Fiscal Deficit and its Threshold Effects on Inflation in Tanzania

Lusajo P. Mwankemwa[‡] and Eliab Luvanda[†]

Abstract
The recent rise in fiscal deficit, coupled with the prolonged increasing trend in public debt poses a significant challenge to the Bank of Tanzania's inflation objectives and overall country's macroeconomic stability. Using quarterly time series data spanning 2001 to 2019, this paper contributes to a better understanding of the threshold effects of fiscal deficit in Tanzania, by estimating the Autoregressive Distributed lag model (ADRL) and the Quadratic regression equation to examine the threshold level of Tanzania's fiscal deficit and its impact on the country's inflation dynamics. The finding reveals a U-shaped relationship between inflation and fiscal deficit, with a fiscal deficit threshold at 2.69 percent of GDP, above which the deficit significantly contributes to the increase in inflation.

Keywords: Fiscal deficit; Inflation, Threshold effect, Tanzania.
JEL Classification Codes : E63, O23, O55.

[‡] Directorate of Economic Research and Policy, Bank of Tanzania. Correspondence Email: lpmwankemwa@bot.go.tz
[†] School of Economics, University of Dar es Salaam. Email: luvanda@udsm.ac.tz

1: Introduction

Over the past decade, fiscal structure in Tanzania has been characterized with high infrastructural expenditures, coupled with inelastic, non-progressive tax structure and narrow tax base, which always have resulted in high budget deficit. The budget deficit rose to 2.0 percent in 2010 and 3.2 percent of GDP in 2015, and further to 2.8 percent in 2019 from 0.5 percent of GDP in 2001 and 1.4 percent of GDP in 2008 (BoT, 2020), due to increased capital spending on infrastructure projects. Traditionally, the government of Tanzania has been borrowing[1] from both bank and non-bank public to close the fiscal gap. The consequence of this has been a rise in public debt from 21.3 per cent of GDP in 2007 to 38.2 per cent in 2019. Total external and domestic government debt as of end of December 2019, stood at USD 17,571.8mn and USD 6,309.3mn respectively, up from USD 5,364.9mn and USD 1,962.7mn recorded in December 2009 (BoT, 2020). These developments pose a significant challenge to the monetary policy and country's overall macroeconomic stability.

The impact of rising fiscal deficits on investors' perception about the country's ability to honour its obligations and access outside capital at reasonable rates of return remains an important policy conundrum. At the same time, deflating the value of the deficit away by monetizing may engineer inflationary pressures. Although a number of concerns have been raised about the rising fiscal deficit and government debt levels in Tanzania, it is not clear whether this deficit level is optimal, given the underlying structure of the Tanzanian economy. Therefore understanding inflationary dispositions and its determinants is a critical issue and attracts interest from policy makers in the drive towards the objective of low and stable prices in the economy, an issue of strong relevance to the Bank of Tanzania. Further motivated by the argument of Arestis, Cipollini and Fattouh (2012)[2], this paper therefore seeks to investigate the relationship between inflation and fiscal deficit, and ascertain the threshold level of fiscal deficit consistent with Tanzania's inflation dynamics.

Is a persistent fiscal deficit inflationary? Empirical studies on this issue have produced mixed results. Some studies that build on Sargent and Wallace (1981) provide evidence in support of the hypothesis that fiscal deficits are inflationary. Most of these studies find a strong correlation only in high inflation countries or during high inflationary periods (de Hann and Zelhorst 1990, Edwards and Tabellini 1991, Fischer, *et al.* 2002, Levin *et al*. 2002, Luis and Marco, 2006). There are some other studies that have built on the Ricardian equivalence hypothesis (Barro 1989)[3]and have found either no correlation or only a weak correlation between fiscal deficits and inflation (Niskanen 1978, McMillin and Beard 1982, Ahking and Miller 1985, Landon and Reid 1990, Ekanayake, 2013). A study by Muzafar *et al*. (2011) on developing Asian countries reveals that, budget deficits are inflationary in developing countries, on account of central banks financing of their deficits through printing money, which may result in greater excess aggregate demand than in increased aggregate supply. Catão and Terrones (2005) demonstrate that the failure of empirical studies in establishing a clear link is probably because of the failure to take into account the non-linearity of the correlation between fiscal deficit and inflation. Their analysis, in which the fiscal deficit is scaled by narrow money to introduce a non-linearity to the model, finds that there is a strong link between fiscal deficits and inflation even in moderately high inflation countries.

Majority of existing studies on the threshold effects of fiscal deficits have largely relied on panel data containing developed or/and developing economies which obscures the different intrinsic

individual country-level dynamics (see for instance Adam and Bevan, 2005; Salma *et al*., 2016; Onwioduokit, 2012). As a consequence, findings from such studies are less useful given the heterogeneous environment of each country. Thus, the crucial weakness of such panel studies calls for more nuanced and in-depth individual country-level studies using rich time series data. There are only a handful of studies that examine the relationship between the fiscal deficit and inflation in a single country context[4]. In the case of Tanzania, however, the relatively scanty studies have focused on examining the relationship between fiscal deficit and inflation without systematically analysing and estimating the optimal level of fiscal deficits (see Ndanshau, 2012). This study thus ascertains the threshold level of deficit for Tanzania.

This paper uses quarterly time series data spanning 2001–2019, and employs threshold endogenous model developed by Sarel (1996), Khan, and Senhadji (2001) and adopted by Pollin and Zhu (2005), Quartey (2010) and Younus (2012) to examine the threshold level of Tanzania's fiscal deficit as well as its impact on the country's inflation dynamics. Foreshadowing the main results, the finding reveals an inverted U-shaped relationship between inflation and fiscal deficit, with a fiscal deficit threshold at 2.69 percent of GDP. More specifically, we find that inflationary impact of fiscal deficit below (above) the threshold is negative (positive) and statistically significant, and therefore we document that fiscal deficit above the threshold significantly contributes to the increase in inflation.

A brief review of the literature is undertaken in Section 2. Section 3 presents the methodology. Discussion of findings is presented in Section 4 while Section 5 concludes the paper by discussing some notable implications for policy.

