Budget Deficit and Inflation in Selected African Countries: Evidence from Granger Causality Tests in the Time and Frequency Domains

Yaya KEHO

Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA) Abidjan. Tel.: (+225) 22 44 41 24, Fax: (+225) 22 48 51 68. 08 BP 03 Abidjan 08, Côte d'Ivoire. Email: yayakeho@yahoo.fr

Abstract: This study examines the causal nexus between budget deficit and inflation for the countries of the West African Economic and Monetary Union (WAEMU). It uses the modified version of the Granger causality test due to Toda and Yamamoto (1995) and the frequency domain Granger causality test. The results from the Toda and Yamamoto causality analysis indicate that budget deficit causes inflation in Benin, Niger, Senegal and Togo. The results from the frequency domain analysis show evidence of causality from budget deficit to inflation for Burkina Faso in the long term, for Niger in the medium term, for Senegal in short term, and for Togo over the short, medium and long terms. The reverse causality from inflation to deficit exists for Burkina Faso over the medium and short terms.

JEL Classification: C32, E31, H62, O55

Keywords: Budget deficits, inflation, frequency domain analysis, African Countries

INTRODUCTION

The effect of budget deficit on macroeconomic variables is one of the widely and hotly debated issues in macroeconomics. Budget deficit occurs when government expenditures exceed its revenues. Budget deficits were blamed for the assortment of ills that beset most African countries. The conventional belief is that persistently high budget deficits give rise to inflation, and high inflation is everywhere an undesirable factor due to its adverse effects on economic growth. The adverse effect of inflation has been a serious concern for the monetary authorities, economists and policymakers. In many countries, the main goal of the central bank is the price stability, i.e. controlling the inflation rate. The relationship between budget deficit and inflation has received a considerable attention both in the theoretical and empirical literature. At the theoretical level, three distinct views are predominant in the literature, revealing the complex relationship that exists between budget deficits and inflation. The most direct link is that budget deficit caused by expansionary fiscal policy increases the aggregate demand and goes up the price level if the economy is operating at full employment. From the monetarist perspective, budget deficits lead to inflation through money supply. This view therefore argues that controlling inflation comes mainly under the purview of the monetary authority. Contrary to this view, the proponents of the fiscal theory of price level contend that inflation is determined partially by fiscal policies and therefore long-run price stability is not fully in the purview of the monetary authority (Sargent and Wallace, 1981). Within this framework, the rate of inflation is dependent upon the coordination between monetary and fiscal authorities.

These competing views have stimulated a growing body of empirical works. However, these studies did not yield conclusive results on the relationship between budget deficit and inflation. While some studies found that deficit leads to inflation (e.g., Choudhary and Parai, 1991; Metin, 1998; Solomon and De Wet, 2004; Agha and Khan, 2006; Oladipo and Akinbobola, 2011; Jalil et al., 2014), others found no significant relationship between the two variables (e.g., Karras, 1994; Ashra et. al., 2004; Ezeabasili et al., 2012). On the other hand, other studies (e.g., Ahking and Miller, 1985; Barnhart and Darrat, 1988; Hondroyiannis and Papapetrou, 1997) found evidence of bidirectional causation between deficit and inflation.

Most of the previous studies in the existing literature focused attention on developed and Asian countries. Despite the significant implications of the issue for all countries, only a handful of studies have examined the nexus between budget deficit and inflation for Sub-Saharan countries. This study therefore attempts to fill the gap for the member countries of the West African Economic and Monetary Union (WAEMU). Faced with the vicious circle of persistent budget deficits, WAEMU member countries have embarked on economic and fiscal reform programs aiming at raising tax revenues and restructuring tax systems. In addition, since 1994, WAEMU countries have adopted convergence criteria aiming at explicit targets for deficits and inflation rate. Most African countries use the budget deficit as a tool in achieving their economic and social objectives. Assessing the causal nexus between budget deficit and inflation not only helps understanding the impact of government budget deficits on inflation dynamics, but also sets a framework for discussion of fiscal policies. If deficit has positive effect on inflation, then restricting the size of budget deficit is absolutely relevant.

The remainder of the study is organized as follows. Section 2 reviews the literature on the relationship between deficit and inflation. Section 3 outlines the econometric methodology. Section 4 analyses the empirical results. Finally, Section 5 provides summary and gives some policy implications.

