INVESTMENT-SAVINGS GAP AND PUBLIC DEBT SUSTAINABILITY IN NIGERIA

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ABSTRACT
This study evaluates the transmission mechanism from investment-savings gap to public debt sustainability through revenue channel in Nigeria using annual data from 1970 to 2021. The theoretical foundation of the paper is rooted in the two gap model. The procedure involves impulse response functions and variance decomposition analyses which have been used to summarise/interpret the Structural Vector Autoregressive model used for estimation. Empirical evidence suggests that negative shocks to investment-savings gap will cause an increase in revenue which will in turn impact public debt sustainability negatively. The researchers conclude that the positive effect of investment-savings gap on revenue is not communicated to public debt sustainability. The recommendations include blocking of revenue leakages through elimination of corruption. Secondly, implementation of an appropriate mix of tax and income policies should be pursued to generate more savings for investment and hence more revenue to address the debt problem.

Keywords: Investment, savings, revenue effect, debt sustainability, fiscal reaction function, debt threshold, two gap model, SVAR
JEL Classification: E21, E22, H62, H63

1. INTRODUCTION
Debt Management Office DMO (2021) reports that the issue of debt sustainability in Nigeria started in the 1970s when the Government borrowed heavily for reconstruction and development projects after the Civil War. Nneka and Dambatta (2021) noted that to meet the revenue requirements, the Government borrowed from multilateral institutions such as the International Monetary Fund (IMF) and the World Bank, and bilateral creditors establishing the Paris Club. DMO (2021) stressed that the oil glut of 1982 produced revenue shortfalls and the Government was unable to pay the heavy loans incurred. This led to increase in interest payments and penalties, triggering a debt crisis. In 2005, a debt relief of US$30 billion due to Paris Club was negotiated. Out of this amount, US$18 billion was cancelled while Nigeria paid the balance of US$12 billion. After the debt relief, the country has again accumulated high debt including from non-Paris Club sources like China, bondholders and private banks. Nigeria now ranks high in Sub- Saharan African as one of the most heavily indebted economy with poor growth rate, increasing poverty level and dwindling revenue (Mobosi & Madueme, 2016; Ebhotemhen, 2020; Yusuf & Mohd, 2021). Debt service payments presently constitute a significant share of recurrent expenditure and government revenue (Hammanjoda, 2020). Debt service as a share of recurrent expenditure has

increased from 23.92% in 2010 to 36.58% (2015) and 58.92% in 2021. Central Bank of Nigeria CBN (2021) reveals that after the 2005 debt relief, debt service as a share of revenue has surged from 23.82% in 2005 to 42.57% (2010) and 96% in 2021. This has overstretched government revenue (Kolawole, 2019) against which the IMF (2021) has cautioned that Nigeria may spend 100% of its revenue on servicing debt in the near future. This further raises questions on the sustainability of Nigeria's public debt hence the need for investigations and solutions.

While Briceno and Perote (2021); Grosu, Pintilescu and Zugravu (2021); Joy and Panda (2020) have variously used panel models to study public debt sustainability by examining the response of primary balance to debt ratio (fiscal reaction functions FRF), Adeosun, Ayodele, and Jongbo (2021); Alloza, Andres, Perez, and Rojas (2020); Diallo and N'Zue (2021); Gnegne, and Jawadi (2013); Hassan and Meyer (2021); Proano, Schoder, and Semmier (2014) on the other hand concentrated on debt thresholds to investigate the problem. Apart from panel models obscuring the peculiarities of individual countries in the sample, Erasmo, Mendoza, and Zhang (2016) argue that country-specific features like investment-savings (IS) gap may cause various FRF models to manifest different results for the same level of debt and primary balance. The problem of debt sustainability may also begin to manifest even before a country approaches the prescribed debt thresholds/ceilings. Again, since debt thresholds depend on the choice of control variables such as IS gap (Dogan & Bilgili, 2014), Makun (2021); Ouyang, and Rajan (2014) noted that there is no acceptable debt threshold for all countries at the same time.

No study to the knowledge of the researchers has examined the effects of IS gap on public debt sustainability within the setting of country-specific characteristics as outlined in this study. Since Nigeria's debt profile is manifesting a revenue crisis, the objective of this study is to assess the pass-through effects of IS gap to public debt sustainability through the revenue channel in Nigeria.

