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# Private and Public Investment: Are they Substitute or Complementary in Driving Economic Growth in Nigeria?

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**ABSTRACT:** *The paper investigates the relationship between government and private investment with a view to ascertaining their complementarity or substitutability in driving economic growth in Nigeria for the period of 1981-2021. To achieve the objective, nonlinear autoregressive distributed lags (ARDL) models and nonlinear Granger causality tests were employed to analyze annual secondary data which were sourced from the Central Bank of Nigeria Statistical Bulletin. Findings show that government investment expenditure displayed a positive and long-term influence on private investment, suggesting a "crowding-in" effect where increased public investment stimulates private investment thereby fostering overall economic growth. Economic adversities or reduced public investment exerted a substantial negative impact on private investment, underscoring the complementarity of government investment expenditure in driving economic growth in Nigeria. Also, the nonlinear Granger causality tests reveal unidirectional relationship as government investment expenditure causes private investment across various embedding dimensions, emphasizing the positive influence of government investment on private investment. The findings generally suggest the need for balanced fiscal policies, prioritizing productive government investments, encouraging private investment, controlling inflation, and making time-sensitive policy decisions to promote economic growth in Nigeria.*

**KEYWORDS**: complementarity, substitutability, investment, expenditure, fiscal policies, inflation

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## INTRODUCTION

It has been established in the literature that the process of economic growth and investment is closely interconnected (Alesina, Perotti and Jose, 1998; Iyoha, 2007 and Oke and Sulaiman, 2012). Generally speaking, investment expenditure which is made by both government and private firms refers to all economic activities which involve the use of resources to produce goods and services. Empirical research has, however, confirmed a much larger role of the private investments in the growth process as compared to the public investments (Alchian, 1955; Khan and Reinhart, 1990; Baddeley, 2003; Furceri and Sousa, 2011). It is for this reason that every country strives to stimulate private investments, both domestic and foreign by bringing about an increase in the level of savings to fund investment needs.

In Nigeria, the low rate of economic growth can be attributed to low private investment spending which is inadequate to spur the economy on the path of sustainable growth (Gbosi, 2008; Agiobenebo, 2003; Choong, Lau, Liew and Puah, 2010; Oke and Sulaiman, 2012; Adeosun, et al, 2021). There are several factors that influence private investment decisions in an economy. These include the level of profit, interest rate, availability of internal fund, political and infrastructural facilities among others (Blejer and Khan 2001; Atukeren, 2005; Ouedraogo, et al, 2020). Incidentally, most of these factors can be influenced by fiscal policy instruments, especially government expenditure (Ghali, 1999; Arestis and Sawyer, 2003 and Laubach, 2009). Private investment can also respond directly to this fiscal policy variables (Kormendi, 1985; Gatawa and Bello 2010; Adeosun, et al, 2021).

The literature on the effects of public expenditure on private investment has given rise to a number of studies focusing on the expansionary impact of fiscal action. Evidence has shown that private investment can be influenced not only by the size of public spending but also by its composition (Angelopoulos et al, 2007; Paternostro, Rajaram and Tiongson, 2007; Nwosa, Adebiyi and Adedeji, 2013; Ouedraogo, et al, 2020). As advocated by the Keynesians, an increase in government spending, both investment and consumption expenditure can stimulate domestic economic activities by a greater proportion through the multiplier process and thereby crowd-in private investment, despite very high real interest rates, especially when the economy is not operating at the full employment level (Hussain, Akram and Irfan, 2009; Chude and Chude, 2013). However, according to the neoclassical growth theory, the increasing government spending especially if it exceeds public revenue could lead to the problems of indebtedness and debt crisis with their attendant negative effects on interest rate and eventual crowding-out of private investment (Atukeren, 2010 and Isah, 2012; Kodongo and Ojah, 2016).

Most of the studies on the effect of government expenditure on private investment have isolated and focused on public investment expenditure with major concern on the degree of substitutability or complementarity between them, while neglecting whether the public consumption and

investment spending could have differential impacts on private capital formation (Asogwa and Okeke 2013; Adeosun, et al 2021). Besides, there are strong reasons to believe that the relationship between these components of government expenditure and private investment may be non-linear.

For instance, public Investment in infrastructure may become effective only after some points, since infrastructure investment usually is associated with large (positive) externalities; yet, after some point, raising expenditures on this category may retard private investment, since their operation may start to become inefficient (Brumby, Kaiser and Kim, 2013; Han, 2015). Also on consumption expenditure, the central government needs a sufficient number of civil servants in order to offer public services efficiently. After a certain number of civil servants, however, the efficiency of services may reduce. This suggests that there is an optimal government spending for both investment and consumption expenditure associated with private investment. As far as we know, no studies are available that analyzed the non-linear relationship between these two components of government expenditure and private investment in Nigeria.

The need to further re-examine the effectiveness of both public consumption and investment expenditures in relation to their effects on private investment has become paramount, particularly at this period when various arms of government are posed to generate employment through private investment stimulation. The study will also establish whether private investment and public investment are substitute or complementary in driving economic growth. In addition, the paper will investigate the possible feedback effect of private investment on the two major components of government expenditure by examining the causal relationship among the variables. Crowding-in may be identified with causality running from public expenditure (consumption and investment) to private investment with a positive coefficient, while the negative coefficient will indicate crowding-out effect. It is also possible that government spending is relatively bland and simply caters for the needs of the private sector generated by private investment itself, in this case, causality will run from private to public investment. These are crucial issues to be resolved as there appears to be conflicting results in the literature and given the renewed interest in stimulating private investment as engine of growth and poverty alleviation in Nigeria.

The rest of the paper is structured as follows: the theoretical and empirical review of the literature is discussed in Section 2. In Section 3 econometric methodology is presented. The empirical results of the study are presented in Section 4, while the summary, policy implications of the findings and concluding remarks are offered in Sections 5.