LITERATURE REVIEW

The debate about the effects of deficits on macroeconomic variables such as inflation and money supply has generated considerable interest as well as controversy both in the theoretical and empirical literature. At the theoretical level, a number of theories describe the relationship between deficit and inflation. The Keynesian view suggests that government budget deficit leads to inflation by stimulating aggregate demand and driving up the real interest rate, which in turn displaces private investment. In an economy in which the output cannot be increased, the increase in aggregate demand will lead to higher prices. The classical explanation of inflation essentially refers to the quantity theory of money which suggests a proportional relation between the inflation rate and the growth rate of money. The monetarists argue that inflation is caused by excessive monetary growth. This argument was earlier advanced by Friedman (1968) who considers inflation always and everywhere as a monetary phenomenon. The Monetarist view suggests that government budget deficits are inflationary because they lead to higher money growth. A higher budget deficit increases deficit financing, which allows the central bank to allocate more credit to the government. This increases high-powered money and the nation's money supply, thereby increasing the price level. Thus, according to the monetarist view, budget deficit leads to inflation only if it is monetized to increase the monetary base of the economy (Hamburger and Zwick, 1981). In contrast, some authors argue that inflation is not purely a monetary phenomenon and that money creation may not be the single channel through which the budget deficits cause inflation. The proponents of the fiscal theory of price level emphasize the role of fiscal variables, especially the budget deficits, on price level determination. They highlight the importance of fiscal and monetary policy coordination while ensuring price stability (Sargent and Wallace, 1981). According to them, the monetary authority's control over inflation might be much more limited than anticipated due to the inter-temporal budget constraint of the government. Under the so-called "monetary dominant" regime, monetary policy determines the price level, and fiscal policy remains reactive. The government balances its inter temporal constraint taking the inflation as given. Sargent and Wallace (1981) argue that, in this coordination scheme, inflation is completely under the control of the monetary authority. In the "fiscal dominant" regime, however, the price level is determined by the government's inter-temporal budget constraint and monetary policy is reactive that is money supply reacts to price level changes to bring the money demand equation in balance (Carlstrom and Fuerst, 2000). In the strong version of the fiscal theory of price level, introduced by Leeper (1991), Sims (1994) and

Woodford (1994) the price level is determined merely by fiscal variables and monetary factors play no role in price determination. Price levels adjust to ensure the government's inter-temporal budget constraint and the adjustment is driven by individuals' wealth effect which raises aggregate demand thereby creating inflation and leaving no role for the monetary authority.

These theories have stimulated an extensive empirical literature devoted to examine the relationship between the budget deficit and inflation. The findings from these studies are mixed and controversial across countries, data and methodologies. Ahking and Miller (1985) found that budget deficit causes inflation in United States. They argued that a deficit financed through domestic sources is more inflationary than financing through foreign sources. Furthermore, they emphasized that money-financed deficits are more inflationary than bond-financed deficits. Giannaros and Kolluri (1986) investigated the relationship between government deficits and the money growth or the rate of inflation for 10 industrialized countries during the period 1950 to 1981. Their results show that the fiscal deficits do not increase the money supply and the inflation rate. The studies by Barnhart and Darrat (1988) for seven OECD countries, Barnhart and Darrat (1989) for United States, and De Haan and Zelhorst (1990) for 17 developing countries, provided evidence that budget deficit does not cause inflation. Choudhary and Parai (1991) found that the growth rate of money supply and budget deficits has a positive relationship to inflation in Peru. Edwards and Tabellini (1991) found that budget deficits are an important determinant of inflation in a wide sample of developed countries. Hondroyiannis and Papapetrou (1994) investigated the relationship between the government budget and inflation in Greece for the period 1960-1992. They found evidence showing that there is a long-run relationship between government budget and price level and supported the hypothesis of bidirectional causality between the two variables. However, Hondroyiannis and Papapetrou (1997) did not find any direct impact of the budget deficit on inflation in Greece. Darrat (2000) tested whether high budget deficits have any inflationary consequences in Greece over the period 1957-1993. The empirical results show that besides money growth, budget deficits have also played a significant and direct role in the Greek inflationary process. Karras (1994) examined the effects of budget deficits on money growth, inflation, and investment and real output growth for 32 countries covering the period 1950-1989. The empirical findings show that deficits do not produce inflation via monetary expansions and deficits negatively affect the rate of growth of real output. Shabbir and Ahmed (1994) analyzed the effect of budget deficit on inflation for the period 1971-1988 in Pakistan. The findings indicate that budget deficits have a positive and significant direct effect on inflation. Metin (1995) analyzed the inflationary process in Turkey for the period from 1950 to 1988. She found that fiscal expansion dominated the determination of inflation. Metin (1998) examined the relationship between inflation and budget deficit in Turkey using cointegration analysis during the period of 1950-1987. The results show that budget deficits have a positive effect on inflation in Turkey because of central bank monetization of the budget deficit. The study by Catao and Terrones (2003) showed that there is a strong positive relationship between budget deficits and inflation among developing countries as well as countries characterized by high inflation, but not among advanced economies with low-inflation. Neyapti (2003) examined the relationship between budget deficits and inflation for 54 developed and less developed countries over the period of 1970-1989. He found that budget deficits have a positive effect on the inflation for these countries. Using Granger causality tests, Ashra et al. (2004) found bi-directional relationship between money and price, but not between budget deficit and inflation in India for the period from 1950 to 2001. Tiwari et al. (2012) found money supply causing fiscal deficit and any causal link between fiscal deficit and inflation in India for the period 1970-2009. Catao and Terrones (2005) investigated the fiscal deficit and inflation relationship for 107 countries between 1960 and 2001 using the autoregressive distributed lag model (ARDL). They found a strong positive relationship between fiscal deficit and inflation among developing countries with high inflation, but not in low inflation, advanced nations. Alavirad and Athawale (2005) investigated the impact of budget deficit on inflation in Iran by employing the ARDL model and data from 1960 to 1999. The results showed that budget deficit has a major impact on inflation in Iran. Agha and Khan (2006) investigated the long run relationship between budget deficit and inflation in Pakistan using the Johansen methodology. They found that budget deficit has a positive impact on inflation, and further, showed that market borrowings are the most inflationary financing source in Pakistan. Lin and Chu (2013) investigated the relationship between inflation and deficits in 91 countries during the period 1960 to 2006 with dynamic panel quantile regression model under the autoregressive distributional lag (ARDL) specification. They found that fiscal deficit has a strong effect on the inflation in the high-inflation events, but it is weak in

