# DOMESTIC AND FOREIGN DEBT DYNAMICS AND NONLINEAR EFFECTS ON PRIVATE INVESTMENTS IN NIGERIA: EVIDENCE WITH ASYMMETRIC ARDL AND CAUSALITY

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**ABSTRACT:** *The ultimate goal of the study was to determine the asymmetric and dynamic effects of public debt on private investment in Nigeria from 1990 to 2019. Because of the nature of data stationarity, the study then adopted the Nonlinear Autoregressive Distributed Lag (NARDL) modelling technique, which can produce both long-run and short-run parameter estimates of negative and positive decomposed values of domestic and foreign investment. The study used the Augmented Dickey-Fuller (ADF) test to ascertain the true order of integration for the study variables. The findings for the NARDL model showed a stable long-run cointegration among private investment, domestic debt, foreign debt, economic growth, inflation and real exchange rate for the study period. The results show an asymmetric relationship between domestic and foreign debts and private investments in the long run. The estimated results further show that private investment is a significant positive function of positive and negative changes in foreign debt, and a significant negative function of positive and negative changes in domestic debt in the long run, while there were significant instant positive s on impacts on domestic and foreign debt shocks in the short-run.*

**KEYWORDS:** Domestic Debt, Foreign Debt, Private Investment, Flexible Accelerator model, NARDL

## INTRODUCTION

Developing countries and investors can overcome numerous challenges including high unemployment, poverty, inequality and low economic growth, as suggested by Ncanywa and Masoga (2018). As a result, most developing countries have designed activities and policies to accelerate old or attract new investments. These are done within the framework of fiscal tools. According to Agyapong and Bedjabeng (2020), African countries with huge savings-investment gaps are traced to high budget deficits. The rationale for public debt is discussed under two theories: debt overhang and crowding-out theories (Akomolafe, Bosede, Emmanuel & Mark, 2015). This situation is a reflection of what Nigeria is experiencing. When government finances its budget deficit through domestic borrowing, it reduces the loanable funds available for private investment as well as leads to higher interest rates and reduces the level of private investment. Also, foreign debt may crowd out private investment in a situation where rising foreign debt reduces private sector access to foreign loans and thereby reduces private access to external markets.

Nigeria's debt burden and the general state of the economy have been the subject of growing concern in recent years. Governments often borrow for future projects, thereby shifting the debt repayment burden to the future, so taxpayers are left with a higher burden of repayment and debt servicing (Chinanuife, Eze & Nwodo, 2018). Between 2010 and 2015, Nigeria's domestic and foreign debt averaged 8.81% and 1.63 per cent of GDP, respectively. From 2015 to 2021, domestic and foreign debts average rose to 10.49% and 6.33% of GDP, respectively. The brief scenario showed that Nigeria's public debt profile keeps increasing with increasing levels of economic uncertainties that justify the need for more debt in Nigeria. For instance, while the account of Huang, Panizza and Varghese (2018) availed that the global financial crisis of 2007/2009 was accompanied by a huge increase in public borrowing, then came the COVID-19 pandemic which countries did not instantly recover from. These have made the Nigerian government increase borrowing as the economic agent from which tax revenues are derived are further suppressed.

From the preceding concern, several empirical studies have concentrated on how public debt has influenced private investments. While some focused on foreign debt (Kocha, Iwedi & Sarakiri, 2021; Agyapong & Bedjabeng, 2020; Omodero, 2019; Tuffour, 2012; Ayadi & Ayadi, 2008), others have adopted the composite public debt framework (Abdulkarim & Saidatulakmal, 2021; Ogunjimi, 2019; Ebhotemhen, 2020; Fagbemi & Adeosun,2020; Ogunjimi, 2019; Ncanywa & Masoga, 2018; Chinanuife, Eze & Nwodo, 2018; Apere, 2014; Hermes & Lensink, 2001) where total debt stock is the consideration for the study. A common feature of these studies is that their results are based on the assumption of a symmetric relationship between public debt and private investment. However, the relationship between public debt and private investment variables might be asymmetric or nonlinear. The works of Apere (2014) and Hermes and Lensink (2001) have long established that the relationship can be nonlinear. This study builds on the already established asymmetric proposition of Apere (2014) and Hermes and Lensink (2001) with a more recent and systematic Nonlinear Autoregressive Distributed Lag (NARDL) which was developed by Shin, Yu and Greenwood-Nimmo (2014). This study fills this gap by examining whether the dynamic relationship between public debt and private investment in Nigeria is symmetric or asymmetric. This study, therefore, is a pioneering study in providing an answer to the question of nonlinearity

in the relationship between public debt and private investment, especially in Nigeria. This study can be important for the economy of Nigeria as the potential for public debt management capacity and a benefitting private investment rate is yet to be realised fully.

A brief overview of the public debt and private investment theoretical and empirical reviews are provided in Section 2 of the paper. Section 3 describes the estimation technique, the NARDL model specifications, the dataset and the variables used. Section 4 presents the analysis of the study results, while Section 5 concludes the study.

## LITERATURE REVIEW

### Theoretical Review

There were numerous theoretical arguments on public debt, including debt overhang, crowding-out, and flexible accelerator theories. A debt overhang is one in which a country is unable to take on additional debt to fund future projects due to a large amount of debt. By creating a debt overhang, current public investment is dissuaded, since all earnings from new projects will go to existing debt holders, leaving the entity with very limited resources for it to recover from. Kocha, Iwedi, and Sarakiri (2021) propose that the debt overhang theory argues public debts are negatively correlated with economic growth in the long run.

The fear of high future taxes and/or debt crises reduces the incentive for private investment (Chowdhury, 2001). This implies that increased public debt negatively impacts economic growth through a decrease in investment. Furthermore, the crowding out theory holds that debt could be so burdensome that government revenue may not be sufficient to provide public services that stimulate private investment and boost private sector engagement. De Leeuw and Holloway (1983) argue that public debt is subject to crowding-out effects, especially when government securities are substituted for capital stock in portfolios containing public assets.

