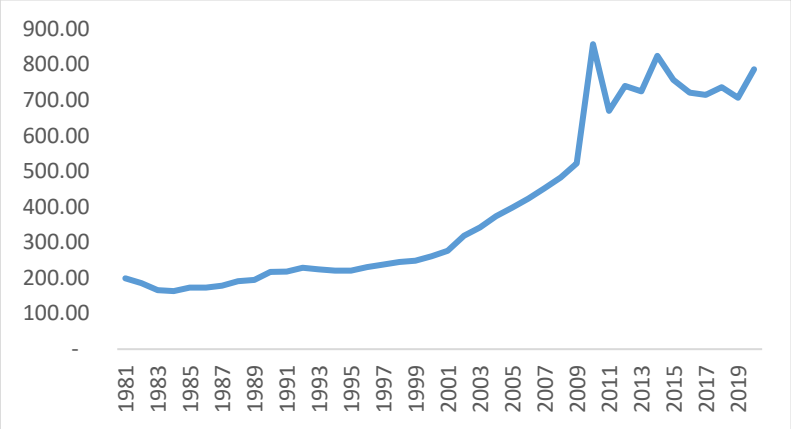

Figure 1. Net Taxes on Products (1981 – 2020).

There have been some swings the value of taxes on products beginning from 2009 to 2020. The value stood at ₦857.09 billion in 2010 and declined to ₦724.12 billion in 2013. It later rose to 824.67 billion in 2014 with a subsequent decline to ₦714.71 billion and ₦706.27 billion as at 2017 and 2019 respectively. In 2020, the value of taxes on products was valued at ₦786.17 billion (CBN, 2020). These fluctuations in the value of taxes on products is worth examining to trace its influence on the aggregate output of the economy.

Understanding the influence of taxation on economic growth and development may be approached from two perspectives: the conventional economic school and the current school of thought (Yaro & Adeiza, 2021). In the classic economic school, Robert Barno (2005), views expressed in the work of Slemrod (2003), low tax rates and low government expenditure were associated with stronger growth while maintaining other factors of growth constant. This suggests that the higher the marginal tax rate, the more likely it is that higher-income tax payers will shift extra time away from productive operations and toward leisure pursuits.

The notion that taxes have an influence on economic growth (Atan, Hasan & Yalcin, 2015) has become politically divisive. This is due, in part, to differing beliefs about what drives economic growth. Some believe in Keynesian, demand-side variables, while others believe in Neo-classical, supply-side ones, while still others believe in a combination of the two or something altogether distinct. Facts, such as historical and regional diversity in crucial characteristics, should throw light on the dispute. However, the economy is complicated enough that almost every hypothesis may find some support in the data. As such, this study is geared towards achieving the following objectives:

i. To investigate the response of aggregate output to taxes on products in Nigeria;

ii. To examine the effect of taxes on product on aggregate output in Nigeria; and

iii. To ascertain the threshold of taxes on products in Nigeria.

The rest of the paper follows the literature review in section 2; the methodology in section 3; empirical findings in section; and the conclusion in section 5.

2. Review of Related Literature

2.1. Theoretical Literature Review

Key theories of interest include the concentration theory, the diffusion theory, the demand and supply theory, and the allocational and efficiency effect of the tax.

The Concentration Theory

The Physiocrats and classical economists supported this view. According to their view, the incidence of a tax falls on a certain segment of income earners who are seen to be appropriating the excess output. The thesis identified landlords as the ultimate bearers of the tax burden since they are the appropriators of excess products in the form of rents. They believed that if a tax was put on any segment of the economy, such as peasants, it would be moved to agricultural rents due to the economy's interdependence.

The Diffusion Theory

According to this view, the incidence of taxation is adequately distributed in the economic system since every factor's earnings contain an element of rent or excess. As a result of the economic system's interdependence, a tax levied in one location may be moved to multiple areas of the economy.

It follows from this reasoning that it makes little difference where the taxes are levied in the initial place since the tax will eventually be broadly distributed. Musgrave disagreed with this result, arguing that we should distinguish between the tax's incidence and its effect. The authorities should not be oblivious to these many consequences. Furthermore, the theory has been chastised for its unrealistic assumption of a perfectly competitive market.

The Demand and Supply Theory

In keeping with this theory, tax incidence can only be altered two main aspects: sales/purchase transactions and price changes. The tax can only be attuned by shifting the demand and/or supply curves, and the spreading of the incidence is governed by the ‘demand and supply elasticities. As a general rule, the portion of the tax liability endured by the vendor will be greater if the product's demand elasticity is greater, and vice versa. Equally, if the product has a greater supply elasticity, the buyer will bear a greater chunk of the tax affliction.