## LITERATURE REVIEW

There are two major schools of thought concerning the issue of the effects of public expenditure on private investment. The first school – Classical and Neoclassical economists advocates free markets and minimal intervention of government in the economy (Adam Smith, 1776). The proponents of this school argued that increased government expenditure, especially if it is financed

by public borrowing from capital market will result in an increase in interest rate as a consequence of increased demand for the available funds. Increased interest rate will in turn result in higher cost of capital for private sector; thereby reduce private investment (Bailey, 1971; Buiter, 1977; Atukeren, 2005). Therefore, increased government expenditures reduce private investments. This is the "crowding-out" hypothesis. The "crowding-out" effect reduces the ability of the government to influence economic activity through fiscal measures.

The second school of thought is the Keynesians which argued that increased government expenditures stimulates demand, bring about better infrastructure, health and education which in turn will stimulate private investment (Arestis and Sawyer, 2003). The argument here is that government sector can afford costs of large-scale investments and projects which require long time gestation unlike the private sector. Spillovers effect of such public investments is highly beneficial for private sector such as reducing transportation costs and other positive externalities (Atukeren, 2005; Hussain et al, 2009). In this context, government expenditures stimulate private investment. In order words, the increased government expenditures increase private investments. This is called "crowding-in" hypothesis. In this case, public expenditure is said to have a complementary relationship with private investment as that type of expenditure improves the productivity of private investment.

Empirically, the relationship between government expenditures and private investment has been investigated substantially in the literature, however, the impact of government expenditure on private investment has remained highly controversial (Voss 2002; Atukeren 2005; Quattara 2005; Afonso and Miguel 2010; Kollamparambil and Nicolaou 2011; Bello, Nagwari, and Saulawa 2012; Nagwari, and Saulawa 2012).

Specifically, Aschaeur (1989) empirically analyzed the effect of public capital investment on private investment in the U.S. using data from 1925 to 1985. He finds that a one percentage increase in the public capital stock is expected to raise the rate of return of private capital by 9 basis points thereby, 'crowd-in' private investment. However, there is an initial downside to this effect. The author explains that crowd-in effect occurs over a time span. On the short term, public infrastructure investment lowers private capital investment as the private sector chooses to utilize public capital for its required purposes instead of expanding its own capacity. But on the longer term, public infrastructure investment comes to complement new and existing private capital investment in the production and distribution of goods and services. As a result, the rate of return on private capital rises.

In their own contribution, Easterly and Schmidt-Hebbel (1993) examined the relationship between public investment and private investment for developing countries. The results varied among countries. For Chile, Colombia, Ghana and Mexico increasing public investment reduces private investment (although the effect was weak for Mexico), while for Thailand and morocco private investment rises with public investment. For Argentina no significant relation was found. Thus,

only two countries provide direct evidence for the widespread presumption that public sector investment is good for private investment. It seems reasonable to infer, then, that for countries with a negative relation between public and private investment (Chile, Colombia, Ghana, and Mexico) or none at all (Argentina), public investment is concentrated in activities that substitute directly for private investment.

Similarly, Karagol (2004) investigates whether disaggregated measures of government expenditures (government consumption and public investment) exert a positive or negative effect on private investment in Turkey over the period 1968-2000. He applied a cointegration analysis of a multivariate system of equations in order to empirically estimate the long run relationship between different measures of government expenditures and private investment. The estimated results show that public investment and government consumption expenditure tend to crowd out private investment. Thus, a large increase in public investment and government consumption expenditure appeared to have adverse effect on private investment and the economic development of the Turkish economy. This finding from runs contrary to the findings by Kustepli (2005) who also investigated the effectiveness of fiscal policy in view of the crowding out hypothesis for the same country from 1967-2003 and finds show that government spending crowded in private investment.

The inconsistent results on whether public investment complements or crowds out private investment inspired Erden and Holcombe (2005) to re-examine the impact of public investment on private investment in developing economies. Applying several pooled specifications of a standard investment model to a panel of developing economies for 1980 to 1997, this study finds that public investment complements private investment, and that, on average, a 10 percent increase in public investment is associated with a 2 percent increase in private investment. The results also indicate that private investment is constrained by the availability of bank credit in developing economies. The same empirical models are run on a panel of developed economies. In contrast to developing economies, public investment crowds out private investment in developed economies. The results show that in a number of important ways, private investment in developed economies is influenced by different factors than private investment in developing economies.

Following this line of argument, Afonso and Aubyn (2008) evaluated the macroeconomic effects of public investment and private investment through VAR analysis, for 14 European Union countries plus Canada, Japan and the US from 1960-2005. The results mostly pointed to the existence of positive effects of both public and private investment on output. On the other hand, the crowding-in effects of public investment on private investment vary across countries, while the crowding- in effect of private investment on public investment is more generalized. Also, Ghassan and Al-Dehailan (2008) investigate the long-run equilibrium relationship between real private investment and public investment in Saudi Arabia over the period 1968 to 2006 using a threshold co-integration test which allows for asymmetric adjustment. Their findings show that the

stability of private investment effort and that the increase in public investment boosts private investment below threshold parameter.

In his own contribution to the argument as regards the effect of government expenditure on private investment, Kandil, (2009) provided important insights on the potential private investment's crowding out possibilities. The author argues that in the developed countries increased government spending crowds out private investment, whereas in the developing countries government expenditure crowds in private investment. This is so because in the developed countries, the available resources are fully utilized, therefore increase in public spending leads to the constraints of private sector's financial resource to fund the activities. Whereas, in the developing countries private investment decisions are mainly dependent on the economic conditions and government spending provides necessary incentives to attract private funds.

This view was supported by Furceri and Sousa, (2011) for a group of developed countries in OECD. According to the authors, government expenditure creates a significant crowding out effect, which has a negative impact on both private consumption and investment. They argued that government expenditure's impact is not significantly different according to the different stages of the economic cycle, but it is very different between the regions. As indicated by them, impact of government expenditure on private investment varies between OECD and non-member countries of this organization (stronger crowding out effect is in OECD countries), but does not depend on the stage of the business cycle. However, expansionary fiscal policy leads to greater crowding out effect than contractionary fiscal policy.

Kollamparambil and Nicolaou (2011) contributed to this argument by analyzing the nature of and relationship between public and private investment in South Africa. Their findings indicated that although public investment was not "crowding-in" private investment, it exerted an indirect impact on private investment through the accelerator effect. Hence, any increase in government spending on infrastructure and social sectors seems likely to enhance private investment in that country.

