AFRICAN ECONOMIC AND SOCIAL RESEARCH INSTITUTE (AESRI) WORKING PAPER SERIES

PUBLIC DEBT AND INFLATION NEXUS IN NIGERIA: AN ARDL BOUNDS TEST APPROACH[1]

Accepted*: Cogent Economics & Finance*

WP/21/09

May 2021

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[1] This working paper also appeared in the UNISA Economic Research Working Paper Series.

PUBLIC DEBT AND INFLATION NEXUS IN NIGERIA: AN ARDL BOUNDS TEST APPROACH

Akingbade U. Aimola[2] and Nicholas M. Odhiambo

Abstract

Inflationary tendencies of public debt have been the cause of an unsettling debate among policymakers in Nigeria. Using the autoregressive distributed lag (ARDL) framework, this study attempts to investigate the impact of total public debt on inflation in Nigeria for the period 1983–2018. The cointegrating regression results reveal evidence of a stable long-run relationship among inflation, total public debt, money supply, interest rate, economic growth, trade openness, and private investment in the presence of structural breaks. Empirical results show that the impact of public debt on inflation is statistically insignificant, irrespective of whether the regression was in the short or the long run. Hence, the study concludes that inflation in Nigeria could be driven by other factors other than public debt.

Keywords: *public debt; inflation; ARDL; Nigeria.*

JEL Classification: *C32, E31, H63.*

1. Introduction

The relationship between public debt and inflation has attracted a number of studies in recent years, but with little consensus reached to date. There are different views in the literature on the causes of inflation. According to the monetarist, inflation is a monetary phenomenon, arguing that an

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expansionary monetary policy will increase real output and general price level in the short run, while, in the long run, only the price level will increase (Friedman, 1968).

Recent studies have emerged to show that inflation is not only a monetary problem but also a fiscal concern that may come from fiscal deficit or public debt (Bleaney, 1996; Catao and Terrones, 2005; Lin and Chu, 2013; Nastansky and Strohe, 2015). Contrary to the monetarist view that only monetary aggregates drive inflation, Sargent and Wallace (1981), and Kwon et al. (2006) argue that the Fiscal Theory of Price Level (FTPL) identifies the wealth effect of public debt as an additional channel of fiscal influence on inflation. They emphasise the role of fiscal policy in the inflation process because money supply alone may not be sufficient to pin down the time path of inflation. They further argue that the success of monetary policy in regulating inflation is determined by its coordination with fiscal policy; hence, high levels of public debt stock may be inflationary (Kwon et al., 2006; Sargent and Wallace, 1981). Public debt accumulation in financing budget deficits must, therefore, be used with caution and efficiently in promoting economic growth in Nigeria. Fiscal policy affects monetary authority's ability to control inflation, especially under a fiscal dominant regime where the central bank may not be able to control inflationary pressures effectively (Leeper, 1991).

The macroeconomic consequences of fiscal policy have continued to be a major concern due to its undesirable consequences of pointing macroeconomic variables towards an unsustainable path. For instance, Budina and Wijnbergen (2000) argue that since 1989, persistent fiscal deficit problems have been the key factors behind inflation volatility for Eastern European countries. Islam and Wetzel (1991) also argue that, for less-developed countries, fiscal deficit has been blamed for much of the debt crisis, high inflation and poor economic growth. According to Sims (2016), a persistent and growing budget deficit will eventually produce inflationary pressures, regardless of policies followed by the central bank. Hence, the need for sustainable inflation requires effective policy coordination among debt, monetary and fiscal authorities (Central Bank of Nigeria, 2011a). According to Fischer et al. (2002), Catao and Terrones (2005), and Lin and Chu (2013), there is a link between fiscal deficit and inflation. Similarly, in their studies, Bleaney (1996), Kwon et al. (2006), Nastansky and Strohe (2015), and Romero and Marin (2017) suggest a link between public debt and inflation.

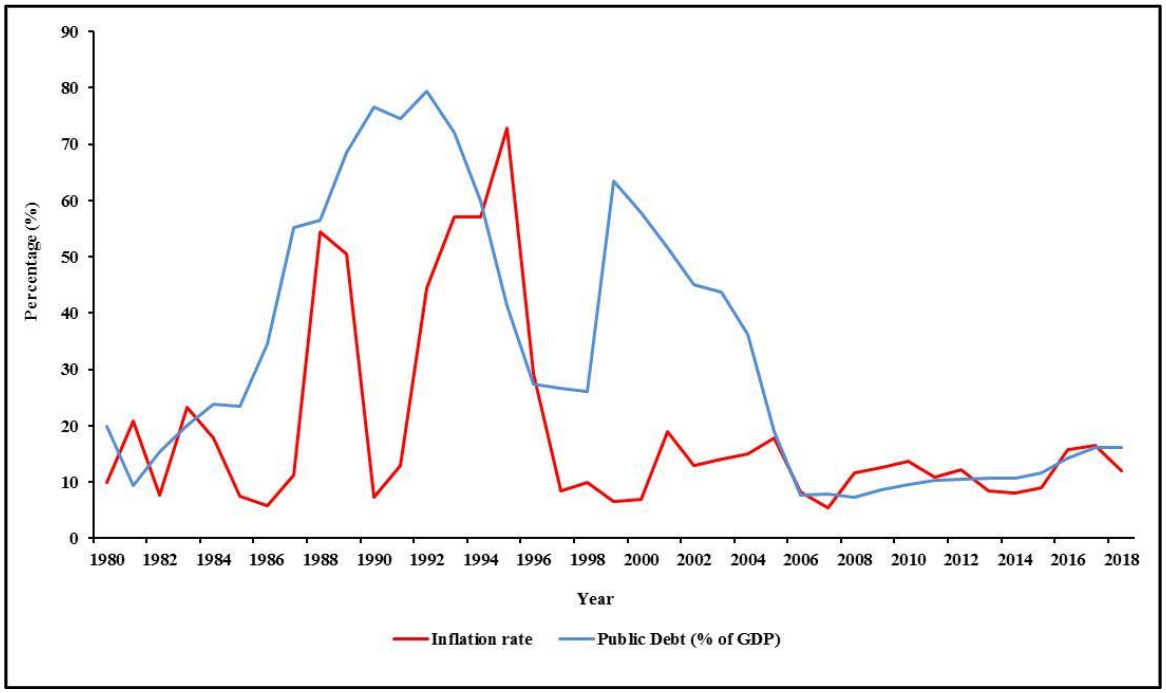
Although a number of studies have been conducted on the link between public debt and inflation, very few studies have been conducted on African countries, and where studies have been done, the results have been inconclusive. In particular, not many studies have been conducted on the link between public debt and inflation in a country such as Nigeria where public debt has contributed significantly in the funding of fiscal deficits. It is against this argument while considering trends in public debt that the current study undertakes an empirical investigation into the individual effects of public debt on inflation in Nigeria. Hence, the primary aim of this study is to investigate the impact of public debt on inflation in Nigeria using the ARDL approach. This analysis is important going forward, for authorities to pay attention to the macroeconomic effects of public debt, especially its impact on inflation in Nigeria. Moreover, apart from contributing to the literature on public debt and inflation, to our knowledge, this might well be the first study of its kind to examine the dynamic relationship between public debt and inflation in Nigeria using the ARDL bounds testing approach.

