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Asymmetric Effects of Fiscal Deficit on Monetary Policy Transmission in Tanzania

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Abstract
This study seeks to investigate the asymmetric effects of fiscal deficit on monetary policy transmission in Tanzania by using quarterly time series data for the period 2001: I to 2019: IV. In the analysis, which is based on the theory of sovereign risk premium, use is made of the asymmetric cointegration modelling in a non-linear autoregressive distributed lag model to distinguish the effects of fiscal deficit on interest rates, exchange rates and inflation. The findings indicate that interest rate and exchange rate react differently to negative and positive changes in fiscal deficit over the long run, and, inflation responds differently to such changes over the long run and short run period. The findings also revealed that interest rate is more sensitive to the worsening in fiscal deficit; and, accordingly fiscal consolidation is an essential requirement for effective transmission of the monetary policy. In particular, implementation of the price based policy framework in Tanzania should be considered carefully, as persistent rise in budget deficits would eventually counter the effectiveness of monetary policy by keeping market interest rates and inflation at high levels. The findings provide evidence in favour of a fiscal policy to stabilise monetary policy variables, but also highlights the importance of long-term fiscal sustainability for the attainment of monetary policy objectives.

Keywords: Asymmetric fiscal effects; ARDL; Fiscal deficit; Monetary policy; Tanzania.
JEL Classification Codes : E63, O23, O55.

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1. Introduction

Since the mid-2000s, several developing countries in and outside the sub-Sahara Africa (SSA) either have "migrated" or shown interest to "migrate" from monetary aggregate based monetary policy regime in favour of the so-called "policy interest rate" based monetary framework. The interest to "migrate" from monetary aggregates to policy rate based monetary policy regime is evidenced by the Bank of Tanzania (BoT) in its Monetary Policy Statement (MPS) that: "In the course of modernizing monetary policy framework during the second half of 2017/18, the Bank will continue to work closely with stakeholders to ensure smooth adoption of the overnight interbank cash market interest rate as operational target of monetary policy, while providing the necessary support" (BoT, 2018: 38). To that effect, under the auspice of the financial sector reforms implemented in earnest in two consecutive reform programmes, the BoT introduced government securities market (Treasury bills and bonds) that served as a benchmark for interest rates determination (BoT, 2011, Nord *et al.*, 2009). In addition, the BoT innovated an Interbank Foreign Exchange Market (IFEM) to serve as a monetary policy instruments for determining the exchange rate which was allowed to freely float since 1996. In practice, the BoT adopted a monetary-targeting policy regime since 1993, where price stability remained the primary objective of monetary policy (BoT, 2011).[1]

Noteworthy, the migration from money-based to price-based monetary policy regime has been based on diverse factors. Some have attributed the migration to difficulties in achievement of quantitative monetary targets (Kovanen, 2011). In Tanzania, inadequacy in targeting monetary aggregates and fiscal policy effect do not feature as a basis of the "desired" migration to price based monetary policy framework. Rather, the migration to the policy rate has been driven by "increased globalization of Tanzania's economy and the associated move towards greater capital account openness" (Adam, Kessy, and Langford, 2016: 93).[2] In addition, it is maintained that the price-based monetary policy regime is to support the monetary authorities' endeavour to strengthen public finance management, maintain transparency in public spending, improve efficiency and provide effective guidance on the stance of monetary policy (IMF 2018; BoT, 2018, Kessy, Nyella and O'Connell, 2017: 241).

Notwithstanding the possible effect of fiscal policy on the monetary policy transmission, the effectiveness of the new policy regime requires renewed commitment of the government to fiscal discipline that cannot be taken for granted in the absence of fiscal sustainability and its potential impact on public debt and the conduct of monetary policy. Unsustainable fiscal policy may hamper efforts by the BoT to ensure price stability and could lead to unconventional monetary policy outcomes. In the context of high levels of fiscal deficits, rise in interest rates would raise the level of sovereign risk default and the cost of servicing public debt, which may instead devalue domestic currency and lead to more inflationary pressure (Bellhocine *et al*., 2013). Moreover, in the context of the so-called sovereign risk premium model, the increase in budget deficits, or levels of government debt, would raise the probability of default that may lead to a fall in expected returns on government bonds. Consequently, demand for government bonds would decrease to cause their equilibrium prices to decrease and interest rates to rise. However, contrary to the predictions of the Keynesian macroeconomic theory, the existing studies have the increase in sovereign risk causes capital outflows, leading to depreciation of the domestic currency (Blanchard, 2004; Favero and Giavazzi, 2004).

Several studies have examined the effect of fiscal policy on monetary policy transmission in and outside developing countries. A majority of the mainstream based on the IS-LM model found a positive effect of fiscal policy expansion on interest rates but consistently failed to explain the accompanying depreciation of exchange rate (Enders *et al*. 2011; Monacelli and Perotti 2010; Kim and Roubini 2008). Other studies, for example, Dungey and Fry (2009) and Corsetti, Meier and Müller (2012) established existence of a negative effect of fiscal policy shock on interest rate. Also, Aktas *et al*. (2010), Zoli (2005), Favero and Giavazzi (2004), and Blanchard (2004), established the link between fiscal position and exchange rate behaviour differed with the exchange regime: a country with nominal fixed regime experienced a real appreciation and that with floating exchange rate regime experienced a real appreciation.

In Tanzania, where transition to a price based monetary policy framework is in vogue, there is lack in knowledge on how fiscal policy actions impacts on, among others, the interest rate, exchange rate and ultimately inflation. Previous studies on Tanzania are not only few but also are not comprehensive enough to inform policy design: they only focused on the interest rate channel of monetary policy transmission mechanism in Tanzania (Mkai and Aikaeli, 2020; Kimolo *et al*, 2019; Mbowe, 2013; Montiel *et al*., 2012). More importantly, while they all found the interest channel was weak they, first only applied linear models (SVAR), and second, none of them considered the likely impact of fiscal policy on the channels of the monetary policy transmission. Specifically, the previous empirical studies on Tanzania separately investigated the link between fiscal policy and either the interest rate or the exchange rate and as a result, they lack focus on both effects and asymmetries of fiscal performance on the policy transmission.

Accordingly, the main purpose in this paper is to shed light on the effect of fiscal position on the transmission mechanism of monetary policy in Tanzania. The value addition of this paper is in three main areas. First, it complements previous studies on Tanzania by focusing on the effects of fiscal deficit on monetary policy fundamentals by using the model of sovereign risk premium. Second, the study investigates both short-run and long-run effects of fiscal deficit on interest rates, exchange rates, and inflation. Third, unlike most of the previous studies, non-linear autoregressive distributed lag (NARDL) models are used to empirically assess strength of the asymmetric effects of fiscal deficit on monetary policy variables in Tanzania. The findings from the analysis revealed interest rate reacts more strongly and significantly to negative changes in the fiscal deficit than to positive changes over the long run. Also, the analysis reveals that the asymmetry for all the transmission variables occurs over the long run Moreover, short-run asymmetry for interest rate and exchange rate is statistically insignificant.

The rest of this paper is structured as follows. Section two (2) provides a theoretical and empirical literature on the relationship between fiscal deficit and monetary variables. Section three (3) is on the methodology, section four (4) discusses the results from the estimation of dynamic asymmetric ARDL models. Finally, concluding remarks are presented in section five (5).

2. Literature Survey

In theory, it is noteworthy that fiscal policy may bear effect on the traditional and non-traditional channels of monetary policy transmission. In the traditional interest rate and exchange rate channels, fiscal policy affects economic activity via its effect on private consumption. In the traditional Keynesian theory, an expansionary fiscal policy in the absence of forward-looking behavior, would stimulate aggregate demand that cause an increase in nominal interest rates and consequently increase in capital inflow that led to appreciation of the exchange rate (Fleming 1962; Mundell 1963). Similarly, the crowding-out theory suggests that a large fiscal deficits may lead to an increase in interest rates. Nonetheless, it considers an increase in the interest rate as a result of government debt crowding out private capital, rather than output growth emanating from expansionary government consumption (Engen and Hubbard 2004).

