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# PUBLIC DEBT AND INFLATION: EMPIRICAL EVIDENCE FROM GHANA[1]

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# Public Debt and Inflation: Empirical Evidence from Ghana

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

## Abstract

This paper investigates the impact of public debt on inflation in Ghana using annual data during the period 1983-2018. The study uses the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration and an error correction model to examine this linkage. The cointegrating regression results reveal evidence of a stable long run relationship between inflation and the explanatory variables in the presence of a structural break. The findings also show a positive and significant impact of public debt on inflation. These results were found to hold, irrespective of whether the regression was conducted in the short run or the long run. The study confirms the presence of the inflationary effects of public debt in Ghana. The government should, therefore, be prudent when considering increases in public debt to minimise volatility in inflation and its associated risks to the economy.

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

***JEL Classification:*** *C32, E31, H63.*

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## 1. Introduction

The control of inflation dynamics is vital to the monetary and fiscal policy objective. Given the significant role that public debt plays in fiscal deficit financing, the relationship between public debt and inflation has emerged as a topical issue in recent decades. Policymakers have started wondering whether the changing levels of public debt have an influence on inflation. Some central banks have adopted inflation-targeting policy largely on the basis that inflation is generally a monetarist's phenomenon. However, some recent studies have found that this assumption is obsolete or unfounded. According to Sims (2013, 2014, 2016), persistent and growing fiscal deficit finance through government borrowings will eventually produce inflationary pressures, regardless of the policies followed by the Central Bank. Hence, debt-financed deficits will require effective coordination with the monetary authority to avoid high and unstable inflation rates that may be harmful to macroeconomic stability. More so, according to Aimola and Odhiambo (2018), the effectiveness of monetary policy in controlling inflation critically depends on its coordination with fiscal policy, suggesting that granting Central Bank autonomy in the hope that it will insulate an economy from having to accommodate imprudent fiscal policies, may not be successful at curbing inflation. The Fiscal Theory of the Price Level (FTPL), as embedded in the non-Ricardian policy shows that fiscal authority alone can dominantly influence inflation irrespective of monetary policy.

Available data on inflation for Ghana shows that between 1983 and 2018, the country recorded high inflation rates in excess of 25% (Bank of Ghana, 2019 & World Bank, 2019). According to Masson *et al*. (1997), a country would be unable to rely on monetary policy alone to target a stable and reduced inflation rate once it experiences annual inflation rates in the range of 15%-25% for several consecutive years. Hence, the relationship between public debt and inflation becomes even more important in a country such as Ghana as changes in public debt levels tend to be linked to rising fiscal deficits.

Although a number of studies have attempted to examine the relationship between public debt and inflation, very few studies have been conducted on African countries, and where studies have been done, a significant gap still exists. Not many studies have been conducted on the relationship between public debt and inflation in Ghana where public debt has played a vital role in the funding

of fiscal deficits. In addition, time-series data were used in these studies, but no attempt has been made to address the issue of structural breaks given that Ghana's economic history has registered some structural changes over time. According to Perron (1989), unaddressed breaks may invalidate statistical test inference. It is against this argument that the relationship between public debt and inflation in Ghana is investigated in this study. Hence, the primary aim of this study is to examine the impact of public debt on inflation in Ghana using the ARDL approach. Apart from contributing to the literature on public debt and inflation by using Ghana as a case study, to our knowledge, this might well be the first study of its kind to examine the dynamic relationship between public debt and inflation in Ghana using the ARDL approach to cointegration in the presence of structural breaks.

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

## 2. Public debt and inflation in Ghana

Ghana's public debt stock has evolved in the last three decades. As a percentage of gross domestic product (GDP), this represent an increase from 26.88% in 1983 to 57.58% in 2018, with a minimum of 19.86% in 2006 and a maximum of 89.22% in 2000 (Bank of Ghana, 2019). The ratio between 1983 and 2003, before external public debt relief in 2004, average 49.92% compared to 40.84% between 2007 and 2018 after external public debt relief (Bank of Ghana, 2019). These ratios are an indication that gains from debt relief that reduced this ratio to 19.86% in 2006 were short lived. Ghana, in 2004 and 2006, secured external public debt relief under the Highly Indebted Poor Countries (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI), respectively, reducing public debt to GDP ratio from 58.35% in 2003 to 45.02% in 2004 and from 37.20% in 2005 to 19.86% in 2006 (Bank of Ghana, 2019). In spite of gains recorded in public debt ratios due to debt forgiveness, Ghana's public debt stock levels have been on the increase, with contribution from both external and domestic public debt stock (Bank of Ghana, 2019).

The structure of Ghana's public debt stock can be broadly categorised into external and domestic public debt. Prior to debt relief in 2004, public debt was characterised by huge external borrowing by government in meeting its financing needs, which resulted in public debt stock that was largely dominated by external public debt stock (Fosu, 2001). The composition of Ghana's public debt stock stood at 49.78% for external public debt stock and 50.21% for domestic public debt stock as at end 2018 (Bank of Ghana, 2019).