the low-inflation episodes. Jalil et al. (2014) also tested the inflation and fiscal deficit nexus for Pakistan during the period 1972 to 2012. Their results suggest that there is a positive relationship between fiscal deficit and inflation. Nguyen (2015) examined the effects of fiscal deficit and money supply on inflation in nine Asian countries over the period of 1985-2012. By using the pooled mean group estimator and the panel differenced GMM estimator, He found evidence that fiscal deficit has a positive impact on inflation in both methods of estimation. Tiwari et al. (2015) investigated the relationship between budget deficits and inflation for nine EU countries during the period of 1990-2013 using the bootstrap causality and Granger causality test in the frequency domain analysis. They did not find a relationship between the two variables with bootstrap causality. The frequency domain causality showed that there is no relationship causality from budget deficits to inflation for all countries, but causality from inflation to budget deficits exists in long run for Belgium and France.

The empirical findings from African countries are also quite mixed. Sowa (1994) found a positive relationship between government budget deficits and inflation in Ghana. He strongly recommended control of inflation-targeting policies to keep the budget deficit as low as possible. Ndebbio (1998) used Granger causality tests and found evidence of bidirectional causality between fiscal deficit and inflation for the Nigerian economy for the period 1970 to 1992. Anoruo (2003) used the Johansen cointegration procedure and Granger causality tests to show that money supply causes both budget deficits and inflation rate in South Africa. He also found bidirectional causal relationship between deficits and inflation. Solomon and De Wet (2004) found a positive relationship between budget deficit and inflation in Tanzania due to massive monetization of deficits by monetary authorities. Makochekanwa (2011) reached the same conclusion in the case of the Zimbabwean economy. In the case of Nigeria, Ogunmuyiwa (2008) found that inflation causes budget deficit, while Chimobi and Igwe (2010) and Oladipo and Akinbobola (2011) established that budget deficit is inflationary in Nigeria. Chimobi and Igwe (2010) also found bilateral causality between budget deficit and inflation. Anayochukwu (2012) examined the causal relationship between inflation and fiscal deficits in Nigeria for the period 1970-2009. Using the ARDL test and Granger causality tests, He found that fiscal deficit as share of GDP causes inflation. However, no feedback mechanism was observed. He also reported a significant negative relationship between growth in fiscal deficit as share of GDP and inflation. Ezeabasili et al. (2012) examined the relationship between fiscal deficits and inflation in Nigeria using Johansen cointegration test and data covering the period 1970–2006, a period of persistent inflationary trends. They found a positive but insignificant relationship between inflation and fiscal deficits. Rather, they reported a positive long run relationship between money supply and inflation.

3. Data and Methodology

3.1 Data Description

The study uses data for seven member countries of the West African Economic and Monetary Union (WAEMU), namely Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. The variables under study are budget balance (surplus or deficit) as share of GDP and inflation rate. All data were obtained from the website of the Central Bank of West African States and cover the time period from 1970/1972 to 2013.