2: Literature review

2.1: Theoretical literature

Theoretical literature on the effect of fiscal deficit on inflation posits that the effect depends on the method of financing the deficit as well as the effect of the deficit on private investment and aggregate demand (Carlstrom and Fuerst, 1999). The fiscal theory of inflation predicts the link between fiscal deficit and inflation through changes in money supply, as well as an independent channel without affecting the supply of money. The channel through which changes in fiscal deficit affect inflation through its impact on the supply of money is the weak form, while the independent channel is the strong form fiscal theory of inflation (Carlstrom and Fuerst, 1999). The weak form fiscal theory considers the fiscal authority and the monetary authority to be in a 'game-of-chicken' where the fiscal authority moves first by committing itself to a path for the budget deficit and the monetary authority is forced to move to generate the necessary seigniorage to maintain the solvency of the budget. Hence, there is fiscal dominance under this channel and monetary policy is said to be accommodative. The creation of seigniorage for fiscal deficit financing increases money supply and this leads to inflation. Thus, the idea of the weak form fiscal theory is that inflation is a monetary phenomenon influenced by fiscal behaviour.

The strong form fiscal theory posits that fiscal deficit can lead to inflation under a fixed money stock; in which case, prices are determined by the willingness of the public to hold money (Carlstrom and Fuerst, 1999). Moreover, it maintains that, in the absence of the budget constraint of the government, prices are not uniquely determined. The theory, therefore, stresses the fact that in the long-run, the government budget constraint is balanced and changes in fiscal policy affect

the price level to the extent that the price level is the equilibrating factor to make the real value of government debts adjusts to a level, which makes it equal to the fiscal budget balance. The shift in price level occurs as a result of the perception of the market about the sustainability of government budget. An increase in price level is the case as long as individuals have the expectation that the deficit is unsustainable. The strong form fiscal theory, however, require very elastic interest elasticity of money demand since it is only under this situation that changes in fiscal policy can directly affect price level (and hence, real money demand) with an unchanged money stock (Carlstrom and Fuerst, 1999).

Friedman (1968) argued that the monetary authorities can control the rate of inflation through the control of money supply. Moreover, fiscal deficit leads to inflation when it is monetized. He further argued that the effect of bond financing depends on whether interest rates are pegged or not. When interest rates are pegged, bond financing would require, at least in the long run, an increase in money supply, leading to inflation (Sergent and Wallace, 1981). Therefore, according to Friedman (1968), bond-financed fiscal deficits causes interest rate to be so high that the financing method would eventually be monetization, thereby leading to inflation. Miller (1983) argued that whether deficit is monetized or not it leads to inflation, through the crowding out effect of private investment once it is bond-financed (that is, bond financing increases interest rate and this crowds out private sector investment, thereby reducing output growth and hence causing rising price level).

The effect of budget deficit on inflation depends, in part, on its effect on private investment. However, its effect on private investment depends on the relevance of the Neoclassical theory, the Keynesian school of thought or the Recardian equivalence. According to the Neoclassical theory, individuals plan their consumption over their life cycle, therefore budget deficit increases consumption while shifting taxes to future generations and the increase in consumption decreases saving (under the assumption of full employment). This leads to higher interest rate and decline in private investment and income. According to the Keynesian theory, budget deficit increases domestic production, as there are unemployed resources and liquidity constraint. Thus, investors become more optimistic and increase private investment, which increases income. The Ricardian equivalence considers budget deficits and taxation to have equivalent effects on the economy (Barro, 1989). Hence, national saving does not change since the increase in private saving is matched by an equivalent decline in public saving. To the extent that national saving, investment and aggregate demand do not change, budget deficit does not affect the price level.

The discussion reveals that, at the theoretical level, there is a link between deficit and monetary growth and deficit and inflation, with the strength of the relationship depending on the method of financing the deficit and the relevance of the crowding out effect.

2.2: Empirical literature

The empirical evidence on the effects of budget deficit on inflation is mixed and the approaches for investigation has been the use of Granger Causality test, Ordinary Least Squares, Vector Autoregression (VAR), Error Correction Models (ECM) and simultaneous equations model. Moreover, the empirical literature shows that both the method of financing and the components of government expenditure have different effect on inflation. Darrat (1985) used the OLS to investigate the effects of fiscal deficit on inflation in the U.S. His result showed that fiscal deficit

had a significant positive effect on inflation. This result is similar to the works of Metin (1995) who applied the error correction model to Turkey over the period 1950-1988 and Choudhary and Parai (1991) who applied the rational expectation macro model of inflation, using quarterly data for Peru over the period 1973-1981. Other studies that have had similar results with Darrat (1985) are Dogas (1992) for Greece, Hondroyiannis and Papapetrou (1994) for Greece, Metin (1998) for Turkey. Darrat (2000) for the U.S. Studies that have found no relationship between fiscal deficit and inflation include Dwyer (1982) and Karras (1994). Most of the empirical studies on the effects of fiscal deficit on inflation revealed that, budget deficit that is financed by monetization leads to inflation and in general, the effect of budget deficit depends on the way the deficit is financed as well as the impact of the deficit on aggregate demand (Saleh, 2003).

In developing countries, studies have also provided mixed evidence. Roubini (1991) finds that the relationship between budget deficits and inflation in developing countries is underpinned by political instability. This view is supported by the results of Edwards and Tabellini (1991). Jha (2001) explains that when a country has no credible and stable policy regimes, it incurs high costs in borrowing from abroad. As a result, it relies on monetary financing of the deficit thereby weakening the independence of monetary policy from fiscal policy. Cottarelli, *et al*. (1998) find a strong correlation between the two variables in countries that have an underdeveloped securities market. This implies that limited access to financial markets drives governments to resort to central banks during times of fiscal distress.

In addition, most studies that have focused on developing countries have used panel data frameworks. However, there are huge differences in the monetary and fiscal policies implemented by different countries, and, sometimes, in the same country at different points in times (Edward and Tabellini 1991). Furthermore, the macroeconomic consequences of a higher fiscal deficit can vary from one country to another, based on the method of financing (Jha 2001). The link between fiscal deficits and inflation is also less obvious in countries that have institutional arrangements to curb fiscal dominance, wider access to external financing, and a broader seigniorage tax base. When the differences in these factors among countries are considerable, it is harder to uncover the relationship between fiscal deficits and inflation from cross-country panel studies (Catão and Terrones 2005). To this end, few studies that examine the relationship between the fiscal deficit and inflation in a single country context[5]. By employing a rational expectations macro model of inflation, Choudhary and Parai (1991) find that the large fiscal deficit and high money growth contribute to inflation in the Peruvian economy. Sowa (1994) finds that inflation in Ghana is influenced more by output volatility or supply side factors than by monetary and fiscal factors. Using a simultaneous equations framework for Pakistan data, Chaudhary and Ahmad (1995) explain that financing a fiscal deficit from domestic sources leads to an increase in the money supply, which generates inflation in the long run. Using the ARDL framework, Alavirad and Athawale (2005) examined the impact of the fiscal deficit on inflation, and found fiscal sector is dominant in explaining price movements in Iran.