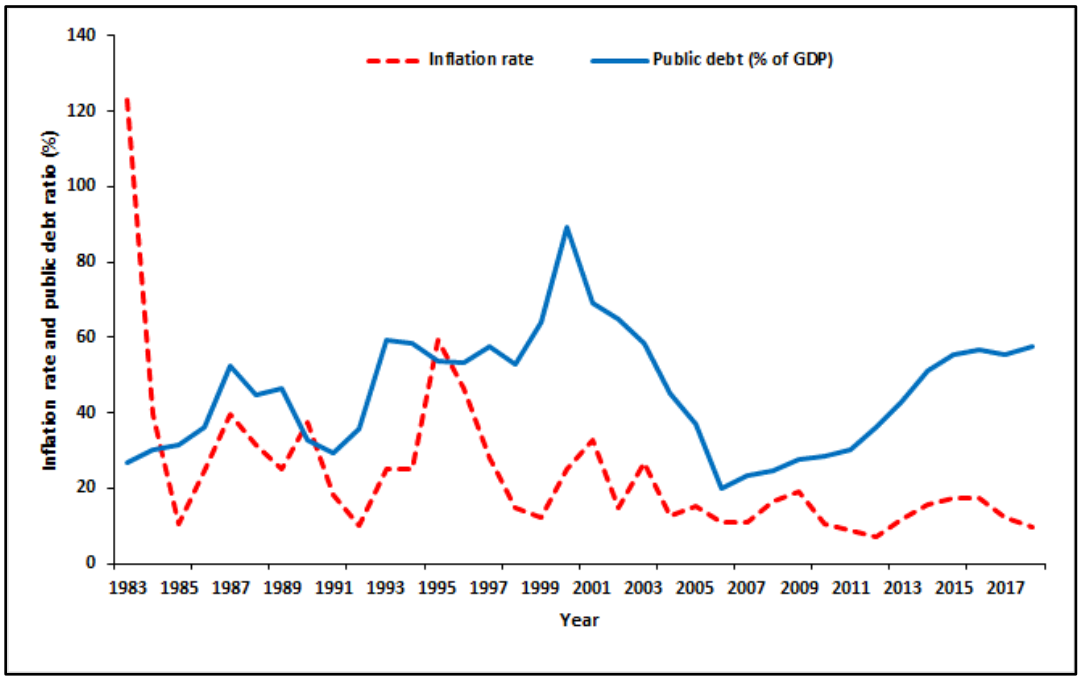
On domestic public debt stock, before the introduction of the Bank of Ghana bills in 1988 to take care of excess liquidity in the economy and to provide investment opportunities for banks, government could not borrow from the domestic market to support the budget and had to rely on the Bank of Ghana (BOG) to finance its deficit by printing money (African Forum and Network on Debt and Development (AFRODAD), 2013). This caused strong inflationary pressures in the economy and the deterioration of the financial sector (AFRODAD, 2013). The introduction of the Bank of Ghana bills saw the emergence of 30-day bills to deal with the short end of the market and longer dated bills (182-day and 2-year) and the 3-year and 5-year bonds. These developments further enhanced the development of the domestic debt market with the issuance of various short-, medium- and long-term debt instruments. Thus, the need to finance fiscal deficits, the issuance of domestic debt instruments for the purposes of domestic debt management strategy and to refinance matured securities have all contributed to increase in domestic public debt stock and public debt stock in Ghana (AFRODAD, 2013; Ghana Medium Term Debt Strategy (MTDS), 2016). Overall, growth in public debt stock for the study period was through fiscal excesses and the implementation of domestic public debt management strategy.

Inflation has been an issue of Ghana's economy during the past few decades. Inflation experience during the study period in Ghana was mixed as the inflation hovered across single, double digit and even triple digit rates. Available data indicates that between 1983 and 2018 Ghana recorded several experiences of high inflation rate in excess of 25%, suggesting that it was unable to rely on monetary policy alone for a stable and reduced inflation rate (Masson et *al*., 1997, World Bank, 2019, and Bank of Ghana, 2019). Inflation rate reached an all-time high of 122.8% in 1983 and an all-time low of 7.13% in 2012. Inflation rate in the 1980s averaged 48.2%; and 27.61% in the 1990s, compared to an average of 15.54% in the 2000s (World Bank, 2019). For instance, in the

1980s, inflation was largely due to excessive demand pressures as a result of government's expansionary fiscal operations (Sowa, 1991). The huge fall within the same period was as a result of the implementation of the Economic Recovery Programme (ERP) that focused on reducing budget deficits and the reliance on bank financing of budget deficit (Sowa, 1991). The high investment by government in the economy to stimulate economic growth showed more in the short and medium term demand increase than output increase, and thus increased inflationary pressures in the country. The high rate of inflation reflected demand pressures driven by fiscal expansion and money growth complimented by weak economic growth (Adom *et al.*, 2015). This episode, which persisted into the 1990s, coincided with a period of expansionary fiscal deficit and money supply growth. Despite the prevalence of price controls between 1983 and 1991 for the study period, inflation rate averaged 38.79%, compared to 19.12% between 1992 and 2018. The swing in changes continued through the 2000s, although changes within this period were relatively stable for the country with single digit rates recorded in 2011, 2012 and 2018 (World Bank, 2019). Overall, major changes in inflation rate for the period under review can be attributed largely to excess domestic demand generated by expansionary fiscal and monetary policies of the government. Inflation rate stood at 9.84% as at end 2018 (World Bank, 2019).