2. LITERATURE REVIEW

2.1 Conceptual Literature

Definitions of the concept of public debt sustainability (PDS) abound in economic literature. Public debt is sustainable if the current expenditure and tax policies can be continued without triggering an explosive debt path (IMF, 2021) and the government fulfills its debt obligations without recourse to financial assistance or default (Foncerrada, 2005). This definition suggests that a default on debt obligation signals that the debt is no longer sustainable. According to Beqiraj, Fedeli and Forte (2018) PDS requires that the government is capable of repaying its debt in the future beginning with the present. In Nigeria, soaring debt levels over the years have generated concerns on the country's ability to repay and service its debt.

2.2 Theoretical Framework

This study applies the two-gap model. The model developed by Chenery and Strout (1966) discusses among others the savings constraint as a major obstacle impinging the capacity of developing countries to undertake the level of investment needed to attain the desired growth rate of the economy. The rationale for public debt is to supplement domestic investment due to the IS gap. Assuming an open economy, Doki and Abu (2017) in Imoughele (2020) observe that the basic tenet of the two-gap model is that most developing economies encounter deficiency of domestic savings for investment and public debt is used to augment the IS gap so as to cushion the effect of resource constraints. Oligbi (2020) reported that the Nigerian economy is bedeviled by shortage of savings for the requisite level of domestic investment. Owing to the vicious cycle of savings-investment gap causing revenue problems, public debt is used to complement this

investment-savings gap. But the rising debt profile has elicited fears concerning the debt service capacity of the government. Thus this theoretical postulation is applied in this study to explore the effects of IS gap on public debt sustainability in Nigeria.

2.3 Empirical Literature

The two gap model argues that in most countries, inadequacy of savings for the requisite investment has made public debt compulsory to supplement domestic investment caused by the savings-investment imbalance (Chenery & Strout, 1966). But the accumulation of debt has thrown up the challenge of debt repayment/service and hence sustainability issues for many economies of the world.

Various scholars have investigated this problem; Lankester-Campos, Loaiza-Marin and Monge-Badilla (2020) used a positive relationship between primary balance and debt/GDP ratio (Fiscal Reaction Function FRF) as a measure of public debt sustainability in a single country study. The study assessed public debt sustainability in Costa Rica from 1974-2018. The authors adopted fan charts to estimate the FRF put forward by Bohn (2007). Findings established that public debt was not sustainable. A major drawback of this study is that a positive relationship between primary balance and the ratio of debt to GDP is not a sufficient condition for public debt sustainability. Grosu, Pintilescu and Zugravu (2021) extended this study on FRF in a panel study by examining developments in public debt sustainability in 11 EU economies spanning 2000-2019. Applying spline regression, results revealed that public debt was sustainable in a handful of economies with findings further indicating weak sustainability in all the countries examined. These findings imply that debt sustainability cannot be achieved by all countries at the same time; it is a function of prevailing economic conditions such as investment, savings and revenue. Studies such as Erasmo, Mendoza, and Zhang (2016) also estimated a FRF for the United States from 1971-2014 but used a combination of both single case and panel studies. Through the Bohn FRF approach, findings show a positive reaction of primary balance to the debt path, indicating sustainability. Revenue constraints were also found to have impeded fiscal solvency, suggesting the likelihood of default on domestic debt. Different FRFs were found to have yielded dissimilar short and long-run patterns of primary balance and public debt, due to differences in macroeconomic and country-specific effects. This questions the use of FRF as a measure of public debt sustainability.

