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Budget Deficits, Money Supply and Inflation in Tanzania: A Multivariate Granger Causality Test, 1967 – 2010

Michael O. A. Ndanshau

ABSTRACT

This paper investigates empirically the nexus between budget deficits, money supply and inflation in Tanzania by employing data for the period 1967 – 2010. Pair-wise Granger causality test established a one-way causal effect, running from inflation to budget deficit and the monetary base. These findings were supported by results from the Vector Error correction model (VECM) estimated. It is shown that there exist a significant inflation inertia and causal effect on budget deficit over the short-run. The VECM results showed that shift in monetary policy regime exerted a significant effect on inflation and budget deficits. Innovation of the ratio of budget deficit to money balances as alternatives for the traditional budget deficit to income ratio was found to lack significant effect on the results. Results are very indicative but highlight the importance of containing inflation to check its effect on budget deficits over the short-to long-run periods. The results also suggest that robust econometric results can be obtained by deflating budget deficits by monetary aggregates or income.

Key words: Inflation, fiscal deficits, money supply, Granger causality, vector error correction model.

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Michael O. A. Ndanshau

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Budget Deficits, Money Supply and Inflation in Tanzania: A Multivariate Granger Causality Test, 1967 - 2010[1]

1. INTRODUCTION

Attainment of fiscal balance, that is, balanced budget, is one of the policy approach given priority during implementation of economic reforms programmes (ERP) in Tanzania since the mid-1980s. The ERP, which was implemented in two successive phases, among others, targeted to lower inflation through prudent fiscal discipline: cuts in government expenditures and efforts to increase government tax revenues collection, coupled with implementation of stringent monetary and trade policies. Emphasis on fiscal discipline arose from two intertwined conventional arguments: one is that development of macroeconomic crises in Tanzania since the 1970s owed explanation from fiscal policy excesses evidenced by increased government participation in both directly and indirectly productive economic activities since promulgation of Arusha Declaration in 1967. Second, there is an argument anchored in mainstream macroeconomic theory that the macroeconomic crises experienced in the country, particularly that an increase in inflationary pressure since the mid-1970s, was caused and curable by fiscal discipline, that is, attainment of internal balance.

The main purpose of this paper is to bring data on Tanzania to bear on the hypothesis that budget deficits, especially when monetized, Granger-cause inflation. In due regard, the causal effect of budget deficits on inflation is investigated by using Granger (1969) type Vector Autoregressive (VAR) method augmented by an error term and two fundamental

[1] The author acknowledge with thanks very valuable comments and suggestions made on the initial version of this paper by Prof. Nehemiah E. Osoro and Prof. Asmeron Kidane of the Department of Economics, and Dr. Charles Saanane of the University of Dar es Salaam. Their comments contributed to the perfection of this paper. The usual disclaimer, however, applies that I am solely responsible for the view and any errors of commission or omissions in this paper. Correspondence: moanda90@yahoo.com

determinants of inflation in developing countries, namely, output and exchange rate. The study covers the period 1967 – 2010, and, its value addition is in one main area: policy relevance and dearth of empirical evidence to inform policy on the nexus between budget deficits, money supply and inflation in Tanzania. Among others, the hypotheses on the nexus between the budget deficit, money supply and inflation are yet to be subjected to rigorous Granger causality tests. Rather, most previous studies on Tanzania estimated short-run and long-run inflation equations with budget deficit and/or money supply as one of the regressands (Nyasebwa and Ndanshau, 2012; Ndanshau, 2010; Solomon and de Wet, 2004; Laryea and Sumaila, 2001; Kilindo, 1992, 1997). In this regard, the present study fills the gap in literature, and, carries information for design of a policy to achieve price stability in the country.

The paper is organized in six sections. After this introductory section, Section 2 presents an overview on evolvement of budget deficit, money supply, and inflation in Tanzania; and, Section 3 reviews the relevant literature. Section 4 dwells on methodology of the study; and Section 5 presents, discusses and interprets empirical results. Section 6 presents the main findings, their policy implications and areas for further research.