Figure 1 illustrates trends in public debt (% of GDP) and inflation rate for Ghana using annual data for the period from 1983 to 2018.

**Figure 1: Public debt and inflation in Ghana**




Source: Bank of Ghana (2019) and World Bank (2019)

A closer look at the graphical representations of public debt and inflation movements in Figure 1 do appear to suggest relationship between these variables. Trends show that peaks in public debt moved quite closely with inflation over the years.

## 3. Literature review

*Theoretical literature*

Inflation as widely known is a monetary phenomenon and its control lies within the purview of monetary authorities. According to Friedman (1968), an expansionary monetary policy will increase both real output and general price level in the short-run and only the price level will increase in the long-run. In recent times, studies have shown that inflation is not only a monetary problem but also of a fiscal concern, with fiscal variables influencing price stability. According to Sargent and Wallace (1981), Leeper (1991), and Woodford (1994, 1996, 2001) fiscal and monetary policy interaction is crucial in establishing links 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 theoretical arguments on the link between public debt and inflation are centred on the Ricardian and non-Ricardian strategy on price level determination. Oscar (2007) 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 and a non-Ricardian policy when it satisfy only the equilibrium price level. Erdogdu (2002) also shows 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 an endogenous determination of monetary and fiscal policy variables. Ricardian policies assume that the Ricardian Equivalence Theorem holds, suggesting that fiscal policy does not create any wealth effects. Ricardian equivalence according to Barro (1974, 1989) is based on monetarist view on inflation that government deficit or debt does not have significant impact on the determination of price level – implying that government bonds are not net wealth.

For the non-Ricardian policy, inter temporal government budget constraint is an equilibrium condition that is 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 (Erdogdu, 2002). The non-Ricardian policies do not follow the Ricardian Equivalence Theorem's assumption that fiscal policy does not create 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). Under a non-Ricardian plan, price level is fundamentally a fiscal phenomenon, with monetary aggregates playing a marginal role (Oscar, 2007).

The validity of the Ricardian policies has been questioned in the developing economies and for most periods in the developed economies, such that anti-inflationary policies followed by apex banks in these economies may not have been sufficient to guarantee price stability and thus requiring an appropriate mix of monetary and fiscal policies (Loyo, 1999; Christiano and Fitzgerald, 2000; Attiya *et. al.*, 2008). 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 *et al.*, 2017).

More so, because these economies are characterised by large public debt, 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, according to Woodford (1995, 1998), the source of change in price level can be explain by FTPL through the positive wealth effect of government debt policy on private consumption demand or increase private spending.

Kwon *et al.* (2006) argue that FTPL identifies the wealth effect of government debt as an additional channel of fiscal influence on inflation. The theory posits that increased government debt adds to household wealth and consequently to their demand for goods and services, leading to price pressures. The non-Ricardians in more recent time 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. Consequently, the determination of price level in an economy will require monetary and fiscal policy interactions (Marzieh, 2015).

Expansionary fiscal policy in the Keynesian view or increased level of debt or a reduction in tax rates, according to Branson (1989), Elmendorf and Mankiw (1999) and Wickens (2008) would, in the short run, affect aggregate demand by increasing disposable income and generating positive wealth effects that may lead to price level pressures. Sargent & 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 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 FTPL shows that fiscal authority alone can dominantly influence inflation irrespective of monetary policy. According to Sims (2013, 2014, 2016) when governments 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 is not default, but inflation. Hence, persistent and growing borrowings by government would eventually produce inflation regardless of policies followed by the monetary authorities.

Finally, the relationship between public debt and inflation can either be direct or indirect according to 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.

In line with all of the above, we expect government debt through wealth effect to increase inflationary pressures. This hypothesis suggests that public debt management policy may have consequences 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.

*Empirical literature review*

The effect of public debt on inflation has generated empirical studies with mixed results using ordinary least square (OLS) model, vector autoregressive (VAR) model, panel data model and vector error correction (VECM) model estimation techniques using data ranging from time series to cross-sectional and panel. Even though results from these studies differ depending on study countries and estimation methods, the majority of the studies tilt more towards a positive association between public debt and inflation.

Available empirical literature surveyed for this study shows evidence supporting both positive and negative impact of public debt on inflation. Pioneering works on government debt and inflation was by Musgrave (1949) and Phelps (1973). The study by Musgrave (1949) opened up debate on the relationship between public debt and inflation. Although the study focused on the contribution of domestic public debt policy to economic stability and in particular to checking inflation,

Musgrave pointed out that if, during some period, private holders of government securities endeavoured to liquidate all or a major portion of their portfolios, and if fiscal authorities were the only buyers, the volume of bank credit would expand rapidly. Such an expansion would not in all probability have any direct connection with the legitimate needs of the economy and extremely powerful inflationary forces would be generated. Phelps (1973) argued on public finance approach to inflation that the central bank should be made the source of inflation, while treasury is left the freedom to make compensating variations in government deficit.