In the non-traditional channels of monetary policy transmission, fiscal policy is linked to monetary policy through the so-called sovereign risk premium model and the market discipline hypothesis. In the case of the sovereign risk premium model, increase in an expansionary fiscal policy, leading to an increase in budget deficits, or the levels of government debt that in turn causes a higher risk premium on government bonds, increase the interest rate due to increase in demand for bonds (Truman, 2001, and Gale and Orszag, 2004). Besides, a high default risk premium is expected to be associated with a weaker domestic currency, given forward-looking economic agents that expect a high exchange rate pass-through effect to import prices and ultimately inflation. Thus, chronic and persistent fiscal deficits worsen government solvency that dampens macroeconomic stability.

In the case of the market discipline hypothesis lenders charge high interest rates to borrowers prevent irresponsible and excessive borrowing with high probability of default by charging high interest rates (Flandreau *et al*., 1998). However, while it is assumed in the weak form of the market discipline hypothesis that the interest rate on bond would rise at a constant rate with the level of indebtedness[3] it is assumed that the relationship between debt variables and interest rate on bond would be non-linear as in the sovereign risk model where the credit markets for sovereign borrowers take the strong form of the market discipline hypothesis (Bayoumi *et al*., 1995). Thus, in contrast with the weak form of the market hypothesis, the marginal cost of borrowing would rise with debt accumulation, as default risk. When a country runs excessive deficits, the risk premium on sovereign bonds increases, interest rates on bond initially increases gradually and later sharply as the budget deficits become persistent. The increase in the cost of borrowing, together with reduced access to credit, acts as an incentive to correct the fiscal mismatch.

It is noteworthy that there are few empirical studies on the effect of fiscal deficit on monetary policy transmission that are based on the sovereign risk premium model (Furceri *et al*., 2012). The majority of empirical studies separately focused on the impact of fiscal policy on either the interest rate or the exchange rate. For example, using panel data on developed countries, Haugh *et al*. (2009) and Schuknecht *et al*. (2009), suggests that fiscal deficits, together with public debt, are positively related to sovereign spreads, as well as the medium-term and long-term interest rates. Similar evidence was obtained by Canzoneri *et al*. (2002, 2011); and Dai and Philippon (2005) which assessed the effect of expansionary fiscal deficit on the long-term interest rate differential in the USA. Also, by using generalized autoregressive conditional heteroskedasticity test, Chen (2011) found that higher government deficit leads to a lower long-term interest rate in Japan.

Moreover, there has been inconclusive evidence regarding the relationship between sovereign risk premium and monetary policy variables in developing countries (Mpapalika and Malikane, 2019). On one hand, empirical studies on fiscal policy and interest rates in developing and emerging market economies suggest existence of a positive relationship between fiscal deficit and interest rates. Among others, studies by Baldacci *et al*. (2008) and Akitoby and Stratmann (2008) suggests that high levels of fiscal deficits and government spending can trigger bond market instability and raise Emerging Market Bond Index (EMBI) spread. In relation, empirical results obtained by, among others, Belhocine and DellErba (2013), Baldacci and Kumar (2010), Lopez *et al*. (2011), Peiris (2010) and Tomsik (2012) suggests that tightening fiscal policy would narrow the spread between domestic government bond and benchmark bond yields. Martinez *et al*. (2013), described that high inflation rate may be attributed to the monetization of the fiscal deficit and the need for higher interest rates.

On the other hand, the effect of fiscal policy on exchange rate movements under the sovereign risk premium model is far greater than the effect of fiscal policy in traditional transmission channels – this weakens the connection between the policy rate and exchange rate In this regard, among others, Zoli (2005) opines that fiscal policy drives the exchange rate, both indirectly through sovereign spreads and directly through news on the effect of fiscal actions on the value of domestic currency. Similar findings on the link and strength of fiscal policy action on the exchange rate were emerged from a study by Aktas *et al*. (2010). Ersel and Zatay (2008) also finds out the positive correlation between the exchange rate and interest rate, arguing that a rise in the interest rate arising from increasing sovereign default probability causes a depreciation of domestic currency. Moreover, Bouakez and Eyquem (2015) suggests that the real exchange rate depreciates in response to positive public spending shocks if the impact of risk premium dominates over the impact of the interest rate channel of monetary policy, even in the case of advanced economies with fiscal consolidation.

The empirical studies on effect of fiscal policy on monetary policy transmission through the sovereign risk premium model lacks specific focus on inflation. Nevertheless, some studies, for example, Blanchard (2004) and Favero and Giavazzi (2004) found large budget deficits were causal to expansion of sovereign spreads and domestic currency devaluation that caused a buildup of inflationary pressures in Brazil during the early 2000s. Also, in a study on Turkey, Aktas *et al*. (2010) found high expected risk premium was associated with a rise in real interest rate that led to a depreciation of the domestic currency and an increase in the inflation rate afterwards. Similarly, Min *et al*. (2003), illustrate that an increase in inflation rate signaling macroeconomic instability will consequently raise the sovereign risk premium. However, the default risk will be high in an inflation-targeting economy if the central bank will not raise the short-term interest rate to curb inflationary tendencies. The expected sign of inflation on the risk premium is positive.

3. Methodology

3.1 Analytical Framework

The analysis of the relationship between fiscal deficit and monetary policy variables is based on the following implicit model.[4]

$$Z_t = \left(b_t^+,\ b_t^-,\ R_t,\ r_t^L,\ logE_t,\ r_t^P,\ \pi_t \right) \quad (1)$$

where R_t denotes the sovereign risk premium, calculated as the difference between the Tanzania and the EU real rate on 2 years Treasury bond - a proxy for the sovereign risk premium, which indicate the possibility of sovereign default by the government (Beirne & Fratzscher, 2012, 61).[5] The r_t^L and r_t^P are, respectively, commercial bank real lending rate and policy rate[6]; $logE_t$ is the log of real exchange rate,[7] π_t is the inflation rate at time t,[8] and, b_t^+ and b_t^- are, respectively, the partial sum processes of positive and negative changes in the ratio of fiscal deficit to GDP:

$$b_t = b_0 + b_t^+ + b_t^- \quad (2)$$

$$b_t^- = \sum_{j=1}^{t} \Delta b_j^- = \sum_{j=1}^{t} \min(\Delta b_j, 0) \quad (2a)$$

and

$$b_t^+ = \sum_{j=1}^{t} \Delta b_j^+ = \sum_{j=1}^{t} \max(\Delta b_j, 0) \quad (2b)$$

According to Engen and Hubbard (2004), Gale and Orszag (2004) and Kim and Roubini (2008), the ratio of fiscal deficit to GDP is used to investigate the effects of the fiscal policy on monetary policy transmission[9].

3.2 Estimation Method

Non-linear Autoregressive Distributed Lag (NARDL) approach to cointegration is used to establish the long-run and short-run effects of fiscal deficit on monetary policy transmission mechanism in the case of Tanzania.[10] The NARDL also outperforms the other cointegration tests as it allows to distinction of symmetric cointegration from asymmetric cointegration and non-cointegration processes (Katrakilidis and Trachanas 2012). Moreover, the NARDL is more efficient than other competing models, such as Engle–Granger two- step approach, because it specifies the long-run equilibrium with a combination of both I (0) and I (1) series.