3.2 Toda and Yamamoto Causality Test in the Time Domain

To make a comparison with the causality test in the frequency domain, we first apply the Granger causality tests in the time domain to gain first insights into the causal link between deficits and inflation. To that end, we apply the Toda and Yamamoto (1995) approach. This approach does not require testing for cointegration and estimating vector error correction model. Another advantage of this procedure is that causality tests can be implemented regardless of whether the variables are mixed integrated or integrated of an order more than two. Performed directly on the coefficients of the levels VAR, the Toda and Yamamoto methodology minimizes the risk associated with possibly wrongly identifying the orders of integration of the series and the presence of cointegration relationship (Giles, 1997; Mavrotas and Kelly, 2001). While the standard Granger causality analysis requires estimating a first-difference VAR(p) augmented with an error correction term, the Toda and Yamamoto (1995) procedure requires estimating a level-augmented VAR(p+d), where d is the maximum integration order of the variables:

$$\begin{bmatrix} \pi_t \\ B_t \end{bmatrix} = \begin{bmatrix} \varphi_1 \\ \varphi_2 \end{bmatrix} + \sum_{i=1}^{p+d} \begin{bmatrix} \beta_{1i} & \gamma_{1i} \\ \beta_{2i} & \gamma_{2i} \end{bmatrix} \times \begin{bmatrix} \pi_{t-i} \\ B_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{1}$$

The null hypothesis of Granger causality is then tested by imposing zero restriction on the first p parameters using a standard Wald statistic. For instance, $\gamma 11 = \gamma 12 = \ldots = \gamma 1p = 0$ shows that budget deficit does not Granger-cause inflation whereas $\beta 21 = \beta 22 = \ldots = \beta 2p = 0$ indicates that inflation does not Granger-cause budget deficit. The optimal lag length p is determined by means of Akaike Information Criteria (AIC), Schwarz Criteria (SC), Hannan-Quinn criteria (HQ).

3.3 Causality analysis in the frequency domain

Causality analysis in the frequency domain was developed by Granger (1969) and Geweke (1982). In the present study, we follow the description in Breitung and Candelon (2006). Let Zt=(πt, Bt)' be a two-dimensional vector of time series. It has a finite-order VAR representation of the form:

$$\theta(L) \begin{pmatrix} \pi_t \\ B_t \end{pmatrix} = \begin{pmatrix} \theta_1(L) & \theta_2(L) \\ \theta_1(L) & \theta_2(L) \end{pmatrix} \begin{pmatrix} \pi_t \\ B_t \end{pmatrix} = \mu_t \tag{2}$$

where $\theta(L) = 1 - \theta_1 L - \theta_2 L^2 - \ldots - \theta_p$ is a 2x2 lag polynomial, θ1, θ2,…,θp are 2x2 autoregressive parameter matrices, and L is the lag operator. The error vector μt is white noise with E(μt)=0 and E(μtμ't)=Σ; where Σ is positive definite. Let G be the lower triangular matrix of the Cholesky decomposition G'G= Σ-1 such that ηt=Gμt and E(ηtη't)=I. If Zt is stationary, the MA representation is:

$$\begin{pmatrix} \pi_t \\ B_t \end{pmatrix} = \phi(L)\eta_t = \begin{bmatrix} \phi_1(L) & \phi_2(L) \\ \phi_1(L) & \phi_2(L) \end{bmatrix} \begin{pmatrix} \eta_{1t} \\ \eta_{2t} \end{pmatrix} \tag{3}$$

where $\phi(L) = \theta(L)^{-1}G$. Using this representation the spectral density of πt can be expressed as:

$$f_\pi(\omega) = \frac{1}{2\pi} \left(\left| \phi_1(e^{-i\omega}) \right|^2 + \left| \phi_2(e^{-i\omega}) \right|^2 \right) \tag{4}$$

The measure of causality suggested by Geweke (1982) is defined as follows:

$$M_{B \to \pi}(\omega) = \log \left[1 + \frac{\left| \phi_2(e^{-i\omega}) \right|^2}{\left| \phi_1(e^{-i\omega}) \right|^2} \right] \tag{5}$$

To test the hypothesis that budget deficit does M not cause inflation at frequency ω, the null hypothesis is:

$$M_{B \to \pi}(\omega) = 0 \Leftrightarrow \left| \phi_2(e^{-i\omega}) \right|^2 = 0 \tag{6}$$

Breitung and Candelon (2006) showed that:

$$\left| \phi_2(e^{-i\omega}) \right| = 0 \Leftrightarrow \begin{cases} \sum_{j=1}^{p} \theta_{2,j} \cos(j\omega) = 0 \\ \sum_{j=1}^{p} \theta_{2,j} \sin(j\omega) = 0 \end{cases} \tag{7}$$