Sargent and Wallace (1981) one of the most referenced pioneering empirical work on government debt and inflation process adopted the framework by Phelps (1973) on public finance approach to inflation to investigate the relationship among debt management, monetary policy and inflation. Sargent and Wallace's Unpleasant Monetarist Arithmetic framework revealed that even for the Ricardian policies, it is possible for fiscal authority to affect the level of prices. They argued that with active fiscal and passive monetary policy, monetary policy would respond by setting growth rate of money to generate the money seignorage necessary to satisfy government budget constraint. This is contrary to the monetarist view that only monetary aggregates drives inflation if fiscal authority acts in a dominant fashion through expansionary fiscal policy. Sargent and Wallace (1981) and Walsh (2010) have also argued that whether government debt is ultimately paid for by taxes or printing money, it is important in the monetary policy process. After these studies, other researchers have tried to assess how monetary and fiscal policies interact in establishing the link between public debt and inflation rate.

The studies by Cardoso and Fishlow (1990), Leeper (1991), Janssen *et al.* (2004), Bildirici and Ersin (2007), Kwon *et al.* (2006), Karakaplan (2009), Reinhart and Rogoff (2010), Faraglia *et al.* (2012), Ahmad *et al.* (2012), Lopes da Veiga *et al.* (2014), Ezirim *et al.* (2014), Ngerebo (2014), Bilan and Roman (2014), Nastansky and Strohe (2015), Nguyen (2015), Ezirim *et al.* (2016), Romero and Marin (2017) and Afonso and Ibraimo (2018) revealed a positive impact of public debt on inflation. On the other hand, a few studies have shown that public debt has a negative impact on inflation. Such studies include Wheeler (1999), Taghavi (2000), Karakaplan (2009), Reinhart and Rogoff (2010), Castro *et al.* (2003), Ezirim *et al.* (2014) and Essien *et al.* (2016).

Table 1 summarises methodology employed on selected studies on the impact of public debt on inflation.

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

| Author (s) | Title | Methodology | Association |
|---|---|---|---|
| **Positive Association** | | | |
| Bleaney (1996) | Inflation and public debt. | • Ordinary Least Square (OLS) | Positive (1973-1982) |
| Taghavi (2000) | Debt, growth and inflation in large European economies: A vector autoregression analysis. | • Hybrid cointegration analysis<br>• Vector autoregressive models | Positive (long-term association) |
| Kwon *et al.* (2006) | Public debt, money supply, and inflation: A cross-country study and its application to Jamaica. | • Vector autoregression (VAR)<br>• Pooled panel OLS<br>• Dynamic fixed effects panel<br>• Panel generalised method of moments (GMM) Arellano-Bond | Positive |
| Bildirici and Ersin (2007) | Domestic debt, inflation and economic crises: A panel cointegration application to emerging and developed economies. | • Vector Error Correction models<br>• Panel cointegration models | Positive |
| Reinhart and Rogoff (2010) | Growth in a time of debt | • Analysis of relevant statistical data. | Positive (emerging economies) |
| Ahmad *et al.* (2012) | Domestic debt and inflationary effects: An evidence from Pakistan. | • OLS estimation technique | Positive |
| Ngerebo (2014) | Domestic debt burden, debt overhang and inflationary pressure in Nigeria | • OLS estimation technique | Positive |
| Bilan and Roman (2014) | Interconnections between public indebtedness and inflation in contemporary economies | • Analysis of relevant statistical data | Positive |
| Lopes da Veiga *et al.* (2014) | Public debt, economic growth, and inflation in African economies. | • Pooled analysis of relevant statistical data. | Positive |
| Nastansky *et al.* (2015) | A vector error correction model for the relationship between public debt and inflation | • Vector Error Correction Model<br>• Generalised Impulse Response analysis | Positive |

| Author (s) | Title | Methodology | Association |
|---|---|---|---|
| | in Germany | • Multivariate Beveridge-Nelson trend/cycle decomposition | |
| Nguyen (2015) | The effects of public debt, inflation, and their interaction on economic growth in developing countries: empirical evidence based on difference panel GMM | • Panel generalised method of moments (GMM) Arellano-Bond | Positive |
| Romero and Marin (2017) | Inflation and public debt. | • Vector autoregression (VAR)<br>• Dynamic fixed effects panel<br>• Panel generalised method of moments (GMM) Arellano-Bond | Positive |
| Afonso and Ibraimo (2018) | The macroeconomic effects of public debt: An empirical analysis of Mozambique | • Vector autoregression model<br>• Impulse response functions<br>• Variance decomposition | Positive |
| **Negative Association** | | | |
| Bleaney (1996) | Inflation and public debt | • Ordinary Least Square | Negative (1983-1989) |
| Wheeler (1999) | The macroeconomic impacts of government debt:<br>An empirical analysis of the 1980s and 1990s | • Vector autoregressive model<br>• Impulse response function<br>• Variance decomposition | Negative |
| Karakaplan (2009) | The conditional effects of external debt on inflation | • Panel generalised method of moments (GMM) Arellano-Bond | Negative (in economies with well-developed financial markets) |
| Reinhart and Rogoff (2010) | Growth in a time of debt | • Analysis of relevant statistical data. | Negative (advance economies) |
| Essien *et al.* (2016) | An empirical analysis of the macroeconomic impact of public debt in Nigeria | • VAR framework<br>• Granger causality analysis<br>• Impulse response function<br>• Variance decomposition | Negative |

Source: (Aimola and Odhiambo, 2020)

Based on the surveyed literature in this study, relationship between public debt and inflation differs according to countries, sample period and estimation method. As a result of these findings, it will be difficult to draw a general conclusion on the relationship between public debt and inflation for

this study. The study will therefore proceed to investigate the impact of public debt on inflation in Ghana.