Following Pesaran and Shin (1999) and Shin *et al*. (2014) the NARDL equations for estimation reads as:

$$\Delta r_t^L = c_{10} + c_{11} + \alpha r^L{}_{t-1} + \beta_1 b^-{}_{t-1} + \beta_2 b^+{}_{t-1} + \beta_3 R_{t-1} + \beta_4 logE_{t-1} + \beta_5 r^P{}_{t-1} + \beta_6 \pi_{t-1} + \sum_{i=1}^{p-1} \varphi_1 \Delta r^L{}_{t-i} + \sum_{i=0}^{q-1} \tau_{1i}\, \Delta b^-{}_{t-i} + \sum_{i=0}^{q-1} \tau_{2i}\, \Delta b^+{}_{t-i} + \sum_{j=0}^{q-1} \tau_{3j}\, \Delta R_{t-j} + \sum_{j=0}^{q-1} \tau_{4j}\, \Delta logE_{t-j} + \sum_{j=0}^{q-1} \tau_{5j}\, \Delta r^P{}_{t-j} + \sum_{j=0}^{q-1} \tau_{6j}\, \Delta \pi_{t-j} + \mu_t^{r^L} \quad (3)$$

$$\Delta logE_t = c_{20} + c_{21} + \gamma logE_{t-1} + \omega_1 b^-{}_{t-1} + \omega_2 b^+{}_{t-1} + \omega_3 R_{t-1} + \omega_4 r^L{}_{t-1} + \omega_5 r^P{}_{t-1} + \omega_6 \pi_{t-1} + \sum_{i=1}^{p-1} \sigma_1 \Delta logE_{t-i} + \sum_{i=0}^{q-1} \rho_{1i}\, \Delta b^-{}_{t-i} + \sum_{i=0}^{q-1} \rho_{2i}\, \Delta b^+{}_{t-i} + \sum_{j=0}^{q-1} \rho_{3j}\, \Delta R_{t-j} + \sum_{j=0}^{q-1} \rho_{4j}\, \Delta r^L{}_{t-j} + \sum_{j=0}^{q-1} \rho_{5j}\, \Delta r^P{}_{t-j} + \sum_{j=0}^{q-1} \rho_{6j}\, \Delta \pi_{t-j} + \mu_t^{logE} \quad (4)$$

$$\Delta \pi_t = c_{30} + c_{31} + \delta \pi_{t-1} + \psi_1 b^-{}_{t-1} + \psi_2 b^+{}_{t-1} + \psi_3 R_{t-1} + \psi_4 r^L{}_{t-1} + \psi_5 logE_{t-1} + \psi_6 r^P{}_{t-1} + \sum_{i=1}^{p-1} \phi_1 \Delta \pi_{t-i} + \sum_{i=0}^{q-1} \nu_{1i}\, \Delta b^-{}_{t-i} + \sum_{i=0}^{q-1} \nu_{2i}\, \Delta b^+{}_{t-i} \sum_{j=0}^{q-1} \nu_{3j}\, \Delta R_{t-j} + \sum_{j=0}^{q-1} \nu_{4j}\, \Delta r^L{}_{t-j} + \sum_{j=0}^{q-1} \nu_{5j}\, \Delta logE_{t-j} + \sum_{i=0}^{q-1} \nu_{6j}\, \Delta r^P{}_{t-j} + \mu_t^{\pi} \quad (5)$$

where c_{j0} and c_{j1} are coefficients of the constant and linear time trend with j = 1, 2, 3. α, γ and δ are parameters of the autoregressive (AR) term in equation 3, 4 and 5; φ_1, σ_1 and ϕ_1 are coefficients on i^{th} lagged differences of Z_t; p and q are lag lengths;[11] and, $\mu_t^{r^L}$, μ_t^{logE} and μ_t^{π} are, by assumption, well behaved white-noise error terms. Three steps characterized the empirical analysis by the NARDL approach: estimation of unrestricted ECM by using the ARDL equation in (3) through (5); estimation of the long run impact multipliers; and, application of the Wald, that is F-test, for existence of long-run relationship amongst the variables. The null hypothesis tested was that: $H_0: \alpha = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$, $H_0: \gamma = \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \omega_6 = 0$ and $H_0: \delta = \psi_1 = \psi_2 = \psi_3 = \psi_4 = \psi_5 = \psi_6 = 0$ for interest rate, exchange rate and inflation model respectively. The estimated F-statistics were compared against the critical values provided by Pesaran *et al*. (2001): lower bound in which Z_t is I (0), the upper bound values in which Z_t is I (1) and region of no co-integration in which the estimated *F* statistic is above the upper bound.

It is noteworthy that the ARDL modelling may exhibit asymmetries: over both the short and the long run; only the long run; and, only over the short run. Thus, following Shin *et al*. (2014) use was made of the Wald test for existence of a nonlinear cointegrating relationship in the estimated model. The relevant null hypothesis is thus: $H_0: \beta_1 = \beta_2 = \beta$ for interest rate, $H_0: \omega_1 = \omega_2 =$

ω for exchange rate and $H_0: \psi_1 = \psi_2 = \psi$ for inflation channel. On the other hands, short-run dynamic adjustments to a variation of positive and negative changes in budget deficit is captured by the parameters τ_{1i} and τ_{2i} for interest rate model, ρ_{1i} and ρ_{2i} and ν_{1i} and ν_{2i} for exchange rate and inflation model respectively. Rejection of the null hypothesis is an indicator of differing adjustments of the dependent variables to either the improvement or deterioration of fiscal deficit.[12]