The Authors proposed a much simpler approach to these linear restrictions. They consider the VAR equation for inflation specifies as follows:

$$\pi_t = \alpha_1 \pi_{t-1} + \ldots + \alpha_p \pi_{t-p} + \beta_1 B_{t-1} + \ldots + \beta_p B_{t-p} + \mu_{1t} \tag{8}$$

The null hypothesis is equivalent to the linear restriction:B

$$H_0 : R(\omega)\beta = 0 \tag{9}$$

where R=[β1, β2,… βp]' and

$$R(\omega) = \begin{bmatrix} \cos(\omega) & \cos(2\omega) & ... & \cos(p\omega) \\ \sin(\omega) & \sin(2\omega) & ... & \sin(p\omega) \end{bmatrix} \tag{10}$$

The causality measure for ω∈[0,π] can be tested using the standard F-test for linear restrictions. The F-statistic follows an F distribution with (2, T-2p) degrees of freedom where 2 is the number of restrictions, T and p are the number of observations and order of VAR model, respectively.

4. EMPIRICAL RESULTS

Before starting estimation, we present in Table 1 statistics on the two variables over two sub-periods. The most striking feature is the persistent of deficit in all countries under study. WAEMU countries also experienced high inflation rate over 1970 to 1990. The statistics show a decline in inflation rate from 7% to 3% after 1990. As noticed earlier, since 1994 WAEMU countries have adopted convergence criteria aiming at explicit targets for deficit and inflation rate. According to these criteria inflation rate must be lower than 3% while budget balance must be positive. The correlation coefficients between the two variables show that deficit and inflation are not significantly related. Correlation, however, does not say anything about causality and thus leaves unsettled the debate concerning the causal relationship between budget deficit and inflation rate. The aim of this study is to find out whether the absence of correlation implies the absence of causality between deficit and inflation rate.

Table 1: Sample Means of Variables

Country	1970-1990		1991-2013		
	Budget (B)	Inflation	Budget (B)	Inflation	Correlation
Benin	-3.52	6.49	-1.29	4.97	0.194 (0.211)
Burkina Faso	-1.53	6.65	-4.04	3.55	0.249 (0.111)
Cote d'Ivoire	-6.38	8.75	-3.21	4.39	-0.025 (0.868)
Mali	-2.53	6.25	-1.64	3.27	-0.012 (0.937)
Niger	-3.43	6.74	-2.91	3.99	0.038 (0.808)
Senegal	-2.68	8.45	-2.29	3.06	-0.016 (0.917)
Togo	-4.84	6.57	-3.64	5.39	-0.255 (0.102)

Note: Numbers in parentheses are the p-values

In the next step, we test for the order of integration of the series by means of unit root tests. To this end, we perform the well-known unit root tests of Phillips and Perron (PP) (1988) and Kwiatkowski, Phillips, Schmidt and Shin (1992) (KPSS). These tests have been performed under the model with constant and trend for the level series and with constant for series in first difference. The results displayed in Table 2 show that all the variables are stationary in their level for all countries.

Table 2: Results of Unit Root Tests

Country	PP test				KPSS test			
	B	**π**	**ΔB**	**Δπ**	**B**	**π**	**ΔB**	**Δπ**
Benin	-3.865	-4.847	-11.434	-26.216	0.116	0.060	0.126	0.500
Burkina Faso	-4.307	-7.421	-12.381	-13.415	0.080	0.068	0.191	0.249
Cote d'Ivoire	-2.559	-4.328	-5.321	-8.706	0.132	0.050	0.076	0.064
Mali	-6.481	-4.784	-25.853	-21.182	0.097	0.079	0.370	0.447
Niger	-3.139	-4.525	-10.344	-18.276	0.176	0.085	0.233	0.256
Senegal	-3.042	-5.548	-10.167	-26.866	0.128	0.064	0.123	0.500
Togo	-3.506	-5.250	-10.373	-23.480	0.102	0.065	0.248	0.500

Notes: Critical values at the 5% level are PP: -3.518 (level), -2.933 (difference); KPSS: 0.146 (level) and 0.463 (difference)

The third step of our empirical analysis consists in testing Granger causality using the Toda and Yamamoto (1995) approach. According to the results of unit root tests, the maximum integration order of the variables is zero. The results shown in Table 3 indicate that there is a unidirectional Granger causality running from budget deficit to inflation for Benin, Niger, Senegal and Togo, and from inflation to deficit for Burkina Faso.