## 4. Estimation techniques and empirical analysis

### *4.1 Estimation techniques*

The study employed the autoregressive distributed lag (ARDL) bounds testing approach by Pesaran *et al.* (2001) to examine the existence of a cointegration relationship among the variables used in this study. Our rationale for adopting this technique, among others, is the robust ability of the ARDL technique in analysing short-run and long-run dynamic relationships in small sample sizes (Pesaran *et al.*, 2001; Narayan and Smyth, 2005; and Odhiambo, 2020a). Before estimating the cointegration relationship, a dummy variable (DUM95) was introduced in the model based on Zivot-Andrews (ZA) unit root test to represent a breakpoint in the series. Hence, the estimated ARDL specification is expressed as:

$$\Delta InINF_t = \psi_0 + \sum_{i=1}^{n} \psi_{1i}\, \Delta InINF_{t-i} + \sum_{i=0}^{n} \psi_{2i}\, \Delta InPD_{t-i} + \sum_{i=0}^{n} \psi_{3i}\, \Delta InMS_{t-i} + \sum_{i=0}^{n} \psi_{4i}\, \Delta InINT_{t-i}$$
$$+ \sum_{i=0}^{n} \psi_{5i}\, \Delta InGDPC_{t-i} + \sum_{i=0}^{n} \psi_{6i}\, \Delta InGFCF_{t-i} + \psi_7 InINF_{t-1} + \psi_8 InPD_{t-1} + \psi_9 InMS_{t-1}$$
$$+ \psi_{10} InINT_{t-1} + \psi_{11} InGDPC_{t-1} + \psi_{12} InGFCF_{t-1} + \psi_{13} DUM95_{t-1} + \omega_t \quad \ldots. \quad (1)$$

Where:
INF = Inflation;
PD = Public debt;
MS = Money supply;
INT = Interest rate;
GDPC = Economic growth;
GFCF = Private investment.

$\psi_0$ is the constants, $\psi_1 - \psi_6$ are the respective short-run coefficients, $\psi_7 - \psi_{12}$ are the respective long-run coefficients, $\omega_t$ is the mutually independent white-noise residuals, *In* is natural logarithm, Δ represents the difference operator, *n* is the lag length and *t* is the time period. The dummy variable *(DUM95)* was introduced in Equation 1 to represent a structural break that is endogenously determined by Zivot-Andrews test in inflation (INF). Long-run estimates from Equation 1 were subjected to the F-test to determine the existence of a long-run relationship among

the variables in the equation. The computed F-statistic was compared with the appropriate asymptotic critical values generated by Pesaran *et al*. (2001). According to Pesaran *et al.* (2001), if the computed F-statistic exceeds the upper critical bound value, the null hypothesis of no cointegration is rejected (see Odhiambo, 2020b). On the other hand, if the computed F-statistic is below the lower critical bound value, the test fails to reject the null hypothesis of no cointegration. If the F-statistic falls between the lower and upper critical bounds, the test is inconclusive.

The error correction representation of Equation 1 is specified in Equation 2.

$$\begin{aligned}\Delta InINF_t = \psi_0 &+ \sum_{i=1}^{n} \psi_{1i}\, \Delta InINF_{t-i} + \sum_{i=0}^{n} \psi_{2i}\, \Delta InPD_{t-i} + \sum_{i=0}^{n} \psi_{3i}\, \Delta InMS_{t-i} + \sum_{i=0}^{n} \psi_{4i}\, \Delta InINT_{t-i} \\ &+ \sum_{i=0}^{n} \psi_{5i}\, \Delta InGDPC_{t-i} + \sum_{i=0}^{n} \psi_{6i}\, \Delta InGFCF_{t-i} + \sum_{i=0}^{n} D_{95}\, \Delta DUM95_{t-i} + \beta_1 ECM_{t-1} \\ &+ \omega_t \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \quad (2)\end{aligned}$$

Where all variables remain as defined in Equation 1. $D_{95}$ is the short run coefficient of the dummy variable. The error-correction term is lagged once ($ECM_{t-1}$) and derived from the estimated cointegrated equation. The coefficient of the lagged error-correction term $\beta_1$ is expected to be negative and statistically significant, suggesting the adjustment speed to equilibrium after a shock to the system (see also Asongu *et al.*, 2013).

### *Data and definition of variables*

The study used annual time-series data from the period 1983-2018. The choice of the period was influenced by the availability of credible and reliable data on the variables for Ghana. Data were sourced from the International Monetary Fund (IMF) and the World Bank data base. Table 2 further shows how each of the data was measured and the 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 | IMF (2020) |

| | | | | |
|---|---|---|---|---|
| **MS** | Money supply | Broad money supply (% of GDP) | Positive | WB (2019) |
| **INT** | Interest rate | Monetary policy rate (annual %) | Positive | IMF (2019) |
| **GDPC** | Economic growth | Real gross domestic product (GDP) per capita, measured as gross domestic product divided by midyear population. | Positive or Negative | WB (2019) |
| **GFCF** | Private investment | Gross fixed capital formation (% of GDP) | Positive | WB (2019) |

Source: Authors' Compilation.