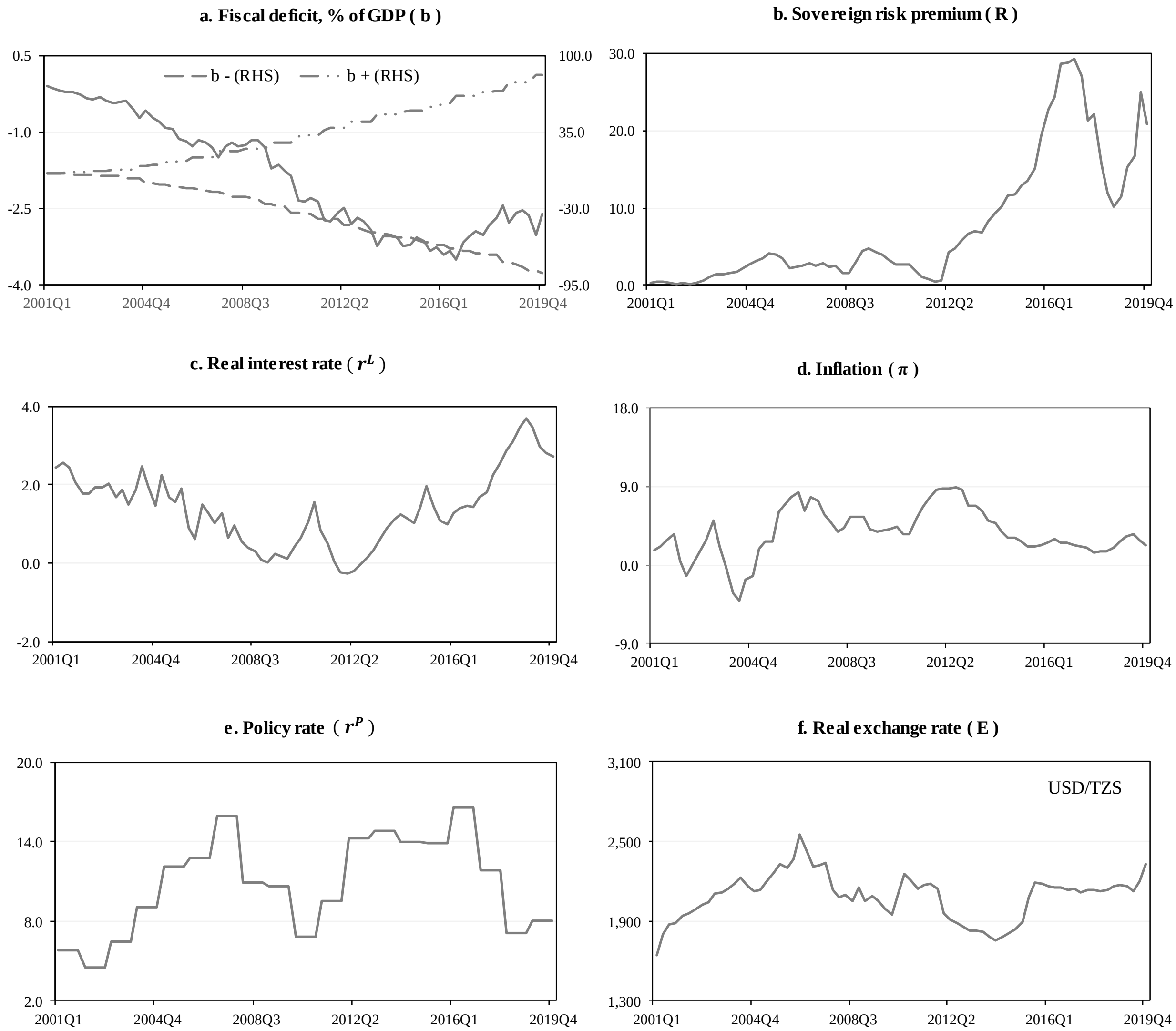
3.3 The Data

The analysis is based on quarterly time series data for the period 2001: I – 2019: IV. The data on interest rate, exchange rate, Treasury bond rate and policy rate was obtained from the data base of the BoT, whereas data on fiscal deficit, inflation and the EU Treasury bond rate obtained from Ministry of Finance and Planning (MoFP), National Bureau of Statistics (NBS), and the Federal Reserve Bank of St. Louis respectively.

Figures 1 illustrate the variables over time, while Table 1 reports some descriptive statistics. In particular, fiscal deficit registered significant weakening ahead of the Global Financial Crisis (GFC), as the government continued borrowing to compensate for the shortfall in domestic revenues and budget support. The one year- real cost of credit has steadily increased for the private sector since 2012 to the sample average of 1.40%, largely due to the limited level of competition between commercial banks, excessive transaction costs, and a high level of risk. Inflation has declined over the recent past, registering sample average of 3.71%, largely due to the combined impact of the implementation of prudent monetary policy and of the recent decreases in global energy prices.

As for the sovereign risk premium, the standard deviation is reasonably large, implying that the probability of sovereign risk is very much volatile, surged up in 2012: II partly on account of the second round effects of the GFC, then plummeted since 2017, and up again since 2018. The Shilling has depreciated sharply against the currencies of the country's major trade partners over the past years. The results of unit root test based on ADF, PP and KPSS as presented in Table 2 shows that all variables are a mix of I(1) and I(0), but not I(2). Thus, the NARDL methodology can be applied.

Figure 1: Time plots of variables included in the model, 2001: I – 2019: IV



Note: RHS – Right hand side scale.
Source: Bank of Tanzania, Ministry of Finance and Planning, National Bureau of Statistics, Federal Reserve Bank of St. Louis.

Table 1: Descriptive statistics

Variable	2001:I - 2019:IV				
	Obs	Mean	Max	Min	Std. Dev.
b	76	-1.6995	1.8787	-7.4509	2.0975
$\mathbf{b}^{+}$	75	33.4260	83.1021	0.0000	25.6829
$\mathbf{b}^{-}$	75	-35.0582	-0.0809	-85.0063	26.3283
R	76	7.5468	29.3696	0.1602	8.3020
r^L	76	1.3964	3.6851	-0.2689	0.9529
logE	76	7.6393	7.8434	7.4051	0.0844
r^P	76	10.7768	18.5353	3.8667	3.9323
π	76	3.7142	8.9667	-4.0933	2.7845

Note: The term "Obs" represents the number of observations, while "Std. Dev" stands for the standard deviation. Min and Max indicate the smallest and largest observation, respectively. The variables b, b_t^+, b_t^-, R, r^L, r^P, and π are measured in percentages, while logE is the log of real exchange rate.

Table 2: Stationarity test

Variable	ADF		PP		KPSS	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
b	-1.8811	-2.0766	-8.0160 ***	-8.9880 ***	0.9546 ***	0.1955 **
$\mathbf{b^+}$	2.3471	-2.1645	3.4860	-2.4601	-1.1660 ***	0.2765 ***
$\mathbf{b^-}$	1.9307	-2.2439	3.7534	-2.6989	1.1708 ***	0.2502 ***
R	-0.9749	-3.3964 *	-1.0245	-2.3065	0.8721 ***	0.1633 **
r^L	-1.4960	-1.6580	-1.5628	-1.6443	0.2856	0.2746 ***
logE	-2.2584	-2.2443	-2.8717 *	-2.8562	0.1186	0.1236 *
r^P	-1.9835	-1.6474	-2.1909	-1.9279	0.3000	0.1263 *
π	-2.331	-2.2552	-2.3368	-2.2798	0.2047	0.1847 **

B: First difference

Variable	ADF		PP		KPSS	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
b	-16.8250 ***	-16.7185 ***	-35.1311 ***	-36.5389 ***	0.0955	0.0828
$\mathbf{b^+}$	-2.3304	-2.5523	-11.1581 ***	-17.2620 ***	0.4810 **	0.1027
$\mathbf{b^-}$	-3.0982 **	-3.9005 ***	-11.8988 ***	-13.9878 ***	0.4824 **	0.1359 *
R	- 4.7871 ***	- 4.7576***	- 6.6384 ***	- 6.6075 ***	0.0703	0.0418
r^L	- 8.5004 ***	- 4.7480 ***	- 8.5000 ***	- 8.7200 ***	0.2579	0.0386
logE	- 6.7375 ***	- 6.6326 ***	- 6.6631 ***	- 6.5462 ***	0.1930	0.1654 **
r^P	- 7.6588 ***	- 7.7504 ***	- 6.5592 ***	- 8.1402 ***	0.1925	0.0758
π	- 3.3756 **	- 3.3963 *	- 6.3537 ***	- 6.3281 ***	0.0683	0.0402

Note:

a: For the ADF and PP tests indicate that the null hypothesis of a unit root is rejected at 10%; (*), 5% (**) and 1% (***) significance levels, while those for the KPSS test indicate that the null hypothesis of stationarity is rejected at 1% (***), 5% (**), and 10%; (*), significance levels.

b: Lag Length based on SIC

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

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

4. Empirical Results

Table 3 present the estimated long-run coefficients of both the symmetric and asymmetric models, together with the bounds tests and diagnostic tests. The findings suggest existence of a long-run asymmetry on the effects of fiscal deficit on monetary policy variables in Tanzania. The Wald test rejects the null hypothesis of long run symmetric restrictions for interest rate ($w_{LR} = 23.6159$ ***), exchange rate ($w_{LR} = 19.8620$ ***), and inflation ($w_{LR} = 8.3790$ ***). The findings firmly reveal positive (b+) and negative (b–) changes in the fiscal deficit over the long run poses differing effects on policy transmission variables (in terms of magnitude, direction and levels of significance). Serve for the interest rate asymmetric regression, where the effect of a positive (b+) change in fiscal deficit is statistically insignificant, the positive change in fiscal deficit (b+) has a significant and powerful effect on the exchange rate and inflation than the negative change in fiscal deficit ($b-$). This implies both exchange rate and inflation are relatively more responsive to improvement than in weakening of fiscal deficit. In particular, weakening in fiscal deficit by 1% would cause interest rates to rise by 0.22%, whereas policy tightening by 1% would rise the interest rate by 0.09%. The significantly positive sign of risk premium in the asymmetric model for interest rate is in line with the theory of sovereign risk premium that a higher level of budget deficits puts upward pressure on interest rates, since investors require a higher premium to bear increasing risk. This result is comparable to the findings of Akitoby and Stratmann (2008), Baldacci et al (2008) and Jaramillo and Weber (2013). Nonetheless, the positive long run transmission from the exchange rate to the interest rate is statistically insignificant.