The rest of this paper is organised as follows: Section 2 presents trends in public debt and inflation in Nigeria. Section 3 discusses the theoretical and empirical literature review. Section 4 presents the estimation technique and empirical analysis. Section 5 concludes the paper.

2. Trends in public debt and inflation in Nigeria

Figure 1 illustrates trends in total public debt and inflation rate using annual data for the period from 1980 to 2018 in Nigeria. Nigeria's total public debt stock had evolved in the last three decades. As a percentage of gross domestic product (GDP), this represent a decrease from 19.83% in 1980 to 16.07% in 2018, with a minimum of 7.26% in 2008 and a maximum of 79.38% in 1992 (Central Bank of Nigeria, 2004, 2019; Debt Management Office Nigeria, 2006). The ratio between 1980 and 2004, before external public debt relief in 2005, averaged 44.34%, compared to 11.15% between 2007 and 2018, after the implementation of the third phase of the Paris Club debt deal and the exit from London Club debt obligations in 2006 (Central Bank of Nigeria, 2004, 2019; Debt Management Office Nigeria, 2006).

Figure 1: Trends in public debt and inflation



Sources: CBN (2004); World Bank (2019); CBN (2019) - Authors' compilation using Excel

The composition of Nigeria's total public debt stock can be broadly categorised into external and domestic public debt. The proportional share of these two sources had alternated since 1980. From 1980 to 1985, it was largely dominated by domestic public debt stock and from 1986 to 2005 by external public debt stock. Starting 2006, it reverted to domestic public debt stock having dominant share up until 2018. The changes in domestic public debt stock in the 1980s and 1990s resulted mainly from the fiscal operations of the central government's large deficits (Central Bank of Nigeria, 2001; Essien et al., 2016; Titus, 2013).

Domestic public debt stock since 2001 had gradually increased its contribution to total public debt stock. The changes between 2004 and 2005 were as a result of three main factors, which were in line with Nigeria's domestic debt management strategy. First was the development of the domestic debt market for financing budget deficits; second was developing and deepening of the financial market; and third was sourcing investment funds (Debt Management Office Nigeria, 2005) Trends from 2006 to 2016 showed a drastic increase in domestic public debt stock. The increased changes

recorded between 2006 and 2007 were largely as a result of deficit finance, securitisation of local contractors' debt and the settlement of Nigeria Airways ex-staff entitlements (Debt Management Office Nigeria, 2006). In addition, increased changes between 2008 and 2018 were as a result of government financed appropriated budget deficits, refinanced matured securities and special projects expected to stimulate economic growth and poverty reduction, and the settlement of part of the arrears to local contractors and other central government obligations (Debt Management Office Nigeria, 2016, 2018).

Prior to external public debt relief in 2005, total public debt was characterised by huge external borrowing by the government in meeting its financing needs, which resulted in public debt stock that was largely dominated by external public debt stock (Central Bank of Nigeria, 2001; Debt Mangement Office Nigeria, 2006). For instance, between 1986 and 2006, a decrease was recorded in 1996 as a result of external public debt reconciliation exercise with creditors to confirm the authenticity of some external claims. Thereafter, external public debt stock continued to grow as a result of the capitalization of defaulted interest payments and accumulation of payment arrears even when no new loans was contracted up until 2005 (Titus, 2013). There was a significant drop in external public debt stock in 2005 by 44.9% and further in 2006 by 83.3% (Debt Management Office Nigeria, 2006). The reduction in 2005 was as a result of the implementation of the first and second phases of the Paris Club debt relief deal, which paid off all the arrears on Paris Club debt and reduced the stock by 33.0%. The significant reduction in 2006 was as a result of the implementation of the third phase of the Paris Club debt deal and the exit from London Club debt obligations (Debt Management Office, Nigeria, 2006). As shown in Figure 1, these changes reduced total public debt to GDP ratio from 36.14% in 2004 to 18.95% in 2005 and 7.69% in 2006.

A closer look at the trend for total public debt to GDP ratio from 2006 reveals an upward trend in this ratio. The change in this ratio from 2005 was largely driven by domestic public debt stock accumulation, which can be attributed to government deepening of the financial market through the development of financial instruments and domestic debt finance of budget deficits (Debt Management Office Nigeria, 2005, 2006, 2009, 2018; Titus, 2013). The composition of Nigeria's public debt stock stood at 37.78% for external public debt stock and 62.21% for domestic public debt stock while total public debt to GDP ratio stood at 16.07% as at end 2018 (Central Bank of

Nigeria, 2019). The composition ratios compare favourably to the optimal target of 60:40 for domestic and external debt, respectively, by end 2019 as contained in the 2016–2019 Nigeria's Debt Management Strategy (Debt Management Office Nigeria Nigeria, 2016) Overall, for the study period, increased changes in the public debt stock were largely through the implementation of domestic debt management strategies and fiscal excesses.

With respect to inflation rate in Nigeria, Figure 1 reveals mixed inflation movements during the study as inflation hovered across single- and double-digit rates. As indicated in Figure 1, between 1980 and 2018, Nigeria recorded several experiences of high inflation rate in excess of 25%. According to Masson et al. (1997), once a country experiences annual inflation rates in the range of 15%-25% for a number of consecutive years, it will be unable to rely on monetary policy alone to target a stable and reduced inflation rate. At high rates of inflation, fiscal and monetary policies become virtually inseparable. As revealed in Figure 1, Nigeria recorded its highest inflation rates in the 1980s and 1990s. For instance, the country recorded rates as high as 57.17% in 1993 and 72.84% in 1995.