### *4.2 Empirical analysis*

#### *4.2.1 Unit root test*

Before estimating the relationship between inflation, public debt, money supply, interest rate, economic growth and private investment, it is important to test the stationarity of variables. This is to ensure that none of the variables used in this study are integrated of order two or higher. The Dickey-Fuller Generalised Least Squares (DF-GLS) and Phillips-Perron (PP) unit root tests have been employed for this purpose both at level and first difference. In addition, the study addressed the structural break issues associated with time-series data by using the Zivot-Andrews (ZA) structural break unit root test. This test endogenously corrects for one structural break to test the order of the integration among the variables. The results of the unit root tests are reported in appendix 1 and 2.

The results of the DF-GLS and PP unit root tests displayed in Appendix 1 show that none of the variables are integrated of order two (i.e. I (2)) or higher. The results of the ZA test reported in Appendix 2 also show that none of the variables is I (2) and that the structural change in inflation took place in 1995. This period coincides with the implementation of the Financial Sector Adjustment Programme (FINSAP), which took place in the 1990s. During this period, the country also moved from direct control to indirect control of monetary aggregates in achieving inflation objectives by focusing largely on the use of market-based monetary policy instruments (Brownbridge, 1995; Sowa, 2002 and World Bank, 2019).

#### *4.2.2 ARDL bounds cointegration test*

The results of the ARDL bounds cointegration test reported in Table 3 show that the calculated F-statistic exceeds the upper bound critical value, as prescribed by Pesaran *et al.* (2001). Hence, the study rejects the null hypothesis of no cointegration, suggesting the existence of a long-run relationship between inflation, public debt, money supply, interest rate, economic growth, private investment, and DUM95.

**Table 3: Results of ARDL bounds cointegration test**

| Dependent Variable | Function | | F-test statistic | | Cointegration Status | |
|---|---|---|---|---|---|---|
| **ARDL (1, 0, 1, 1, 0, 0, 0) Selected based on Akaike Information Criteria** | | | | | | |
| Inflation | F(*In*INF\| *In*PD, *In*MS, *In*INT *In*GDPC, *In*GFCF, DUM95) | | 7.04*** | | Cointegrated | |
| **Asymptotic critical values** | | | | | | |
| **Critical values** Pesaran *et al*. (2001), p.300, Table CI(iii) Case III | **1%** | | **5%** | | **10%** | |
| | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| | 3.15 | 4.43 | 2.45 | 3.61 | 2.12 | 3.23 |

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

### *4.2.3. Long-run and short-run estimates*

Given the presence of a long run relationship between inflation and the explanatory variables, long run and short run estimates were estimated for Equation 1. These results are presented in Table 4.

**Table 4: Long-run and short-run coefficients**

| *Panel A: Long-Run Coefficients (Dependent Variable is INF)* | | | |
|---|---|---|---|
| **Regressor** | **Coefficient** | **T-ratio** | **[p-value]** |
| Constant | 6.2044*** | 7.7520 | [0.0000] |
| Public debt | 1.0109* | 1.9294 | [0.0651] |
| Money supply | -0.8682 | -1.1763 | [0.2506] |
| Interest rate | -0.1083 | -0.1981 | [0.8446] |
| Economic growth | -1.5827** | -2.5110 | [0.0189] |
| Private investment | 0.0608 | 0.1547 | [0.8783] |
| DUM95 | 0.2268 | 0.5837 | [0.5646] |
| *Panel B: Short-Run Results (Dependent variable ΔINF)* | | | |
| **Regressor** | **Coefficient** | **T-ratio** | **[p-value]** |
| Δ Public debt | 0.7074** | 2.3101 | [0.0294] |
| Δ Money supply | -1.8161*** | -4.1726 | [0.0003] |

| | | |
|---|---|---|
| Δ Interest rate | 0.9291*** | 3.5413 [0.0016] |
| Δ Economic growth | -1.1075** | -2.7191 [0.0117] |
| Δ Private investment | 0.0426 | 0.1556 [0.8776] |
| Δ DUM95 | 0.1587 | 0.5679 [0.5752] |
| $ECM_{t-1}$ | -0.6996*** | -7.8179 [0.0000] |
| | | |
| R-Bar Squared | 0.7172 | |
| F-Statistic | 29.7458*** [0.0000] | |
| Akaike Info. Criterion | 0.5326 | |
| Schwarz-Bayesian Info. Criterion | 0.7104 | |

*Note: ***, ** and * denote statistical significance at 1%, 5%, and 10% level, respectively.*

The long-run and short-run results presented in Table 4 (Panel A and Panel B) show that the coefficient of public debt is positive and statistically significant, irrespective of the period. These results suggest that public debt plays a significant role in the process of inflation levels in Ghana, regardless of whether it is in the long run or in the short run. This finding is consistent with previous studies such as Kwon *et al.* (2006), Lopes da Veiga *et al*. (2014), Nastansky and Strohe (2015) and Romero and Marin (2017) that found a positive association between public debt and inflation. The argument for this result could also be based on a similar reason highlighted in the fiscal theory of price level determination. The theory posits that public debt through wealth effect has a positive impact on inflation (Kwon *et al.*, 2006).