In another study, Afonso and Jalles (2016) relied on the long-run cointegrating relationship between government expenditure and revenue as a measure of the sustainability of public debt in 18 OECD economies from 1970-2010. The study applied unit root as well as Johansen cointegration test but found no long-run relationship, suggesting that public debt was not sustainable in most of the countries. Results indicated debt sustainability in the case of the United Kingdom, Austria, Sweden, Canada, Netherlands, Japan France, and Germany. A limitation of the study is that though cointegration test may suggest that public debt is sustainable, practical evidence may suggest otherwise. Rather, Briceno and Perote (2021) adopting stationarity of primary surplus/GDP ratio as a measure of sustainability investigated public debt sustainability and its determinants in 19 Eurozone economies in the wake of the COVID-19 pandemic. Through the General Method of Moments (GMM) technique results pointed to a stationary ratio of primary surplus to GDP in Ireland, Italy, Portugal, and Cyprus, suggesting debt sustainability. Findings also revealed an inverse relationship between primary deficit and debt in Cyprus, Ireland and Greece. The use of stationarity test as a measure of public debt sustainability is flawed especially if the ratio of primary surplus/GDP is stationary while the ratio of debt/GDP is stationary but persistent.

Apart from the FRF and stationarity models, other studies on public debt sustainability focused on debt thresholds/ceilings; Dogan and Bilgili (2014) explored the nonlinear effect of external debt component on economic growth in Turkey covering the period 1974-2009. Using the Markov-switching model, results indicated an inverse and nonlinear relationship between external debt and economic growth. The study established that debt thresholds are influenced by choice of control variables such as investment. However, the challenge of most developing economies is the shortage of savings for investment (investment- savings gap). Since debt thresholds depend on the choice of control variables, further studies are needed on public debt sustainability. In this direction, Galstyan and Velic (2017) extended the study to the determinants of debt thresholds in a panel of 10 emerging market economies spanning 1990–2011. The threshold regression found exchange rate differential and inflation responsible for debt thresholds in economies with high debt. The role of exchange rate in debt sustainability could be inferred from its effect on debt service payments on external debt. Diallo and N'Zue (2021) concentrated on the optimal threshold for Guinea (1990-2018) using the Autoregressive Distributed Lag (ADL) approach. Results established a threshold of 25.2% of debt to GDP. The pitfall of threshold analysis is absence of agreement on a common debt ceiling due to peculiarities of individual countries.

From the literature reviewed, the existing gap is that due to country-specific peculiarities, results obtained from panel studies are not generalizable for all countries in the sample. Further, various FRF models are prone to producing different results due to country-specific features and macroeconomic conditions of economies subsumed in the sample. These country-specific features include the IS gap. No study has explored the effect of IS gap on public debt sustainability in the context of structural autoregressive model in a single model as set out in this study.

3. METHODOLOGY

3.1 Model Specification

This research uses Structural Vector Autoregressive (SVAR) model. Unlike the traditional VAR, the SVAR approach relies on economic theory and is used to impose contemporaneous structural restrictions that are in line with a priori expectations and prior knowledge of the Nigerian economy. This enables capturing the relationship among the variables of interest. The objective of this study is to assess the effect of IS gap on public debt sustainability through the revenue channel in Nigeria. To accomplish this, SVAR is essential to evaluating the pass-through effect of IS gap to public debt sustainability through the revenue channel. This brings to the fore the appropriateness of this technique compared to other approaches.

A generic SVAR model is formulated as:

$$A_0 Z_t = A_1 Z_{t_{-1}} + \varepsilon_{it}$$

Where A_0 is an nxn matrix of contemporaneous coefficients; $Z_t =$ nx1 column vector of endogenous variables; $A_1 =$ nxn matrix of lagged endogenous variables; $Z_{t_{-1}} =$ nx1 column vector of lagged endogenous variables; and $\varepsilon_{it} =$ nx1 column vector of error term in the model.

In line with the two gap model, IS gap is expected to affect public debt sustainability. The Nigerian economy is characterized by shortage of savings for the required level of domestic investment. Due to the vicious cycle of savings-investment constraints resulting to revenue challenges, public debt is resorted to in order to supplement this investment-savings gap. The high volume of debt has generated concerns about the debt service capability of the government. The interactions between these variables have been modeled using the Structural Vector Autoregressive (SVAR) approach. Therefore the transmission is expressed as follows:

$$ISGap_t \Rightarrow R_t \Rightarrow PDS_t$$

Where:
ISGap= Investment/Savings Gap; R=government revenue; and PDS= Public Debt Sustainability.
A transposition of this transmission gives:

$$PDS_t = f\left(PDS_{t_{-1}}, R_{t_{-1}}, ISGap_{t_{-1}}, R_t, ISGap_t\right) \quad \text{.....[1]}$$

$$R_t = f\left(PDS_{t_{-1}}, R_{t_{-1}}, ISGap_{t_{-1}}, PDS_t, ISGap_t\right) \quad \text{.....[2]}$$

$$ISGap_t = f\left(PDS_{t_{-1}}, R_{t_{-1}}, ISGap_{t_{-1}}, PDS_t, R_t\right) \quad \text{.....[3]}$$