According to the traditional Keynesian IS-LM model, an increase in government expenditures would lead to an increase in public debt that would have an expansionary effect on the economy because of an increase in income and transaction demand. Also, Koyck's flexible accelerator model, which holds that investment is determined by changes in output, can be used to examine the expansionary effects of public debt on capital accumulation (Kocha, Iwedi & Sarakiri, 2021). As he explains at the firm level and extends them to the aggregate level, Koyck discusses the lags in the adjustment of output and capital stock. To meet the increased demand for output, the firm uses its inventories first, then its capital stocks more intensively. Firms will increase their demand for capital stock if output demand increases significantly and persists for a long time. This is the decision-making lag. There may be an administrative lag in ordering the capital. Since capital is not readily available and abundant in the financial capital market, raising funding to buy capital may take some time. Finally, capital orders take a while to be delivered.

In this study, we adopt the flexible accelerator model, in which capital is adjusted toward its desired level and therefore, the firm's net investment is proportional to the change in desired capital

(Latruffe, 2004). The model is essentially a partial adjustment model. According to the flexible accelerator theory of investment behaviour, actual investment is a function of changes in demand or output (Sisay, 2010).

$$INV = f(GDP)$$

The main implication of the model is that the investment expenditure of an investment firm is proportional to its output while its output is a function of demand (Sisay, 2010). From this standpoint, the model is usually employed with modifications; i.e., simplifying the lag structure and inclusion of other characteristics which researchers are interested in using to explain investment. Following this practice, this study has considered public debt variables in addition to demand, so that we get:

$$INV = f(GDP, fiscal\ policy, public\ debt, trade, return\ to\ capital, infrastructure, \\ macroeconomic\ uncertainty, political\ instability, FDI \ldots\ldots)$$

By holding other variables constant, this study modifies the investment model above to be dependent on public debt, hence the proposed functional form of this study's investment model becomes:

$$INV = f(public\ debt, GDP)$$

$$INV = f(pd_t, GDP)$$

Where, $pd_t$ is public debt at time t

Among the various approaches considered in modelling fiscal policy and public capital formation as one of the major determinants of private investment, the flexible accelerator model appears to be the most popular and has often been applied in most empirical researches in developing countries (Ouattara, 2004; Adeyemi, Ogunleye & Oloruntuyi, 2018). This model is most appropriate to developing countries as a result of institutional and structural factors present in most developing countries, such as the absence of well-functioning financial markets, the extensive role of the government in the provision of investment, foreign exchange constraints, and other market imperfections (Adeyemi, Ogunleye & Oloruntuyi, 2018). Thus, the flexible accelerator framework is used to incorporate other variables accounting for private investment behaviour in developing countries.

**EMPIRICAL REVIEW**

Abdulkarim and Saidatulakmal (2021) examined the impact of fiscal policy variables on private investment in Nigeria with the ARDL technique panning the period 1980-2017 and found that public external debt had a deleterious effect on private investment both in the long and short run. Kocha, Iwedi and Sarakiri (2021) examined the Dynamic Impact of Public External Debt on Capital Formation in Sub-Saharan Africa from 2000 to 2008 using the PMG estimation approach and found that increasing external debt stock and interest payment on it only have a marginal

impact on capital formation in the short run but a more serious negative effect in the long run. Agyapong and Bedjabeng (2020) examined the role external debt and foreign direct investment played in influencing financial development in Africa from 2002 to 2015 with dynamic panel and GMM estimation technique and found that external debt and foreign direct investment have a significant positive relationship with financial development in African economies.

Ogunjimi (2019) examined the impact of public debt on investment: Evidence from Nigeria both in the short-run and the long-run using the ARDL framework over the period, 1981-2016, and found that domestic debt improves or crowds in both private and public investments, and external debt crowds-in private investment both in the short-run and the long-run. Moreover, the impact of external debts on all forms of investmen in Nigeria is greater than domestic debts. Ebhotemhen (2020) assesses the impact of debt overhang and crowding out effects hypotheses on investment in Nigeria from 1981 to 2018. With the Vector Error Correction Model, the study found that Debt-Export Ratio confirms its expansionary effect on investment. Fagbemi and Adeosun (2020) examine the long run relationship and interconnections between public debt and domestic investment in 13 West African countries from 1986 to 2018 with Panel Dynamic Least Squares (DOLS) and Panel Fully Modified Least Squares (FMOLS), and found debts (% of GDP) have an insignificant effect on investment in the long run.

Ogunjimi (2019) investigated the impact of the components of public debts on the various forms of investment in Nigeria with the ARDL framework over the period, 1981-2016, and found that domestic debt crowds in both private and public investment, and also that external debt crowds-in private investment both in the short-run and the long-run; crowds-out public investment. However, the impact of external debts on all forms of investment in Nigeria is greater than domestic debts. Omodero (2019) considered the consequences of external loans on capital investment in Nigeria from 1996 to 2018 with the ordinary least squares multiple regression method and found that external debt has a significant negative impact on capital investment while debt servicing cost has a strong and significant positive effect on capital investment.

Picarelli, Vanlaer and Marneffe (2019) exploited a panel dataset for 26 EU countries, between 1995 and 2015, to examine the extent to which increased levels of public debt have led to reduced public investment, based on the 'debt overhang' hypothesis. The study found evidence that: (i) the results are mainly driven by high-debt countries; (ii) the negative impact of debt on investment is slightly smaller in the Eurozone than in the entire EU; (iii) both the stock and flow of public debt play a role in reducing public investment with the impact of the later that is found to be more profound. Mabula and Mutasa (2019) explored the effect of public debt on private investment in Tanzania from 1970 to 2016 with the ARDL technique and found that the combined effect of domestic and external debt on private investment is statistically significant both in the long run and short run.

Thilanka and Sri Ranjith (2018) examined the impact of public debt on private investment in Sri Lanka for the period 1978 to 2015 and found evidence for the presence of the crowding-in effect of public debt on private investment, in the long run, implying that the government has diverted borrowed funds. Ncanywa and Masoga (2018) investigated if the public debt can influence public investment and ultimately economic growth from 1994 to 2016 with the ARDL technique, and

found out that, in the long run, there is a negative relationship between public debt and investment. Huang, Panizza, and Varghese (2018) carried out a study to enquire if public debt crowds out corporate investment in international scope with an unbalanced panel of 537,526 firms in 69 countries over the period 1998-2014. The study found that the relationship between public debt and investment is likely to be causal and that public debt crowds out corporate investment by tightening credit constraints.