The Allocational and Efficiency Effect of the Tax

The tax has the effect of changing the relative pricing of various commodities, causing consumers to reallocate their spending habits. When a sales tax raises the price of one product relative to another, the customer will lower their purchase of the costlier commodity while increasing their purchase of the

other. As a result, production will change, with resources shifting from the manufacture of the taxed item with low demand to the production of the other commodity with high demand.

2.2. Empirical Literature Review

Barro and Redlick (2009) discover that average marginal income taxes were stifling economic development in the US from 1912 to 2006. However, they have presented an intriguing case that the tax has no link to growth during conflict. Ljungqvist and Smolyansky (2016) utilize firm level data from 1970 to 2010 to answer the question of whether corporation tax increases kill employment in the US. The paper's major conclusion is that raising corporation taxes is bad for employment and income while having little effect on economic activity.

Okafor (2012) used Gross Domestic Product (GDP) data from 1981 to 2007 to investigate the link between federally produced money and Nigerian economic progress. The study's findings revealed a favorable and substantial link between Nigeria's income tax revenue cum the country's economic development. Bukie and Adejumo (2013) looked studied the waves of tax revenue on Nigerian 'economic growth' from 1970 to 2011, regressing 'economic growth' indices (domestic investment, labour force, and foreign direct investment) on tax revenue. Domestic investment, labour force, and foreign direct investment all have a positive and substantial link with economic growth, according to the results.

Olatunji and Adegbite (2014) investigated the impact *of petroleum profit tax, interest rate, and money supply* on the Nigerian economy from 1970-2010; multiple regression was used to examine the link between the variables. The research indicated that the *Petroleum Profit Tax* had a beneficial short-run effect on economic growth. This shows that petroleum has a favourable impact on revenue generation.

Cornelius *et al*. (2016) scrutinised the influence of tax income on the Nigerian economy. Their findings demonstrated a substantial association between 'petroleum profit tax' and Nigerian economic growth, but no significant relationship between firm income tax and Nigerian economic growth. They concluded and urged that the government attempt to give social amenities to the nooks and crannies of the country; participate in a full reform of the tax administration machinery; and eliminate tolerable issues of tax evasion.

Using the error correction model, Mdanat *et al*. (2018) discover that income tax, corporate tax, and personal tax all have a negative influence on growth in Jordan. They argue that, regardless of tax collection, the government's primary priority should be on people's social justice. Dladla and Khobai (2018) find comparable results in South Africa, where income taxes are negative. Federici and Parisi (2015) analysed data from 880 enterprises in Italy to demonstrated that 'corporation tax' is harmful for investments when both 'effective average' and 'marginal tax rates' are considered.

Odhiambo and Olushola (2018) used Nigeria as a case to scrutinise the link between taxes and resource-rich country's 'economic growth'. The study investigated the relationships between increased resource revenue availability and condensed taxation strength of extra revenue sets, plus their effects on growth. The stated model was estimated by means of the OLS estimation approach. Taxation has a momentous influence on 'real GDP growth rates', according to empirical findings. However, with respect to the

volume of economic activity and total output value, the share of tax influence to growth rate falls below the best situation.

Dibia and Onwuchekwa (2019) investigated the link between taxation and Nigerian economic development in their study. It explicitly investigated the relationships between firm income tax, 'petroleum profit tax', and Nigerian economic growth as captured by 'real gross domestic product' (RGDP), utilizing time series data from 1981 to 2016. The *Ex Post-Facto* study design was used. According to the findings, the 'petroleum profit tax' (PPT) and 'corporate income tax' (CIT) have a positive and substantial influence on Nigeria's RGDP.

For the period 1991–2016, Neog and Gaur (2020) investigated the long-run and short-run link amid tax structure and state-level growth performance in India. The panel regression approach was utilized to verify the link amid taxes and economic development, which is based on the model of Acosta-Ormaechea and Yoo (2012). Using data from 14 Indian states, Panel Pool mean group estimate shows that income and commodity–service taxes have a negative influence on state economic growth, but property and capital transaction taxes have a substantial beneficial effect. According to this analysis, there is a U-shaped link amid tax structure and growth performance.