In the 1980s inflation was largely influenced by government's expansionary fiscal operations that were financed by the Central Bank of Nigeria's credit and monetisation of oil revenue, and the repurchase of external debt with new local currency obligation (Bawa et al., 2016; Moser, 1994). This episode, which persisted into the 1990s, coincides with a period of expansionary fiscal deficit and high money supply growth that exacted higher inflationary pressures through growth in money supply (Bawa et al., 2016; Moser, 1994). For the period from 2000 to 2018, double-digit rates were largely recorded for inflation rate even though single digit rates were also recorded occasionally during this period. Inflation rate was at its minimum for this period at 5.39% in 2007 and maximum at 18.87% in 2001. The change to double digit in 2008 was attributed to global food shortages and financial crisis, while, in other periods, double-digit inflation largely due to expansionary fiscal and monetary policy operations (Central Bank of Nigeria, 2010). Overall, even though there are other factors, such as depreciation in exchange rate, inadequate power supply, and weak infrastructure facilities that have contributed to changes in inflation rate for the period under review, major changes in inflation rate were largely due to excess domestic demand generated by

expansionary fiscal and monetary policy in Nigeria. Annual inflation rate stood at 12.09% in 2018 compared to 9.97% in 1980.

Although the descriptive analysis above provides us with some insight into the reality of public debt and inflation in Nigeria, it is important to note that such analysis only gives or shows a general picture. To complement this analysis, it is paramount to undertake an econometric investigation of the individual effect associated with public debt given its significant role in fiscal policy determination for the study period in Nigeria.

3. Literature review

3.1. Theoretical literature review

Theoretically, the most widely accepted school of thought on inflation is that it is a monetary phenomenon and its control is within the purview of the monetary authorities. According to Friedman (1968), inflation is a monetary phenomenon. An expansionary monetary policy will increase both real output and general price level in the short run, while, in the long run, only the price level will increase (Friedman, 1968). The monetarist theory of price level determination is based on the argument that the monetary authority has total control over prices. The theory is defined by active monetary policy and passive fiscal policy operating within a Ricardian framework (Erdogdu, 2002).

There are, however, two competing views on the interaction between monetary and fiscal policies and their effects on price stability. The classical view of Ricardians argues that it is the demand for liquidity and its progress over time that defines the path of prices (Attiya et al., 2008). In such rule, fiscal policy is passive, suggesting that government bonds are not net wealth, and monetary policy works through interest rates to determine prices. The Ricardian view assumes that price levels are mainly determined by money supply in the long run (Attiya et al., 2008). The Ricardian equivalence, according to Barro (1974, 1989), is based on a monetarist view on inflation that government deficit or public debt does not have a significant impact in the determination of price level, implying that government bonds are not net wealth. He argues that household wealth is effectively reduced because the existence of uncertainty with respect to individual future tax

liabilities, suggesting that public debt may increase the overall risk contained in household balance sheets.

According to Leeper (1991), Davig and Leeper (2007, 2011) and Marzieh (2015), an active monetary policy with a passive fiscal policy would yield a Ricardian equilibrium, suggesting that debt management policy has no monetary significance. An active monetary policy and a passive fiscal policy, with a fiscal policy that adjusts taxes sufficiently in response to government debt will produce the monetarist outcome that inflation is always a monetary phenomenon. In addition, Oscar (2007) further argues that when government policy is formulated in such a way that intertemporal budget constraint is satisfied for any price level, it is a Ricardian policy. It is a non-Ricardian policy when it satisfies only the equilibrium price level. This argument is also supported by the study conducted by Erdogdu (2002). This study reveals that the relationship between real value of government debt and price level can be Ricardian or non-Ricardian policy depending on the fulfillment of government budget constraint. It is Ricardian policy if government budget constraint is satisfied for all price levels, with endogenous determination of monetary and fiscal policy variables.

The Ricardian policies assume that the Ricardian Equivalence Theorem holds. Meaning that public debt or fiscal policy does not create any wealth effects. In a related study, Walsh (2010) also establishes the link between public debt and inflation under the Ricardian and Non-Ricardian regimes. He argues that fiscal and monetary policies are linked through government sector's budget constraint, such that decisions by the fiscal authority can have implications for money growth and inflation. The model he postulated shows that public debt is not involved in the determination of price level under the Ricardian regime, only nominal stock of money does. On the other hand, the model shows that nominal money supply and the nominal stock of government's debt are involved in the determination of price level under the Non-Ricardian regime.

Under the non-Ricardian policy, the inter-temporal government budget constraint is an equilibrium condition not satisfied for every price levels. Before the price level is determined, the level of surplus is set such that any threat to the solvency of budget constraint is met by market mechanism moving the price level. Contrary to the monetarist view that only monetary aggregate drives

inflation, in a non-Ricardian environment with active monetary and fiscal policies, price level is only a function of fiscal policy variables. The non-Ricardian policies do not follow the Ricardian Equivalence Theorem assumption that fiscal policy does not create a wealth effect. An increase in the value of government bonds affects the households' lifetime budget set. Fiscal disturbances affect price level through wealth effect on private consumption demand (Woodford, 1998).

In a non-Ricardian plan, price level is fundamentally a fiscal phenomenon, with monetary aggregates playing a marginal role (Oscar, 2007). Recent developments in public finance have led to a renewed interest in fiscal policy concern for price stability. Expansionary fiscal policy in the Keynesian view (increase level of debt or a reduction in tax rates) may lead to price level pressures. According to Branson (1989) and Elmendorf and Mankiw (1999), expansionary fiscal policy in the short run affect aggregate demand by increasing disposable income and generating positive wealth effects that may lead to price level pressures. Sargent and Wallace (1981), Leeper (1991), and Woodford (1994, 1996, 2001), in their studies, have also shown that fiscal and monetary policy interaction is crucial in establishing the relationship between public debt and inflation. Hence, the control of inflationary pressures in an economy does not depend alone on the control of money supply.

The fiscal theory of price level explains the relationship between fiscal policy, public debt and inflation. Under this theory, changes in inflation rate are not only determined by the volume of money supply but largely by fiscal deficits and the stock of public debt used for financing it. Hence, variations in inflation rate are largely based on the actions of the fiscal authorities in an economy. The FTPL, as embedded in the non-Ricardian policy, seems to have particular relevance for developing economies because they issue domestic currency debt and often lack the fiscal capacity to mobilise the necessary real tax revenues, giving rise to an "active" fiscal authority, while the concerns for capital flows imply that monetary policy tends to be "passive" (Beck-Friis and Willems, 2017). More so because these economies are characterised by large public debt in the funding of fiscal deficits, Blanchard (2004) and Favero and Giavazzi (2004) suggest that an increase in interest rate in an economy with large public debt aimed at controlling inflation within the target range may increase the cost of debt service, debt level, default probability and country premium, which may trigger capital outflows and exchange rate depreciation that would affect

inflation expectations and in the end inflation itself. Hence, the source of change in price level in an economy can be explained by FTPL within the framework of fiscal deficits and public debt through the positive wealth effect of government debt policy on private consumption demand or increased private spending (Castro et al., 2003; Kwon et al., 2006; Woodford, 1995, 1998).