Chinanuife, Eze and Nwodo (2018) sought to investigate if public debt spirals the level of domestic investment in Nigeria with ARDL for time series ranging from 1981 to 2016, and found that public debt has a negative and statistically significant impact on public investment in Nigeria. Amankwah, Ofori-Abebrese and Kamasa (2018) set out to investigate if Ghana's debt is sustainable in the long run and also ascertain if the solvency condition holds for the country from 1990 to 2016 with the Autoregressive Distributed Lag (ARDL) method, and found that fiscal policymakers react to rising debt levels by adjusting primary balance positively when debt rises. Dantama, Gatawa and Galli (2017) examined the long-run impact of fiscal deficit on private investment employing from 1980 to 2014 with the Error Correction Model (ECM) and found that fiscal deficit, government revenue and exchange rate crowd-in private investment while public expenditure crowd-out private investment in the long run.

Nwaeze (2017) investigated the possible crowding-out effect of public borrowing on private investment in Nigeria with the study adopted the vector auto-regression (VAR) technique and found domestic borrowing component crowding-out private investment in Nigeria. Oche, Mah and Mongale (2016) investigated the effect of public debt on foreign direct investment in South Africa from 1983 to 2013 with the Vector Error Correction Model and found that the relationship between public debt and foreign direct investment is positive and statistically significant. Akomolafe, Olanike, Oni and Achukwu (2015) investigated the effect of public borrowing on private investment in Nigeria with the Johansen Co-integration test and Vector Error Correction Model (VECM) and found that domestic debt crowds-out domestic investment while external debt crowds-in domestic investment in the long run.

Apere (2014) examined the impact of public debt on private investment in Nigeria over the period 1981 – 2012 and found that domestic debt has a linear and positive impact on private investment while external debt had a nonlinear impact on private investment. Estimation results revealed only domestic public debt variables were statistically not significant at all. Apere (2014) was innovative enough to identify the nonlinearity in its analysis, with a quadratic function. Madni (2014) analysed the effect of fiscal deficit on private investment in Pakistan from 1979 to 2012 with the ARDL bounds approach and found that fiscal deficit, rate of interest, inflation and external debt negatively affected private investment. Tuffour (2012) analysed the effect of external debt on the crowding-out of private investment in Ghana from 1970 to 2009 with multiple regression analyses and found that debt overhang existed for the study period through its crowding-out effect on private investment. Also, the huge debt and debt service raised future tax expectations and discouraged the private sector from undertaking investment projects.

Isaac and Samwel (2012) investigated the effects of fiscal policy on private investment and economic growth in Kenya from 1973 to 2009 with a two-stage instrumental variable estimation

method and found that fiscal policy impacts on investment and investment play a major role in the determination of economic growth in Kenya. Motivated by the modified version of the Flexible Accelerator Model of investment behaviour, Sisay (2010) empirically investigated the determinants of Private Investment in Ethiopia with a multivariate single equation ECM estimation method for data from 1950 to 2003 in two sub-periods. The study found private investment in Ethiopia is influenced positively by the domestic market, return to capital, trade openness and liberalisation measures, infrastructural facilities and FDI; but, negatively by government activities, macroeconomic uncertainty and political instability.

Ayadi and Ayadi (2008) comparatively examined the impact of external debt on economic growth for Nigeria and South Africa with ordinary least squares (OLS) and generalised least squares (GLS) and found a negative impact of debt on growth in Nigeria and South Africa, but South Africa performed better in the application of external loans to promote growth. In addition, external debt contributes positively to grow up to a point after which its contribution becomes negative in Nigeria (reflecting the presence of non-linearity effects). Hermes and Lensink (2001) analysed the impact of fiscal policy on private investment for a sample of thirty-three LDCs over three periods: 1970-1979, 1980-1989 and 1990-1998, and found that capital expenditure and expenditure on defence started to have a positive impact on private investment only after a minimum level of expenditure on these categories has been reached. The study's main contribution is that it is the first attempt to analyse the existence of a non-linear relationship between fiscal policy variables and investment.

From the array of empirical works, it can be observed that there exists a methodological gap for this study in an attempt to chart a new course in the public debt-investment nexus in Nigeria. Leading from the works of Apere (2014) and Hermes and Lensink (2001), thus, this study fills these gaps in the literature by investigating how positive and negative shocks to domestic and foreign debt affect private investments, as well as the interaction between economic growth, inflation, and real interest rates, and the causality between shocks from domestic and foreign debt on private investments in Nigeria using a recently developed asymmetric ARDL by Shin, Yu, and Greenwood-Nimmo (2014). In particular, this study has several important contributions. First, it employs the NARDL model, which has a distinct advantage over linear models, which are widely used in price shock literature. Based on the size and stance of the shocks (whether loose or tight), the NARDL model can be used to assess the asymmetric effect of domestic and foreign debt shocks. Additionally, the NARDL model uses the Wald test to confirm the relationship between the variables (Goshit, Jelilov, Iorember & Celik, 2020). Moreover, the NARDL model computes a cumulative dynamic multiplier that evaluates how the target variable adjusts to changes in domestic and foreign debt. Similarly, the use of an asymmetric causality test for the nature of causality between domestic and foreign debt shocks and private investments is novel in this area.

## DATA AND METHODOLOGY

### Data and Sources

The data needed for this study include domestic debt (DOMD), foreign debt (FRND), the real exchange rate (RXR), the inflation rate (INFN) and real GDP growth rate (ECG). Time series data were used in the study and they are entirely secondary data. The data series covered a period between 1990 to 2021. The data were obtained from the World Bank database and the Central Bank of Nigeria (CBN) statistical bulletin.

### Model specification

Under linear or symmetric ARDL, the response of private investments to public debt is fundamentally and silently assumed to be the same. This is not actually the case in reality, as the transmission rates from public debt changes are obviously different, depending on individual behaviours and shock responses. The NARDL model introduces nonlinearity by means of partial sum decompositions into the conventional ARDL model by Pesaran, Shin, and Smith (2001). In addition to the earlier introduction of the NARDL model, it is imperative to establish that the NARDL model does not require identical order of integration [i.e., I (1)] for all the series in the model. Therefore, following Goshit, Jelilov, Iorember and Celik (2020), the first step in modelling the NARDL model is to decompose the exogenous variables (DOMD, FRND) into partial sum processes to account for the asymmetries in the underlying relationship between public debt shocks and private investment.