In general, irrespective of the theoretical camp they belong to, most empirical studies suggest that (i) budget deficits are not inflationary, (ii) there is only a weak correlation between the two, and (iii) there is a strong link between fiscal deficits and inflation only during high inflationary episodes even though the link is well defined by the theory.

3: Methodology

3.1. Model specification

The empirical model adopted in this paper is a varied version of the flexible accelerator model designed to capture key determinants of inflation in Tanzania, by estimating a non-linear relationship that allows for identification of the turning point in the fiscal deficit-inflation nexus. The threshold effects are therefore estimated using the threshold endogenous model, as developed by Sarel (1996), Khan, and Senhadji (2001), and adopted by Pollin and Zhu (2005), Quartey (2010) and Younus (2012). Thus, the model takes the form of inflation regression equation augmented with fiscal deficit.

$$\pi_t = \beta_0 + \beta_1 b_t + \beta_2 X_t + \varepsilon_t \quad (1)$$

where π_t is the headline inflation/GDP deflator, b_t is the ratio of fiscal deficit[6] to GDP (in absolute values). β_0 is constant, β_1 is the coefficient of fiscal deficit[7]. X_t is a vector of other explanatory variables and ε_t is the error term. Friedman (1968) argued that the monetary authorities can control the rate of inflation through the control of money supply. Moreover, fiscal deficit leads to inflation when it is monetized, the monetary aggregate growth (*m2*) is thus included in the model to capture the effects of monetary policy on inflation. It further argued that that the effect of budget deficit on inflation depends, in part, on its effect on private investment, its effect on private investment depends on the relevance of the Neoclassical theory, the Keynesian school of thought or the Ricardian equivalence. It is based on this argument, the private sector's ratio of capital formation to GDP (*pi*) is also included. The real exchange rate (*ex*) and the ratio of import of goods and services to GDP (*imp*) are used as the other explanatory variables to control the impact of trade openness and external factors on inflation. Given the importance of agricultural output in the volatility of Tanzania's inflation, the growth of crop production (*crop*), which is the percentage change in the crop production index, is included in the inflation equation. Thus, the inflation equation estimated is given as:

$$\pi_t = \beta_0 + \beta_1 b_t + (\beta_2 crop_t + \beta_3 ex_t + \beta_4 m2_t + \beta_5 imp_t + \beta_6 pi_t) + \varepsilon_t \quad (2)$$

Theoretically, the expected effects of other explanatory variables in equation 2 is as follows. According to Keynesian theory, which states that inflation can be caused by increase in demand and/or increase in cost (Jhingan, 2010). It is therefore expected that change in crop productivity index to be negatively correlated to inflation ($\beta_2 < 0$). When the exchange rate defined as the rate of change between two national currencies, increases will be exist in the overall level of prices (Dornbuch, 1976). Then when the exchange rate falls, that is, when the domestic currency appreciates, prices are expected to fall in the general level ($\beta_3 > 0$). As Milton Friedman put it, "inflation is always and everywhere a monetary phenomenon", it is therefore expected that increased growth in the broad money supply would have a positive effects on inflation ($\beta_4 > 0$). The Mundell-Fleming extensions of the Barro and Gordon (1983) model suggest there is an inverse relationship[8] between openness and inflation ($\beta_5 < 0$). On the presence of fiscal deficit, the link between inflation and private investment is inconclusive, depending on the method of financing the deficit (Miller and Russek, 1997). It is based on this proposition, the coefficient of private investiment is expected to be either positive or negative ($\beta_6 < 0 \; or \; \beta_6 > 0$).

3.2: Estimation strategy

The inflation-fiscal deficit regression is estimated by means of Ordinary Least Square (OLS) method. Prior to the OLS estimation, the ADRL Model (General to Specific) is used to modify an over parameterized model to a parsimonious model[9]. The general conditional ARDL modelling specifications for equation 2 is given by

$$\Delta\pi_t = c_0^{\pi} + \delta^{\pi}{}_t + \alpha^{\pi}\pi_{t-1} + \beta_1^{\pi} b_{t-1} + \beta_2^{\pi} crop_{t-1} + \beta_3^{\pi} ex_{t-1} + \beta_4^{\pi} m2_{t-1} + \beta_5^{\pi} imp_{t-1} + \beta_6^{\pi} pi_{t-1} + \sum_{i=1}^{p-1} \varphi_1^{\pi} \Delta\pi_{t-i} + \sum_{i=0}^{q-1} \tau_{1i}^{\pi} \Delta b_{t-i} + \sum_{i=0}^{q-1} \tau_{2j}^{\pi} \Delta crop_{t-i} + \sum_{i=0}^{q-1} \tau_{3j}^{\pi} \Delta ex_{t-i} + \sum_{i=0}^{q-1} \tau_{4j}^{\pi} \Delta m2_{t-i} + \sum_{i=0}^{q-1} \tau_{5j}^{\pi} \Delta imp_{t-i} + \sum_{i=0}^{q-1} \tau_{6j}^{\pi} \Delta pi_{t-i} + \varepsilon_t^{\pi} \quad (3)$$

3.3: Fiscal deficit threshold modeling effects on inflation

To examine the existence of a non-linear relationship between fiscal deficit and inflation, most empirical studies use the threshold endogenous model developed by Sarel (1996) and Khan and Senhadji (2001). However, this model requires a large set of data to results valid statistical inferences. Therefore, for small sample in here we use Pollin and Zhu (2005) and Quartey (2010), adopted by Younus (2012) - quadratic function to estimate threshold effect of fiscal deficit on inflation. The function is as follows

$$\pi_t = \beta_0 + \beta_1 b_t + \beta_2 b_t^2 + (\beta_3 crop_t + \beta_4 ex_t + \beta_5 m2_t + \beta_6 imp_t + \beta_7 pi_t) + \varepsilon_t \quad (4)$$

The other variables in equation 4 is as defined in equation 2, excerpt for term b_t^2. In this mode, it is expected that b_t would have a negative sign, which indicate the low inflation effects on low rates of fiscal deficit, whereas b_t^2 is expected to have a positive sign and should have adverse impact with higher rate of fiscal deficit. The combination of positive significance b_t and negative significant b_t^2 implies a U-shape curve. This demonstrates that the spillover from negative effect to positive effect fiscal deficit exceeds a threshold level. The prime point of the quadratic function identifies the threshold level, which the marginal effects of fiscal deficit become negative. The threshold level of fiscal deficit from the quadratic model (equation 4) requires two conditions to be satisfied to get a minimum level of inflation. First order necessary condition[10], and the second order sufficient condition[11]. Analysis of the non-linearity hypothesis is estimated in both linear and squared term. If both coefficients are significantly different from zero, then the threshold level of the fiscal deficit is such that:

$$\frac{d\pi_t}{db_t} = \beta_1 + 2\beta_2 b_t = 0 \quad (5)$$

$$b_t^{*} = -\frac{\beta_1}{2\beta_2} \quad (6)$$

3.4: Data and definition of variables

The paper used time series data from 2001Q1-2019Q4. The data used were sourced from World Bank (WB), Bank of Tanzania (BoT), Tanzania's National Bureau of Statistics (NBS) and Food and Agriculture Organization (FAO). Formal definitions of variables and their measurement are displayed in Table.1.