The results also show that the coefficient of economic growth is negative and statistically significant in both the short run and long run. This suggests that economic growth negatively influences the rate of inflation, irrespective of the period. This finding is in line with previous studies such as Stockman (1981) that advocates a negative relationship between these variables. In the short run, money supply has a negative impact on inflation, but no impact in the long run. This result, although contrary to the expectation of the study, is not unusual (see also Bairam, 1990; West African Monetary Agency (WAMA), 2009). The coefficient of interest rate suggests a positive impact on inflation in the short run, but no impact in the long run. The findings, however, reveal that private investment and DUM95 have no impact on inflation, irrespective of the period in Ghana. This implies that an increase in private investment in Ghana is unlikely to lead to an increase in inflation. It also shows that the structural change that occurred in 1995 did not significantly affect inflation in Ghana. The estimated result of the $ECM_{t-1}$ from Table 4 (Panel B)

also shows that the sign of $ECM_{t-1}$ is negative as expected and statistically significant. The regression results are a good fit, as indicated by the adjusted R-squared of about 72%.

The study performed stability tests for the estimated ARDL framework using the cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) tests. Brown et al. (1975) and Pesaran and Pesaran (1997) have also used these tests for model stability. Figure 2 and 3 show that the plots of CUSUM and CUSUMSQ statistics are within the 5% critical bounds, suggesting that the model is stable over time.

**Figure 2: Plot of CUSUM test**

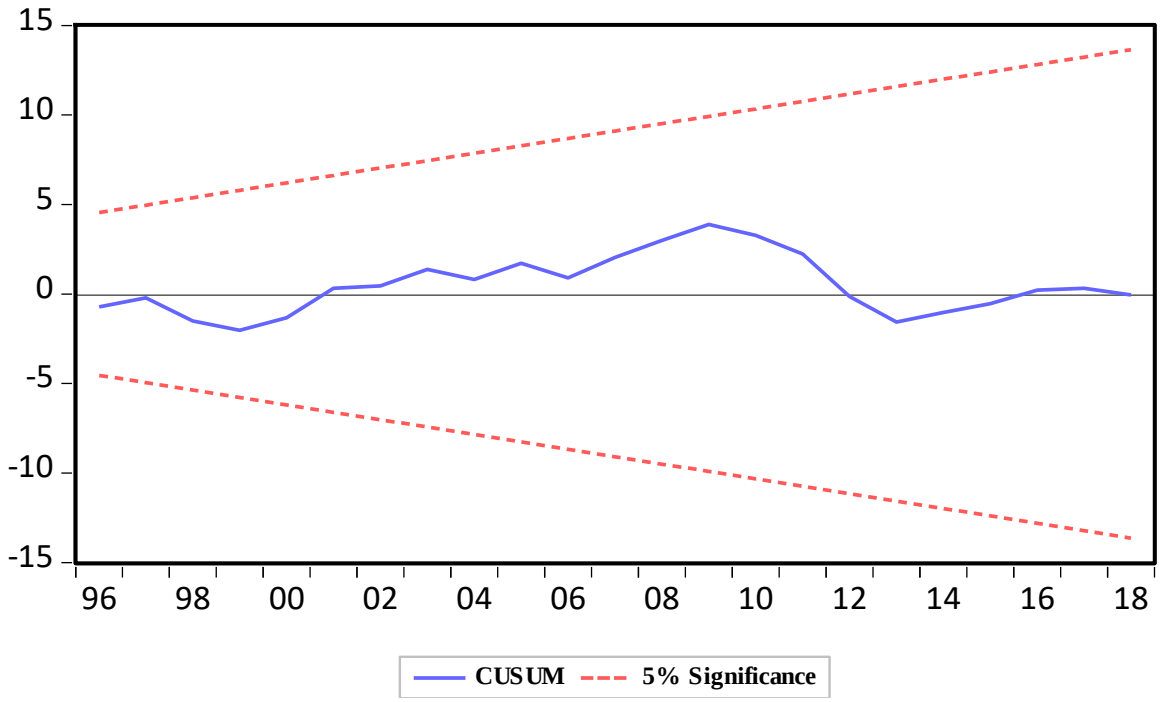
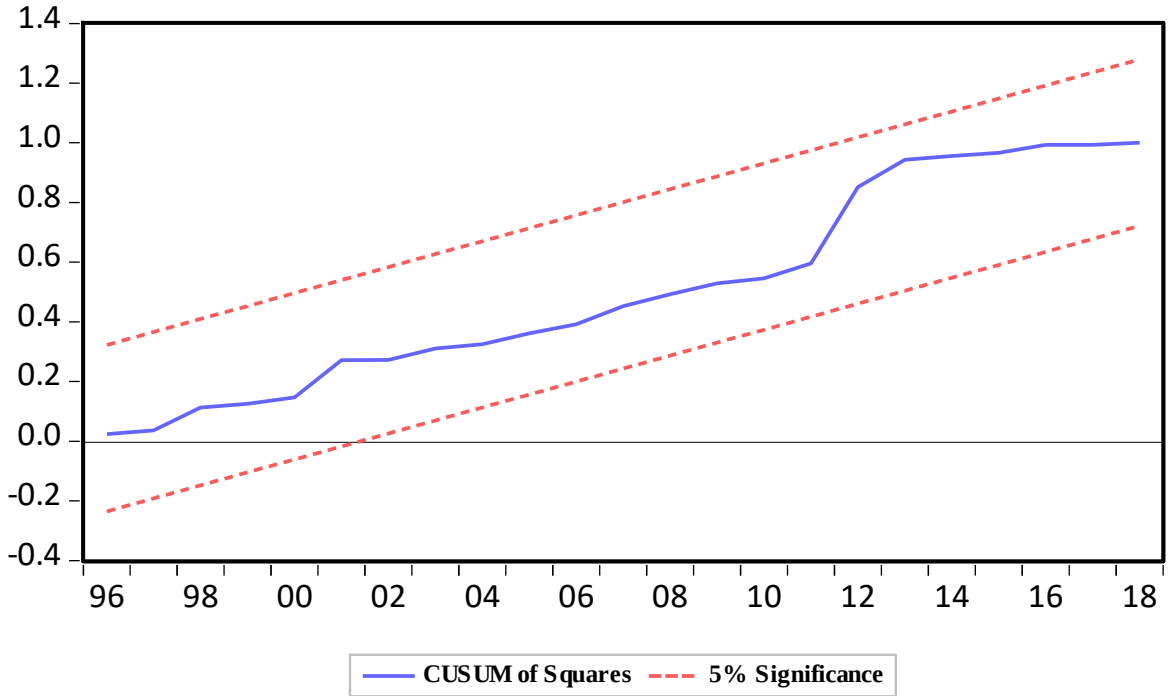