Hence, the non-linear model is specified as follows;

$$PRV_t = \alpha_0 + \varphi_1^+ DOMD_t^+ + \varphi_2^- DOMD_t^- + \varphi_3^+ FRND_t^+ + \varphi_4^- FRND_t^- + \varphi_5 ECG_t + \varphi_6 INFN_t + \varphi_7 RXR_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where, $DOMD_t^+$ and $DOMD_t^-$; and $FRND_t^+$ and $FRND_t^-$ are the partial sums of positive and negative changes in $DOMD_t$ and $FRND_t$ defined as;

$$DOMD_{i,t}^+ = \sum_{j=1}^{t} \Delta DOMD_{i,j}^+ = \sum_{j=1}^{t} max\,(\Delta DOMD_{i,j}, 0);$$

$$DOMD_{i,t}^- = \sum_{j=1}^{t} \Delta DOMD_{i,j}^- = \sum_{j=1}^{t} min\,(\Delta DOMD_{i,j}, 0)$$

$$FRND_{i,t}^+ = \sum_{j=1}^{t} \Delta FRND_{i,j}^+ = \sum_{j=1}^{t} max\,(\Delta FRND_{i,j}, 0);$$

$$FRND_{i,t}^- = \sum_{j=1}^{t} \Delta FRND_{i,j}^- = \sum_{j=1}^{t} min\,(\Delta FRND_{i,j}, 0)$$

By imputing these new decomposed variables into the traditional linear form of ARDL Bounds test model, we obtain the NARDL as:

$$\Delta PRV_t = \alpha_0 + \varphi_1 PRV_{t-1} + \varphi_2^+ DOMD_{t-1}^+ + \varphi_3^- DOMD_{t-1}^- + \varphi_4^+ FRND_{t-1}^+ + \varphi_5^- FRND_{t-1}^-$$
$$+ \varphi_8 ECG_t + \varphi_7 INFN_t + \varphi_8 RXR_t + \sum_{i=0}^{n} \theta_1^+ \Delta PRV_{t-i} + \sum_{j=1}^{m} \theta_2^+ \Delta DOMD_{t-j}^+$$
$$+ \sum_{j=1}^{m} \theta_3^+ \Delta DOMD_{t-j}^- + \sum_{j=1}^{m} \theta_4^+ \Delta FRND_{t-j}^+ + \sum_{j=1}^{m} \theta_5^+ \Delta FRND_{t-j}^-$$
$$+ \sum_{j=1}^{m} \theta_6 \Delta ECG_{t-i} + \sum_{j=1}^{m} \theta_7 \Delta INFN_{t-i} + \sum_{j=1}^{m} \theta_8 \Delta RXR_{t-i} + \mu_t \ldots\ldots..(2)$$

**Wald Test for Long-run and Short-run Asymmetries**

If we have established that a long-run relationship exists, we proceed to test if the difference in the asymmetric coefficients is statistically significant. To do this, we need to make a judgment on asymmetry, and this we do by first determining the asymmetric coefficients. Again, we are going to construct the long-run levels asymmetric coefficients by:

**i.** Dividing the negative of the coefficients of positive price variables ($ie\ \varphi_i^+$) by the coefficients of government expenditures ($ie\ \varphi_1$): $\frac{-(\varphi_i^+)}{\varphi_1}$

**ii.** Dividing the negative of the coefficients of negative price variables ($ie\ \varphi_i^-$) by the coefficients of private investment ($ie\ \varphi_1$): $\frac{-(\varphi_i^-)}{\varphi_1}$

To test if the difference in the asymmetric coefficients is statistically significant, we construct these statements of hypotheses:

$$H_0: \frac{-(\varphi_i^+)}{\varphi_1} = \frac{-(\varphi_i^-)}{\varphi_1} \qquad \text{and} \qquad H_A: \frac{-(\varphi_i^+)}{\varphi_1} \neq \frac{-(\varphi_i^-)}{\varphi_1}$$

If we reject $H_0$, it means there is long-run asymmetry. In other words, the magnitude of the change in private investment when public debt increases is not the same as when public debt decreases.

**Asymmetric Long-run and short-run Models Estimation**

Once cointegration is established between private investment and public debt shocks, the NARDL long-run and short-run models can be specified and estimated in the form of,

$$PRV_t = \alpha_0 + \varphi_1 PRV_{t-1} + \varphi_2^+ DOMD_{t-1}^+ + \varphi_3^- DOMD_{t-1}^- + \varphi_4^+ FRND_{t-1}^+ + \varphi_5^- FRND_{t-1}^-$$
$$+ \varphi_8 ECG_t + \varphi_7 INFN_t + \varphi_8 RXR_t + + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(3)$$

where,

$\alpha_0$     =     intercept

$\varphi_i^+, \varphi_i^-$ =     coefficients of long-run estimates

$\mu_t$     =     error term of long-run estimates

Following the opinion of Shin, Yu and Greenwood-Nimmo (2014) that the approach of bound testing proposed by Pesaran, Shin and Smith (2001) are also applicable in NARDL, and so we extended the application to include the asymmetric short-run model estimation and asymmetric error correction model (AECM) as specified below:

$$\Delta PRV_t = \alpha_0 + \sum_{i=0}^{n} \theta_1^+ \Delta PRV_{t-i} + \sum_{j=1}^{m} \theta_2^+ \Delta DOMD_{t-j}^+ + \sum_{j=1}^{m} \theta_3^+ \Delta DOMD_{t-j}^-$$

$$+ \sum_{j=1}^{m} \theta_4^+ \Delta FRND_{t-j}^+ + \sum_{j=1}^{m} \theta_5^+ \Delta FRND_{t-j}^- + \sum_{j=1}^{m} \theta_6 \Delta ECG_{t-i}$$

$$+ \sum_{j=1}^{m} \theta_7 \Delta INFN_{t-i} + \sum_{j=1}^{m} \theta_8 \Delta RXR_{t-i} + \sigma ECT_{t-1}$$

$$+ \mu_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (4)$$

Where,

$ECT$     =     error correction term derived from equation …., and

$\sigma$     =     the speed of adjustment.