The emergence of recent studies has shown that inflation is not only a monetary problem but also of a fiscal concern, with fiscal variables influencing price stability. The non-Ricardian assumption on fiscal policy forms the key defining characteristics of the more recent FTPL. The fiscal theory of the price level shows a more recent explanation in the understanding of the consequences of the non-Ricardian view of inflation. According to Kwon et al. (2006), FTPL identifies the wealth effect of government debt as an additional channel of fiscal influence on inflation. This theory posits that increased government debt adds to household wealth and hence, to demand for goods and services, leading to price pressures. The non-Ricardian supporters, in more recent times, are of the view that under an active fiscal regime, changes in government debt will necessitate changes or fluctuations in inflation even if monetary policy is exogenous; thus, the determination of price level in an economy will require monetary and fiscal policy interactions (Marzieh, 2015).

The relationship between public debt and inflation can either be direct or indirect as suggested by Nastansky and Strohe (2015). It is direct when the central bank buys public bonds. On the other hand, it is indirect when the demand for public bonds is by the private sector. It may also be indirect through the banking sector's demand for public bonds, and through inflation expectation of the economic agents owing to high levels of public debt. Sims (2013, 2014, 2016) also argued on public debt and inflation relationship that when government want to pay off debt without increasing taxes and printing money, they pay off the old debt by issuing new debt. The effect of simply rolling over debt according to him is not default, but inflationary. He further concluded that persistent and growing borrowings by government would eventually produce inflation regardless of policies followed by the monetary authorities.

In line with all of the above, the surveyed literature established a theoretical link between public debt and inflation. Fiscal and monetary policy coordination is, therefore, necessary for inflation control, suggesting that public debt may have consequence on inflation. Against this theoretical

background, the study will further review empirical studies on the link between public debt and inflation that have used different country dataset.

3.2. Empirical literature review

On the empirical front, the relationship between public debt and inflation was pioneered by Musgrave (1949) and Phelps (1973). Musgrave (1949) opened up the debate on this relationship suggesting that if private holders of government securities tried to liquidate all or a major portion of their portfolios, where fiscal authorities are the only buyers, the volume of bank credit would expand rapidly. Such expansion may not have any direct connection with the legitimate needs of the economy, generating an extremely powerful inflationary force. Phelps (1973) argument was on the public finance approach to inflation. He suggested that the Central Bank should be made the source of inflation, while Treasury is left the freedom to make compensating variations in government deficit.

There are several empirical studies that have investigated the relationship between public debt and inflation. Afonso and Ibraimo (2018) adopted the vector autoregressive (VAR) estimation method to conclude a positive relationship between public debt and inflation in Mozambique, meaning that an increase in public debt level is inflationary. Kwon et al. (2006) demonstrate, for a sample of 71 countries consisting of 13 major advance economies, 10 other advance economies and 48 developing countries, spanning up to 43 years, that an increase in public debt is typically inflationary in indebted developing countries, weakly in other developing countries that are not indebted, but generally not in developed economies. Lopes Da Veiga et al. (2016) for example, further concluded that a positive relationship is prominent in developing countries with high levels of public debt. On the other hand, Wheeler (1999), Taghavi (2000), and Karakaplan (2009) found that economies with well-developed financial market, advanced countries, and developing countries with low levels of public debt have shown negative relationship between public debt and inflation. Wijnbergen and Budina (2001) have also suggested for countries in which debt markets are in their infancy, fiscal deficits have played an important role in the monetary process and has fuelled inflation.

Cardoso and Fishlow (1990) opine for Brazil that inflation acceleration between 1979 and 1985 was linked to the switch from external to domestic finance of budget deficit in the country. The switch from external to domestic budget deficit finance pushed both real interest rates and inflation rate upward between 1979 and 1985. In Nigeria, for instance, after external public debt relief, there has been a switch from external to domestic budget deficit finance, largely because of tax revenue shortfalls. Recent data has also shown that domestic public debt stock constitutes a significant portion of total public debt stock in Nigeria (Debt Management Office Nigeria, 2009, 2011, 2014, 2018; Central Bank of Nigeria, 2019).

Bildirici and Ersin (2007) suggested that inflationary process is unavoidable through the wealth effect with increases in domestic debt and decreasing maturity rates. They argue for emerging countries that inflation spirals experienced by most of these countries could be explained by the cost of domestic debt. Countries experiencing inflationary periods follow interest rate policies resulting from tight monetary policies. This process further increases interest payments and amplifies domestic debt stock. They further argue that a country may eventually secure debts at higher cost and low maturity and further contributing to inflationary pressure. In another related study by Ahmad et al. (2012) in Pakistan, their findings corroborate the argument put forward by Bildirici and Ersin (2007). They concluded for Pakistan that the stock of domestic debt and its related debt service cost has contributed to fluctuations in general price level. On the other hand, for external debt, Karakaplan (2009), for the period from 1960 to 2004, revealed the effects of external public debt on inflation in 121 countries that included developed, emerging market and developing countries. Results from the study support the hypothesis that external debt is less inflationary in economies with well-developed financial markets. The study further suggests that the relationships are heterogeneous across countries.

Lopes Da Veiga et al. (2016) suggest that the relationship between public debt and inflation depends on the level of indebtedness. They demonstrate that high levels of public debt reflect a positive relationship with inflation. Meaning that in the group of 52 African countries studied between 1950 and 2012, high level of public debt contributed to increasing inflation rates in these countries. Results from the study further underline the importance of different levels of public debt, and their relationship with inflation. In a related study, Reinhart and Rogoff (2010) revealed

for emerging market economies that high public debt levels coincided with higher inflation episodes. On the other hand, for advance economies, there was no systemic relationship between high levels of public debt and inflation for a sample of 20 advanced economies and 24 emerging market economies that were examined over the period from 1946 to 2009. In a more recent study, Romero and Marin (2017) using data for the period 1961 to 2015, for 52 countries, found, for countries whose public debt was already high, a positive relationship between public debt and inflation. Meaning further increases in public debt are inflationary in those countries for the study period.

Sims (2013, 2014, 2016) demonstrates that the effect of paying off old debt by issuing new debt (rolling over debt) is not default but inflation. When the government pays off debt without increasing taxes and printing money, inflationary pressure is not as a result of the size of the debt alone but also the size of the debt relative to public's expectations of future tax increases and spending cuts to finance the debt. The study concluded that regardless of policies followed by the monetary authorities, persistent and growing borrowings by a government would eventually produce inflation.