Table1: Definition of variables and data sources

Variable	Description	Source
Inflation ($\boldsymbol{\pi}$)	GDP inflation/deflator[12] a measure of change in prices of all goods and services - ratio of GDP in market prices (2015) to GDP in constant prices.	World Development Indicators –WB.
Fiscal deficit, as a percentage of GDP ($\boldsymbol{b}$)	The ratio of overall balance (cheques issued) after grants to GDP – in absolute terms.	Bank of Tanzania (BoT)
Change in crop production index ($\boldsymbol{crop}$)	Parentage change in crop production index, a measure of agricultural production for each year	Food and Agriculture Organization (FAO)
Real exchange rate ($\boldsymbol{ex}$)	Defined based on purchasing power parity (PPP): $E = e * (P_f/P)$ .e is nominal exchange rate (TZS/USD), P_f is US consumer price index (CPI) and P is domestic CPI. A positive change thus indicates real depreciation of the TZS against USD	Bank of Tanzania (BoT)
Broad money supply ($\boldsymbol{m2}$)	Growth in broad money supply.	Bank of Tanzania (BoT)
Import of goods and services to GDP ($\boldsymbol{imp}$)	The ratio of imports of goods and services to GDP	Bank of Tanzania (BoT).
Private investment to GDP ($\boldsymbol{pi}$)	The ratio of capital formation by other sectors to GDP	National Bureau of Statistics (NBS)

Source: Bank of Tanzania (BoT), National Bureau of Statistics (NBS), Food and Agriculture Organization (FAO), World Bank (WB)

4: Results and discussions

4.1 Preliminary results

Table 2 displays the descriptive statistics of the variables while Figure 1 illustrates the variables over time. Inflation and fiscal deficit registered a maximum of 16.3808 percent and 7.4509 percent respectively, around the 2008 - 2009, with the sample mean of 7.9009 percent and 1.6995 percent respectively. The percentage change in crop production, money supply, real exchange rate and imports of goods and services have all been more volatile during the sample period. In particular, the percentage change in crop production registered a deceleration around 2004 and 2017 (Figure 1).

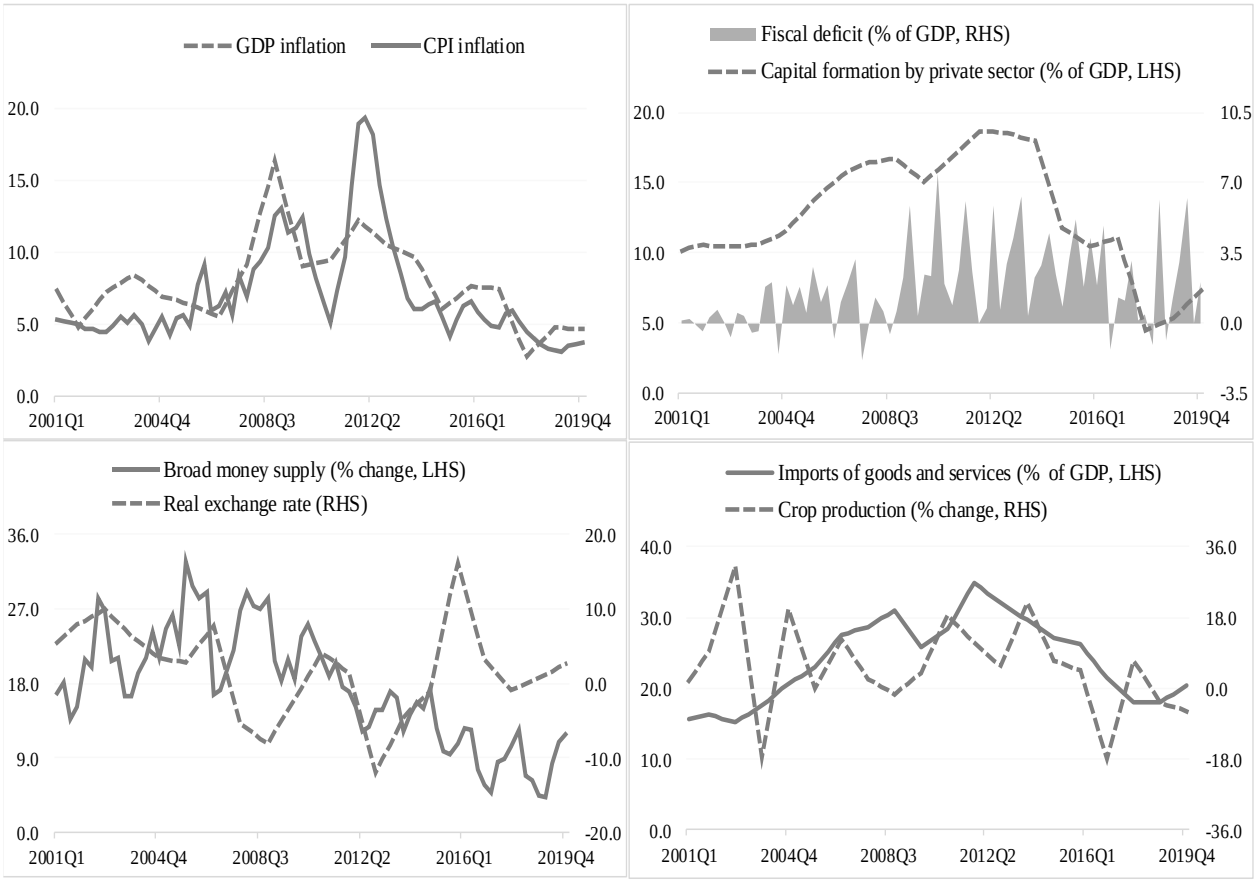
Table 2: Summary statistics of variables

	b	crop	ex	m2	imp	pi	π
Mean	1.6995	5.8401	1.7172	17.4744	24.1791	12.8387	7.9009
Maximum	7.4509	31.1506	16.1718	32.8141	34.8960	18.6983	16.3808
Minimum	-1.8787	-18.0228	-11.9952	4.2335	15.1670	4.4833	2.7037
Std. Dev.	2.0975	9.4124	5.7776	6.9295	5.7061	4.0589	2.7432
Kurtosis	3.1080	3.2620	2.6886	2.2879	1.7151	2.1420	3.4244
Observations	76	76	76	76	76	76	76