The error correction model shows the speed of adjustment needed to restore the long-run equilibrium following a short-run shock. The $\sigma$ is the coefficient of the error correction term in the model and must be negative and statistically significant for the return back to long-run asymmetric equilibrium to hold (Pesara, Shin & Smith, 2001).

Furthermore, the short-run asymmetric effect was obtained by deriving the cumulative dynamic multiplier of a unit change in $DOMD_t^+$ and $DOMD_t^-$; $FRND_t^+$ and $DOMD_t^-$ as:

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial PRV_{t+j}}{\partial DOMD_t^+} ; \qquad m_h^- = \sum_{j=0}^{h} \frac{\partial PRV_{t+j}}{\partial DOMD_t^-}; \qquad m_h^+ = \sum_{j=0}^{h} \frac{\partial PRV_{t+j}}{\partial FRND_t^+} ; \qquad m_h^-$$

$$= \sum_{j=0}^{h} \frac{\partial ORV_{t+j}}{\partial FRND_t^-}$$

For $h = 1, 2, 3, \ldots$

Where,

If $h \to \infty$, then $m_h^+ \to \dfrac{-(\varphi_i^+)}{\varphi_1}$ and $m_h^- \to \dfrac{-(\varphi_i^-)}{\varphi_1}$

**Asymmetric Dynamic Multipliers and Short-run Asymmetries**

Since the asymmetric ARDL proposed to estimate the parameters of this study, the pairwise granger specification is the extended to capture the positive and negative shocks of public debt variables (ie domestic and foreign debts) and private investments in the fashion of Goshit, GJelilov, Iorember and Celik (2020):

$$PRV_{k,t}^- = \alpha_i PRV_{k,t-j}^+ + \beta_i^+ PD_{k,t-j}^+ + \beta_i^- PD_{k,t-j}^- + \mu_{it}$$

$$PRV_{k,t}^+ = \partial_i PRV_{k,t-j}^- + \emptyset_i^+ PD_{k,t-j}^+ + \emptyset_i^- PD_{k,t-j}^- + \mu_{it}$$

$$PD_{k,t}^+ = \delta_i^+ PD_{k,t-j}^+ + \theta_i^+ PRV_{k,t-j}^+ + \theta_i^- PRV_{k,t-j}^- + \mu_{it}$$

$$FP_{k,t}^- = \varphi_i^- FP_{k,t-j}^- + \pi_i^+ PRV_{k,t-j}^+ + \pi_i^- PRV_{k,t-j}^- + \mu_{it}$$

Where $PI_{k,t}^+$ and $PI_{k,t}^-$ are the positives and negative shocks of private investments and $PD_{k,t}^+$ and $PD_{k,t}^-$ public debt variables (ie domestic and foreign debts) vectors, given as domestic debts and foreign debts in Nigeria.

**RESULTS AND DISCUSSIONS**

Table 1 is descriptive statistics. The statistics suggest that foreign public debt by foreign creditors, which is slightly more than one and half times the public debt by domestic creditors on average, remains the largest proportion of Nigeria's total public debt. Its variation is also higher compared to the domestic public debt by domestic creditors.

**Table 1: Descriptive Statistics**

|  | PRV | DOMD | ECG | FRND | INFN | RXR |
|---|---|---|---|---|---|---|
| Mean | 24.8579 | 11.3937 | 4.3201 | 19.2682 | 18.0608 | 108.2550 |
| Median | 24.0496 | 10.2081 | 4.4306 | 10.3965 | 12.7158 | 100.2585 |
| Maximum | 48.2702 | 23.0430 | 15.3292 | 60.3696 | 72.8355 | 272.9995 |
| Minimum | 12.8005 | 5.7720 | -2.0351 | 1.2436 | 5.3880 | 49.7447 |
| Std. Dev. | 9.9367 | 4.5276 | 4.0172 | 20.0836 | 16.3651 | 49.3622 |
| Skewness | 0.6071 | 1.1541 | 0.4354 | 0.8096 | 2.1701 | 1.8778 |
| Kurtosis | 2.4057 | 3.5466 | 3.2866 | 2.2070 | 6.6334 | 6.4164 |
|  |  |  |  |  |  |  |
| Jarque-Bera | 2.4368 | 7.5019 | 1.1207 | 4.3340 | 42.7188 | 34.3682 |
| Probability | 0.2957 | 0.0235 | 0.5710 | 0.1145 | 0.0000 | 0.0000 |
|  |  |  |  |  |  |  |
| Sum | 795.4538 | 364.5987 | 138.2437 | 616.5822 | 577.9467 | 3464.1610 |
| Sum Sq. Dev. | 3060.8810 | 635.4626 | 500.2737 | 12503.8400 | 8302.2630 | 75535.4800 |
|  |  |  |  |  |  |  |
| Observations | 32 | 32 | 32 | 32 | 32 | 32 |

**Source:** *Authors' computation*

**Empirical Analysis**

The NARDL estimation starts with unit root tests. Then, employs standard ordinary least squared (OLS) from which it executes the general-to-specific approaches to trim the model. Next, conducts the asymmetric bounds test for cointegration with the Wald F test as well as the test for asymmetric effects from domestic and foreign debt. And finally, examines both long-run and short-run asymmetry in the cointegrated model. Table 2 is the unit root test results generated by Augmented Dickey-Fuller (ADF) test to test the unit root. The results demonstrate that all the variables of the study except real growth of GDP (ECG) are I(1), while real growth of GDP (ECG) is I(0) and there is no I(2) variable. The results find that all variables are stationary and integrated of order zero [I(0)] and order one [ I(1)], and valid for the bounds test.