Bleaney (1996), Bilan and Roman (2014), Nguyen (2015), and Nastansky and Strohe (2015) further argue for a positive relationship between public debt and inflation, while Wheeler (1999), Taghavi (2000), and Essien et al. (2016), on the other hand, argued for a negative relationship between these variables. There is a dearth in literature on the negative relationship between public debt and inflation. Although studies have not established any conclusive and consistent evidence on the relationship between public debt and inflation, findings have shown different results based on countries, estimation methods used and/or variable selected for estimation. Evidence on the impact of public debt on inflation from literature reviewed in this study tilts towards a positive relationship. Table 1 summarises the results of the selected studies that have assessed the nature of the relationship between public debt and inflation.

Table 1: Selected studies on the nature of relationship between public debt and inflation

Author(s)	Region/ Country	Methodology	Association
Positive Association			
Bleaney (1996)	15 OECD countries	• Ordinary Least Square (OLS)	Positive (1973-1982)
Taghavi (2000)	France, Germany, Italy and United Kingdom	• Hybrid cointegration analysis • Vector autoregressive models	Positive (long-term association)
Kwon *et al.* (2006)	71 countries (13 major advance economies; 10 other advance economies; and 48 developing countries)	• Vector autoregression (VAR) • Pooled panel OLS • Dynamic fixed effects panel • Panel generalised method of moments (GMM) Arellano-Bond	Positive
Bildirici and Ersin (2007)	Emerging and developed economies	• Vector Error Correction models • Panel cointegration models	Positive
Reinhart and Rogoff (2010)	20 advanced economies 24 emerging market countries	• Analysis of relevant statistical data.	Positive (emerging economies)
Ahmad *et al.* (2012)	Pakistan	• OLS estimation technique	Positive
Ngerebo (2014)	Nigeria	• OLS estimation technique	Positive
Bilan and Roman (2014)	22 developed and developing countries	• Analysis of relevant statistical data	Positive
Lopes da Veiga *et al.* (2016)	52 African economies	• Pooled analysis of relevant statistical data.	Positive
Nastansky and Strohe (2015)	Germany	• Vector Error Correction Model • Generalised Impulse Response analysis • Multivariate Beveridge-Nelson trend/cycle decomposition	Positive
Nguyen (2015)	60 developing countries (22 in Asia, 11 in Latin America and 27 in Africa)	• Panel generalised method of moments (GMM) Arellano-Bond	Positive
Romero and Marin (2017)	52 Countries	• Vector autoregression (VAR) • Dynamic fixed effects panel • Panel generalised method of moments (GMM) Arellano-Bond	Positive
Afonso and Ibraimo (2018)	Mozambique	• Vector autoregression model • Impulse response functions • Variance decomposition	Positive
Negative Association			
Bleaney (1996)	15 OECD countries	• Ordinary Least Square	Negative (1983-1989)
Wheeler (1999)	United States	• Vector autoregressive model • Impulse response function • Variance decomposition	Negative

Author(s)	Region/ Country	Methodology	Association
Karakaplan (2009)	121 countries	• Panel generalised method of moments (GMM) Arellano-Bond	Negative (in economies with well-developed financial markets)
Reinhart and Rogoff (2010)	20 advanced economies 24 emerging market countries	• Analysis of relevant statistical data.	Negative (advance economies)
Essien *et al.* (2016)	Nigeria	• VAR framework • Granger causality analysis • Impulse response function • Variance decomposition	Negative

Source: (Aimola and Odhiambo, 2020)

In Nigeria, total public debt to GDP ratio has reduced significantly in recent years at rates below 55% international debt limit threshold set by the International Monetary Fund and World Bank for countries in Nigeria's peer group and 70% set by the Economic Community of West African States Convergence Threshold. Given the increasing trends in the contribution of domestic public debt stock in total public debt stock and trend in government expenditure, the study expects public debt to have a positive impact on inflation.

4. Estimation technique and empirical analysis

4.1. Model specification and data

This study investigates the link between total public debt and inflation. In specifying the model, theoretical and empirical literature has been used to identify explanatory variables in the inflation (INF) function. The model is specified explicitly as follows:

$$\mathrm{INF} = f(\mathrm{PD}, \mathrm{MS}, \mathrm{LR}, \mathrm{GDPC}, \mathrm{TOP}, \mathrm{GFCF}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where,
INF = Inflation;
PD = Public debt;
MS = Money supply;
LR = Interest rate;

GDPC = Economic growth;
TOP = Trade openness; and
GFCF = Private investment.

To investigate and provide estimates of the short-run dynamics and long-run relationships of Equation 1, this study adopted the ARDL model approach, and the ensuing model specification following Pesaran *et al*. (2001) is expressed as:

$$\begin{aligned}\Delta INF_t = \varphi_0 + \varphi_1 t + \sum_{i=1}^{n} \varphi_{2i}\, \Delta INF_{t-i} + \sum_{i=0}^{n} \varphi_{3i}\, \Delta PD_{t-i} + \sum_{i=0}^{n} \varphi_{4i}\, \Delta MS_{t-i} + \sum_{i=0}^{n} \varphi_{5i}\, \Delta LR_{t-i} \\ + \sum_{i=0}^{n} \varphi_{6i}\, \Delta GDPC_{t-i} + \sum_{i=0}^{n} \varphi_{7i}\, \Delta TOP_{t-i} + \sum_{i=0}^{n} \varphi_{8i}\, \Delta GFCF_{t-i} + \varphi_9 INF_{t-1} + \varphi_{10} PD_{t-1} \\ + \varphi_{11} MS_{t-1} + \varphi_{12} LR_{t-1} + \varphi_{13} GDPC_{t-1} + \varphi_{14} TOP_{t-1} + \varphi_{15} GFCF_{t-1} + \varphi_{16} DUM_{98} \\ + \mu_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}\end{aligned}$$

Where all variables remain as defined in Equation 1.
φ_0 = constant;
t = trend component;
$\varphi_2 - \varphi_8$= short run coefficient;
$\varphi_9 - \varphi_{15}$= long run coefficient;
Δ = difference operator;
n = lag lengths; and
μ_{1t} = white-noise error term.

The dummy variable (DUM_{98}) is introduced in Equation 2 to represent a structural break that is endogenously determined by the Zivot-Andrews test in inflation (INF). The dependent variable (inflation) undergoes a structural break in 1998. The dummy variable (DUM_{98}) takes the value of 0 until 1997, and 1 thereafter.

The corresponding error correction model is specified as follows:

$$\begin{aligned}\Delta INF_t = \varphi_0 + \varphi_1 t + \sum_{i=1}^{n} \varphi_{2i}\, \Delta INF_{t-i} + \sum_{i=0}^{n} \varphi_{3i}\, \Delta PD_{t-i} + \sum_{i=0}^{n} \varphi_{4i}\, \Delta MS_{t-i} + \sum_{i=0}^{n} \varphi_{5i}\, \Delta LR_{t-i} \\ + \sum_{i=0}^{n} \varphi_{6i}\, \Delta GDPC_{t-i} + \sum_{i=0}^{n} \varphi_{7i}\, \Delta TOP_{t-i} + \sum_{i=0}^{n} \varphi_{8i}\, \Delta GFCF_{t-i} + \sum_{i=0}^{n} D_{98}\, \Delta DUM_{t-i} \\ + \omega_1 ECM_{t-1} + \mu_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}\end{aligned}$$

Where:
ω_1 = coefficient of the lagged error-correction term (ECM_{t-1}).
D_{98} = short run coefficient of the dummy variable.