Normalising the SVAR (1) system of equation produces:

$$PDS_t = \Psi^1_{11} PDS_{t_{-1}} + \Psi^1_{12} R_{t_{-1}} + \Psi^1_{13} ISGap_{t_{-1}} + \Psi^0_{12} R_t + \Psi^0_{13} ISGap_t + \varepsilon_{1_t} \quad \text{.....[4]}$$

$$R_t = \Psi^1_{21} PDS_{t_{-1}} + \Psi^1_{22} R_{t_{-1}} + \Psi^1_{23} ISGap_{t_{-1}} + \Psi^0_{21} PDS_t + \Psi^0_{23} ISGap_t + \varepsilon_{2_t} \quad \text{.....[5]}$$

$$ISGap_t = \Psi^1_{31} PDS_{t_{-1}} + \Psi^1_{32} R_{t_{-1}} + \Psi^1_{33} ISGap_{t_{-1}} + \Psi^0_{31} PDS_t + \Psi^0_{32} R_t + \varepsilon_{3_t} \quad \text{.....[6]}$$

Rearranging the contemporaneous effects to the left hand side (LHS) gives:

$$PDS_t - \Psi^0_{12} R_t - \Psi^0_{13} ISGap_t = \Psi^1_{11} PDS_{t_{-1}} + \Psi^1_{12} R_{t_{-1}} + \Psi^1_{13} ISGap_{t_{-1}} + +\varepsilon_{1_t} \quad \text{.....[7]}$$

$$-\Psi^0_{21} PDS_t + R_t - \Psi^0_{23} ISGap_t = \Psi^1_{21} PDS_{t_{-1}} + \Psi^1_{22} R_{t_{-1}} + \Psi^1_{23} ISGap_{t_{-1}} + \varepsilon_{2_t} \quad \text{.....[8]}$$

$$-\Psi^0_{31} PDS_t - \Psi^0_{32} R_t + ISGap_t = \Psi^1_{31} PDS_{t_{-1}} + \Psi^1_{32} R_{t_{-1}} + \Psi^1_{33} ISGap_{t_{-1}} + +\varepsilon_{3_t} \quad \text{.....[9]}$$

Equations [7]-[9] can be expressed in matrix form as follows:

$$\begin{bmatrix} 1 & -\Psi^0_{12} & -\Psi^0_{13} \\ -\Psi^0_{21} & 1 & -\Psi^0_{23} \\ -\Psi^0_{31} & -\Psi^0_{32} & 1 \end{bmatrix} \begin{bmatrix} PDS_t \\ R_t \\ ISGap_t \end{bmatrix}$$

$$= \begin{bmatrix} \Psi^1_{11} & \Psi^1_{12} & \Psi^1_{13} \\ \Psi^1_{21} & \Psi^1_{22} & \Psi^1_{23} \\ \Psi^1_{31} & \Psi^1_{32} & \Psi^1_{33} \end{bmatrix} \begin{bmatrix} PDS_{t-1} \\ R_{t-1} \\ ISGap_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad \text{.....[10]}$$

Therefore, $A_0 Z_t = A_1 Z_{t_{-1}} + \varepsilon_{it}$ .....[11]

Where, A_0 denotes a 3x3 matrix of contemporaneous coefficients of endogenous parameters. Z_t = nx1 column vector of endogenous variables; A_1 = nxn matrix of lagged endogenous variables; $Z_{t_{-1}}$ = nx1 column vector of lagged endogenous variables; and ε_{it} = nx1 column vector of error term in the model.

The number of parameters in the model exceeds the number of equations. Hence, it cannot be estimated using SVAR. That is, the model is overparameterised. This study imposes certain restrictions on the A_0 matrix for the SVAR (ρ) model to be identified using the recursive method prevalent in empirical literature by setting $-\Psi^0_{12}, -\Psi^0_{13}, -\Psi^0_{23}$ to zero. The restrictions are based on institutional knowledge and economic theory.