The results in Table 3 also shows the coefficients on $b-$ and $b+$ in exchange rate model are both negative and statistically significant at the 5% and 1%, respectively, implying that changes in exchange rate are inversely related to positive and negative changes in fiscal deficit. Specifically, 1% weakening in the fiscal deficit would lead to 5.37% real depreciation of the domestic currency (TZS).[13] In contrast, the results suggest the TZS would appreciates by 9.04% as a result of 1% improvement in the fiscal deficit. Furthermore, the results equally reveal the exchange rate responds positively to the interest rate and inflation, but negatively to changes in monetary policy actions.

Table 3: Long-run estimates of ARDL and NARDL models

Dependent variable: r^L				**Dependent variable: logE**				**Dependent variable: π**			
Symmetry (ARDL)		Assymmetry (NARDL)		Symmetry (ARDL)		Assymmetry (NARDL)		Symmetry (ARDL)		Assymmetry (NARDL)	
b	- 1.7138 *	b^+	- 0.0383	b	- 0.1110 *	b^+	- 0.0947 ***	b	- 9.4452 ***	b^+	- 2.8349 ***
		b^-	- 0.2201 ***			b^-	- 0.0552 **			b^-	- 2.4015 ***
R	0.7029 **	R	0.0933 ***	R	0.0240 *	R	0.0033	R	0.8903 ***	R	0.1983
r^L	-	r^L	-	r^L	0.1254	r^L	0.2441 ***	r^L	6.4969 ***	r^L	8.4712 ***
logE	-11.0020 *	logE	0.5907	logE	-	logE	-	logE	- 22.0205 ***	logE	- 83.2744 ***
r^P	0.0070	r^P	0.0946 ***	r^P	- 0.0317	r^P	- 0.0172 **	r^P	0.4754 ***	r^P	- 1.0560 ***
π	0.0105	π	- 0.1218 ***	π	0.02247	π	0.0222 ***	π	-	π	-
@trend	- 0.2651 **			@trend	- 0.0118 *	@trend	0.0434 ***				
EC(t-1)	-0.2674 ***	EC(t-1)	-1.2404 *** +++	EC(t-1)	-0.0883 ***	EC(t-1)	-0.3039 ***	EC(t-1)	-0.8420 ***	EC(t-1)	-0.5010 ***
F_{III}	4.1509 **	F_V	7.6460 ***	F_{III}	6.5226 ***	F_{III}	8.1379 ***	F_V	5.1432 **	F_V	6.7555 ***
t_{III}	-	t_V	- 6.4732 ***	t_{III}	-	t_{III}	-	t_V	-4.8575 **	t_V	-4.4255 *
		W_{LR}	23.6159 ***			W_{LR}	19.8620 ***			W_{LR}	8.3790 ***
χ^2_{SC}	0.1570 (0.8553)	χ^2_{SC}	0.3989 (0.6747)	χ^2_{SC}	1.2376 (0.2969)	χ^2_{SC}	0.7685 (0.4718)	χ^2_{SC}	0.6536 (0.5353)	χ^2_{SC}	0.8740 (0.4343)
χ^2_{HET}	0.7984 (0.7411)	χ^2_{HET}	0.7054 (0.8438)	χ^2_{HET}	0.3119 (0.9589)	χ^2_{HET}	0.9317 (0.5798)	χ^2_{HET}	1.1406 (0.4023)	χ^2_{HET}	0.6150 (0.9129)
J_{NOR}	3.1622 (0.2057)	J_{NOR}	21.0608 (0.000)	J_{NOR}	15.5569 (0.0004)	J_{NOR}	1.5854 (0.4526)	J_{NOR}	0.9130 (0.6335)	J_{NOR}	9.4467 (0.0089)
t_{FF}	0.0646 (0.8009)	t_{FF}	0.3082 (0.5829)	t_{FF}	0.2435 (0.6234)	t_{FF}	0.4437 (0.5098)	t_{FF}	5.2255 (0.0372)	t_{FF}	5.9028 (0.0252)

Note: F_v and F_{III} are the F statistics for testing the long-run coefficients significance with a constant and constant and trend. The respective asymptotic critical value bounds are presented on Table 5. W_{LR} denotes the Wald test for long-run symmetry. The test statistics χ^2_{SC} , χ^2_{HET}, J_{NOR}, and t_{FF} represent the LM tests for serial correlation, heteroscedasticity, normality, and functional form, respectively. The numbers in parentheses are the p values. The asterisk ****, **, * represent significance at the 1%, 5%, and 10% levels, respectively. EC(t-1) represent error correction term, +++ means that the speed of adjustment is oscillatory convergence i.e., the long run deviation is corrected by 124 percent by the following period, that is full adjustment to equilibrium takes less than a quarter. (See Loayza and Ranciere, 2005) .

The symmetric model results suggest existence of positive relationship between weak fiscal position and inflation. The estimated long-run coefficient on b indicates higher inflation rates resulting from increasing fiscal deficits, which is consistent with the theoretical model of sovereign risk premium, and empirical findings of Celasun *et al*. (2004) and Cerisola and Gelos (2005.) Similarly, the results of the asymmetric model suggest a weakening of fiscal deficit would increase inflation by 2.40%; and, in contrast, improvement in fiscal deficit would lower inflation by 2.84%. Both results suggest fiscal deficits have been one of the major drivers of inflation in Tanzania. The long run results and related policy implication are robust: diagnostic tests subjected to both symmetric and asymmetric models of interest rate and exchange rate passes the RESET test for functional miss specification.

Table 4 presents regression results on the short-run dynamic asymmetry. The existence of nonlinear relationship in this case, however, needs to be interpreted with caution, since the Wald test cannot reject the null hypothesis of short-run symmetry, between the positive and negative components of fiscal variable for interest rate ($w_{SR} = 2.6039$) and exchange rate ($w_{SR} = 0.2637$), but rejects the null hypothesis of short-run symmetry between the positive and negative components of fiscal variable for inflation ($w_{SR} = 23.5141 ***$). On the basis of the Wald tests the findings suggest that the asymmetry occurs only in the long run in the case of the interest rate and exchange rate channels, and in both short run and long run in the case of inflation. Notable, however the size of the coefficients on the lagged positive fiscal policy variable in the inflation model is larger in the short run. This implies inflation is more responsive to improvement in fiscal deficit in the short run period.