On their own part, Kodongo and Ojah (2016) examined the relationship between infrastructure spending and economic growth for a panel of 45 Sub-Saharan African countries and found that spending on infrastructure and increments in the access to infrastructure influence economic growth and development in Sub-Saharan Africa. This significant positive relationship was noted especially for lesser developed economies of the region than for the relatively more developed economies.

In a more recent study, Ouedraogo, et al (2020) examined the impact of public investment on private investment in sub-Saharan Africa using the finite mixture model. We argue that the impact of public investment on private investment differs across groups of countries with similar but unobserved characteristics. Contrary to previous studies, the paper incorporates the potential

presence of hidden heterogeneity and tries to explain the group membership. Using a sample of 42 countries, we find that the impact of public investment on private investment differs across three different groups of countries. Moreover, we find that countries with high risk of conflict, terrorism and repatriation of profits are less likely to be in the group where public investment crowds in private investment. The paper underscores the need for sub-Saharan African countries to ensure private investment security by reducing the risks associated with conflicts and terrorism, and preserving contract viability and repatriation of profits.

Adeosun, et al (2021) explores the asymmetric linkage between public investment and private sector performance in Nigeria. The study found that positive investment shocks exhibit a non-negligible and substantial stimulating (dampening) influence on the long-run performance of private sector in the economy while the negative investment shocks dampens the performance of private sector in the log run. Though, there is evidence that the negative shocks to investment may not dampen the effectiveness of private sector in the short run, and this thus brings to bear the debate on the tenability of public investment as a potent counter cyclical tool in enhancing short-run private sector growth. The study concludes that Nigeria still depends exclusively on public investment.

## METHODOLOGY AND DATA

The relationship between public investment and private investment is hinged on some theoretical positions such as the accelerator-cash flow investment theory, neoclassical investment theory, liquidity theory, Tobin's Q theory, and expected profit theory (Aschauer, 1989; Jorgenson, 1963, 1971; Erenburg and Wohar, 1995; Su and Bui, 2017). While the potency of crowding-in and crowding-out influences of public and private investment is explicit given these theories (Aschauer, 1989), the incorporation of public investment, public capital, stock cash flow, and private investment provides a common similarity among these theories (Erenburg and Wohar, 1995; Adeosun et al., 2021). This paper aligns more with flexible accelerator investment and neo-classical investment theories (Jorgenson, 1963). The study specifies an econometric model hinged on these theories.

$$\Pr iv_t = \alpha_0 + \alpha_1 Pub_t + \alpha_2 Gov_t + \alpha_3 FDI_t + \alpha_4 INF_t + \varepsilon_t \qquad (1)$$

Here, $\Pr iv_t$ denotes private investment, $Pub_t$ is public investment (partitioned into consumption and investment expenditure), $Gov_t$ denotes government size, $FDI_t$ symbolizes foreign direct investment, and $INF_t$ depicts inflation. The study estimates equation (1) by applying the autoregressive distributed lag cointegration approach. Further, the dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS) are employed as robustness checks.

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**The Nonlinear model**

A thrust of this study is to investigate the non-linear relationship between the components of public (consumption and investment) expenditure and private investment in Nigeria. Therefore, a typical model incorporating asymmetric relationship is depicted in model 2:

$$\Pr iv_t = \alpha_0 + \alpha_1 Pub_t^{+} + \alpha_2 Pub_t^{-} + \alpha_3 Gov_t + \alpha_4 FDI_t + \alpha_5 INF_t + \varepsilon_t \quad (2)$$

To estimate this model, we adopt the Shin et al. (2014) nonlinear autoregressive distributed lag (NARDL) approach as an extension of the linear autoregressive distributed lag (ARDL) by Pesaran et al. (2001). The NARDL version of model 2 is shown in equation (3)

$$\begin{aligned}\Delta(\Pr iv)_t = {} & \rho\left(\Pr iv\right)_t + \alpha_1^{+'}(Pub)^{+}_{t-1} + \alpha_2^{-'}(Pub)^{-}_{t-1} + \alpha_3(Gov)_{t-1} + \alpha_4(FDI)_{t-1} + \alpha_5(INF)_{t-1} \\ & + \sum_{j=1}^{p-1}\phi_0\Delta\left(\Pr iv\right)_{t-j} + \left(\sum_{j=0}^{q-1}\left(\vartheta_1^{+'}\Delta Pub_{t-j}{}^{+} + \vartheta_2^{-'}\Delta Pub_{t-j}{}^{-}\right)\right) \\ & + \sum_{j=0}^{r}\varsigma_3\Delta Gov_{t-j} + \sum_{j=0}^{s}\tau_4\Delta FDI_{t-j} + \sum_{j=0}^{u}\pi_5\Delta INF_{t-j} + \mu_t\end{aligned} \quad (3)$$

Resimplifying more precisely in error correction form, equation (3) gives:

$$\begin{aligned}\Delta(\Pr iv) = {} & \rho\xi_{t-1} + \sum_{j=1}^{p-1}\phi_0\Delta\left(\Pr iv\right)_{t-j} + \left(\sum_{j=0}^{q-1}\left(\vartheta_1^{+'}\Delta Pub_{t-j}{}^{+} + \vartheta_2^{-'}\Delta Pub_{t-j}{}^{-}\right)\right) \\ & + \sum_{j=0}^{r}\varsigma_3\Delta Gov_{t-j} + \sum_{j=0}^{s}\tau_4\Delta FDI_{t-j} + \sum_{j=0}^{u}\pi_5\Delta INF_{t-j} + \mu_t\end{aligned} \quad (4)$$

Where $\xi_t = \Pr iv_t - \chi^{+'}Pub^{+}{}_t - \chi^{-'}Pub^{-}{}_t$ are the asymmetric error correction term and $\chi^{+} = \frac{-\alpha_i^{+}}{\rho}$ and $\chi^{-} = \frac{-\alpha_i^{-}}{\rho}$ are the asymmetric long-run parameters (Shin et al., 2014). Models 3 and 4 signify the long-run and short-run components of the NARDL model specified, where $p, q, r, s, u$ are the lag operators. $\sum_{j=0}^{q-1}\vartheta_1^{+'}$ and $\sum_{j=0}^{q-1}\vartheta_2^{-'}$ define the short run positive and negative impacts of public investment on private investment. The nonlinear dynamic multiplier influence of percentages in the positive and negative components of government investment (i.e., $Pub_t^{+}$ and $Pub_t^{-}$) on private investment is depicted in equation (5).