The parsimonious form of the SVAR model after the restrictions is:

$$\begin{bmatrix} 1 & 0 & 0 \\ -\Psi^0_{21} & 1 & 0 \\ -\Psi^0_{31} & -\Psi^0_{32} & 1 \end{bmatrix} \begin{bmatrix} PDS_t \\ R_t \\ ISGap_t \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad \text{.....[12]}$$

Where, $\varepsilon_t = \beta\eta$; and

$$\beta = \begin{bmatrix} \delta_1 & 0 & 0 \\ 0 & \delta_2 & 0 \\ 0 & 0 & \delta_3 \end{bmatrix} = Var(\eta) = 1.$$ That is unit variance

$$A_0 = \begin{bmatrix} 1 & 0 & 0 \\ -\Psi_{21}^0 & 1 & 0 \\ -\Psi_{31}^0 & -\Psi_{32}^0 & 1 \end{bmatrix} \begin{bmatrix} PDS_t \\ R_t \\ ISGap_t \end{bmatrix} = \begin{bmatrix} \delta_1 PDS & 0 & 0 \\ 0 & \delta_2 R & 0 \\ 0 & 0 & \delta_3\, ISGap \end{bmatrix} \begin{bmatrix} U_t PDS \\ U_t R \\ U_t ISGap \end{bmatrix} \quad [13]$$

This suggests that the normalized SVAR model, $A_0 Z_t = A_1 Z_{t_{-1}} + \varepsilon_{it}$ becomes $A_0 = \beta\eta_t$. However, since $\beta\eta_t = \beta\mu_t$, the baseline for the estimated model is expressed in its reduced form as follows:

$$A_0 = \beta\mu_t \quad [14]$$

Where, A_0 is matrix of long run contemporaneous coefficients; e_t = error term column vector matrix of the corresponding variables; β = matrix of structural shocks; and μ_t = column vector of structural shocks.

Therefore, the 'S'matrix is expressed as follows:

$$e_t = A_0\,\beta\mu_t = \begin{bmatrix} e_t^{PDS} \\ e_t^{R} \\ e_t^{ISGap} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ -\Psi_{21}^0 & 1 & 0 \\ -\Psi_{31}^0 & -\Psi_{32}^0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{PDS} \\ \mu_t^{R} \\ \mu_t^{ISGap} \end{bmatrix} \quad [15]$$

While this states the initial impact of shocks in the model, the final impact of shocks in the SVAR model is capture by impulse response functions.

3.2. Techniques and Procedures of Data Estimation

To achieve the objective of assessing the effects of IS gap on public debt sustainability through the revenue channel in Nigeria, this study has used a number of techniques and procedures; Firstly, the descriptive properties of the data in terms of normality have been tested. Secondly, the data has been subjected to unit root/stationarity tests. Thirdly, the optimal lag for the model has been selected using several lag selection criteria such as Shwarz and Hannan–Quin. Fourthly, the SVAR model has been estimated and analysed using impulse response functions and variance decomposition analysis. SVAR model has been chosen due to its ability to adequately capture the transmission mechanism between macroeconomic variables. Thus, this study has used SVAR to assess the pass-through effect of IS gap to public debt sustainability through revenue. Lastly, diagnostic checks such as model stability, autocorrelation test have been performed to check model adequacy.

3.3 Data Sources

This study uses secondary data from 1970-2021. These are data on: gross savings/GDP ratio and gross fixed capital formation /GDP ratio (a proxy for investment). Debt service, revenue as well as revenue as a share of GDP have also been used. While debt service, revenue, and revenue as a share of GDP have been sourced from the CBN, the others have been obtained from the World Bank. Whereas IS Gap has been computed based on World Bank data, public debt sustainability has been calculated as debt service to revenue ratio based on CBN data. All the data have been converted to percentages.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Descriptive Properties of Data

Table 1 presents the descriptive characteristics of the data. Apart from PDS, both the ISGap and R series exhibit probabilities which are respectively greater than 0.05 at 95% level of significance, suggestive of a normally distributed data. Luthkepol (2005) noted that the assumption of normality of a distribution is not required for an SVAR model. This is because the technique is associated with bootstrapping of data which does not require the preciseness of the impulse response functions.