**Table 2: Stationarity Tests**

| Variables | ADF Tests: Levels | | ADF Tests First Difference | | Order of Integration |
|---|---|---|---|---|---|
| | Test Statistic with intercept | p-values | Test Statistic with intercept | p-values | |
| PRV | -1.8369 | 0.3564 | -4.6591 | 0.0008 | I(1) |
| DOMD | -2.3329 | 0.1692 | -3.7332 | 0.0090 | I(1) |
| FRND | -1.7852 | 0.3803 | -3.5804 | 0.0124 | I(1) |
| RXR | -2.3860 | 0.1537 | -4.7505 | 0.0006 | I(1) |
| INF | -2.4267 | 0.1430 | -4.5732 | 0.0010 | I(1) |
| ECG | -3.6256 | 0.0109 | | | I(0) |

**Source:** *Author's computation*

**Autoregressive Distributed Lag (ARDL) Bounds test for Cointegration**

The bounds F test is present in Table 3. As shown in Table 3, the F-statistic of the estimated ARDL model is significant at the 5% level.

**Table 3: ARDL Bounds test**

| Model Specification | F-statistic | 5% Lower Bound Value | 5% Upper Bound Value | Decision |
|---|---|---|---|---|
| PRV Model | 6.203681 | 2.17 | 3.21 | Reject H0 |

**Source:** *Author's computation*

The results indicated that the F-statistic is 6.203681, and it turned out to be obviously larger than the 5% upper bound critical value of 2.17. Accordingly, there is a public debt-investment cointegration, suggesting a public debt-investment cointegration nexus prevails in Nigeria.

Results from table 4 provide the summary of the results of the Wald test for asymmetry. The public debt-private investment model for Nigeria showed that both domestic debt and foreign debt variables had asymmetric effects on private investment in the model structures. That is, negative shocks from public debt from Nigeria will have a significantly different long-run run impact (in

sign and magnitude) on private investment than positive shocks, so they should be treated separately.

**Table 4: Wald Test for Asymmetry and Model Choice**

| Horizon | Variable | Wald Test p-values | Decision |
|---|---|---|---|
| Long-run | DOMD | 0.0000*** | Asymmetry |
| | FRND | 0.0635* | Asymmetry |
| Note: *, ** and *** denotes significance at 10%, 5% and 1% | | | |

*Source: Authors' Computation*

While the asymmetric effect of domestic debt was significant at 1%, that of foreign debt was at 10%. These findings further support that a linear ARDL model for the domestic and foreign debt shocks in Nigeria would be incorrectly specified. Based on this, the choice of model estimation for the public debt investment for Nigeria is Non-linear Autoregressive Distributed Lag (NARDL).

In the model involving domestic and foreign debt effects on private investment, the lag selection criteria based on the Akaike model selection is defined as NARDL (1, 1, 2, 2, 2, 2, 1, 2). Based on the lag specification of the NARDL lags, the long run model is given as:

$$PRV = 16.92 - 3.45 * DOMD_{POS} - 4.19 * DOMD_{NEG} + 1.06 * FRND_{POS} + 1.04 * FRND_{NEG} - 0.79 * ECG + 0.65 * INFN + 0.06 * RXR$$

From the model estimation above, the coefficient of positive and negative shocks from domestic debt exerted negative impacts on private investment in Nigeria, while those from foreign debt was positive. As for the control variables, while economic growth exerted a negative impact, inflation and exchange rate had a positive impact on private investment in Nigeria. However, the greater impact is from positive shocks of foreign debt with a coefficient of 1.06.

After the confirmation of the long-run relationship, the next step is to estimate the confirmation of the error correction term, which must be smaller than the unity in coefficient and should be negative and statistically significant. Because the NARDL bounds test had earlier shown that there is a long-run asymmetric relationship between domestic and foreign debts and private investments in Nigeria, it is expected that the ECT have a negative coefficient, indicating convergence back to long-run equilibrium (Nkoro & Uko, 2016). The parsimonious model estimates of the short-run relationship between conventional fiscal policy and private investment activities are presented in Table 5.

**Table 5: Asymmetric Short-run and Error Correction Model Estimate**

| ARDL Error Correction Regression | | | | |
|---|---|---|---|---|
| Dependent Variable: D(PRV) | | | | |
| Selected Model: ARDL(1, 1, 2, 2, 2, 2, 1, 2) | | | | |
| | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| | | | | |
| D(DOMD_POS) | 0.4117 | 0.3979 | 1.0348 | 0.3310 |
| D(DOMD_NEG) | 0.8014 | 0.2080 | 3.8526 | 0.0049 |
| D(DOMD_NEG(-1)) | 3.9922 | 0.3494 | 11.4267 | 0.0000 |
| D(FRND_POS) | 2.5077 | 0.2918 | 8.5930 | 0.0000 |
| D(FRND_POS(-1)) | 1.6582 | 0.2058 | 8.0593 | 0.0000 |
| D(FRND_NEG) | 1.1649 | 0.1463 | 7.9641 | 0.0000 |
| D(FRND_NEG(-1)) | -0.4745 | 0.0977 | -4.8542 | 0.0013 |
| D(ECG) | -0.7825 | 0.0814 | -9.6171 | 0.0000 |
| D(ECG(-1)) | 0.1987 | 0.0776 | 2.5614 | 0.0336 |
| D(INFN) | 0.2209 | 0.0600 | 3.6826 | 0.0062 |
| D(RXR) | 0.3946 | 0.0423 | 9.3188 | 0.0000 |
| D(RXR(-1)) | 0.2314 | 0.0324 | 7.1400 | 0.0001 |
| ECT(-1)* | -1.1782 | 0.1115 | -10.5672 | 0.0000 |
| | | | | |
| R-squared | 0.9407 | | | |
| Adjusted R-squared | 0.8961 | | | |
| Durbin-Watson stat | 2.0270 | | | |

**Source:** *Authors' computation*

The adjusted R-squared of 0.8961 is an indication that about 89.61% of short-run variations in private investment activities were explained by variations in positive and negative shocks in domestic debt and foreign debt, and lag of the Error Correction Term (ECT) in Nigeria, respectively. So, the coefficient of -1.1782 in Nigeria meets the theoretical expectation. This means that a unit change in the positive and negative shocks in domestic debt and foreign debt decisions causes a speed of adjustment of 117.82% back to the equilibrium with private investment.

Apart from the positive shocks in domestic debt, economic growth and lag of negative shocks in foreign debt, it can be inferred that short-run shocks in domestic and foreign debts boosted or crowd-in private investment in Nigeria.