3. Methodology

3.1. Model Specification

The model for this study is captured as:

$$GDP_t = f(TAX_t) \quad (1)$$

Where:

GDP = Gross Domestic Product (Aggregate Output)

TAX = Tax on Products.

The above model is transformed into its estimable form based on the analytical approach to be employed. This is clearly done in section 3.3 below.

3.2. Data and Sources of Data

The data were collected on the two variables of interest being gross domestic product (aggregate output) and taxes on product. The data covers the first quarter of 2010 (2010Q1) to the fourth quarter of 2020 (2020Q4). This constitutes a total of 44 observations which is long enough for us to capture the volatility in the variables over time. The data on the two variables were obtained from the Central Bank of Nigeria statistical bulletin.

3.3. Analytical Technique

The data were analysed using the technique of Granger causality test, vector autoregression (VAR), impulse response function (IRFs), variance decomposition, and threshold regression.

3.4. Granger Causality

The Granger causality test is used to ascertain the pattern of the causal link that exist amid aggregate output and taxes on products. The model of the test is specified as follows:

$$GDP_t = \emptyset + \sum_{k=1}^{k} \delta_1 GDP_{t-k} + \sum_{k=1}^{k} \delta_2 TAX_{t-k} + \varepsilon_{1t} \quad (2)$$

$$TAX_t = \theta + \sum_{j=1}^{j} \gamma_1 GDP_{t-j} + \sum_{j=1}^{j} \gamma_2 TAX_{t-j} + \varepsilon_{2t} \quad (3)$$

The model simply states that the current value of GDP is determined by the past value of GDP and the past values of TAX; and the current value of TAX is defined by the past value of GDP and the past value of TAX. An estimation of the above model can yield different result depending on the significance of the test statistic (F-statistic). We can have situation of no causality, unidirectional causality, and bidirectional causality.

3.5. VAR Model

The VAR model is utilized to detect the response of GDP to shocks in TAX. The model is specified based on the VAR(2) framework. The choice of the framework has been justified via the optimal lag length selection. The VAR model is specified thus:

$$GDP_t = \beta_{10} + \beta_{11} GDP_{t-1} + \beta_{12} GDP_{t-2} + \gamma_{11} TAX_{t-1} + \gamma_{12} TAX_{t-2} + \mu_{1t} \quad (4)$$

$$TAX_t = \beta_{20} + \beta_{21} GDP_{t-1} + \beta_{22} GDP_{t-2} + \gamma_{21} TAX_{t-1} + \gamma_{22} TAX_{t-2} + \mu_{2t} \quad (5)$$

The VAR model is estimated through a simultaneous equation model approach and this is done quite easily with the use of our econometric software. This is followed by estimating the associated impulse response function and the variance decomposition.

3.6. Threshold Regression

The threshold regression is carried out to detect the optimal tax on products that will not be detrimental on aggregate output. The threshold equation is specified as follows:

$$GDP_t = \gamma_{TAX} + \beta_1 d_t^{TAX}(TAX_t - TAX^*) + \beta_2(1 - d_t^{TAX})(TAX_t - TAX^*) + \delta_{TAX}\mu_{t-1} + \varepsilon_t \quad (6)$$

Where GDP is a measure of aggregate output; TAX is the taxes on products; d is the dummy variable; and μ_{t-1} is an autoregressive component employed to clear up the influence of other control variables with δ as the corresponding coefficients. The influence of TAX is captured by β_1 for periods in which the taxes on products is greater than the threshold (the high TAX regime) while represents the influence of TAX on GDP when the taxes on product is lower than the threshold value (the low TAX regime).

4. Empirical Results

The empirical result proceeds from Granger causality test to the VAR estimation, and then to the threshold regression.

4.1. Granger Causality Test

The Granger causality test ascertains the pattern of the linkages amid GDP and TAX. The result is presented in Table 1 below.

Table 1. Pairwise Granger Causality Test

Null Hypothesis:	Observations	F-Statistic	Prob.
TAX does not Granger Cause GDP	42	20.3387	0.0000
GDP does not Granger Cause TAX		1.46868	0.2433

The result form the *Pairwise Granger causality test* showcases evidence of a unidirectional causality flowing from TAX to GDP. As such, TAX causes GDP and the reverse does not hold. This will require the estimation of a VAR model to ascertain the response of GDP to shocks in TAX.

4.2. Lag Selection

The Lag selection is done to detect the optimal lag length to be included in the VAR estimation. The choice of the lag length is premised upon the selection criteria with the minimum value. The result is as captured in Table 2 below.