Table 1: Descriptive Statistics

	ISGAP	R	PDS
Mean	*0.552581*	15.26065	46.85681
Median	*1.920710*	14.75660	43.24875
Maximum	*23.73645*	30.69270	112.9495
Minimum	*-22.62168*	5.475386	23.30555
Std. Dev.	*9.563051*	6.875456	19.81078
Skewness	*-0.356078*	0.348670	1.135796
Kurtosis	*3.408801*	2.032958	4.216578
Jarque-Bera	*1.460949*	3.079816	14.38708
Probability	*0.481680*	0.214401	0.000751
Observations	*52*	52	52

Note. Computed using E-views 10

4.2. Stationarity and Unit Root Tests

The unit root/stationarity characteristics of the data are reported in Table 2. The ADF and PP tests on the premise of their null hypothesis suffer from a low power of rejecting the null hypothesis. KPSS is thus used in this study as a confirmatory test. This is in line with (Akeyede, Danjuma & Bature, 2016; Amano & Norden, 1992; Pfaff, 2008). Based on this criteria, all the series are integrated of order zero except ISGap.

Table 2: Results of Stationarity/Unit Root Test

Variable: ISGap

Test	**Level**	**Critical value @5%**	**1st difference**	**Critical value @5%**	**Order of integration**	**Decision**
ADF	-3.1340	-2.9199	-	-	1(0)	
PP	-3.0051	-2.9199	-	-	1(0)	1(1)
KPSS	0.5918	0.4630	0.3833	0.4630	1(1)	

Variable: R

Test	**Level**	**Critical value @5%**	**1st difference**	**Critical value @5%**	**Order of integration**	**Decision**
ADF	-2.6220	-2.9199	-7.6232	-2.9211	1(1)	
PP	-2.6143	-2.9199	-7.9709	-2.9211	1(1)	1(0)

KPSS	0.2389	0.4630		1(0)	

Variable: PDS

Test	Level	Critical value @5%	1st difference	Critical value @5%	Order of integration	Decision
ADF	-3.5784	-2.9199	-	-	1(0)	
PP	-3.6495	-2.9199	-	-	1(0)	1(0)
KPSS	0.2044	0.4630	-	-	1(0)	

*Note***.** Based on Authors' Computation Using E-views 10.

4.3 Correlation Matrix

Table 3: Correlation Matrix for Series: ISGap, R, and PDS

Variable	ISGap	R	PDS
IS Gap	1.000000		
R	0.363946	1.000000	
PDS	-0.337566	-0.459438	1.000000

Note. Computed using E-views 10

To check the absence of orthogonality of the variables and absence of multicollinearity in the model, correlation analysis has been performed. Table 3 indicates a low positive correlation between ISGap and R. A low negative correlation has been revealed between R and PDS, ISGap and PDS. These low correlation coefficients suggest that the series are not orthogonal and are also indicative of the absence of multicollinearity among the variables.

4.3. Optimal Lag Length Criteria

Table 4 shows the lag selection by the different criteria. The results reveal that all the lag selection criteria suggest lag 1 as the optimal lag length. Lag 1 is thus chosen as the optimal lag length for the SVAR framework.

Table 4: Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-516.1933	NA	498540.3	21.63305	21.75000	21.67725
1	-468.7796	86.92500*	100711.5*	20.03248*	20.50028*	20.20927*
2	-461.9060	11.74244	110606.7	20.12108	20.93973	20.43045
3	-458.7335	5.023157	142747.8	20.36390	21.53340	20.80585
4	-452.0382	9.763995	160792.5	20.45992	21.98027	21.03447

Note. Based on Authors' Computation 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; and HQ= Hannan-Quinn information criterion.