Table 3: Results of Toda and Yamamoto Granger-Causality Test

Country	Lag	Deficit does not cause inflation	Inflation does not cause Deficit
Benin	1	5.352 (0.020)**	0.387 (0.533)
Burkina Faso	3	5.718 (0.126)	6.878 (0.075)**
Cote d'Ivoire	2	1.269 (0.530)	2.694 (0.259)
Mali	1	0.323 (0.569)	0.357 (0.549)
Niger	1	2.956 (0.085)**	0.018 (0.891)
Senegal	1	21.920 (0.000)*	0.410 (0.521)
Togo	1	9.306 (0.002)*	0.094 (0.758)
Note: Numbers in parentheses are the p-values. * and ** denote statistical significance at the 5% and 10% levels, respectively.			

The final, and the main step of our empirical investigation, is to present the results of the frequency domain analysis. To measure short, medium and long terms causal dynamics, we calculate test statistics for frequencies $\omega \in \{0.5; 1; 1.5; 2; 2.5; 3\}$. The frequency ($\omega=2.5$) corresponds to a periodicity of 2.5 years, the frequency ($\omega=1.5$) corresponds to a periodicity of 4.2 years, and the frequency ($\omega=1$) corresponds to a periodicity of 6.3 years. Table 4 presents the causality test results in frequency domain. The results suggest that causality from budget deficit to inflation exists for Burkina Faso in long term, for Niger over the medium term, for Senegal over short term, and for Togo over the short, medium and long terms. Furthermore, budget deficit lowers inflation rate in Burkina Faso and Niger, and increases inflation in Senegal and Togo. The reverse causality running from inflation rate to deficit exists only for Burkina Faso over the medium and short terms. On the contrary, there is no evidence of causal relationship between budget deficit and inflation rate for Cote d'Ivoire and Mali, suggesting that the movements of deficit and inflation do not have any significant impact upon each other.

WTable 4: Results of Frequency Domain Granger-Causality Test

Country	H0: Budget deficit does not cause inflation					
	Long term		Medium term		Short term	
	ω=0.5	ω=1.00	ω=1.W50	ω=2.00	ω=2.50	ω=3.0
Benin	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Burkina Faso	2.858 (0.072)**	2.614 (0.088)**	1.663 (0.205)	1.315 (0.282)	1.312 (0.283)	1.332 (0.278)
Cote d'Ivoire	0.634 (0.535)	0.634 (0.535)	0.634 (0.535)	0.634 (0.535)	0.634 (0.535)	0.634 (0.535)
Mali	0.000 (1.000)	0.250 (0.780)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Niger	0.000 (1.000)	0.000 (1.000)	4.000 (0.026)*	4.000 (0.026)*	0W.000 (1.000)	2.000 (0.149)
Senegal	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	16.00 (0.000)*	16.00 (0.000)*
Togo	16.00 (0.000)*	16.00 (0.000)*	8.000 (0.001)*	16.00 (0.000)*	16.00 (0.000)*	16.00 (0.000)*
Country	H0: Inflation does not cause budget deficit					
	Long term		Medium term		Short term	
	ω=0.5	ω=1.00	ω=1.50	ω=2.00	ω=2.50	ω=3.0
Benin	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.250 (0.780)	0.500 (0.610)
Burkina Faso	2.169 (0.130)	2.184 (0.129)	2.586 (0.090)**	3.297 (0.049)*	3.438 (0.044)*	3.418 (0.045)*
Cote d'Ivoire	1.347 (0.272)	1.347 (0.272)	1.347 (0.272)	1.347 (0.272)	1.347 (0.272)	1.347 (0.272)
Mali	0.500 (0.610)	0.500 (0.610)	0.250 (0.780)	0.250 (0.780)	0.000 (1.000)	0.000 (1.000)
Niger	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Senegal	0.500 (0.610)	0.500 (0.610)	0.500 (0.610)	0.500 (0.610)	0.500 (0.610)	0.500 (0.610)
Togo	0.062 (0.939)	0.000 (1.000)	0.062 (0.939)	0.062 (0.939)	0.125 (0.882)	0.125 (0.882)

Note: Numbers in parentheses are the p-values. * and ** denote statistical significance at the 5% and 10% levels, respectively.

4. CONCLUSION

In this article, we have examined the causal relationship between budget deficit and inflation rate for the member countries of the West African Economic and Monetary Union. We first applied the Toda and Yamamoto (1995) Granger causality approach in time domain. The results indicate that budget deficit causes inflation in Benin, Niger, Senegal and Togo, and inflation causes deficit in Burkina Faso. Since time domain causality test does not consider time varying nature of the relationship, we performed the frequency domain causality test which allows us to distinguish short, medium and long run causality. The results from the frequency domain analysis shows evidence of causality from budget deficit to inflation for Burkina Faso in long term, for Niger in the medium term, for Senegal in short term, and for Togo over the short, medium and long terms. The reverse causality from inflation rate to deficit exists for Burkina Faso over the medium and short terms. In light of these findings, we can conclude that the general belief that budget deficits are inflationary does not hold for most WAEMU countries. These findings suggest that budget deficits cannot be held responsible to inflation in most WAEMU member countries.