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$$m_h^+ = \sum_{j=0}^{h} \frac{\partial \Pr iv_{t+j}}{\partial \Pr ub^+_t} = \sum_{j=0}^{h} \lambda_j^+, m_h^- = \sum_{j=0}^{h} \frac{\partial \Pr iv_{t+j}}{\partial \Pr ub^-_t} = \sum_{j=0}^{h} \lambda_j^-, h = 0,1,2... \quad (5)$$

Given $h \to \infty\ m_h^+ \to \beta^+\ m_h^- \to \beta^-$, $m_h^+$ and $m_h^-$ show the dynamic asymmetric adjustment patterns. Models 6 and 7 show the partial sums decomposition of positive and negative changes in public investment.

$$\Pr ub^+_t = \sum_{j=1}^{t} \Delta \left( Pub \right)_j^+ = \sum_{j=1}^{t} \max \left( \Delta Pub_j, 0 \right) \quad (6)$$

$$\Pr ub^-_t = \sum_{j=1}^{t} \Delta \left( Pub \right)_j^- = \sum_{j=1}^{t} \min \left( \Delta Pub_j, 0 \right) \quad (7)$$

Given the space constraint, we further refer the readers to Diks and Panchenko (2006) for the specifics of nonparametric nonlinear Granger causality modeling. The data adopted in this paper, which spanned between 1981 and 2021, is sourced from the Central Bank of Nigeria and World Bank Development Indicators databases. All data are calculated in logarithmic form. We show the statistical and stochastic properties of data in Tables 1 and 2. The summary statistic is shown in Table 1. Among the variables, the high mean and low volatility of government size may imply that the public sector plays a significant role in the Nigerian economy and that its size remains relatively stable over time. The high mean shows a larger government sector, portending higher government spending, taxation, and public services. The low mean (0.08) and high standard deviation of FDI suggest that foreign investment in the economy is not consistently high and records significant variations, suggesting policy inconsistencies, economic uncertainties, and fluctuations in global markets.

A persistent flow of FDI is important for economic growth and stability. The higher volatility of investment expenditure compared to consumption expenditure shows capital investments by the public sector can be more varied than expenditure on consumption items, indicating the need for more stable and long-term investment planning in Nigeria. Statistically, the negative skewness exhibited by FDI, government size, and consumption expenditure implies that they exhibit lower values. The leptokurtic tendencies of consumption expenditure and government size show that extreme values are more inherent in the variables indicating potentials for sudden and significant economic events or policies influencing government spending and consumption. The non-normality of the Jarque Bera statistic for consumption expenditure and government size indicates the presence of nonlinearity and asymmetry. The BDS nonlinear independence tests (Table 2) show that virtually all series show nonlinear structures. The Augmented Dickey Fuller (ADF) and the Phillips and Perron (PP) unit root tests (Table 3) show mixed order of integration among the variables, further suggesting the appropriateness of the ARDL and NARDL approaches adopted

in the paper. The weaknesses of the ADF and PP amidst breaks were captured by the Andrews and Zivot (ZA) tests. The ZA shows break dates for concomitant global events such as the global financial crisis and energy shocks. The break date indicates time variation in the series given global political and economic phenomena similar to the experiences of the GCC countries (Adeosun et al., 2021; Ari et al., 2019). The evidence of breaks and nonlinearity further authenticates the appropriateness of the nonlinear approaches adopted in the study**.**

## FINDINGS AND DISCUSSION OF RESULTS

By estimating model 1, the paper conducts a baseline linear regression as it applies the linear ARDL and further employs the DOLS and FMOLS as robustness checks given that they are co-integrating regressions (see Table 4). Thereafter, we estimate equations 2-7 by applying nonlinear approaches. The baseline models 1 and 2 show the consumption expenditure and investment expenditure components of public investment, respectively, while models 3-4 and 5-6 are the robustness checks of the baseline models. Model 1 shows a negative and significant influence of consumption expenditure on private investment, implying that when households and businesses spend more on consumption, they have less capital available for investment. As such, the higher level of consumption can "crowd out" private investment, potentially resulting in slower economic growth in the long run. The finding aligns with Karagol (2004) but contradicts Kustepli (2005). The negative and significant influence may also suggest that the consumption component of public investment and private investment are substitutes, given that an uptick in consumption expenditure dampens private investment. The positive and significant sign of investment expenditure indicates that when the public sector invests more in infrastructure, research and development, or other forms of capital formation, private investment tends to rise, suggesting a crowding-in phenomenon. A crowding-in effect occurs where public investment complements private investment, leading to overall economic growth via the multiplier effect, corroborating the Keynesian proposition (Keynes, 1929; Arestis, 1979; Cavallo and Daude, 2008; Hussain, Akram, and Irfan, 2009; Chude and Chude, 2013; Adeosun et al., 2021). The fact that the investment expenditure component of public investment exerts a positive effect on private investment suggests a complementary relationship. We establish consistent results for the control explanatory variables: FDI, government size, and inflation. FDI shows a positive and significant effect, indicating that FDI inflows can stimulate private investment. FDI is seen as injection rather than withdrawal; as such, the injection of foreign capital, technology, and expertise into the domestic economy boosts the attractiveness of investing in the country. Our findings align with the theoretical position of Stevens and Lipsey (1992), where FDI inflows stimulate and FDI outflows discourage the home country's domestic investment. Given the imperfect financial market and scarcity of financial inputs amidst capital outflow, the financial liquidity available to spur new investment activities dwindles, and domestic private firms face challenges in raising funds in the domestic financial market.

The positive and non-negligible effect of government size on private investment may imply that a larger government sector has the tendency to stimulate private investment. This could mean that

government spending on infrastructure or public goods creates a favorable environment for private businesses and investment, although the nexus depends on the nature of government spending and prevailing public policy. The negative sign of inflation rates shows that inflationary pressures erode the purchasing power of money, making it less attractive to hold cash or invest in assets. High inflation rates can also introduce uncertainty into the economic environment, discouraging long-run investment. It was observed that there are tradeoffs between consumption and investment expenditure; as such, encouraging higher savings rates or creating incentives for businesses to reinvest profits could help boost private investment. Monetary policies to stem inflation are pivotal to stimulating a conducive investment climate.