Table 2. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-576.2439	NA	3.12e+09	27.53542	27.61817	27.56575
1	-555.7802	38.00401	1.42e+09	26.75144	26.99967	26.84243
2	-532.5477	40.93333*	5.71e+08*	25.83561*	26.24934*	25.98725*

*Note: * denotes lag order selection by criterion; LR is the sequential modified LR test statistic (at 5% level); FPE is the final prediction error; AIC is the Akaike information criterion; SC is the Schwarz information criterion; and HQ is the Hannan-Quinn information criterion*

From Table 2, all the selection criterion (AIC, SC, and HQ) indicates that the optimal length is lag 2. This is because the criterion produced the minimum value at the stated lag length. As such, our VAR model is estimated based on VAR(2) model.

4.3. VAR Estimation

The result of our VAR(2) result is presented in Table 3 as follows.

Table 3. VAR Estimation Result

	GDP	TAX
GDP(-1)	0.452978	0.003073
	(0.18924)	(0.00566)
	[2.39362]	[0.54262]
GDP(-2)	0.232058	-0.006778
	(0.17393)	(0.00520)
	[1.33423]	[-1.30223]
TAX(-1)	-2.922547	-0.070998
	(5.37349)	(0.16080)
	[-0.54388]	[-0.44153]
TAX(-2)	-27.41625	-0.680630
	(5.02809)	(0.15046)
	[-5.45261]	[-4.52356]
C	10940.70	384.8131
	(1653.77)	(49.4883)
	[6.61563]	[7.77585]
R-squared	0.710161	0.579849
Adj. R-squared	0.678827	0.534427

Note: *Standard errors in ( ) & t-statistics in [ ]*

From the VAR estimates, GDP is strongly endogenous in predicting itself in the one-period lag. As such, the past realization in linked with a 0.45% increase in GDP. Tax is also strongly exogenous in predicting GDP in the two-period lag. Hence, the negative effect of tax on GDP is characterised with the fact that a unit percent increase in will lead to a 27.42% decrease in GDP. Further, TAX is strongly endogenous in predicting itself only in the two-period lag. This is followed by the fact that the past realization in TAX accounts for about 0.68% decrease in TAX. Meanwhile, GDP is weakly exogenous in predicting TAX. The R-squared in our GDP model indicates that the lags of GDP and TAX explains 71.02% of the total variations in the current GDP; while that of the TAX model indicates that the lags of GDP and TAX explains only 57.98% of the total variations in TAX.

Since TAX is strongly exogenous in predicting GDP, we therefore trace the response of GDP to shocks in TAX. Thus, we compute in Impulse Response Functions (IRFs) and the Variance Decomposition (VD) of the variables over time.

4.4. Impulse Response Function (IRFs)

The IRFs helps us to detect the response of GDP to innovations or shocks in TAX. The result is portrayed in Figure 2, where we captured the response of the variables to a *one standard deviation innovation* in the explanatory variable.