μ_{2t} = white-noise error term.

The study used annual time-series data from the period 1983 to 2018. This period was chosen based on availability of reliable data on some variables. The primary source of data for this study was World Bank Development Indicators database (World Bank, 2019). The data source for public debt was the Central Bank of Nigeria Statistical Bulletin (CBN, 2004; 2019). Table 2 further shows detailed sources of data, how each of the data was measured and theoretical expectation of the coefficient for each variable.

Table 2: Data sources and measurement of variables

Variables	Description	Measurement	Expectation	Source
INF	Inflation	Consumer prices (annual %)	-	WB 2019
PD	Public debt	Total public debt (% of GDP)	Positive	CBN 2004, 2019
MS	Money supply	Broad money supply (% of GDP)	Positive	WB 2019
LR	Interest rate	Lending rate (annual %)	Positive	WB 2019
GDPC	Economic growth	Real gross domestic product per capita, measured as gross domestic product divided by midyear population.	Negative or Positive	WB 2019
TOP	Trade openness	Measured as the sum of exports and imports of goods and services (% of GDP)	Negative	WB 2019
GFCF	Private investment	Gross fixed capital formation (% of GDP)	Positive	WB 2019

Source: Authors' Compilation.

4.2. Estimation technique and result

4.2.1. Unit root test

Pretesting variables before proceeding with ARDL estimation is essential. It is necessary to conduct unit root tests for all variables to confirm that none is integrated of order 2 or above. The presence of an I(2) variable would render the use of an ARDL technique inappropriate because the critical values of the F-statistics computed by Pesaran et al. (2001) are based on the assumption that the variables are either I(0) or I(1) (see also Odhiambo, 2009). For this purpose, the study used the Phillips–Perron (PP) and Dickey–Fuller Generalised Least Squares (DF-GLS) unit root tests both at level and first difference. In order to address the structural break issues associated with

time-series data, the current study adopted Zivot–Andrews structural break unit root test. This test corrects for one structural break endogenously. The results of the unit root tests are reported in Tables 3 and 4.

The results displayed in Table 3 show that none of the variables is integrated of order two (i.e. I (2)), or higher for PP and DF-GLS unit root test. Table 4 also shows that the results reported for ZA test confirmed that none of the variables is I (2). The structural change in inflation took place in 1998. This period coincides with the implementation of the Structural Adjustment Programme (SAP) that commenced in 1986. The 1990s was characterised by the indirect control of monetary aggregates through the use of market-related instruments in achieving the inflation target (Dada, 2016). The 1990s, according to Bawa et al. (2016), coincide with a period of expansionary fiscal deficit and high money supply growth that exacted higher inflationary pressures through growth in money supply. According to the Central Bank of Nigeria (2011b), monetary policy was focused within a short-run perspective. The short-term monetary policy framework regime showed that monetary and financial targets were mostly missed, and the poor performance for this period was largely attributed to expansionary fiscal policies by government and the resultant liquidity overhang, as well as by the lack of coordination in the implementation of fiscal and monetary policy in Nigeria (Central Bank of Nigeria, 2011b). Because monetary policy actions affect inflation with substantial lags, in 2002, the CBN adopted a medium-term perspective in monetary policy formulation for unrestricted policy implementation, free from the problem of time inconsistency, and to minimise overreaction to temporary shocks (Central Bank of Nigeria, 2011b). This monetary policy framework is still in operation to date.

Table 3: Results of standard unit root test

Variables	*Stationarity of all variables in levels*				*Stationarity of all variables in first difference*			
	Dickey-Fuller generalised least squares (DF-GLS)		*Phillips-Perron (PP)*		*Dickey-Fuller generalised least squares (DF-GLS)*		*Phillips-Perron (PP)*	
	Constant	*Trend and constant*	*Constant*	*Trend and constant*	*Constant*	*Trend and constant*	*Constant*	*Trend and constant*
INF	-1.1163	-1.7168	-2.5953	-2.6456	-5.9265***	-6.1211***	-9.2090***	-9.2283***
PD	-1.6684*	-2.3823	-1.5313	-2.4106	-4.1520***	-4.2778***	-4.1495***	-4.1464***
MS	-0.6890	-2.7800	-0.4764	-1.9583	-4.7918***	-4.8802***	-5.0635***	-6.8776***
LR	-2.0552**	-2.6117	-2.6110	-2.4525	-3.6822***	-3.7994***	-6.6059***	-6.7691***

GDPC	-0.9429	-3.6267**	-5.0340***	-4.8034***	-2.2926**	-3.8437***	-	-
GFCF	-0.7492	-3.1914**	-3.0974**	-5.2386***	-3.0063***	-4.7029***	-	-
TOP	-1.9058*	-2.3993	-2.5642	-2.3823	-7.3176***	-7.3965***	-7.6939***	-13.2102***

Source: Authors' compilation.

Note: ***, ** and * denote stationarity at 1%, 5% and 10% significance levels, respectively.

Table 4: Results of structural break unit root test

Zivot-Andrews structural break unit root test				
Variables	***At levels***		***At first difference***	
	t-Statistic	*Break date*	*t-Statistic*	*Break date*
INF	-4.3279	1998	-7.1992***	1996
PD	-4.2712	2005	-5.0421*	1997
MS	-6.1049***	2007	-	-
LR	-5.7136***	1994	-	-
GDPC	-5.2950**	2002	-	-
GFCF	-6.7208***	2012	-	-
TOP	-4.1887	1997	-5.9800***	2010

Source: Authors' compilation.

Note: *** and ** denote stationarity at 1% and 5% significance levels, respectively.

The results reported in Tables 3 and 4 show that none of the variables used in this study is I(2). Table 4 shows that structural change in inflation (INF) took place in 1998 during the indirect approach to monetary management.

4.2.2. Bound cointegration test

Before estimating the cointegration relationship, a dummy variable was introduced in the model to capture the presence of one structural break. The dummy variable (DUM_{98}) takes the value of 0 until 1997, and 1 thereafter. Table 5 presents the results for the bound cointegration test using the ARDL technique.