In the short run, the one-period lag of private investment is positive in models 1 and 2, suggesting inertia or persistence in investment decisions. The contemporaneous consumption expenditure (Model 1) aligns with the long-run results, suggesting that when households and businesses are spending more on consumption in the current period, they are allocating fewer resources to investment, possibly due to limited available funds. Therefore, increased consumer spending may divert resources away from investment. However, the positive effect of the one-period lag in consumption expenditure could be attributed to patterns of consumer behavior or seasonality. In Model 2, the lagged effect of investment expenditure shows that while public investment might have an immediate impact on private investment; it positively influences it in subsequent periods, possibly due to delays or lags in the response of private investment to changes in public investment. The positive contemporaneous effects of FDI and government size on private investment may be due to the immediate positive effect of foreign investments and government spending on economic activity. The error correction term (ECT) suggests that there is a tendency for the system to correct itself if it deviates from long-run equilibrium, indicating that economic factors work to bring the system back into balance over time. The ARDL diagnostics confirm its appropriateness. Given the K explanatory variables, the F-statistics reveal a long-run relationship since they exceed the upper bound at the conventional 5 percent level. The normality and heteroskedasticity tests further confirm the robustness of the model. The robustness checks in models 5 and 6 further align the baseline models 1 and 2.

The major thrust of this study is to account for nonlinearity in the relationship between government expenditure and private investment (Brumby, Kaiser, and Kim, 2013; Han, 2015; Adeosun et al., 2021). Table 5 displays the Shin et al. (2014) NARDL results. In model 1, private investment reacts negatively to positive shocks to consumption expenditure by a tune of 1.888, suggesting that when consumption expenditure increases due to factors such as increased consumer demand, private investment tends to decrease. Arguably, during periods of strong consumer spending, firms may allocate fewer resources to investment as they prioritize meeting immediate consumer demand. The insignificance of negative consumption expenditure shocks suggests that factors resulting in a reduction in consumption spending do not portend a clear and consistent impact on private investment (Adeosun et al., 2021). We observe that the negative and marginally significant effect of positive investment expenditure shocks on private investment. The negative coefficient

of investment expenditure indicates that an increase in negative components of investment expenditure has a significant negative impact on private investment, suggesting that private businesses may be particularly sensitive to adverse economic conditions or reduced public investment. The result suggests that policymakers need to ensure a stable economic environment and robust investment. They may need to consider policies that encourage private investment even during periods of increased consumer spending or positive public investment, as private investment is essential for long-term economic growth and job creation.

The short-run findings show that government consumption expenditure and investment expenditure can exert both short-run positive and negative effects on private investment. Past high levels of government consumption spending tend to deter private investment, whereas a reduction in current government consumption expenditure can encourage it, underscoring the relevance of government fiscal policies in influencing private investment decisions. Positive spillover effects from past government investment expenditures show that government investments in the past contribute positively to current private investment levels, emphasizing sustained investment efforts by the government in infrastructure. This shows that government investment expenditure is productive (see Pereira, 1999; Adeosun et al., 2021). The results further show that adverse economic conditions or reductions in investment expenditure can have a substantial negative effect on private investment, suggesting that policymakers should carefully manage government spending, balancing consumption with productive investment to support economic stability and create a favorable environment for private sector investment and economic growth.

Generally, the asymmetric structure inherent in the results is further confirmed by the cumulative dynamic multiplier graphs (see Figure 1). In the 1-4 period horizon (short-term), the multipliers for both the positive and negative components of government consumption expenditure, as well as the asymmetry plot, start in the positive quadrant. Beyond the $4^{th}$ period, they transition to the negative quadrant, continuing in that direction from the 5–15 period horizon (medium to long term). These results could mean that an increase in government consumption expenditure can stimulate economic activity and possibly lead to higher private sector investments in the short term, but as we move into the medium and long term, its impact starts to diminish or even reverse. As such, in the longer term, an overreliance on government consumption spending, especially if it is not productive or efficient (see Easterly and Levine, 2001; Adeosun et al., 2022), may lead to fiscal imbalances, inflation, or crowding out of private investment. This finding may be a pointer to policymakers not to solely consider consumption expenditure as a long-term economic growth strategy. Besides, striking a balance between short-term stimulus and long-term fiscal responsibility is paramount. Regarding the dynamic multiplier graph of government investment expenditure, it exhibits oscillatory patterns across the period horizon. The results show that government investment spending is not consistent across different time frames, suggesting the need for a balanced approach to fiscal policy. Government investment should be targeted and efficiently managed to maximize its positive impact and avoid negative consequences in the medium and long term. There is also the need for complementary policies that encourage private

sector investment and productivity in order to support sustained economic growth amidst changing multipliers over time.

Drawing insights from Mensi et al. (2017) and Adeosun et al. (2021), we embed private investment and the positive and negative components of government consumption and investment expenditure under the VAR framework, where they are treated endogenously. Table 6 therefore shows the nonlinear variance decomposition to further deepen the analysis and serve as a robustness check for the NARDL model. The decreasing standard error indicates that private investment becomes more stable as time progresses, suggesting economic predictability. The response of private investment to its own shock decreases over time, suggesting that the impact of its own past shocks diminishes, showing a tendency towards economic equilibrium. The responses to positive government consumption and investment expenditure shocks show an increasing trend, with a stronger reaction to investment expenditure. This implies that private investment becomes more positively influenced by government investment expenditures over time. The responses to negative government consumption and investment expenditure also increase over time, with a stronger impact of the negative consumption expenditure shock. The findings show that policies that promote productive government investment can be an effective strategy for stimulating private investment and economic growth. Indeed, the importance of prioritizing productive government investment cannot be overemphasized, as it can have a more immediate and substantial effect on stimulating private sector investment and fostering long-term economic growth. Fiscal authorities should also carefully consider resource allocation, fiscal responsibility, and long-term planning to maximize the benefits of government expenditure in spurring private sector performance and economic diversification (Adeosun et al., 2021). However, there is a need to strike a balance between consumption and investment and adopt a long-term perspective to maximize the benefits of such policies.