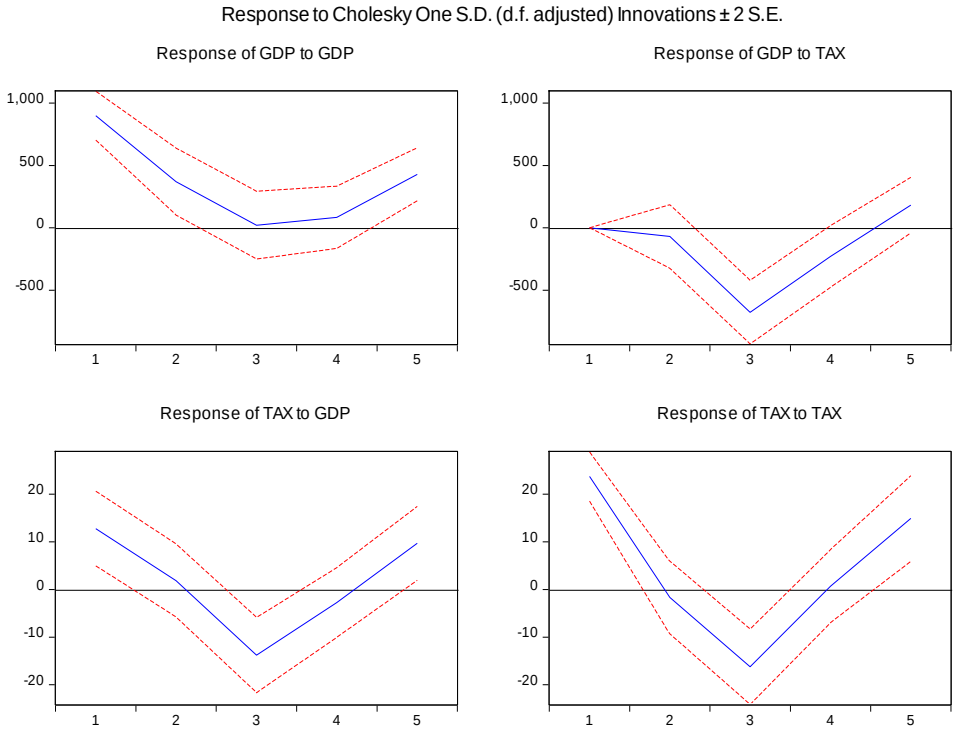

Figure 2. Response to Shocks in the Model

As captured in Figure 2, GDP responds negatively to shocks in TAX from the first period up to the third period, and then respond positively to such shocks from the third period to the fifth period. The proportion of such response is captured by our estimated variance decomposition.

4.5. Variance Decomposition (VD)

The VD indicates the proportion of the forecasted error variance that is being explained by the shocks in other variable over time. The result of such is portrayed in Table 4 below.

Table 4. Decomposition of the Error Variance

Variance Decomposition of GDP: Period	S.E.	GDP	TAX
1	899.9476	100.0000	0.000000
2	975.6487	99.49522	0.504780
3	1187.575	67.18596	32.81404
4	1212.435	64.94991	35.05009
5	1298.994	67.49473	32.50527
Variance Decomposition of TAX: Period	**S.E.**	**GDP**	**TAX**
1	26.93055	22.43319	77.56681
2	27.04716	22.71299	77.28701
3	34.42292	30.03622	69.96378
4	34.53805	30.46208	69.53792
5	38.83625	30.31177	69.68823

Cholesky Ordering: GDP TAX

The VD of GDP indicates that GDP is strongly endogenous from period one to period two where it accounts for 100% and 99.50% of its forecasted error variance in the first and second period respectively. In the same period, TAX is weakly exogenous in predicting GDP since t contributed nothing to its forecasted error variance in the first period and a meagre 0.50% in the second period. As such, GDP is strongly endogenous in the short-run while TAX is weakly exogenous in predicting GDP in the short-run. From period 3 to period 5, we observe that TAX exhibited greater influence on GDP. For example, it contributes about 32.81% to the forecasted error variance in period 3, and this rose to about 35.05% in the fourth period. This declined to 32.50% in the fifth period. As such, TAX exerts some greater long-run influence on GDP within the study period.

The VD of TAX indicates a shared influence of both GDP and TAX on TAX. In the first period, GDP accounts for about 22.43% of the forecasted error variance in TAX and this rose significantly in the long-run to about 38.84% in the fifth period. Meanwhile, TAX accounted for 77.57% of its forecasted error variance in the first period while it declined steadily to 69.69% in the fifth period. This means that TAX is strongly endogenous both in the short-run and in the long-run. however, GDP remained fairly strongly exogenous in predicting TAX both in the short-run and in the long-run.

4.6. Post Estimation Test

The post estimation test includes the stability test, and the heteroscedasticity test.

4.6.1. Stability Test

The stability test is conducted using the *Roots of Characteristic Polynomials* (RCP) and the *Inverse Roots of the AR Characteristic Polynomial* (IRARCP).

Table 5. Roots of Characteristic Polynomial (RCP)

Root	Modulus
0.022259 - 0.908774i	0.909046
0.022259 + 0.908774i	0.909046
0.835413	0.835413
-0.497952	0.497952

The result from the RCP shows that none of the modulus are statistically significant. This can further be illustrated using the IRARCP.