Table 5: Results of ARDL bound cointegration test

ARDL (1, 1, 1, 1, 0, 0, 0, 0) Selected based on Akaike Information Criteria			
Dependent Variable	**Function**	**F-test statistic**	**Cointegration Status**
Inflation	F(INF| PD, MS, LR, GDPC, TOP, GFCF, DUM_{98})	6.38***	Cointegrated
Asymptotic critical values			
Critical values	**1%**	**5%**	**10%**

Pesaran *et al*. (2001), p.301, Table CI(v) Case V	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	3.34	4.63	2.69	3.83	2.38	3.45

Note: **** denote statistical significance at 1% level.*

The results reported in Table 5 show that the calculated F-statistic exceeds the upper bound critical value at 1% significance level. Hence, the study rejects the null hypothesis of no cointegration, suggesting the existence of a long-run equilibrium relationship among the estimated variables. Given the presence of cointegration among variables, the study proceeds to obtain long- run and short-run estimates for the model.

4.2.3. Estimated long-run and short-run coefficients

The Akaike Information Criterion (AIC)-based lags selected for the study were ARDL (1, 1, 1, 1, 0, 0, 0, 0). Table 6 (Panels A and B) presents the results of the long-run and short-run dynamic model estimated within the ARDL framework, respectively.

Table 6: Long-run and short-run results of the selected model

Panel A: Long run regression coefficients – *Dependent variable is INF*			
Regressor	**Coefficient**	**t-Statistic**	***P*-value**
PD	0.7063	1.2616	0.2203
MS	0.9283	0.7159	0.4816
LR	-0.0113	-0.0053	0.9958
GDPC	-3.6290**	-2.4237	0.0240
GFCF	-3.4325**	-2.1015	0.0473
TOP	-0.2076	-0.5502	0.5877
DUM_{98}	0.0195	0.1108	0.9128
Panel B: Short run regression coefficients – *Dependent variable is ΔINF*			
Regressor	**Coefficient**	**t-Statistic**	***P*-value**
ΔPD	-0.0907	-0.5356	0.5976
ΔMS	-0.7443	-1.0762	0.2935
ΔLR	1.1156**	2.0879	0.0486
ΔGDPC	-2.2246***	-3.5167	0.0019
ΔGFCF	-2.1041***	-3.1481	0.0047
ΔTOP	-0.1273	-0.5516	0.5868
ΔDUM_{98}	0.0120	0.1130	0.9110
ECM(-1)	-0.6130***	-8.2010	0.0000
C	1.1035***	7.9508	0.0000
@Trend	-0.0263***	-7.3868	0.0000

R-squared	0.7039		
Adjusted R-squared	0.6528		
F-statistic	13.7856***		
Prob. (F-statistic)	0.0000		
Akaike info criterion	-1.8011		
Schwarz criterion	-1.5345		

Note: *** and ** denote statistical significance at 1% and 5% levels, respectively. Δ denotes first difference operator.

The estimated long-run and short-run results presented in Table 6 (Panel A and Panel B) show that the coefficient of public debt is statistically insignificant, irrespective of whether the regression was conducted in the short or the long run. This implies that public debt has a neutral impact on the inflation process of Nigeria. Hence, inflation in Nigeria could be driven by other factors other than public debt. The argument for this result could be based on a similar reason highlighted by the Ricardian Equivalence Theorem. According to Barro (1974, 1989), the theorem is based on the monetarist view on inflation, namely that public debt does not have a significant impact in determining the price level, meaning that public debt does not create any wealth effects.

Other results presented in Table 6, Panel A and Panel B, show that the coefficients of economic growth are negative and stastistically significant both in the short- and long run. These results infer that economic growth negatively influences the inflation process in Nigeria. This finding is consistent with previous studies, such as that by Stockman (1981), which suggests a negative relationship between these variables. The coefficients of private investment are negative and statistically significant, irrespective of whether the regression was conducted in the short- or long run. This finding contradicts the *a priori* expectation of a positive relationship between private investment and inflation. This result, although contrary to expectation, is not unusual (see also Ahmad *et al*., 2012). In the short run, interest rate has a negative and statistically significant impact on inflation, but no significant impact in the long run. The results from Table 6 further show that money supply, trade openness and DUM_{98} have no statistically significant impact on inflation, irrespective of whether the analysis was conducted in the short- or long run. This implies that money supply, trade openness and DUM_{98} have a neutral impact on the inflation process of Nigeria.

The coefficient of lagged error correction term (ECM_{t-1}) measures the adjustment speed of inflation to long-run equilibrium. From Panel B, the estimated result shows that the sign of ECM_{t-1} is negative, as expected, and statistically significant at the 1% significance level. This coefficient indicates that if the system is shocked in the previous year, convergence to the steady state is corrected by 61.3% in the current year. The value of the adjusted R-squared suggests that 65.28% of the variations in inflation are explained by variations in the estimated independent variables.

The reliability and stability of the model were ensured by conducting diagnostic tests on the estimated parameters. Table 7 shows diagnostic test results for serial correlation, heteroscedasticity, normality and functional form.

Table 7: Post-estimation diagnostic test results

Null Hypothesis (F-statistic)	F-statistic [p-value]
Breusch-Godfrey Test: No Serial Correlation	0.3073 [0.5852]
Heteroskedasticity Test ARCH: No ARCH terms	0.2513 [0.6196]
Ramsey RESET Test: Functional Form	4.0646 [0.0568]
Normality: CHSQ (2)	1.4535 [0.4835]

As illustrated in Table 7, the diagnostic test statistics reveal that the model passed all diagnostic tests. Residuals in the model were not serially correlated. The heteroskedasticity test also shows that there was no heteroscedasticity in the error variance. The p-value of the Ramsey RESET test is also found to be >0.05, which shows that, overall, the model is normally specified. In addition, the cumulative sum of the recursive residual (CUSUM) and the cumulative sum of squares of the recursive residual (CUSUMSQ) were used to test the stability of the inflation model. These tests have also been used by Brown et al. (1975) and Pesaran and Pesaran (1997) to test model stability. The results displayed in Figures 2 and 3 show that the CUSUM and CUSUMSQ statistics are within the critical bounds, suggesting that the model is stable over time.