Note: Inflation ($\boldsymbol{\pi}$), Fiscal deficit, as a percentage of GDP ($\boldsymbol{b}$), Change in crop production index ($\boldsymbol{crop}$), Real exchange rate($\boldsymbol{ex}$), Broad money supply ($\boldsymbol{m2}$), Import of goods and services to GDP($\boldsymbol{imp}$), Private investment to GDP ($\boldsymbol{pi}$)

Results of the ADF and PP tests for unit root with intercept and trend are presented in Table 3. The results reveals that at levels, the variables comprise a mixture of stationary and non-stationary series. However, at their first difference, all the variables become stationary.

Figure 1: Time plots of variables included in the model, 2001Q1 - 2019Q4



Note:

a. RHS – Right hand side scale, LHS – Left hand side scale.
b. Real exchange rate: +ve – depreciation, -ve – appreciation.

Source: Bank of Tanzania, National Bureau of Statistics, World Bank.

Table 3: Results of Unit Root test

Variable	Level				First difference			
	ADF		PP		ADF		PP	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
π ++	-1.1753	-1.2256	-1.8135	-1.8829	-2.4139	-2.7588	-4.0275 ***	-4.0609 ***
b	-1.8811	-2.0766	-8.0160 ***	-8.9880 ***	-16.8250 ***	-16.7185 ***	-35.1311 ***	-36.5389 ***
crop	-1.7305	-3.1328	-3.0175 **	-3.0606	-3.8877 ***	-3.8327 **	-4.3970 ***	-4.3718 ***
ex	-3.7786 ***	-3.7920 **	-2.3460	-2.3450	-3.5102 **	-3.5048 **	-3.7655 ***	-3.7585 **
m2	-0.5135	-2.6132	-2.1478	-3.5808 **	-8.6628 ***	-8.7008 ***	-9.2494 ***	-9.1973 ***
imp	-2.1058	-1.9311	-1.5465	-1.0450	-2.8022*	-2.9188	-3.0579 **	-3.2315*
pi	-1.9611	-1.6834	-0.8916	-1.1643	-1.2321	-2.0906	-3.2380**	-3.3400 *

Note:

a: Inflation ($\boldsymbol{\pi}$), Fiscal deficit, as a percentage of GDP ($\boldsymbol{b}$), Change in crop production index ($\boldsymbol{crop}$), Real exchange rate($\boldsymbol{ex}$), Broad money supply ($\boldsymbol{m2}$), Import of goods and services to GDP($\boldsymbol{imp}$), Private investment to GDP ($\boldsymbol{pi}$)

b: For the ADF and PP tests indicate that the null hypothesis of a unit root is rejected at 10%; (*), 5% (**) and 1% (***) significance levels. At first difference, the ADF on Π++ rejected the null of a unit root with no constant and trend (none) -2.3917 **

c: Lag Length based on SIC

d: Probability based on MacKinnon (1996) one-sided p-values

e: Probability based on Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

4.2 Quadratic regression model results

The deficit threshold level is determined through a quadratic regression model estimated by means of Ordinary Least Square (OLS) method. However, prior to that, the ARDL model is estimated as in equation 3. Table 1A in the appendix I provides the coefficients of the estimated model that establish positive and linear effect of fiscal deficit on inflation from the ARDL model. General to specific approach is further used to modify an over parameterized model to a parsimonious model. According to Hendry's (1995) the statistically insignificance regressors are been successively eliminating to obtain the final parsimonious equation (David F. Hendry. 1995). Table 4 shows the quadratic regression results of the parsimonious model.

Table 4: Quadratic regression model results

Variable	Coefficient	Std. Error	t-Statistic
C	-1.2887***	0.4694	-2.7452
π (-1)	1.2681 ***	0.1058	11.9801
π (-2)	-0.4432 ***	0.1044	-4.2460
b	-0.1518 **	0.0684	-2.2195
b(-1)	-0.2015 ***	0.0752	-2.6781
b(-2)	-0.2351 ***	0.0806	-2.9171
b(-3)	-0.2209 ***	0.0810	-2.7280
b(-4)	-0.0995 **	0.0475	-2.0952
b²	0.0395 ***	0.0128	3.0906
b²(-1)	0.0344 **	0.0135	2.5538
b²(-2)	0.0397 ***	0.0141	2.8122
b²(-3)	0.0373 ***	0.0139	2.6831
crop	-0.0201**	0.0083	-2.4428
ex(-1)	0.0500 ***	0.0180	2.7790
m2	0.0345 **	0.0145	2.3870
m2(-5)	-0.0485 ***	0.0168	-2.8788
imp	0.3285 ***	0.0972	3.3806
imp(-1)	-0.2560 **	0.1041	-2.4600
pi	0.1252 ***	0.0457	2.7389
R-squared	0.9795		
Adjusted R-squared	0.9724		
Durbin-Watson stat	2.0543		

Note: ***, **, * denote significance level at 1%, 5% and 10% respectively. Inflation ($\boldsymbol{\pi}$), Fiscal deficit, as a percentage of GDP ($\boldsymbol{b}$), Change in crop production index ($\boldsymbol{crop}$), Real exchange rate($\boldsymbol{ex}$), Broad money supply ($\boldsymbol{m2}$), Import of goods and services to GDP($\boldsymbol{imp}$), Private investment to GDP ($\boldsymbol{pi}$).