Table 4. Dynamic NARDL models

Dependent variable: r^L			**Dependent variable: logE**			**Dependent variable: π**		
Variable	Coefficient	*t*- statistic	Variable	Coefficient	*t*- statistic	Variable	Coefficient	*t*- statistic
b^+_{t-1}	-0.0475	-0.5360	b^+_{t-1}	-0.0288 ***	-4.1145	b^+_{t-1}	-1.4202 ***	-3.1897
b^-_{t-1}	-0.2730 ***	-2.8714	b^-_{t-1}	-0.0168 **	-2.5574	b^-_{t-1}	-1.2031 ***	-3.1366
R_{t-1}	-0.1158 ***	-3.7561	R_{t-1}	0.0010 ***	0.4996	R_{t-1}	0.0994	0.8856
r^L_{t-1}	-1.2404 ***	-6.4732	r^L_{t-1}	0.0742 ***	5.9277	r^L_{t-1}	4.2439 ***	4.3197
$\log E_{t-1}$	0.7327	0.6082	$\log E_{t-1}$	-0.3039 ***	-3.5849	$\log E_{t-1}$	-41.7188 ***	-4.6704
r^P_{t-1}	0.1174 ***	3.3936	r^P_{t-1}	-0.0052 ***	-4.4551	r^P_{t-1}	0.5290 ***	3.8530
π_{t-1}	0.1511 ***	1.9194	π_{t-1}	0.0067 ***	3.2755	π_{t-1}	-0.5010 ***	-4.4255
Δb^+	0.0147	0.0334	Δb^+	-0.0068 *	-1.9633	Δb^+	0.5852 ***	2.8999
Δb^+_{t-1}	0.0865	1.5917	Δb^+_{t-1}	-0.0103 *	-1.6985	Δb^+_{t-1}	1.6537 ***	4.4459
Δb^+_{t-2}	0.0979 **	2.0772	Δb^+_{t-2}	0.0077	1.4263	Δb^+_{t-2}	1.8084 ***	4.8937
			Δb^+_{t-3}	0.0094 **	2.1774	Δb^+_{t-3}	2.0440 ***	5.3017
			Δb^+_{t-4}	0.0063	1.6744	Δb^+_{t-4}	1.5841 ***	4.5607
			Δb^+_{t-5}	0.0074**	2.3284	Δb^+_{t-5}	1.5536 ***	4.1730
						Δb^+_{t-6}	1.3062 ***	3.9961
						Δb^+_{t-7}	0.6069 ***	3.2583
Δb^-	-0.0144	-0.3177	Δb^-	-0.0077 **	-2.1567	Δb^-	-0.5600 **	-2.4125
Δb^-_{t-1}	0.1763**	2.2976	Δb^-_{t-1}	0.0064	1.0678	Δb^-_{t-1}	0.414	1.6828
Δb^-_{t-2}	0.0824	1.4328	Δb^-_{t-2}	0.0111 **	2.0845			
Δb^-_{t-3}	0.0031	0.0609	Δb^-_{t-3}	0.0075	1.617			
Δb^-_{t-4}	-0.1566 ***	-3.5448	Δb^-_{t-4}	0.0153 ***	3.5987			
Δb^-_{t-5}	-0.1283 **	-2.6688	Δb^-_{t-5}	0.0091 ***	2.5603			
Δb^-_{t-6}	-0.0829 ***	-6.0155						
Δr^L_{t-1}	0.4362 **	7.0727	Δr^L	0.0212 *	1.9305	Δr^L	-1.6692 **	-2.7295
Δr^L_{t-2}	0.1314	0.9497	Δr^L_{t-1}	-0.0479 ***	-3.7097	Δr^L_{t-1}	-5.4437 ***	-4.3054
Δr^L_{t-3}	0.3359 **	2.6629	Δr^L_{t-2}	-0.0397 ***	-3.3474	Δr^L_{t-2}	-6.8652 ***	-4.6468
			Δr^L_{t-3}	-0.0321 ***	-2.6121	Δr^L_{t-3}	-5.5818 ***	-4.3603
			Δr^L_{t-4}	-0.014	-1.1919	Δr^L_{t-4}	-6.4965 ***	-5.6377
			Δr^L_{t-5}	-0.0205 *	-1.7505	Δr^L_{t-5}	-5.1754 ***	-4.9737
						Δr^L_{t-6}	-3.2911 ***	-4.2514
						Δr^L_{t-7}	-3.1999 ***	-4.0797
ΔR	-0.0565 *	-2.0264	ΔR	0.0048 **	-2.2772	ΔR	-0.2277 **	-2.1766
ΔR_{t-1}	-0.1286 ***	-3.8003	ΔR_{t-1}	0.0020	0.8567	ΔR_{t-1}	-3.3459 ***	-3.1415
ΔR_{t-2}	-0.1342 ***	-5.0713	ΔR_{t-2}	-0.0035	-1.2243	ΔR_{t-2}	-0.4062 **	-5.0008
ΔR_{t-3}	-0.1508 ***	-4.0022	ΔR_{t-3}	0.0002	0.0689	ΔR_{t-3}	-0.3796 **	-2.2372
ΔR_{t-4}	-0.2039 ***	-4.1555	ΔR_{t-4}	0.0112 ***	3.1878	ΔR_{t-4}	-0.1794	-1.1252
ΔR_{t-5}	-0.1958 ***	-3.7560	ΔR_{t-5}	0.0048	1.4606			
ΔR_{t-6}	-0.1670 ***	-3.8105						

Table 4. *Continued*

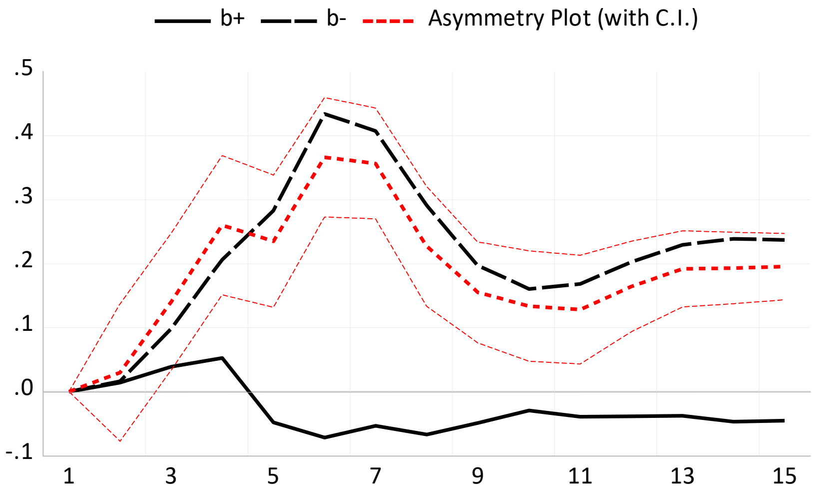
Dependent variable: r^L			**Dependent variable: logE**			**Dependent variable: π**		
Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic	Variable	Coefficient	t-statistic
ΔlogE	3.9162 **	2.2040				ΔlogE	-14.8903 **	-2.1152
ΔlogE_{t-1}	4.4815 **	2.5390				ΔlogE_{t-1}	19.7204 **	2.4932
						ΔlogE_{t-2}	11.9071 *	1.7388
						ΔlogE_{t-3}	30.0226 ***	3.6283
						ΔlogE_{t-4}	25.2343 ***	3.6100
						ΔlogE_{t-5}	18.9543 ***	3.0181
Δr^P	0.0188	0.6695				Δr^P	0.2862 **	2.6308
Δr^P_{t-1}	-0.0790 **	-2.5163				Δr^P_{t-1}	-0.5082 **	-2.7884
Δr^P_{t-2}	-0.0272	-0.8781				Δr^P_{t-2}	-0.5591 ***	-2.9305
Δr^P_{t-3}	-0.0584 **	-2.1722				Δr^P_{t-3}	-0.6675 ***	-3.6256
Δr^P_{t-4}	-0.0272	-0.9716				Δr^P_{t-4}	-0.4055 ***	-2.8617
						Δr^P_{t-5}	-0.4158 **	-2.8291
						Δr^P_{t-6}	-0.3681 ***	-3.1309
						Δr^P_{t-7}	-0.2567 *	-2.0813
Δπ	-0.0934**	-2.7256	Δπ	0.0027	0.8716	$\Delta \pi_{t-1}$	-0.1481	-0.9360
C	-1.2236	-0.1390	C	2.1124 ***	3.4029	C	-302.3145 ***	-4.5817
@trend	-0.3155 ***		@trend	0.0132 ***	4.2122	M2	0.0211	0.2878
W_{SR}	2.6039		W_{SR}	0.2637		W_{SR}	23.5141 ***	

Note: The final NARDL specification is automatically in a model with a maximum lag length of 6, 7 for interest rate equation, 7, 5 for exchange rate equation and 2, 8 for inflation equation. W_{SR} denotes the Wald test for short-run symmetry. The numbers in parentheses are the p values. The asterisk ****, **, * represent significance at the 1%, 5%, and 10% levels, respectively.