Figure 2: Plot of CUSUM test

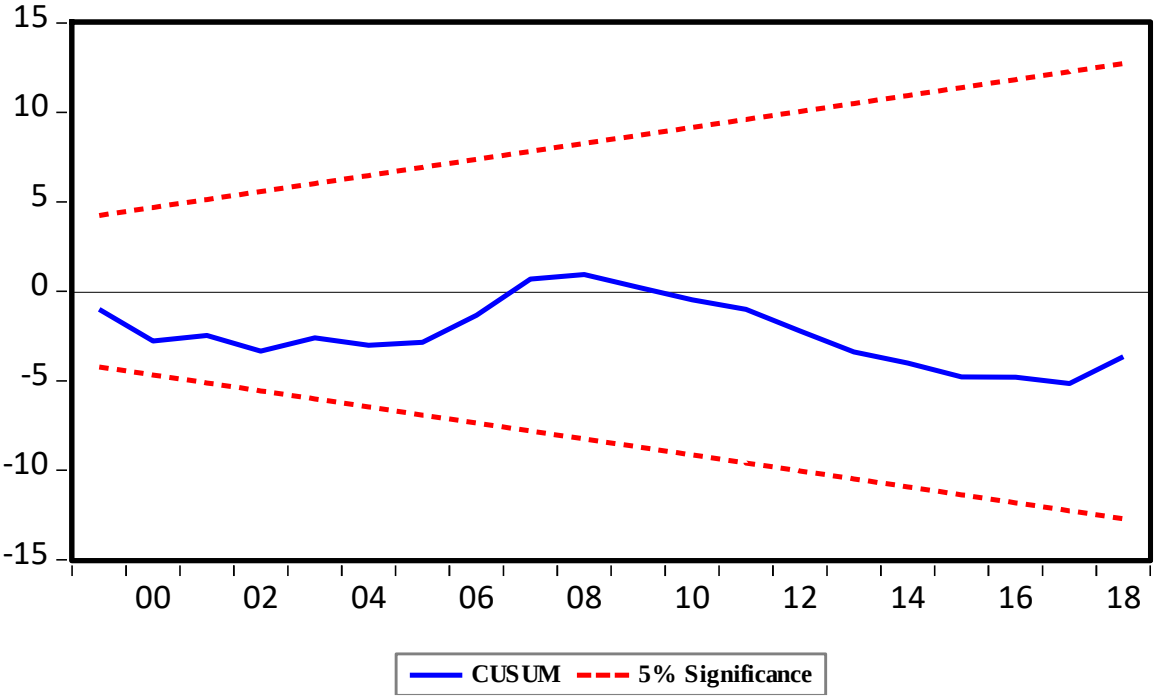
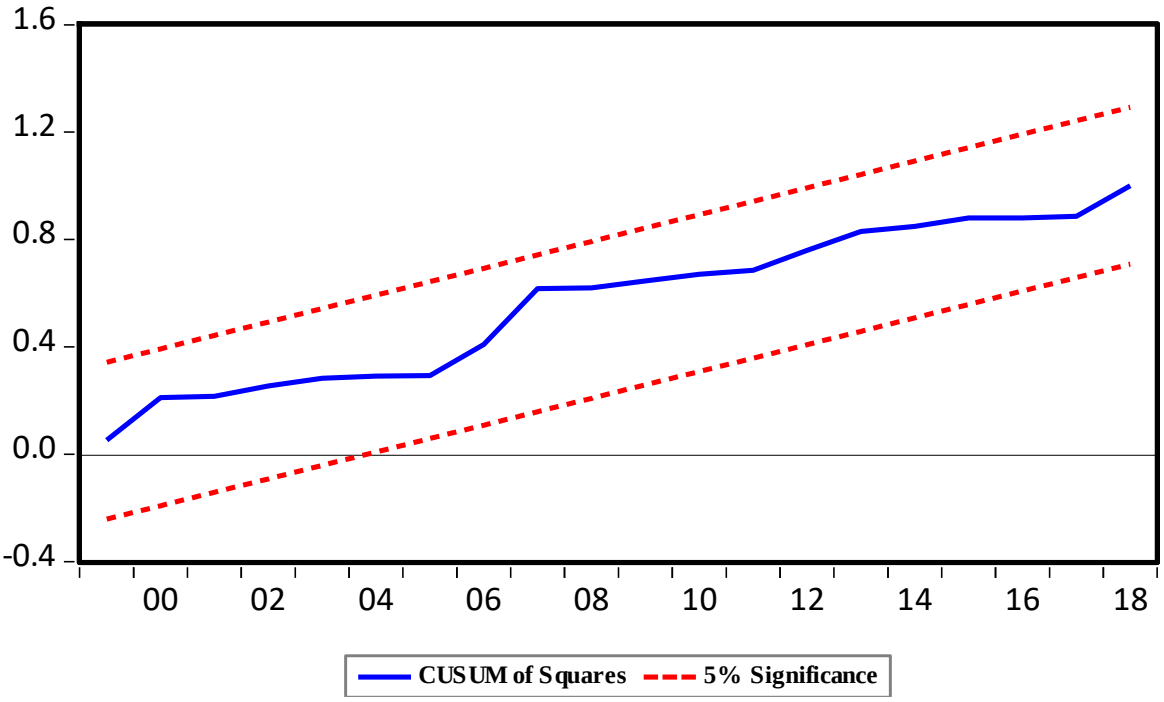

15
10
5
0
-5
-10
-15
00
02
04
06
08
10
12
14
16
18
CUSUM
5% Significance

Figure 3: Plot of CUSUMSQ test



5. Conclusion

The objective of this study was to investigate the relationship between public debt and inflation in Nigeria. Although a number of studies have been conducted on the relationship between public debt and inflation, very few studies have been conducted on African countries. In particular, few studies on the link between public debt and inflation have been conducted in a country such as Nigeria, where public debt has contributed significantly to the funding of fiscal deficits. This study employed the ARDL approach to cointegration and the error correctional model to examine the link between public debt and inflation in Nigeria—using annual time-series data covering the period 1983–2018. The study also used the Zivot–Andrews structural break unit root test to account for the structural break. The findings revealed a stable long-run cointegration among inflation, public debt, money supply, interest rate, economic growth, trade openness, and private investment in the presence of structural breaks. Applying the ARDL model, the empirical results show that total public debt does not have a statistically significant impact on inflation in Nigeria.

This finding supports the Ricardian Equivalence Theorem, which is based on the monetarist view on inflation. The theorem posits that public debt does not have a significant impact in determining the price level, meaning that public debt does not create any wealth effects. Overall, the study confirms the neutral impact of total public debt on the inflation process of Nigeria. Inflation in Nigeria could be driven by other factors other than public debt. Hence, the government should continue the implementation of prudent debt management strategies that would move public debt into a downward trend. The control of inflation dynamics is vital to the effectiveness of monetary and fiscal policy objective. Notwithstanding the promising results, this research is limited by the use of aggregated data for public debt, rather than disaggregated data that shows the effect of external and domestic public debt. Consequently, we are unable to distinguish the impact of external and domestic public debt on inflation. Future research may be able to integrate long length and disaggregated time-series data in order to investigate the impact of external and domestic public debt on inflation. This will help to disentangle the impact of external and domestic public debt on inflation in Nigeria.

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