Considering concerns about inflation and its impact on poverty reduction, the determinants of inflation is very relevant to be researched into the more. The analysis can be extended to include other relevant variables such as economic growth, trade openness, import prices of goods, urbanization and money growth. Another interesting topic that has not been investigated in previous empirical studies is the presence of nonlinearity in the causal relationship between budget deficit and inflation. In standard causality tests, the state of the economy and whether or not budget is worsening or improving does not matter. Using non-linear Granger causality tests to reexamine the budget deficit and inflation nexus would be an interesting topic for further research.

REFERENCES

Agha, A. I. and Khan, M. S. (2006). An Empirical Analysis of Fiscal Imbalances and Inflation in Pakistan, State bank of Pakistan Research Bulletin 2(2): 343-362.

Ahking, F.W. and Miller, S.M. (1985). The Relationship between Government Deficits, Money Growth and Inflation. Journal of Macroeconomics 7: 447-467.

Alavirad, A. and S. Athawale (2005). The impact of the budget deficit on inflation in the Islamic Republic of Iran. OPEC Review 29 (1): 37-49.

Anayochukwu, O. B. (2012). Fiscal Deficits and Inflation in Nigeria: The Causality Approach. International Journal of Scientific and Technology Research 1(8): 2277-8616.

Anoruo, E. C. (2003). An empirical investigation into budget deficit-inflation nexus in South Africa. South African Journal of Economics 71(2): 146-154.

Ashra, S. Chattopadhyay, S. and Chaudhuri, K. (2004). Deficit, Money and Price: the Indian experience. Journal of Policy Modeling 26: 289-299.

Barnhart, S. W. and Darrat, A F. (1988). Budget Deficits, Money Growth and Causality: Further OECD Evidence. Journal of International Money and Finance 7: 231-242.

Barnhart, S.W. and Darrat, A. F (1989). Federal Deficit and Money Growth in the United states. Journal of Banking and Financing 13:137-149.

Breitung, J. and Candelon, C. (2006). Testing for short-and long-run causality: a frequency-domain approach, Journal of Econometrics 132: 363-378.

Carlstrom, C.T. and Fuerst, T.S, (2000). The fiscal theory of the price level. Economic Review, Federal Reserve Bank of Cleveland: 22–32.

Catão, L. A. and Terrones, M. (2003). Fiscal Deficits and Inflation: A New Look at the Emerging Market Evidence. IMF Working Paper, No. 65, Washigton, DC: International Monetary Fund.

Catão, L. A. and Terrones, M. E. (2005). Fiscal deficit and inflation. Journal of Monetary Economics 52(3):529–554.

Chimobi, O. P. and Igwe, O. L. (2010). Budget Deficit, Moneny Supply, and Inflation in Nigeria. European Journal of Economics, Finance and Administration Sciences 1:52-60.

Choudhary, M. A. S. and Parai, A. K. (1991). Budget Deficit and Inflation: The Peruvian Experience. Applied Economics 23(6):1117-1121.

Darrat, A. F. (2000). Are budget deficits inflationary? A reconsideration of the evidence. Applied Economics Letters 7(10), 633–636.

De Haan, J. and Zelhorst, D. (1990). The impact of government deficit on money growth in developing countries. Journal of International Money and Finance 9(4):455–469.

Edwards, S. and Tabellini, G. (1991). Explaining fiscal policies and Inflation in developing countries. Journal of International Money and Finance 10(1):16–48.

Ezeabasili, V., Mojekwu, J. and Herbert, W. E. (2012). An Empirical Analysis of Fiscal Deficits and Inflation in Nigeria. International Business and Management 4(1):105-120.

Friedman, M. (1968). The Role of Monetary Policy. American Economic Review, 58: 1-17.

Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. Journal of the American Statistical Association 77: 304-313.

Giannaros, D.S. and Kolluri, B.R. (1986). Deficit Spending, Money, and Inflation: Some International Empirical Evidence. Journal of Macroeconomics 7:401-417.

Giles, D. (1997). Causality between the Measured and Underground Economies in New Zealand. Applied Economics Letters 4:63-7.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross spectral methods, Econometrics 37: 424-438.

Hamburger, M.J. and Zwick, B. (1981). Deficits, money and inflation. Journal of Monetary Economics 7(1):141–50.