2. FISCAL DEFICIT, MONEY SUPPLY AND INFLATION IN TANZANIA: A BROAD OUTLINE

At attainment of political independence in December 196,1 the first post-colonial Government led by President Julius K. Nyerere in the then Tanganyika, now the United Republic of Tanzania (URT) after the 1964 union with the Isles of Zanzibar, declared ignorance, poverty, and diseases arch-enemies left by the British colonial rule. In this regard,

and consistent with the 1960 "ten decade declaration" of the United Nations, the government pursued several macroeconomic policy strategies targeted attainment of rapid economic growth. In December 1960, the government prepared a three years development plan implemented during the period 1961/62-1963/64, and, it was succeeded by the First Five Years Plan (FFYP) implemented during the period 1964/65-1969/70 in which import substitution industrialization (ISI) strategy featured prominently.

Moreover, in order to simultaneously reduce structural imbalance characterized by dominance of agricultural sector in the national output and foster rapid industrialization that was considered critical for rapid economic development the government launched the Basic Industry Strategy (BIS) under the Second Five Year Plan (SFYP) implemented during the period 1975-95. Also, in order to expand outreach to the hinterland, the government launched a Decentralization Policy in 1972 that lasted briefly but led to an in the number of local government authorities (LGAs) (URT, 1972). Furthermore, to expressly fight poverty and ignorance amongst majority of the population, the government launched several programmes and policy strategies during the period 1967-1986. They included compulsory villagization implemented between 1972 and 1974; subsidized agricultural credit for small-scale farmers; free delivery of basic social services (health services, education, and water); nationalization of private firms; and establishment of several state-owned enterprises (SOEs).[2]

The programmes in development plans implemented during the period 1967-1986 led to a significant rise in the share of development expenditure in the annual fiscal budgets.[3] For example, between 1967 and 1980, the ratio of the nominal Government expenditure to

[2] The SOE were elsewhere referred to as parastatal organizations or public enterprises, to partake productive economic activities in what were referred to as key sectors of the economy, among others, industry, mining, agriculture, banking, transport and communication, trade, and oil refinery.

[3] Three five year development plans were implemented during the period 1961-1986, *viz*, the First Five Year Plan (FFYP) of 1964-1969; Second Five Year Plan (SFYP) of 1969-1974; and the Third Five Year Plan (1976-1981). Implementation of the latter was delayed by lack of financial resources.

the nominal GDP rose from 18.01 percent to 33.1 percent. However, the government lacked adequate domestic financial resources. The tax base and taxable capacity of the economy were very small; and, tax collection was weak and structurally ill-suited to provide the requisite resources. As a result, the large government size relative to tax revenues translated to large budget deficits that, as a ratio of the GDP, rose from about (absolute) 3 percent in the 1960s to as high as about 13 percent in early 1980s (Table 1). To aggravate budget deficits, there were several internal and external shocks that increased government expenditure. They included : a) adverse weather conditions in 1975 that affected the agricultural sector that particularly necessitated food imports; b) oil crisis in 1973/1974 and 1979, 2000s; c) break down of the first generation of the East African Community (EAC) in 1977; d) the war against President Idi Amin of Uganda in 1978/1978; and e) subsidies to financially ailing SOEs; f) decrease in the taxable capacity of the economy, mainly due to poor performance in key sectors of the economy, including agriculture, mining and industry. Others included spill-over into the country of global financial crisis as well as a drought in 2008/09 that were accommodated by a fiscal package of 2 percent of GDP and monetary easing implemented by the government with support from the IMF's Exogenous Shock Facility (ESF).[4]

There are several ways of financing fiscal deficits.[5] However, seigniorage revenues, that is, revenues from creation of money supply, appear to have been the most viable option that was available to the government. The importance of seigniorage revenues increased

[4] To also address the Global Financial Crisis (GFC), the government of Tanzania additionally filled the gap in revenue caused by the GFC. The government accommodated in the budget for FY2009/10 a net domestic financing (NDF), equivalent to 1.2 percent of GDP in 2008/9 and 1.6 percent of GDP in 2009/10. b) Reduce the tax rate: such as the VAT rate from 20 percent to 18 percent and income tax of selected categories from 30 percent to 25 percent. Lunogelo, Mbilinyi and Hangi (2010), p. 22

[5] There are four ways for financing budget deficit: "printing money, running down foreign exchange reserves, borrowing abroad, and borrowing domestically" (Fischer and Easterly, 1990: 130). According to Easterly and Schmidt-Hebbel (1993), and also Fischer and Easterly (1990), each of the major type of financing budget deficit can cause macroeconomic imbalance if excessively used.