4.4. SVAR Estimation

The results of the estimated pattern matrix $e_t = A_0 \beta \mu_t$ in Eq. [15] are presented in Table 5. The model assumes that PDS being the most endogenous variable is not affected by innovations to R

and ISGap. This estimation captures the initial impact of shocks in the model while impulse response functions capture the final impact of shocks in the SVAR model. It is pertinent to emphasise that through a rearrangement of the estimated Matrix A from the left hand side to the right, a hitherto positive coefficient accordingly changes to negative. C(1) indicates that PDS is positively related to own shocks. The rest of the result suggests an inverse relationship between the following variables: PDS and R, C(2); R to own shocks, C(3); PDS and ISGap, C(4); R and IS Gap, C(5). All the results are statistically significant except the response of R to PDS, C(2).

Table 5: Results of Pattern Matrix from ISGap⇒R⇒PDS Model

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.294691	0.106657	-2.762975	0.0057***
C(2)	0.411256	0.276392	1.487943	0.1368
C(3)	1.003506	0.341347	2.939841	0.0033***
C(4)	5.881148	0.588115	9.999999	0.0000***
C(5)	4.435447	0.443545	9.999999	0.0000***
C(6)	10.70578	1.070578	9.999999	0.0000***
Log likelihood	-494.4490			

Note. Based on Authors' Computation Using E-views 10. ***, **, and * indicate significance at 1%, 5%, and 10% level of significance, respectively.

4.5 Diagnostic Tests

Table 6 contains the results of the LM autocorrelation test and test for normality. Since the probability of the LM-Statistic is greater than the specified level of significance (0.05), the null hypothesis that no autocorrelation exists in the residuals up to the chosen lag is accepted. This implies that there is no autocorrelation in the residuals. The probability of the Jarque-Berra statistic is greater than 0.05, denoting that the series are jointly normally distributed. Figure 1 also reveals that all roots lie within the unit circle, suggesting the stability of the SVAR model, and by implication the validity of the impulse response functions.

Figure 1: Inverse Roots from the *ISGap⇒R⇒PDS Model*

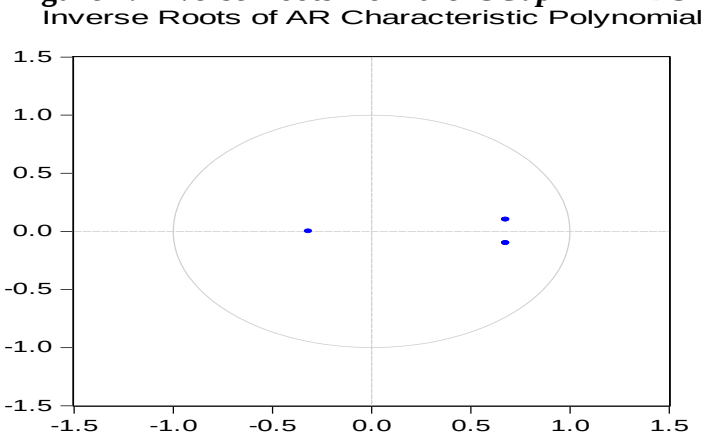


Table 6: Results of LM Autocorrelation Test, and Test for Normality

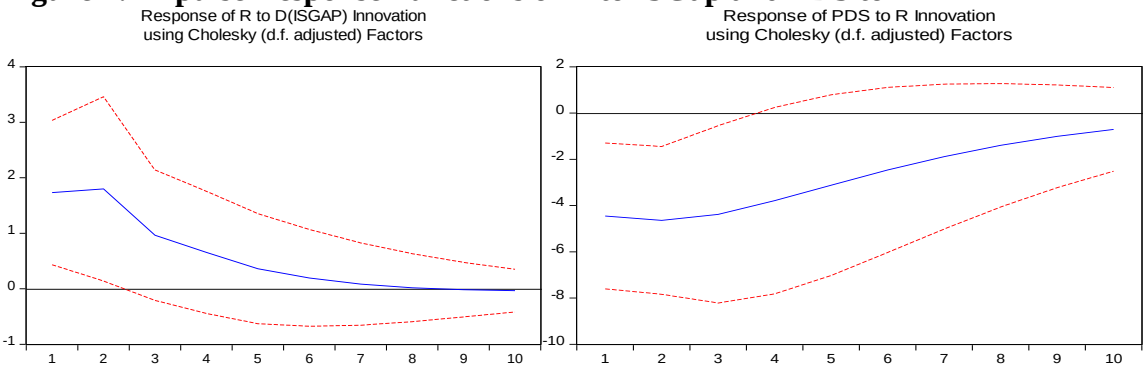
Type of Check	Test	Conclusion
LM Test	LM Statistic: 5.13; Probability: 0.82.	No autocorrelation
Normality Test	(Joint Test) Jarque-Berra test Statistic: 0.38; Prob (0.83)	Multivariate Normal

Note. Based on Authors' Computation using E-Views 10.