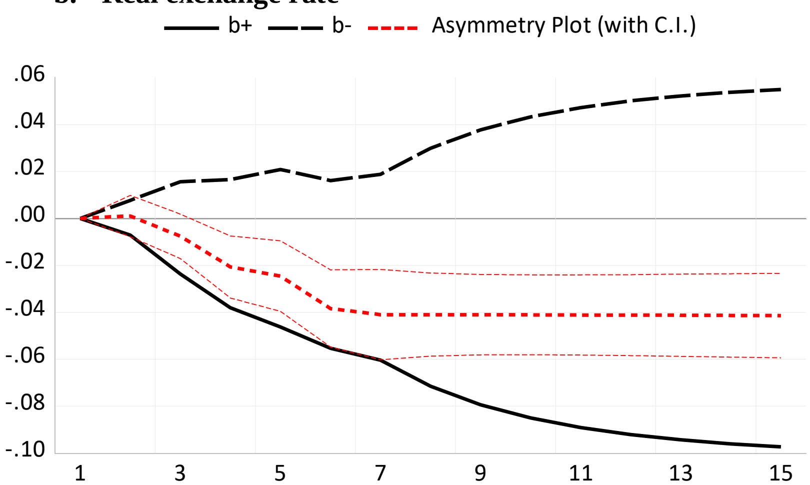
On the one hand, the dynamic multipliers in Figure 2a shows that the interest rate responds promptly and more strongly to negative than positive variations in fiscal deficit. Specifically, the plots suggest existence of between 8 to 9 quarters in convergence of the dynamic multipliers to the long-run equilibrium which is reached in about the 14^{th} quarter. On the other hands, the results suggest existence of weak response of the exchange rate to both improvement and weakening of fiscal balance in the first quarter. However, the empirical evidence suggests existence of smooth adjustment of the exchange rate to positive shock in fiscal balance that starts in the 3^{rd} quarter and converges to the long-run equilibrium thereafter (Figure 2b). The dynamic movement of inflation (Figure 2c) indicates immediate and rapid adjustment to negative fiscal policy shocks in the short run that decrease smoothly with improvement in fiscal balance towards the end of the 4^{th} quarter and reach the long run equilibrium after the 12^{th} quarter - suggesting presence of lags of the adjustment of inflation to fiscal policy shocks and its other determinants. Figure 3presents robustness measure for empirical results, both cumulative sum (CUSUM) and the cumulative sum of squares (CUSUM of squares) tests for the stability of the models. The plots fall within the 95% confidence bands, which verifies the stability of estimated parameters in all cases.

Figure 2: Dynamics of nonlinear multipliers for the relationship between the fiscal balance and monetary variables

a. Real interest rate



b. Real exchange rate



c. Inflation

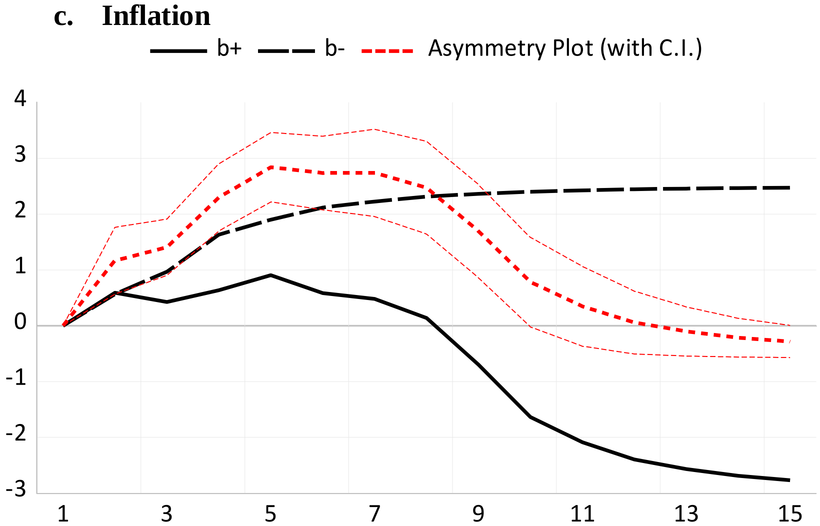
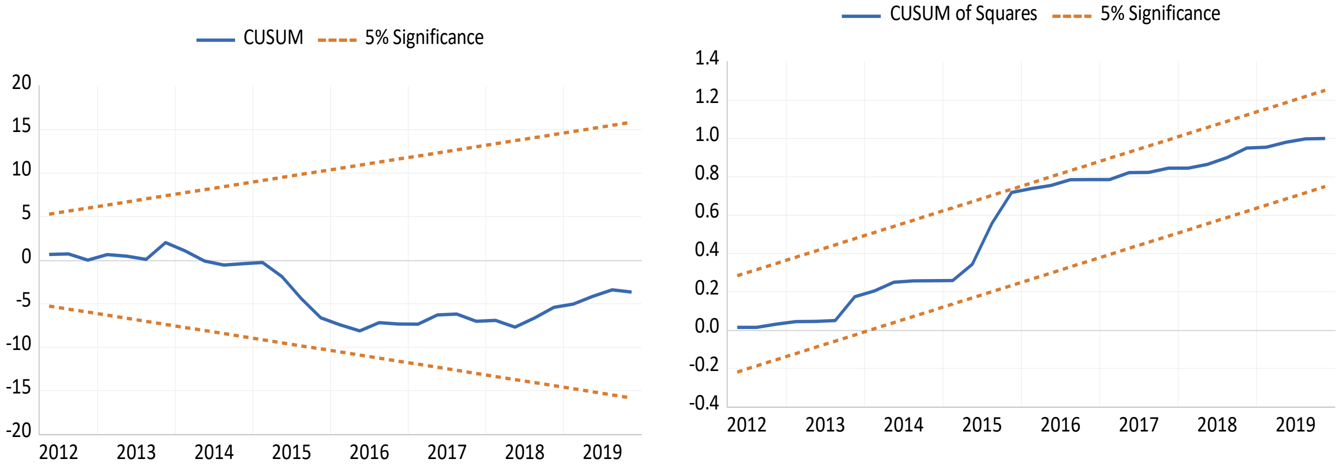
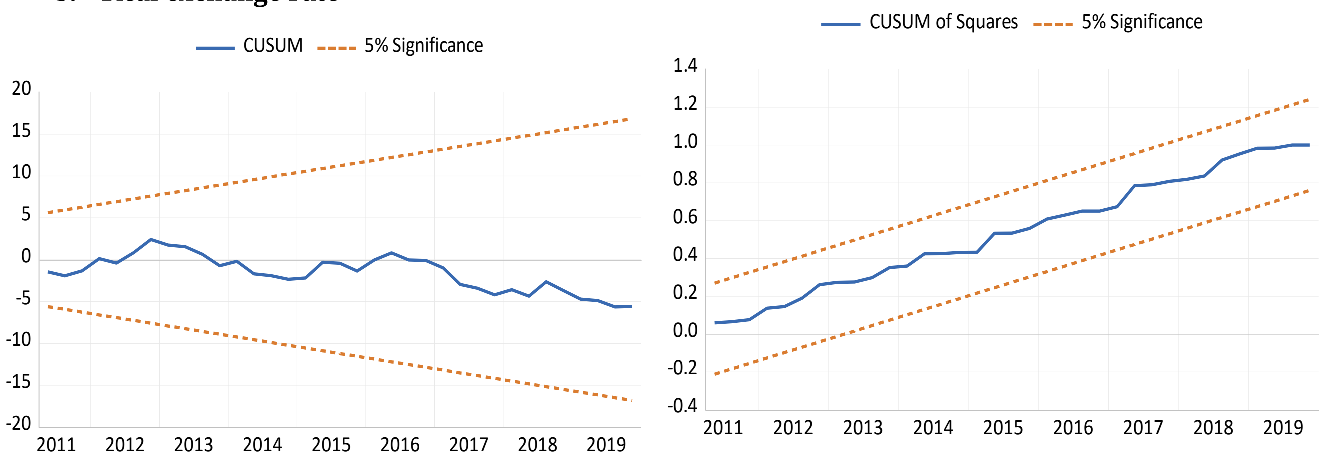