during the period under study for several reasons. They included the following: a) limited tax and non-tax revenues collected by the Government partly due to massive tax avoidance, evasion and exemptions; b) decrease in the inflows of external finance; c) the soft budget constraint syndrome enjoyed by government in its recourse to a bail-out by the banking system until the repeal of the 1966 charter of the Bank of Tanzania in favour of the Bank of Tanzania Act of 1995 that, among others, legally underscored importance of price stability by use of conventional financial policies; d) the financial system, liberalized since 1991, lacked the requisite savings for lending to the government; and, e) poverty amongst majority of the population adversely affected borrowing from the non-bank public.

Table 1 show that inflation in Tanzania rose dramatically from 2.89 percent during the period 1967-70 to unprecedented 32.5 percent during the period 1983-86. By the early 1980s, Tanzania was in severe macroeconomic crises such that the annual inflation rate rose rapidly from a low of 3.3 percent in 1970 to as high as 30.3 percent in 1980, a rate not representative of the so-called hyperinflation cases.[6] Moreover, the rate of economic growth fell from 5.8 percent in 1970 to negative 0.5 percent in 1981 that rendered budget deficits unsustainable.[7] Besides, the country was faced with very large deficits in the balance of payments, leading to severe foreign exchange constraints that adversely affected the import capacity of the economy, and in tandem, adversely affected production in key sectors that depended on imported intermediate inputs, among others, the industrial manufacturing sector, transport and communication as well as import of consumable.[8]

[6] According to Cagan (1956) hyperinflation episodes are characterized by monthly inflation rate above 50 percent in a period of one year or more.

[7] High and rapid rates of economic growth allow the economy to obtain more revenues by printing money or conversely allow large budget deficits. See Fischer and Easterly (1990).

[8] By March 1986 external payments arrears stood at 700 million dollars and total debt service were equivalent to about 60 percent of total export earnings (http://www.tzaffairs.org/1986/09/tanzanias-economic-recovery-programme).

Table 1: Inflation, Fiscal Budget and Monetary Facts, 1967 - 2010

Year	Inflation (π)	Government expenditure to GDP ratio	Nominal Revenue to GDP ratio	Deficit to GDP ratio (bd) (nominal)	Growth in Government expenditure to GDP ratio(real)	Real Revenues to real GDP	Money supply (M2) growth	Base Money (H) Growth
1967-70	2.89	14.70	11.75	-2.94	52.24	11.75	24.85	13.26
1971 -74	10.50	23.77	17.51	-6.26	67.92	17.51	18.33	17.17
1975 - 78	12.88	27.49	19.10	-8.39	45.37	19.10	20.18	17.77
1979 -82	24.09	31.02	18.19	-12.83	28.96	18.19	27.95	29.44
1983– 86	32.50	24.60	16.41	-8.19	8.13	16.41	19.93	23.95
1987– 90	31.92	15.77	10.29	-5.48	1.65	10.29	34.98	33.45
199 – 94	27.23	15.61	11.34	-4.27	0.60	11.34	30.74	52.08
1995– 98	19.56	12.10	11.54	-0.57	0.19	11.54	14.97	17.28
1999-2002	5.87	15.02	10.93	-4.10	0.16	10.93	16.75	13.92
2003 – 06	6.47	21.20	12.23	-8.97	0.18	12.23	22.04	11.44
2007- 10	9.99	25.28	15.41	-9.88	0.15	15.41	23.55	16.54

Note: The inflation and deflation of the nominal variables is based on the old CPI (base 2011).

The poor economic performance prompted the government to launch two “home made” stabilization programs, namely, National Economic Survival Program (NESP) that targeted mobilization of domestic resources through austerity measures and an export drive to earn foreign exchange, which was implemented in the period 1981-1982, and a Structural Adjustment Program (SAPs) implemented between 1983 and 1985 that targeted to increase export earnings by liberalizing internal trade and some commercial activities (Bagachwa, 1992: 4). It is acknowledged by both domestic and foreign policy makers including development practitioners that the two stabilization programmes failed to stabilize the economy (Bagachwa, 1992; Lipumba, 1992). Accordingly, in 1986 the government conceded to implement the International Monetary Fund (IMF) and World Bank supported Economic Recovery Programme (ERPs). The ERPs engendered deployment of stringent fiscal and

monetary policies aimed, among others, at combating inflation by reducing excess liquidity in the economy and attaining both internal (fiscal) and external balance.[9]