4.6 Impulse Response Functions

On the basis of the diagnostic checks carried out, impulse response functions have been used to assess the reaction of each variable in the SVAR model to shocks from other variables. The impulse responses of revenue to IS gap shocks and the impulse response of public debt sustainability to revenue shocks are depicted in Figure 2. The solid line is the function depicting the response of a series to a one standard deviation (1SD) shock in another series over a 10-year horizon. The dotted lines show the 95% confidence interval. If the dotted lines (95% confidence interval) falls within zero the response of a series to an innovation in another is equal to zero and therefore statistically insignificant.

Figure 2: Impulse Response Functions of R to ISGap and PDS to R



While the impulse response functions for revenue lie in the positive region that of public debt sustainability is in the negative territory. This suggests that a positive shock to ISGap will result to an increase in revenue and vice versa. Further, a negative innovation in revenue will cause a negative reaction in PDS and vice versa. These results are statistically significant at the 95% level of significance. The implication of these findings is that any positive shock in ISGap will give rise to an increase in revenue but this increase in revenue has failed to impact PDS positively. This indicates that ISGap has a significant negative effect on public debt sustainability through the revenue channel in Nigeria. This result reflects the negative relationships between ISGap and PDS and R and PDS earlier found in the contemporaneous structural parameters. This is in agreement with Adeosun and Adedokun (2019) who established a negative relationship between government revenue and public debt sustainability in Nigeria. Insufficient revenue generation or revenue leakages caused by corruption, wasteful spending, and subsidy payments may have accounted for this result.

4.7 Variance Decomposition

The results of the Variance Decomposition (VD) featured in Table 7 reveal that own shocks explain 82.17% of total variations in R in the short term. This contribution of own shocks diminished to 79.80% in the long term. The results also indicate that the dwindling effect of IS Gap shocks explained 16.32% of changes in R in the short term, and 15.07% in the long term. Empirical evidence also indicates a 59.90% and 51.88% contribution of own shocks to total variation in PDS in the short and long term, respectively. R on the other hand is shown to have accounted for 19.99% of fluctuations in PDS in the short term and 26.87% in the long term. The rising contribution of R to PDS signifies that future shocks to R would be effective in determining PDS in the future.

Table 7: Results of VD from ISGap⇒R⇒PDS Model

Response	R	R	R	PDS	PDS	PDS
Shock	ΔISGap	R	PDS	ΔISGap	R	PDS
Short Term (period 3)	16.32%	82.17%	1.51%	20.11%	19.99%	59.90%
Medium Term (period 6)	15.33%	80.55%	4.12%	21.31%	25.57%	53.11%
Long Term (period 10)	15.07%	79.80%	5.12%	21.25%	26.87%	51.88%
Trend	Decreasing	Decreasing	Increasing	Fluctuating	Increasing	Decreasing

Note. Based on Authors' Computations Using E-Views 10. Δ indicates first difference of ISGap.

5. CONCLUSION/RECOMMENDATIONS

This study evaluates the effects of investment-savings gap on public debt sustainability in Nigeria through the revenue channel. The researchers discovered that any positive shock to investment-savings gap will result to an increase in revenue which will in turn affect public debt sustainability negatively. That is, the positive effect of investment-savings gap on revenue is not transmitted to public debt sustainability. In view of the foregoing, the researchers recommend that firstly, the government should block revenue leakages in order to boost the revenue profile of the economy. This can be achieved by tackling the prevailing corruption in the country. Secondly, the government needs to fix the oil refineries to reduce importation of petroleum products thereby reducing huge revenues spent on payment of subsidy. The money spent on subsidy can then be directed to debt service payments to alleviate the debt burden. Thirdly, more revenue generation should be enhanced by increasing savings and investment through an appropriate mix of income and tax policies.

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