Accordingly, coefficients of the linear terms fiscal deficit (b) are positive, while those of the squared terms (b^2) are all negative, and both are statistically significant. The results suggest presence of a nonlinear relationship (inverted U-shaped) between fiscal deficit and inflation. The findings suggest that lower levels of fiscal deficit is suitable for growth in prices of goods and services in the economy. However, there exist a turning point/threshold level of fiscal deficit above which, further deterioration in fiscal deficit brings about increased inflation. Based on equation 5 and 6, the threshold level of the deficit is obtained through setting partial derivative equal to zero and solve for b_t^*

$$\frac{d\pi_t}{db_t} = -0.1518 + 2(0.0395)b_t = 0 \quad (7)$$

$$\frac{d^2\pi_t}{db_t^2} > 0: 2(0.0395) = 0.075 > 0 \quad (8)$$

Since both conditions are satisfied, the threshold level of fiscal deficit is such that:

$$b_0{}^* = -\frac{\beta_1}{2\beta_2} = -\frac{-0.1518}{2(0.0395)} = 1.92\%$$

$$b_1{}^* = -\frac{\beta_1}{2\beta_2} = -\frac{-0.2015}{2(0.0344)} = 2.93\%$$

$$b_2{}^* = -\frac{\beta_1}{2\beta_2} = -\frac{-0.2351}{2(0.0397)} = 2.96\%$$

$$b_3{}^* = -\frac{\beta_1}{2\beta_2} = -\frac{-0.2209}{2(0.0373)} = 2.96\%$$

$$b^* = \frac{1.92\% + 2.93\% + 2.96\% + 2.96\%}{4} = 2.69\% \quad (9)$$

Equation 9 indicates that the ratio of fiscal deficit to GDP reaches the threshold level at 2.69 per cent, at which the level of inflation is at the lowest point. Such that, when the deficit deteriorates further below the threshold, extra deficit contributes to the rise in inflation. Based on the coverage of the sample data, the fiscal deficit is suggested to have reached its threshold in the year 2012, recording annual average of 2.64 per cent of GDP. However, fiscal deficit continued to deteriorate to average of 3.3 per cent in 2016, partly on account of implementation of fiscal policy that geared to counter the second round effects of the 2008/2009 GFC. Nevertheless, the impact of increased fiscal deficit on inflation[13] was subdued due to the tightening monetary policy stance[14] by the Bank of Tanzania that sees growth of broad money supply (*m2*) decreasing to an average of 8.8 per cent in 2019, from 13.7 per cent in 2012. The response by the monetary policy, together with the impact of improved crop production have subdued the impact of increased fiscal deficit above the threshold during 2012 - 2019.

4.3: Residuals diagnostic tests for Quadratic equation

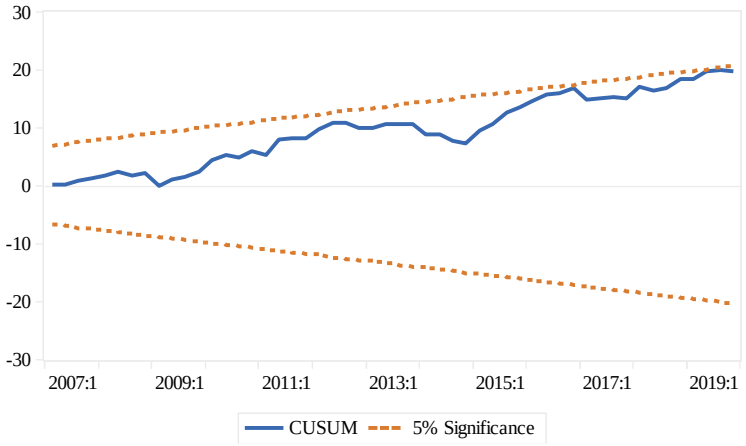
To ensure the robustness of the outcomes of the results as well as the significance of the variables, diagnostics tests such as autocorrelation, functional form, normality, heteroscedasticity, and structural stability of the model are presented on Table 5. The results suggest that the model passes the test of misspecification, heteroscedasticity, normality and serial correlation. Figure 2 confirm the stability of the model coefficients.

Table 5: Diagnostic tests

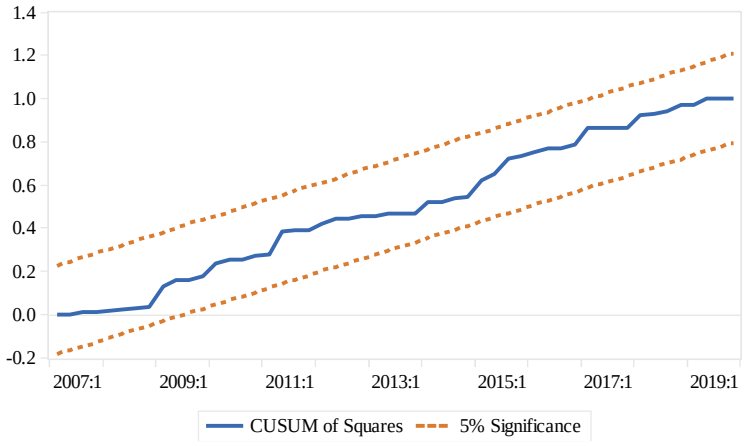
Normality Test (JB Test)	4.9032	Prob	0.0862
Serial Correlation (LM Test)			
F-statistic	0.0693	Prob. F(2,50)	0.9332
Obs*R-squared	0.1962	Prob. Chi-Square(2)	0.9066
Heteroskedasticity: Breusch-Pagan-Godfrey			
F-statistic	1.2049	Prob. F(18,52)	0.2919
Obs*R-squared	20.8965	Prob. Chi-Square(18)	0.2847
Scaled explained SS	18.0701	Prob. Chi-Square(18)	0.4510
Ramsey RESET Test		Probability	df
t-statistic	1.0236	0.3109	51
F-statistic	1.0477	0.3109	(1, 51)
Likelihood ratio	1.4438	0.2295	1

Figure 2: Stability diagnostic test

a. CUSUM tests



b. CUSUM of squares test



5: Conclusion and policy implication

The paper empirically examined the relationship between inflation and fiscal deficit in Tanzania, and investigated the possible threshold effect between the two variables. The results demonstrate that the relationship between inflation and fiscal deficit is non-linear with a subsistence of a break point. In line with empirical evidence, the paper has shown that low levels of fiscal deficit is significant in maintaining inflation at low levels, whereas the fiscal deficit above a threshold level of 2.69 per cent contributes to the increase in inflation. The results suggest that the deficit (at least below the threshold) is not universally detrimental to the economy. Keynes has argued that, provided the government spend more money to develop the economy and create jobs (even if it means increasing its fiscal deficit), the government's current fiscal deficit is justified by the possibility that such actions can help the country's future growth.

It is in this regards, we recommend that the government keep fiscal deficit at the optimal level where inflation objective is not jeopardized, and prioritize expenditures in a way that limited revenues are spent on productive projects whose returns exceed the funding cost. Noteworthy, the extent through which the economy can sustain the increased inflation emanated from increase in fiscal deficit is a matter of further empirical investigation. Low or moderate inflation points to macroeconomic soundness and creates a friendly atmosphere for doing business. However, lower level of inflation, alone cannot accomplish the enough provision for economic growth in Tanzania. Higher inflation is politically unviable for a popular government, nevertheless, calls for the increase in money circulation in the economy has recently been critical in political and social platforms. This calls for the re-assessment of the optimal inflation level that ensures Tanzania's macroeconomic stability.