To address the last objective of this paper, which is to examine the possibility of feedback between the components of government expenditure and private investment, we apply the Granger causality procedure. However, since the BDS nonlinear independence tests affirm asymmetry in the structure of investment series, conducting Granger causality under the assumption of linearity may be inappropriate. Therefore, we apply the nonparametric nonlinear Granger causality test of Diks and Panchenko (2006) to establish possible causality and feedback between government and private investment amidst nonlinearity. The results are depicted in Table 7 across the embedding dimensions 2 to 5. Causality from private investment to government consumption expenditure is observed at embedding dimensions 2, 3, and 4, implying that past values of private investment carry information useful for predicting government consumption expenditure. The causality weakens at embedding dimension 5, suggesting a diminishing effect. Causality from government investment expenditure to private investment is observed across the dimensions, implying that government consumption expenditure affects private investment. Causality from private investment to government investment expenditure is observed at embedding dimensions 2 and 4 but weakens at embedding dimension 5. Causality from government investment expenditure to

private investment is observed at embedding dimensions 2, 3, and 4. This indicates government investment expenditure affects private investment positively. Like the previous cases, the causality weakens at embedding dimension 5. The findings generally suggest that government consumption and investment expenditure appear to affect private investment in the short run and vice versa, suggesting bidirectional causality. The inherent diminishing effects in the $5^{th}$ embedding dimension may imply that while there are short-term linkages, the long-term dynamics between the series may be more complex or subject to other influencing factors. The dynamics between public and private investments may weaken as the time horizon extends beyond a certain point, highlighting the need for time-sensitive policy decisions. This finding suggests to policymakers the need to balance fiscal policies to stimulate private sector growth while considering the time dimension of the relationship, which is pivotal for economic stability and growth.

## CONCLUSION

The paper examines the relationship between government investment and private investment in Nigeria, addressing possible nonlinearity and feedback effects. Specifically, it investigates the connections between the consumption and investment expenditure components of public investment and private investment. To achieve the objective, we apply the nonlinear autoregressive distributed lags (ARDL) models and nonlinear Granger causality tests to data spanning 1981 to 2021. Findings show that consumption expenditure exhibited a long-term negative impact on private investment, implying that heightened consumer spending may divert resources away from investment, potentially hindering economic growth. Investment expenditure displayed a positive and long-term influence on private investment, suggesting a "crowding-in" effect where increased public investment stimulates private investment, fostering overall economic growth.

Economic adversities or reduced public investment exerted a substantial negative impact on private investment, underscoring the sensitivity of private businesses to adverse economic conditions. In the short run, government consumption and investment expenditure demonstrated both positive and negative influences on private investment. High past levels of government consumption expenditure tended to deter private investment, while a decrease in current government consumption expenditure encouraged it. The positive spillover effects from previous government investment expenditures emphasized the significance of continued government investment in infrastructure. Nonlinear Granger causality tests revealed bidirectional causality between government consumption expenditure and private investment, implying that past values of private investment carried useful information for predicting government consumption expenditure. However, this causality weakened over time, suggesting a diminishing effect. Causality was also observed from government investment expenditure to private investment across various embedding dimensions, emphasizing the positive influence of government investment on private investment. The findings generally suggest the need for balanced fiscal policies, prioritizing productive government investments, encouraging private investment, controlling inflation, and making time-sensitive policy decisions.

British Journal of Multidisciplinary and Advanced Studies:
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Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
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| | Dependent | | | Explanatory | | |
|---|---|---|---|---|---|---|
| Variable | Priv | Con_exp | Inv_exp | Gov_size | Fdi | Inf |
| Mean | 2.1758 | 3.9914 | 3.4421 | 4.5460 | 0.0827 | 2.6805 |
| Std.Dev | 0.3546 | 0.4425 | 0.5200 | 0.0661 | 0.8122 | 0.6759 |
| Skewness | 0.3802 | -1.7917 | 0.0739 | -0.9101 | -0.0961 | 0.8831 |
| Kurtosis | 2.2937 | 6.4301 | 2.1193 | 4.0151 | 2.5102 | 2.9971 |
| Jarque-Bera | 1.8397 | 42.0341*** | 1.3623 | 7.4199** | 0.4730 | 5.3287* |
| Obs | 41 | 41 | 41 | 41 | 41 | 41 |

Table 1: Summary statistic

NB: Priv shows private investment; con_exp, Inv_exp, Gov_size, FDI, and INF denote consumption expenditure, investment expenditure, government size, foreign direct investment, and inflation. *, **, *** denote 10, 5, and 1 percent significance level.

| Variable | m=2 | m=3 | m=4 | m=5 |
|---|---|---|---|---|
| Priv | 0.1179*** | 0.1969*** | 0.2478*** | 0.2856*** |
| | (0.0079) | (0.0128) | (0.0155) | (0.0165) |
| Con_exp | 0.1438*** | 0.2479*** | 0.3074*** | 0.3349*** |
| | (0.0156) | (0.0254) | (0.0310) | (0.0331) |
| Inv_exp | 0.1838*** | 0.3199*** | 0.4085*** | 0.4584*** |
| | (0.0078) | (0.0126) | (0.0152) | (0.0161) |
| Gov_size | 0.0105 | 0.0168 | -0.0089 | -0.0184 |
| | (0.0124) | (0.0201) | (0.0245) | (0.0260) |
| Fdi | 0.0651*** | 0.1062*** | 0.1148*** | 0.0865*** |
| | (0.0092) | (0.0148) | (0.0179) | (0.0189) |
| Inf | 0.0805*** | 0.1270*** | 0.1749*** | 0.1955*** |
| | (0.0145) | (0.0236) | (0.0288) | (0.0308) |

Table 2: BDS Stat.

NB: . *, **, *** denote 10, 5, and 1 percent significance level.