Figure 3: CUSUM and CUSUM of squares tests

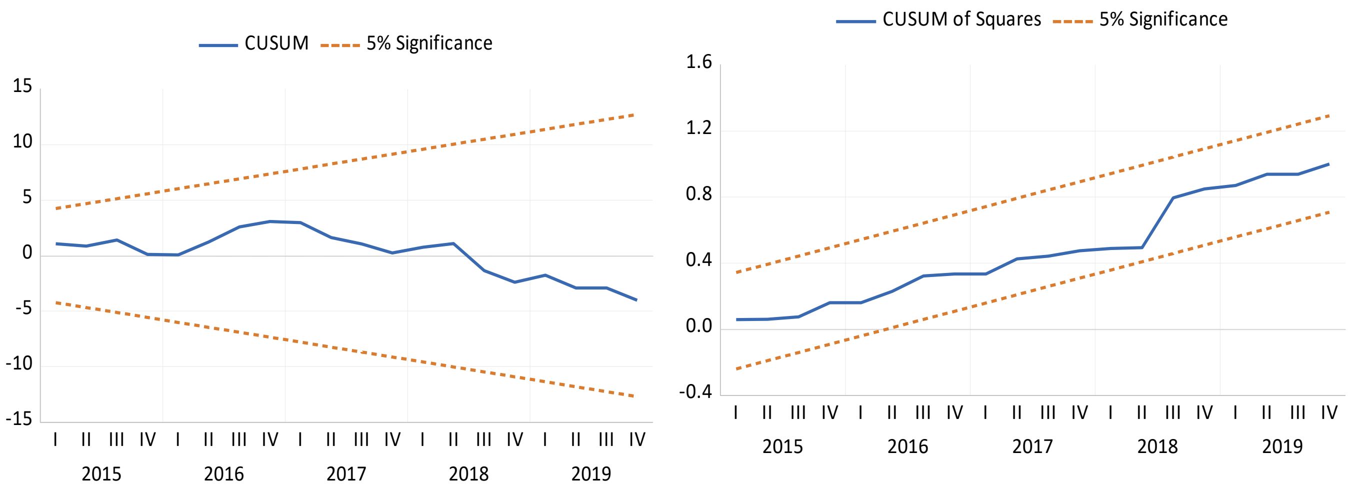
a. Real interest rate



b. Real exchange rate



c. Inflation



5. Conclusion

This paper has dwelt on the analysis of the effects of the fiscal deficit on the transmission of monetary policy to interest rates, the exchange rate and inflation in Tanzania by using quarterly time series data for the period 2001: I – 2019: IV. The paper utilise a combination of non-linear cointegration methods and dynamic ARDL models to explore the possible existence of asymmetric impact of fiscal deficit on real interest rate, real exchange rate, and inflation in Tanzania – underpinned by the theoretical foundations of the sovereign risk premium, stating that when a country suffers from a weak fiscal position, an increase in fiscal deficits could raise the probability of sovereign default, which then leads to an increase in interest rates, a depreciation of domestic currency, and ultimately, higher inflation rates.

The findings obtained in this study are consistent with a number of existing studies that, apart from monetary policy, there exist a significant long run asymmetric effects of both deterioration and improvement of fiscal deficit on interest rate, exchange rate and inflation. The finding implies large fiscal deficits prompt real depreciation of the Shilling, increases in interest rate and inflation. While the response of the interest rate to fiscal improvement is found insignificant, it rather poses significant and powerful effects on real exchange rate and inflation. This has one important policy implication: - government commitment to long-term fiscal consolidation is essential for effective monetary policy action via the price based policy framework in Tanzania. Besides, the empirical findings imply expansionary fiscal policy actions should be carefully pursued as may potentially lead to fiscal dominance, as the deficit has been on rising trajectory over the past recent years.

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[1] The financial reform measures were constituted in First Generation Financial Sector Reforms Programme (FGFSR) implemented during the period (1991-2003) and the Second Generation Financial Sector Reforms Programme (SGFSR) program launched in 2006 to strengthen the gains from implementation of the FGFSR.

[2]The price-based regime was approved by the Board of Directors of the BoT on July 16, 2014.

[3] The marginal cost of extra borrowing remains unchanged as debt accumulates.

[4] The model builds on Baldacci and Kumar (2010), Blanchard (2004) and Cerisola and Gelos (2005).

[5] There are various proxies that approximate the value of the credit risk of a country or region. Ratings from rating agencies have been used in several studies (Datta et al. 1999; Remolona et al. 2007). However, the drawback of using ratings is that they are infrequently reviewed and, therefore, show low variability, making the proxy less dynamic for analysis. In addition, Altman and Rijken (2004) indicated that rating agencies focus on a long-term horizon and that they do not take into account short-term movements. The use of sovereign spreads is also common in the literature (Bayoumi et al. 1995; Bernoth et al. 2012; Ağca and Celasun 2012). Risk premiums represent the difference between the sovereign bond yields of a specific country and a specific maturity relative to a bond with similar characteristics for a country that acts as a benchmark.

[6] One year commercial bank lending rate is used; and 364 days Treasury bill rate is used as a proxy for a policy rate.

[7] Nominal exchange rate is defined as Tanzanian Shilling (TZS) per 1 USD. Real exchange rate is 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.

[8] Core inflation (12 month percentage change).

[9] Unlike Baldacci and Kumar (2010), government debt is excluded in order to avoid its potential with budget deficits.

[10] The approach builds on the ARDL procedures developed by Pesaran and Shin (1999) and Pesaran et al. (2001) which has several advantages over other tests for cointegration, for example, the Johansen and Juselius (1990) approach: it can be applied without prior knowledge of the cointegrating rank of the regressors; can be used regardless of whether variables are purely I (0), or purely I (1), or mixed; it attends to serial correlation problem potential in models with endogenous regressors; and, it yields efficient cointegrating relationships in small and finite sample sizes (Pesaran and Shin 1999; Pahlavani 2005). Also, short run parameter estimates of the ECMs can be obtained from the estimated ARDL model.

[11] The number of lag lengths, p, varies across independent variables.

[12] In accordance with the asymmetric relationship found in the previous step, the asymmetric cumulative dynamic multiplier effects of a unit change in b_t^+ and b_t^- on policy transmission variables is generated. For instance, dynamic multipliers from equation (3) is presented as:

$$m_h^+ = \sum_{k=0}^{h} \frac{\partial r_{t+k}^L}{\partial b_t^+}; \quad m_h^- = \sum_{k=0}^{h} \frac{\partial r_{t+k}^L}{\partial b_t^-} \quad h = 0, 1, 2 \ldots ....$$

$h \to \infty, m_h^+ \to \gamma^+$ and $m_h^- \to \gamma^-$, with γ^+ and γ^- are the asymmetric long-run coefficients computed as $\gamma^+ = -\left(\frac{\beta_2^{r^L}}{\alpha^{r^L}}\right)$ and $\gamma^- = -\left(\frac{\beta_1^{r^L}}{\alpha^{r^L}}\right)$, respectively.

[13] The exchange rate is log-transformed. Interpretation on the effect of the regressor is such that (exp (-0.0552) – 1) * 100 = -5.3704%. For every 1% change in the independent variable, the dependent variable changes by about -5.3704%.