This means private investors in Nigeria are very sensitive to domestic and foreign debt changes, although in varying directions. This could mean that increasing government borrowings would encourage private investments in Nigeria. This is justifying the reason by the current administration of Muhammadu Buhari that constant reliance on borrowing is based on the premise that it "borrows to finance critical infrastructure as he claimed the country cannot make meaningful

headway in its quest for development if it does not borrow more". However, what the government does not know is the long-run implication of their borrowing decisions on private investment.

From figure 4.8, it can be observed that private investments in Ghana respond positively to both positive and negative shocks in both foreign and domestic debts in the long run. It was observed that private investments in Nigeria respond negatively to negative shocks from foreign debt as well as positively to positive shocks in foreign debt in the long run and in equal magnitudes, especially from the fourth period. Before the fourth period, the magnitude of the positive response of private investment to positive shocks from foreign debt was higher. Interestingly, the asymmetric effect from foreign debt faded away in the seventh period, which explains why the Wald test revealed a weak asymmetry from foreign investment.
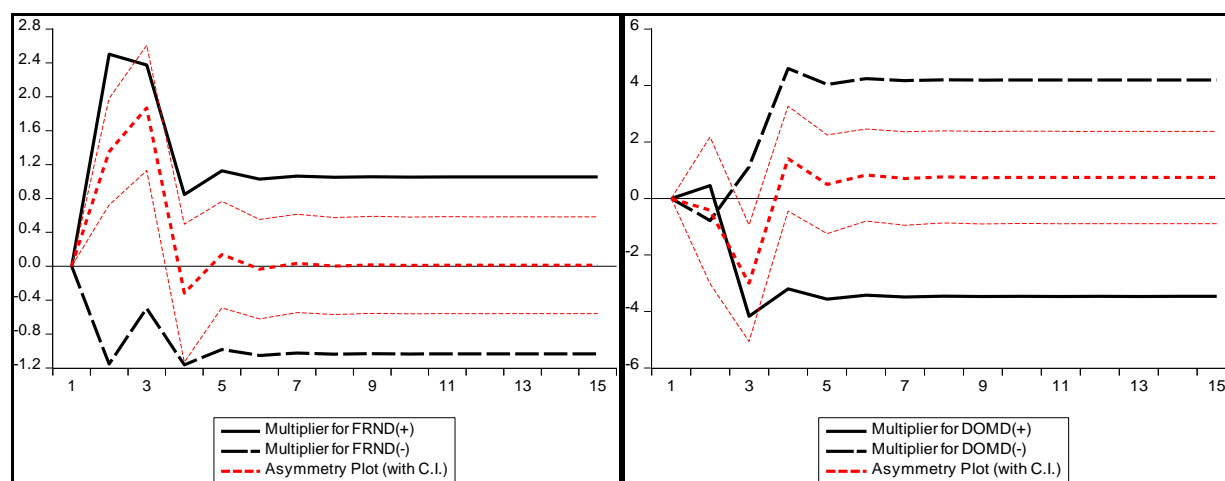


**Figure 1: Asymmetric Dynamic Multiplier of public debt and private investment in Nigeria**

Further results from figure 1 revealed private investments in Nigeria respond positively to negative shocks from domestic debts in the long run, and negatively to positive shocks in domestic debts. However, the positive response of private investment in Nigeria is more or less equal in magnitude to the negative shocks. This is evident as the thick black line below the zero line covers almost the same space as the dotted thick line above the zero line. Because of this, positive shocks from domestic debts weigh the same on private investments in Nigeria as negative shocks from it. The asymmetric plot not lying on the zero line further proves the presence of asymmetric effects from domestic debt.

The next section provides estimates for both long-run coefficients within the NARDL framework. The estimates presented in Table 6 show private investment is a negative function of positive and negative changes in domestic debt in the long run. The coefficients of positive and negative variations in domestic debt (DOMD+, DOMD-) are statistically significant in the long run. These results suggest the private investment effect of variations in domestic debt in Nigeria. This implies that an increase in domestic debt is detrimental to private investment in Nigeria. The findings compare favourably with similar studies by Picarelli, Vanlaer and Marneffe (2019), Mabula and

Mutasa (2019), Nwaeze (2017) and Ncanywa and Masoga (2018) that also suggest that domestic debt and total debt impedes private investments in Nigeria. This means that the Nigerian government has been diverting borrowed funds, and disagrees with the findings of Ogunjimi (2019), Fagbemi and Adeosun (2020) and Thilanka and Sri Ranjith (2018) that domestic debt has positive or no significance on private investments in Nigeria.

The findings suggest that as the government continues to borrow domestically, it could cause diminishing effects on private investments. When domestic lenders are major creditors to the government and if the government continues to incur large borrowing domestically, it could be likely to crowd-out the private sector in three ways. First, it reduces the availability of credit to the private sector; second, banks may prefer the government sector over the private sector due to lower risk premium; and third, leads to more expensive borrowing to the private sector due to increasing
demand for credit from the government (Chung-Yee, Ismail & Ai-Lian, 2020). Higher public debt by domestic creditors crowding-out the size of credit resources to the private sector which is crucial for economic activities and resource efficiency. As such, a reduction in debt level allows banks to divert more credit resources to the private sector to finance investment and stimulate economic activities; increasing the efficiency of resource allocation.