As would be expected, inflation fell continuously since the launch of economic reforms in 1986 until the period 2003-06 when it took up an upward trend. Both inflation and the nominal ratio of government expenditure to the Gross Domestic Product (GDP) rose during the period 1967-86; fell during the period 1983-86 and 1995-98; and rose during the period 1999-2002 and 2007-2010 (Table 1). The ratio of nominal government revenues to GDP rose during the period 1967-1978; fell during the period 1979-1990; and, generally, rose since 1995, a period also marked by launch of the Tanzania Revenue Authority (TRA), an institution entrusted with tax administration in the country (Table 1). In real terms, the ratio of government expenditure to the GDP rose dramatically between 1967-70 and 1971-74 but then fell continuously to an unbelievable low rate of 0.15 during the period 2007-2010. The latter increase also resulted more from a decrease in development spending from double digit in the mid-1980s to a single digit in the late 1990s. Osoro (1997) notes correctly that the trend in fiscal deficits followed closely development in government development expenditure.

The fall in government revenues as government expenditure rose since the late 1970s led to fluctuations in budget deficits. As a percentage of the GDP, the budget deficits rose from a modest low of -2.94 in 1967-70 to -12.83 percent in 1979-82, when the country entered into war with Uganda (Table 1). Thereafter, the ratio of the budget deficit to the GDP fell continuously to a low of -0.57 in 1995-98. It was followed by a rise to -9.88 in the period 2007-10. Table 1 shows that the behavior of inflation was almost characterized by the same

[9] The implementation of ERP-I and ERP-II was succeeded by monetary and tax reform programmes. The former led to the repeal of the charter of the Bank of Tanzania of 1966 in 1995; and the latter led to the launch of Tanzania Revenues authority (TRA) and Value Added Tax (VAT) in 1998.

cycles exhibited by the ratio of budget deficits to the GDP, rising during the period 1967 and 1982 and falling during the periods 1983-86 to 1995-98; and rising again since the period 1999-2002 (Table 1). The ratio of budget deficit more increased dramatically in the period 2003-06 and 2007-2010, particularly so since 2008, due to a mild spill-over into the country of the Global Financial Crisis (GFC).[10]

This may suggest two things. One, the trend of money growth (M2) was dependent on the size of budget deficits that, according to Maliyamkono and Mason (2006), depended on the size of government development expenditure. Second, inflation (deflation) in Tanzania was positively related to an increase (decrease) in money growth. This is supported by the decrease in budget deficit (bd), which is most evident in the period 1995-98, and was accompanied by a fall in the growth rate of M2 and the monetary base (H) (Table 1).[11] It is noteworthy, however, that the correlation between budget deficit and inflation is -0.11, and, it is 0.32 for inflation and money supply (m2). On one hand, the poor correlation between budget deficit and inflation in Tanzania could be attributed to low inflation that existed during the sample period, which was lower than the so-called "moderate inflation" or the hyperinflation episodes type. On the other hand, the correlation between money growth and inflation suggests that inflation in Tanzania may not entirely be a monetary phenomenon.

[10] A task force formed to evaluate the effect of the GFC and propose mitigation strategies found reported in 2009 that the crisis had led to reduced production capacity and job cuts in different sectors. Accordingly, the government of Tanzania set aside 1.7 trillion shillings (about 1.3 billion U.S. dollars) as an economic stimulus package, among which over 200 billion shillings (152.67 million dollars) to aid local banks in separate programs from credit financing to traders, cooperative societies and large-scale farmers who were falling behind on loan payments during the fiscal year 2009/10. For more details, among others, see Lunogelo, Mbilinyi and Hangi (2010)

[11] The government failed to reach fiscal policy benchmarks for stabilization set by the IMF during the period 1993 to 1995. This was, however, corrected after the enactment of the Bank of Tanzania Act in 1995 by which the bank became able to contain expansion in domestic credit.