**Figure 3: Plot of CUSUMSQ test**




## 5. Conclusion

The main objective of this study was to examine the relationship between public debt and inflation in Ghana using annual data from 1983 to 2018. The study employed the ARDL approach to cointegration and the error-correction model. The study also used Zivot and Andrews (1992) model to account for the possibility of a structural break in the series. The findings revealed a stable long-run relationship between inflation, public debt, money supply, interest rate, economic growth, and private investment in the presence of structural breaks. Similarly, the long-run and short-run coefficient estimates from the ARDL framework show that public debt has a positive and significant impact on inflation in Ghana. This finding supports the Fiscal Theory of the Price Level which posits that government debt adds to household wealth. Hence, the demand for goods and services would increase exacting price pressures. Overall, the study confirms the inflationary effects of public debt management in Ghana. Hence, the government should be prudent when considering increases in public debt to minimise volatility in inflation and its associated risks on

the economy. The control of inflation dynamics is vital in achieving the objectives of monetary and fiscal policy. Notwithstanding its novel contribution, this research is limited by the use of aggregate public debt data. In future studies, researchers may, therefore, wish to use disaggregated public debt data in order to disentangle the impact of external and domestic public debt on inflation. In addition, the possibility of nonlinearity within the framework could also be investigated in order to explore the dynamic impact of public debt on inflation fully.

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## Appendices

## Appendix 1: 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)*** | |
| | *Without Trend* | *With Trend* | *Without Trend* | *With Trend* | *Without Trend* | *With Trend* | *Without Trend* | *With Trend* |
| *In*INF | -0.0450 | -1.9819 | -0.1425 | -5.1238*** | -4.2921*** | -5.6049*** | -9.7520*** | -16.2091*** |
| *In*PD | -0.9562 | -1.8229 | -1.7845 | -2.0563 | -3.9662*** | -4.6730*** | -5.2911*** | -5.2643** |
| *In*MS | -1.0515 | -1.7646 | -2.2603 | -1.7543 | -6.5860*** | -4.7017*** | -6.5099*** | -9.1770*** |
| *In*INT | -1.5322 | -1.9026 | -1.8685 | -2.3638 | -5.0477*** | -5.5221*** | -5.5153*** | -5.5296*** |
| *In*GDPC | 1.1817 | -1.4541 | 1.5165 | -0.6578 | -3.1274*** | -3.7159*** | -3.5497** | -4.0991** |
| *In*GFCF | -1.4527 | -2.0286 | -3.8941*** | -3.0442 | -3.3516*** | -4.6126*** | - | -5.2587*** |

**Source:** Authors' compilation.

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

## Appendix 2: Results of structural break unit root test

| **Zivot-Andrews structural break unit root test** | | | | |
|---|---|---|---|---|
| | ***ZA test at level*** | | ***ZA test at first difference*** | |
| *Variables* | *t-Statistic* | *Break year* | *t-Statistic* | *Break year* |
| *In*INF | -4.7497 | 1995 | -5.8441*** | 1998 |
| *In*PD | -3.8407 | 2004 | -5.7083*** | 2007 |
| *In*MS | -5.0849* | 2006 | -6.0286*** | 2003 |
| *In*INT | -2.9708 | 1999 | -6.3665*** | 2012 |
| *In*GDPC | -3.4239 | 2002 | -4.9565* | 2010 |
| *In*GFCF | -3.9519 | 2006 | -7.1585*** | 2012 |

**Source:** Authors' compilation.

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