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Table 3: Unit root test

| Variable | ADF | | PP | | ZA | |
|---|---|---|---|---|---|---|
| | Level | 1st Diff | Level | 1st Diff | | |
| Priv | -3.6954** | | -2.6312 | -10.3700*** | -8.2573*** | 2007 |
| Con_exp | -4.3272*** | | -5.3549*** | | -4.6022 | 2015 |
| Inv_exp | 0.4150 | -5.2605*** | 0.2174 | -5.2914*** | -3.4338 | 2015 |
| Gov_size | -4.2695*** | | -4.2036** | | -5.5027* | 2015 |
| Fdi | -3.0653 | -9.6527*** | -2.8736 | -16.4394*** | -3.2019 | 1990 |
| Inf | -4.4948*** | | -3.2884* | -9.3311*** | -6.6163*** | 1997 |

NB: . *, **, *** denote 10, 5, and 1 percent significance level.

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| Variable | ADRL | | DOLS | | FMOLS | |
|---|---|---|---|---|---|---|
| Dependent: Priv | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Con_exp | -0.9071* | | -0.1638 | | -0.5446*** | |
| | (0.4722) | | (0.5042) | | (0.1502) | |
| Inv_exp | | 0.1897* | | -0.0709 | | 0.2460* |
| | | (0.3496) | | (0.2748) | | (0.1449) |
| Fdi | 0.4252*** | 0.2406*** | 0.4132** | 0.3247** | 0.1043 | 0.0894* |
| | (0.1380) | (0.0802) | (0.1468) | (0.1214) | (0.0849) | (0.0520) |
| Gov_size | 3.7741** | 2.4323*** | 5.1672** | 4.9383*** | 1.9295* | 1.7638*** |
| | (1.7184) | (0.7657) | (2.0293) | (1.5568) | (0.9878) | (0.6113) |
| inf | -0.2763*** | -0.2860*** | -0.4237*** | -0.3351** | -0.1893** | -0.0832 |
| | (0.0819) | (0.0904) | (0.1287) | (0.1353) | (0.0802) | (0.0517) |
| Constant | -8.6217*** | -5.5648*** | -19.8873** | -19.4397** | -8.2804* | -5.0611* |
| | (1.0833) | (1.9649) | (7.9114) | (6.8849) | (4.2769) | (2.7054) |
| Short Run | | | | | | |
| Priv(-1) | 0.2479*** | 0.5927*** | | | | |
| | (0.1081) | (0.1200) | | | | |
| Con_exp | -0.5495*** | | | | | |
| | (0.1731) | | | | | |
| Con_exp(-1) | 0.4057** | | | | | |
| | (0.1552) | | | | | |
| Inv_exp | | -0.0598 | | | | |
| | | (0.1657) | | | | |
| Inv_exp(-1) | | 0.4497** | | | | |
| | | (0.1739) | | | | |
| fdi | 0.0871*** | 0.0823*** | | | | |
| | (0.0286) | (0.0292) | | | | |

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Online ISSN: 2517-2778
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| | | | | | | |
|---|---|---|---|---|---|---|
| Fdi(-1) | 0.1511*** | 0.0823*** | | | | |
| | (0.0408) | (0.0292) | | | | |
| Gov_size | 1.9716*** | 1.4415*** | | | | |
| | (0.3659) | (0.4248) | | | | |
| Gov_size(-1) | -1.5149*** | | | | | |
| | (0.4131) | | | | | |
| Inf | 0.0243 | -0.0337 | | | | |
| | (0.0303) | (0.0313) | | | | |
| ECT(-1) | -0.7510*** | -0.5927*** | | | | |
| | (0.0939) | (0.0828) | | | | |
| Diagnostic | | | | | | |
| K | 4 | | | | | |
| f-stat | 10.5691 | 8.9641 | | | | |
| Jacque-Bera | 0.9691 | 0.2165 | | | | |
| Breusch-Pagan | 0.7129 | 1.3426 | | | | |
| R2 | 0.8246 | 0.6254 | 0.9185 | 0.9203 | 0.5762 | 0.7650 |

Table 4. Linear cointegration tests

NB: *, **, *** denote 10, 5, and 1 percent significance level.

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Economics and Finance5 (2),1-25, 2024
Print ISSN: 2517-276X
Online ISSN: 2517-2778
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| Variable<br>Dependent: Priv | NARDL COINTEGRATION TEST | |
|---|---|---|
| | (1) | (2) |
| Inf | -0.3553*** | 0.1371*** |
| | (0.1122) | (0.0423) |
| Fdi | 0.8414*** | -0.0020 |
| | (0.1667) | (0.0244) |
| Gov_size | 4.0271*** | 0.2227 |
| | (0.9573) | (0.2940) |
| Con_exp$^{+}$ | -1.8888** | |
| | (0.7557) | |
| Con_exp$^{-}$ | 0.6182 | |
| | (0.5285) | |
| Inv_exp$^{+}$ | | -0.3610* |
| | | (0.1776) |
| Inv_exp$^{-}$ | | -0.7843*** |
| | | (0.1844) |
| Short-Run | | |
| Constant | -8.8444*** | -0.4611*** |
| | (0.7315) | (0.0606) |
| fdi | 0.1270*** | 0.1153*** |
| | (0.0234) | (0.0222) |
| Fdi(-1) | -0.2773*** | 0.1774*** |
| | (0.0234) | (0.0270) |
| Inf | 0.0793*** | 0.0162 |
| | (0.0203) | (0.0267) |
| Inf(-1) | -0.2279*** | -0.2121*** |
| | (0.0382) | (0.0226) |
| gov_size | 2.5832*** | 0.2889 |
| | (0.4353) | (0.4149) |
| con_exp(-1)$^{+}$ | -0.7153*** | |
| | (0.1934) | |
| con_exp$^{-}$ | -0.8411*** | |
| | (0.1696) | |
| Inv_exp(-1)$^{+}$ | | 0.4303* |
| | | (0.2037) |
| Inv_exp$^{-}$ | | -1.7999*** |
| | | (0.2595) |
| ECT(-1) | -0.6415*** | -1.2970*** |

| | | |
|---|---|---|
| | (0.0539) | (0.1241) |
| Diagnostic | | |
| K | 5 | |
| f-stat | 18.6564 | 13.8801 |
| Jacque-Bera | 2.3866 | 1.0586 |
| Breusch-Pagan | 0.4934 | 0.6599 |
| R2 | 0.8246 | 0.4520 |

Table 5. Nonlinear cointegration test

NB: *, **, *** denote 10, 5, and 1 percent significance level.