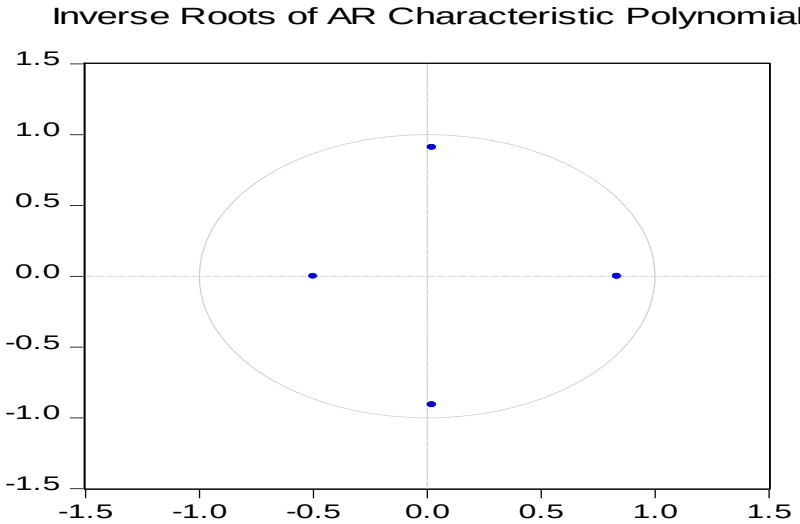

Figure 3. Inverse Root of the AR Characteristic Polynomial Test for Stability

It is observed from the above that *no root lies outside the unit circle*. As such, the stability condition is being satisfied by the VAR.

4.6.2. Heteroscedasticity Test

The heteroscedasticity test is conducted based on the levels and squares approach. This captures both the joint and individual components of the residuals.

Table 6. VAR Residual Heteroskedasticity Tests (Levels and Squares)

Joint test:					
Chi-square	df	Probability			
29.80691	24	0.1912			
Individual components:					
Dependent	R-squared	F(8,33)	Probability	Chi-square(8)	Probability
res1*res1	0.121320	0.569543	0.7950	5.095452	0.7473
res2*res2	0.072941	0.324557	0.9507	3.063542	0.9303
res2*res1	0.314490	1.892415	0.0948	13.20857	0.1049

At both the joint and individual components, it is observed that the Chi-Square statistic are not statistically significant at the 5% level. As such, the null hypothesis of no heteroscedasticity is rejected at the 5% level. Thus, there is homoscedasticity (constant variance of the error term).

4.7. Threshold Regression

In ascertaining the optimal threshold of tax on products that will not retard aggregate output, the threshold regression is employed as follows.

Table 7. Discrete Threshold Regression Result

Threshold variable: TAX

Variable	Coefficient	Standard Error	t-Statistic	Probability
TAX < 159.5774 -- 12 observations				
TAX	114.1992	3.362297	33.96465	0.0000
159.5774 <= TAX < 206.9 -- 16 observations				
TAX	87.20067	2.288161	38.10949	0.0000
206.9 <= TAX -- 16 observations				
TAX	74.34427	1.794453	41.43004	0.0000

From the threshold regression result, three threshold levels for tax has been identified. At the threshold level of tax being less than 159.5774 billion (with 12 observations being captured), the aggregate output will increase by 114.1992 billion. Meanwhile, at the threshold level of tax being in the range of 159.5774 billion to 206.9 billion (with 16 observations), the aggregate output tends to grow by 87.20067 billion. And then, at the threshold level of tax greater than 206.9 billion (with 16 observations), aggregate output increases by 74.34427 billion. It is evident that both at the upper and lower threshold levels, the coefficients have the same sign and thus, the nonlinearity effect is absent. The result indicates that lower tax level encourages growth than higher taxes. Hence, the optimal threshold level of tax is 159.58 billion.

5. Conclusion

Taxation can drive down the productivity in diverse sectors due to his allocational effect. This will impede investment which hitherto leads to a decline in aggregate production. In these regards, this paper examined the response of aggregate output to shocks in taxes on product in Nigeria from 2010Q1 to 2020Q4. To achieve the set objective, we utilized the Granger causality test, VAR, Impulse Response Function, and the variance decomposition, and the threshold regression. The Granger causality revealed that TAX Granger Causes GDP. This means that a unidirectional causality runs from TAX to GDP. In the VAR result, it was observed that GDP is strongly endogenous in the short-run, accounting to about 0.45% of its increase. Meanwhile, TAX was also seen to be strongly exogenous in influencing GDP. This is captured with the fact that a unit percent increase in TAX will lead to a 27.42% decrease in aggregate output. The IRFs indicated that GDP responded negatively to shocks in GDP from the first period through the third period, but responded positively to shocks in TAX throughout the long-run. The variance decomposition further approved of the fact that GDP is strongly endogenous in the short-run but TAX exerted more influence in the long-run. The threshold regression informed us of the fact that the optimal tax on product should be put at 159.5774 billion. Anything above this value will have a detrimental impact on the aggregate output of the economy. As such, this paper concludes that proper

fiscal policy that ensures sustainable taxation should be put in place to avoid the crowding out of domestic production.

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