Hondroyiannis, G. and Papapetrou, E. (1994). Cointegration, Causality and the Government Budget-Inflation Relationship in Greece. Applied Economic Letters 1:204-206.

Hondroyiannis, G. and Papapetrou, E. (1997). Are Budget Deficits Inflationary? A Cointegration Approach. Applied Economics Letters 4(8): 493–96.

Jalil, A., Tariq, R. and Bibi, N. (2014). Fiscal Deficit and Inflation: New Evidences from Pakistan Using a Bounds Testing Approach. Economic Modeling 37:120-126.

Karras, G. (1994). Macroeconomic effects of budget deficits: further international evidence, Journal of International Money and Finance 13(2):190-210.

Kwiatkowski,D., Phillips, P.C.B, Schmidt, P. and Shin, Y.(1992). Testing for null hypothesis of stationarity against the alternative of unit root: How sure are we that economics time series have a unit root. Journal of Econometrics, 54(1–3):159–78.

Leeper, E.M. (1991). Equilibria under "Active" and "Passive" Monetary and Fiscal Policies. Journal of Monetary Economics 27:129-147.

Lin, H.Y. and Chu, H.P. (2013). Are Fiscal Deficits Inflationary? Journal of International Money and Finance 32: 214-233.

Mavrotas, G. and Kelly, R. (2001). Old Wine in New Bottles: Testing Causality Between Savings and Growth. The Manchester School, 69: 97-105.

Makochekanwa, A. (2011). Impact of budget deficit on inflation in Zimbabwe. The Economic Research Guardian 1(2): 49-59.

Metin, K. (1995). An Integrated Analysis of Turkish Inflation. Oxford Bulletin of Economics and Statistics 57:513-531..

Metin, K. (1998). The Relationship between Inflation and the Budget Deficit in Turkey, Journal of Business and Economic Statistics 16(4):412-422.

Ndebbio, J. E. (1998). Fiscal deficits and inflationary process in an open economy: The case on Nigeria. The Nigerian Journal of Economics and Social Studies 40(3): 411-431.

Neyapti, B. (2003). Budget Deficits and Inflation: The Roles of Central Bank Independence and Financial Market Development. Contemporary Economic Policy 21:458-475.

Nguyen, V. B. (2015). Effects of Fiscal Deficit and Money M2 Supply on Inflation: Evidence from Selected Economies of Asia. Journal of Economics, Finance and Administrative Science 20: 49-53.

Ogunmuyiwa, M. S. (2008). Fiscal Deficit-Inflation-Nexus in Nigeria. Indian Journal of Economics 3(10):580-585.

Oladipo, S. O. and Akinbobola, T. O. (2011). Budget Deficit and Inflation in Nigeria: A Causal Relationship. Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 2 (1): 1-8.

Phillips, P. C. B. and Perron, P. (1988). Testing for a Unit Root in a Time Series Regression, Biometrika 75 (2):335–346.

Protopapadakis, A.A. and Siegel, J.J. (1987). Are Money Growth and Inflation Related to Government Deficits? Evidence from Ten Industrialized Economies. Journal of International Money and Finance 6: 31-48.

Sargent, T. J. and Wallace, N. (1981). Some Unpleasant Monetarist Arithmetic. Federal Reserve Bank of Minneapolis Quarterly Review, 5:1-17.

Shabbir, T. and Ahmed, A. (1994). Are Government Budget Deficits Inflationary? Evidence from Pakistan. The Pakistan Development Review, 33(4), 955-967.

Sims, C. (1994). A Simple Model for the Study on the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy. Economic Theory 4:381-399.

Solomon, M. and De Wet, W. A. (2004). The Effect of a Budget Deficit on Inflation: The Case of Tanzania. South African Journal of Economic and Management Sciences 7(1):100-116.

Sowa, N. K. (1994). Fiscal Deficits, Output Growth and Inflation Targets in Ghana. World Development Report 22(8): 1105-1117.

Tiwari, A. K., Tiwari, A.P. and Pandey, B. (2012). Fiscal Deficit and Inflation: What Causes What? The Case of India. Journal of International Business and Economy 13(1): 57-81.

Tiwari, A. K., Bolat, S. and Koçbulut, Ö. (2015). Revisit the Budget Deficits and Inflation: Evidence from Time and Frequency Domain Analyses. Theoretical Economics Letters 5: 357-369.

Toda, H.Y. and Yamamoto, T. (1995). Statistical Inference in Vector Auto Regressions with Possibly Integrated Processes. Journal of Econometrics 66:225-250.

Woodford, M. (1994). Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy. Economic Theory 4: 345-380.