Table 6. Nonlinear variance decomposition

| Period | S.E Priv | Priv-Priv | Priv-con_exp$^+$ | Priv-con_exp$^-$ |
|---|---|---|---|---|
| 1 | 0.1636 | 100.0000 | 0.0000 | 0.0000 |
| 2 | 0.2105 | 97.5111 | 0.2123 | 2.2766 |
| 3 | 0.2238 | 91.5387 | 0.2917 | 8.1696 |
| 4 | 0.2309 | 86.0788 | 0.3850 | 13.5361 |
| 5 | 0.2354 | 82.9666 | 0.5580 | 16.4755 |
| 6 | 0.2381 | 81.2122 | 0.7533 | 18.0345 |
| 7 | 0.2400 | 79.9678 | 0.9169 | 19.1153 |
| 8 | 0.2416 | 78.8871 | 1.0467 | 20.0662 |
| 9 | 0.2433 | 77.8587 | 1.1549 | 20.9864 |
| 10 | 0.2450 | 76.8746 | 1.2499 | 21.8755 |
| Period | S.E Priv | Priv-Priv | Priv-inv_exp$^+$ | Priv-inv_exp$^-$ |
| 1 | 0.1632 | 100.000 | 0.0000 | 0.0000 |
| 2 | 0.2210 | 95.5159 | 4.4695 | 0.0146 |
| 3 | 0.2338 | 92.7019 | 7.2847 | 0.0134 |
| 4 | 0.2361 | 91.7981 | 8.0416 | 0.1603 |
| 5 | 0.2373 | 91.1794 | 8.1426 | 0.6780 |
| 6 | 0.2390 | 90.3243 | 8.0790 | 1.5968 |
| 7 | 0.2412 | 89.1393 | 7.9423 | 2.9183 |
| 8 | 0.2440 | 87.5335 | 7.7624 | 4.7041 |
| 9 | 0.2475 | 85.3881 | 7.5700 | 7.0420 |
| 10 | 0.2520 | 82.5933 | 7.4016 | 10.0052 |

NB: *, **, *** denote 10, 5, and 1 percent significance level.

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Economics and Finance5 (2),1-25, 2024
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| Lagx=Lagy | Priv to Con_exp | Con_exp to Priv | Priv to Inv_exp | Inv_exp to Priv |
|---|---|---|---|---|
| 2 | 1.612** | 1.452* | 1.266* | 1.331* |
| 3 | 1.316* | 1.451* | 0.965 | 1.405* |
| 4 | 1.319* | 1.511* | 1.431* | 1.237* |
| 5 | 0.935 | 1.304* | 0.736 | 0.201 |

Table 7. Nonlinear: Granger Causality

NB: *, **, *** denote 10, 5, and 1 percent significance level.

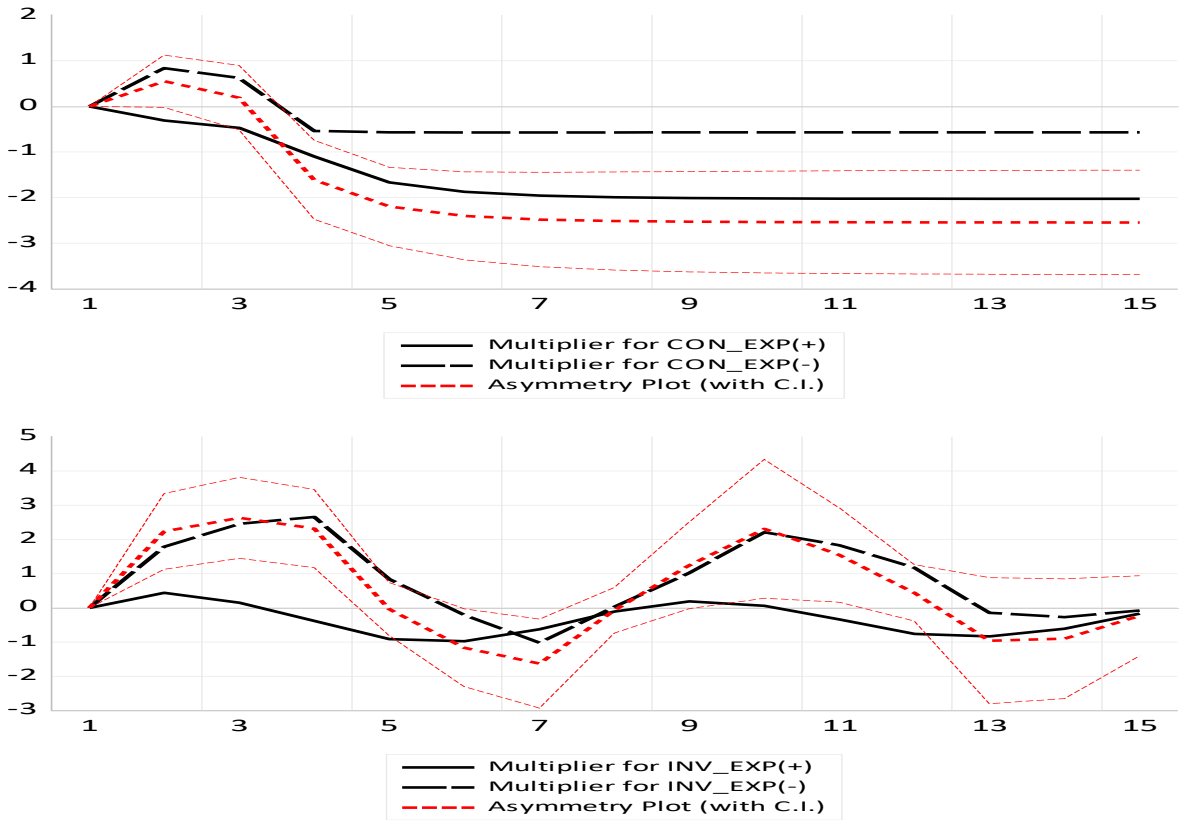


Figure 1. Dynamic Multiplier Graphs

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