**Table 6: Asymmetric Long-run Model Estimate**

| Variable | Coefficient | T-stat. | Prob. |
|---|---|---|---|
| DOMD_POS | -3.4508 | -5.5140 | 0.0006*** |
| DOMD_NEG | -4.1937 | -6.1595 | 0.0003*** |
| FRND_POS | 1.0565 | 3.8181 | 0.0051*** |
| FRND_NEG | 1.0367 | 9.4383 | 0.0000*** |
| ECG | -0.7976 | -3.6074 | 0.0069*** |
| INFN | 0.6486 | 4.5189 | 0.0020*** |
| RXR | 0.0613 | 1.3470 | 0.2149 |
| C | 16.9173 | 2.1232 | 0.0665* |
| | | | |
| Note: *, ** and *** denotes significance at 10%, 5% and 1% | | | |

**Source:** *Authors' computation*

Again, since the p-values for both negative and positive shocks of foreign debt in Nigeria (0.0000; 0.0051) were less than the significance level (0.05), meaning that both negative and positive shocks in domestic debt in Nigeria has a statistically significant positive impact ($\beta$ = 1.0367; 1.0565) on private investment level in Nigeria for the long-run period of 1990 to 2021. This agrees with Ebhotemhen (2020) because the debt-Export ratio confirms its expansionary effect on investment, Agyapong and Bedjabeng (2020)'s findings that external debt, alongside foreign direct investment (FDI), has a significant positive relationship. The studies by Abdulkarim and Saidatulakmal

(2021), Kocha, Iwedi and Sarakiri (2021), Chinanuife, Eze and Nwodo (2018) and Omodero (2019) that foreign debt crowd-out private investment in variance with the finding of this study. It can be inferred that the strict details of adherence to repaying foreign debt where the government's manipulative influence is less could very well explain this. The government do not have many options other than to honour the terms of usage and repayment contained in foreign debts.

From these findings, the optimal model for estimating the relationship between public debt (domestic and foreign) and private investment in Nigeria should include asymmetric specification in the short run and in the long run. Based on these findings, using the NARDL model, the study further investigates the impact of domestic and foreign debt on private investment in Nigeria.

Diagnostic tests show that residual series are normally distributed, homoskedastic and have no serial correlation. The tests involved are Jacque Berra for normality, ARCH and Berusch-Godfrey for serial correlation as well as the LM test.

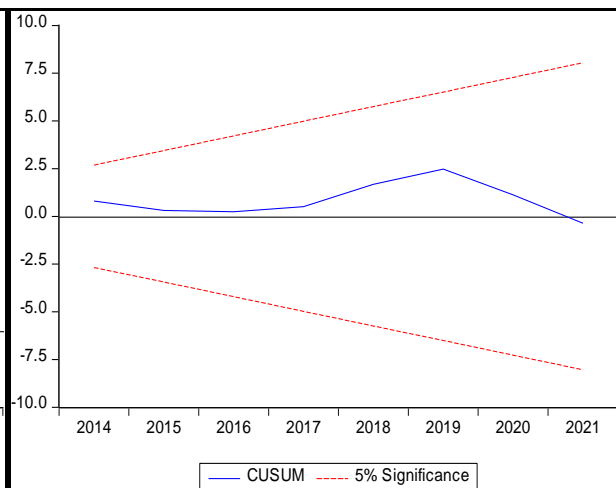**Table 7: Diagnostic Tests Estimates**

| Residual Tests | P-values | Remark |
|---|---|---|
| Jarque-Bera Normality Test | 0.6343 | Normally Distributed |
| Breusch-Godfrey Serial Correlation LM Tests | 0.1761 | No Autocorrelation |
| Breusch-Pagan-Godfrey Tests | 0.4234 | Homokedastic Distribution |

**Source:** *Author's computation*

Since the p-value of the probability values of the Chi-square in all three tests were greater than 0.05, it means that the null hypotheses are accepted. Hence, we conclude that the data series are normally distributed, homoskedastic and not serially correlated.
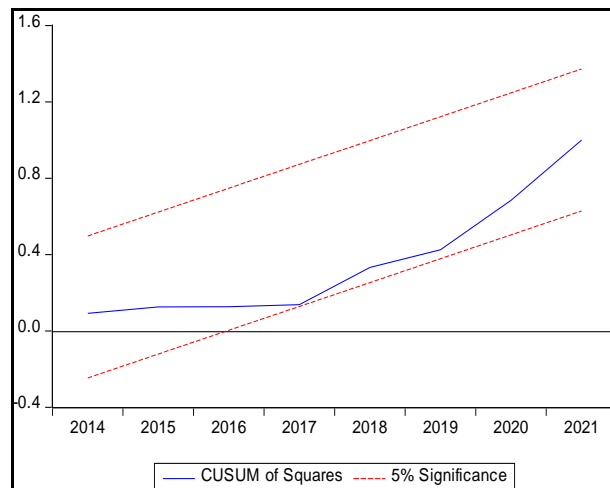


**Figure 1: CUMSUM Test**                    **Figure 2: CUMSUM of Square Test**

Source: *Author's computation*

Finally, an inspection of the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) graphs (see Figures 1 and 2) from the recursive estimation of the model reveals that there is stability, and there is no systematic change detected in the coefficient at the 5% significant level over the sample period. The plot of the stability test results (CUSUM and CUSUMSQ) of the model are given in Figures 1 and 2. The CUSUM and CUSUMSQ plotted against the critical bound of the 5% significance level show that the model is stable over time; this, can therefore be used for policy prescription. However, the overall model is stable and suitably specified since none of the two test statistics deviated away from the 5 per cent bounds level.

## CONCLUSION AND RECOMMENDATION

The ultimate goal of the study was to determine the asymmetric and dynamic effects of public debt on private investment in Nigeria from 1990 to 2019. Because of the nature of data stationarity, the study then adopted the Nonlinear Autoregressive Distributed Lag (NARDL) modelling technique, which can produce both long-run and short-run parameter estimates of negative and positive decomposed values of domestic and foreign investment. The study used the Augmented Dickey-Fuller (ADF) test to ascertain the true order of integration for the study variables. The findings for the NARDL model showed a stable long-run cointegration among private investment, domestic debt, foreign debt, economic growth, inflation and real exchange rate for the study period. The results show an asymmetric relationship between domestic and foreign debts and private investments in the long run. The estimated results further show that private investment is a significant positive function of positive and negative changes in foreign debt, and a significant negative function of positive and negative changes in domestic debt in the long run, while there were significant instant positive impacts on domestic and foreign debt shocks in the short-run.

Overall, the study confirms the deleterious effect of domestic on private investment and the crowding-in effect of foreign debt on private investment. The study, therefore, suggests that an optimal estimation technique for testing the relationship between public debt and private investment in Nigeria should incorporate the nonlinear approach. The study also recommends that the government of Nigeria should approach more foreign debt and less domestic debt. Notwithstanding, the significant contribution of this study to existing literature, the disaggregation of total public debt into foreign and domestic debts further highlights the respective effects, as their effects have not been the same.

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