References

Adam, C and D.L.Bevan (2005).Fiscal Deficits and Growth in Developing Countries. *Journal of Public Economics*, Vol.89, pp. 571–97.

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

Arestis, P., Cipollini, A., and Fattouh, B., (2012).Threshold Effects in the U.S. Budget Deficit. Working Paper No. 358.

Bank of Tanzania (2020). Monetary Policy Statement 2019/20. Mid Review, February 2020. [Online] Available: https://www.bot.go.tz/Publications/Filter/3.

Barro, R. 1989. The Ricardian approach to budget deficit. *Journal of Economic Perpectives*, 3:37-54.

Egwaikhide, F.O. 1999. Effects of budget deficit on trade balance in Nigeria: A simulation exercise. *African Development Review*, 11(2): 265-89.

Catão, L. and Terrones, M. E. 2005. Fiscal deficits and inflation. *Journal of Monetary Economics* 52: 529-554.

Carlstrom C.T. and T.S. Fuerst. 1999. Money growth and inflation: Does fiscal policy matter? Economic Commentary, Federal Reserve Bank of Cleveland, April 15, 1999.ISSN 0428-1276.

Choudhary, M.A.S. and A.K. Parai. 1991. Budget deficit and inflation: The Peruvian experience. .*Applied Economics*, 23: 1117-21.

Chaudhary, M.A., Ahmad, N. and Siddiqui, R., 1995. Money Supply, Deficit, and Inflation in Pakistan. *The Pakistan Development Review*, 34(4), pp.945-956.

David F. Hendry. (1995). Dynamic econometrics. *Oxford University Press*, Oxford.

Darrat, A.F. 1985. Inflation and federal budget deficits: Some empirical results. *Public Finance Quarterly*, 13: 206-15.

Darrat, A.F. 2000. Are budget deficits inflationary? A reconsideration of the evidence. *Applied Economics*, 7(10): 633-36.

De Haan, J. and Zelhorst, D. 1990. The impact of government deficits on money growth in developing countries. *Journal of International Money and Finance* 9: 455-469.

Dwyer, G.P. 1982. Inflation and government deficits. *Economic Inquiry*, XX: 315-29.

Dogas, D. 1992. Market power in a non-monetarist inflation model for Greece. *Applied Economics*, 24: 367-78.

Edwards, S. and Tabellini, G. 1991. Explaining fiscal policies and inflation in developing countries. *Journal of International Money and Finance* 10: 16-48.

Ekanayake HK (2013). The link between fiscal deficit and inflation: do public sector wages matter? *ASARC Working Paper* 2012/14, pp 9–10.

Fischer, S., Sahay, R. and Vegh, S. 2002. Modern hyper and high inflations. *Journal of Economic Literature* XL: 837-880.

Friedman, M. 1968. The role of monetary policy. *American Economic Review*, 58: 1-17.Ghali,

Khalifa H. 1997. Government Spending and Economic Growth in Saudi Arabia. *Journal of Development Economics*, 22(2):165-72.

Gupta P (2013). The impact of expectations of reduced Federal Reserve security purchases on emerging markets. *MPRA*, pp 18–19.

Hondroyiannis, G. and E. Papapetrou. 1994. Cointegration, causality and government budget inflation relationship in Greece. *Applied Economic Letters*, 1: 204-6.

Jha, R. (2001), Macroeconomics of fiscal policy in developing countries, *World Institute for Development Economic Research* (WIDER), Finland.

Karras, G. 1994. Macroeconomic effects of budget deficits: Further international evidence .*Journal of International Money and Finance*, 13: 190-210.

Khan, M. S., and Senhadji, A. S., (2001). Threshold Effects in the Relationship between Inflation and Growth. *IMF Staff Paper* Vol. 48, No. 1.

Landon, Stuart and Reid, Bradford G, (1990), Government Deficits and Money Growth. *The Review of Economics and Statistics*, 72, issue 3, p. 382-89.

Levin A, Lin C, Chu C (2002). The economics of internet markets. *NBER Working Papers*: 16852. National Bureau of Economic Research, Inc., pp 27–33.

Luis C, Marco ET (2006) Macroeconomic dynamics of fiscal deficits and inflation. *IMF Staff Paper* No.03/65, pp 16–18.
[Online] Available https://www.imf.org/en/Publications/WP/Issues/2016/12/30/Fiscal-Deficits-and-Inflation-16352

McMillin, W. and Beard, Thomas R., (1982), Deficits, money and inflation: Comment, *Journal of Monetary Economics*,10, issue 2, p. 273-277.

Miller, P. 1983. Higher deficit policies lead to higher inflation. *Quarterly Review*, Federal Reserve Bank of Minneapolics, 7(1): 8-19.

Miller, S.M. and F.S. Russek. 1997. Fiscal structures and economic growth. *Economic Inquiry*, 35: 603-613.

Metin, K. 1995. An integrated analysis of Turkish inflation. *Oxford Bulletin of Economics and Statistics*, 57: 513-33.

Metin, K. 1998. The relationship between inflation and the budget deficit in Turkey. *Journal of Business and Economic statistics*, 16(4): 412-22.

Muzafar SH, Chee KC, Baharom A (2011) Budget deficits and inflation in thirteen Asian developing countries. *International Journal of Business and Social Science* 2:192.

Ndanshau MA (2012) Inflation, deficit and capital accumulation under a finite horizon. *Journal Monetary Economics* 8:247–260.

Oladipo N, Akimbobola G (2011) Inflation and budget deficit in a peripheral economy. The Nigerian experience. ISS, pp 80–82.

Onwioduokit, E. A. (2013). Threshold Analysis of Budget Deficit and Economic Growth in Sierra Leone', *West African Financial and Economic Review*, Vol. 10, No. 1, pp. 93–121.

Roubini, N. (1991). Economic and political determinants of budget deficits in developing countries. *Journal of International Money and Finance*, 10(1), 49–72.

Saleh, A.S. 2003. The budget deficit and economic performance: A Survey. *Economic Working Paper Series* No. WP 03-12. University of Wollongong.

Salma, S., E. A. Idriss and T. Said (2016). Threshold Effects of Fiscal Policy on Economic Growth in Developing Countries. *Journal of Economic and Financial Studies*, Vol. 4, No. 3, pp. 24–37.

Sergent, T. and N. Wallace (1981). Some unpleasant monetarist arithmetic. *Quarterly Review*, Federal Reserve Bank of Minneapolis, 5: 1-8.Soludo, C.C. 1997.

Sarel, Michael, (1996), Nonlinear Effects of Inflation on Economic Growth, *IMF Staff Papers*, 43, issue 1, p. 199-215.

Sowa, N. K. (1994). Fiscal deficits, output growth and inflation targets in Ghana, *World Development*, Vol.22, No. 8, pp. 1105-1117.

Tchokote, J. 2005. An empirical analysis of the impact of budget deficit on the current account balance in Cameroon. *African Journal of Economic Policy*, 12(2):37-71.

William A. Niskanen, (1978), Deficits, government spending, and inflation: What is the evidence?, *Journal of Monetary Economics*, 4, (3), 591-602.

Younus, S. (2013). Estimating growth-inflation tradeoff threshold in Bangladesh. Policy Analysis Unit Research Department. Bangladesh Bank.

[1] The underdeveloped nature of the local financial market and the non-availability of sophisticated vehicles for alternative financing, the central bank is usually compelled to pick up a hefty slack (IMF, 2018)

[2] That fiscal authority would only intervene by cutting deficits when they have reached a certain threshold (also see, Feldstein, 2004).

[3] An increase in budget deficit does not affect aggregate demand, interest rate or price level. Since,government tax cut in the current period would be financed by proportionate tax increases in the future.Thus, knowing that a higher tax would be imposed on them in the future to enable the government to repay its debt, consumers would not consider themselves wealthier and/or increase their demand to the extent that it would lead to inflation. However, the identification of Ricardian and non-Ricardian fiscal behavior empirically is far more complex and, therefore, the strong-form of fiscal theory is still looked at skeptically.

[4] Egwakhide (1999), Oladipo and Akimbobola (2011) for Nigeria and Tchokote (2005) for Cameroon and Ndanshau (2012) for Tanzania.

[5] Egwakhide (1999) for Nigeria and Tchokote (2005) for Cameroon and Ndanshau (2012) for Tanzania.

[6] Fiscal deficit including grants, on cheques issued basis.

[7] It is expected that $\beta_1 < 0$

[8] In these models, expansionary monetary policy causes an increase in domestic output, deterioration in the terms of trade and the economy will get surprise inflation. As openness changes, the incentives the (discretionary) monetary policy maker faces change because openness alters the slope of the Phillips curve and the effect of monetary policy on output. The inflation cost is increased and the output gain from surprise inflation is reduced. As the degree of openness rises, the Phillips curve trade-off becomes less favourable and optimal policy is less expansionary. This mechanism therefore generates an inverse relationship between openness and inflation.

[9] According to Hendry's (1995) the variables which are statistically insignificance regressors will be been successively eliminated to obtain the final parsimonious equation (David F. Hendry. 1995).

[10] i.e., $\frac{d\pi_t}{db_t} = 0$

[11] i.e. $\frac{d^2\pi_t}{db_t^2} > 0$

[12] The CPI headline inflation, the most widely used inflation indicator for Tanzania has several weaknesses. The CPI inflation may not represent the whole country, as it is based on a budget survey. It also includes goods that are subsidised or subject to price controls. On the other hand, the GDP deflator can be biased when there is an export price rise in primary commodities.

[13] Inflation trended downward to average of 4.69% in 2019 from 11.13% in 2012.

[14] Growth in *m2*(-5) has been found to reduce inflation i.e., 1% change in growth lead to 0.0485% reduction in inflation –suggesting presence of monetary policy reaction to previous increased in inflation (Table 4)

Appendix I

Table 1A: ARDL selected model (2, 4, 1, 2, 5, 5, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
π (-1)	1.393641	0.101332	13.75321	0.0000
π (-2)	-0.482645	0.107093	-4.506783	0.0000
b	-0.057085	0.037442	-1.524624	0.1347
b(-1)	-0.146904	0.0381	-3.855749	0.0004
b(-2)	-0.137795	0.03711	-3.713119	0.0006
b(-3)	-0.140765	0.03722	-3.782015	0.0005
b(-4)	-0.102733	0.037764	-2.720376	0.0094
crop	-0.01528	0.011526	-1.325681	0.1919
crop(-1)	0.019287	0.011072	1.741966	0.0887
ex	-0.01977	0.041851	-0.472388	0.6390
ex(-1)	0.110377	0.068025	1.62259	0.1120
ex(-2)	-0.04737	0.040326	-1.174697	0.2466
m2	0.042593	0.01768	2.409078	0.0203
m2(-1)	-0.054523	0.021121	-2.58145	0.0133
m2(-2)	-0.008945	0.018864	-0.474204	0.6378
m2(-3)	-0.005256	0.016433	-0.319869	0.7506
m2(-4)	-0.005573	0.02094	-0.266128	0.7914
m2(-5)	-0.034713	0.018292	-1.8977	0.0645
imp	0.550573	0.114525	4.807445	0.0000
imp(-1)	-0.800087	0.218467	-3.66228	0.0007
imp(-2)	0.364592	0.207295	1.758812	0.0857
imp(-3)	-0.015342	0.193821	-0.079156	0.9373
imp(-4)	-0.279001	0.196059	-1.423049	0.1619
imp(-5)	0.316135	0.116036	2.724447	0.0093
pi	0.74815	0.136112	5.496584	0.0000
pi(-1)	-0.926314	0.251128	-3.688615	0.0006
pi(-2)	0.24298	0.171377	1.417813	0.1635
C	-1.366794	0.446078	-3.064023	0.0038

R-squared	0.9915	Mean dependent var	8.0381
Adjusted R-squared	0.9862	S.D. dependent var	2.7778
S.E. of regression	0.3266	Akaike info criterion	0.8871
Sum squared resid	4.5866	Schwarz criterion	1.7794
Log likelihood	-3.4910	Hannan-Quinn criter.	1.2419
F-statistic	185.9519	Durbin-Watson stat	2.0834
Prob(F-statistic)	0.0000		

Note: Inflation ($\boldsymbol{\pi}$), Fiscal deficit, as a percentage of GDP ($\boldsymbol{b}$), Change in crop production index ($\boldsymbol{crop}$), Real exchange rate($\boldsymbol{ex}$), Broad money supply ($\boldsymbol{m2}$), Import of goods and services to GDP($\boldsymbol{imp}$), Private investment to GDP ($\boldsymbol{pi}$).