3. REVIEW OF RELEVANT LITERATURE

3.1 Theoretical Framework

Macroeconomic theory posits for existence of a link between budget deficits and inflation rates. The dominant view is that monetization of fiscal budget deficits has unidirectional "causal effect" on inflation (Friedman, 1968; King and Plosser, 1985; Hamberger and Zwick, 1991; Easterly and Schmidt-Hebbel, 1993; Agénor and Montiel, 2008). The monetarists view on nature of causality between budget deficits and inflation is thus, monetization of budget deficits increases the monetary base that, given a stable money multiplier or money demand function, increase money supply and finally inflation, as it is in the Quantity Theory of Money (QTM) context. This traditional view is challenged in literature in several contexts. On one hand, Sargent and Wallace (1973) maintain that bi-directional causality is the most appropriate categorization of nature of the link between budget deficits and inflation. The underlying argument is that inflationary finance aggravates further budget deficits, whose monetization leads to expansion of money supply that lead further to inflation. According to Aghevli and Khan (1978), the implied "reverse causality," causality between inflation and budget deficits, is a possibility in that while persistent government budget deficits would cause inflation, prolonged inflation rates may potentially widen the budget deficit by increasing government expenditure (Tanzi, Blejer and Teijeiro, 1987). Monetisation of such deficit would further lead to an increase in money supply and consequently, inflation would ensue. Furthermore, through the so-called Olivera-Tanzi effect, inflation may also widen the fiscal budget deficit by eroding tax revenue.

On the other hand, it is maintained that existence of causal effect between budget deficit and inflation is contingent upon sources of its financing. Causal effect of budget

deficit on inflation would only be obtained if it is financed by "printing money," that is, money creation (Easterly and Schmidt-Hebbel, 1993:212). However, in an economy with a vibrant financial system, first, sustained government borrowing from the banking system to finance budget deficits would increase interest rates that would lead to a decrease in private investment and consequently the volume of goods and services available in the economy. The supply constraint would, given the existing money volume of money balances in the economy, lead to an increase in the general price level. Second, even where money creation is used to finance budget deficit, the effect on inflation will depend on stability of the money demand function (Easterly and Schmidt-Hebbel, 1993:212). Implicitly, an unstable money demand function would blur the causal effect of money creation on inflation. Third, according to Easterly and Schmidt-Hebbel (1993) and also Catão and Torrenes (2003), mechanisms other than monetization of budget deficit that can influence inflation may blur the budget deficit-inflation nexus over the short-run. For example, depreciation of domestic exchange rate can push up prices, and, stubborn inflationary expectations will also sustain high inflation rates over the short-run (Easterly and Schmidt-Hebbel, 1993). Sargent and Wallace (1981) and also Basetto and Butters (2010) are of a view that the effect of budget deficits may not be contemporaneous due to lagged effect of monetary policy. It is also maintained in literature that high inflation may not be associated with large deficits in economies where central banks have independence from the executive branch of the government (Basetto and Butters, 2010: 83).

3.2 Empirical Literature Review

Evidence on the nature of causality between either budget deficit and inflation or budget deficits and both money supply and inflation in and outside the sub-Saharan African (SSA) countries is mixed.[12] Some studies carry evidence in support of the unidirectional causality of inflation by large budget deficits, for example, Chang (1994) in a study on Taiwan; Darrat (2000) in the case of Greece; and Habibullah, Cheah and Baharom (2011) in a study, which covered Asian countries. Existence of a unidirectional causal effect of budget deficits on inflation has been established by some country specific studies in SSA, for example, studies on Nigeria (Oladipo and Akinbobola, 2011); Ethiopia (Wolde-Rufael, 2008); Zimbabwe (Makochekanwa, 2008); Ghana (Ghartey, 2001; Islam and Wetzel, 1991); and Uganda (Barungi, 1997). Other studies established existence of a bidirectional causality between budget deficit and inflation, for example, Hondroyiannis and Papapetrou (1994) in a study on Greece; Okpanachi (2004) and Chimobi and Igwe (2010) in the case of Nigeria; and, Aghevli and Khan (1977, 1978); as well as Sandy (2003) in a study on Sierra Leone. Notable from literature is that some studies have failed to establish existence of causal effect of budget deficits on inflation in some developing countries: Hondroyiannis and Papapetrou (1997) in Greece; and Easterly and Schmidt-Hebbel (1993) in a study of ten countries in Latin America, Africa and Asia. Aside the budget deficits-inflation nexus, some studies on SSA countries have also established existence of a causal effect of budget deficit on monetary expansion, for example, Moser (1994) and Egwaikhide, Chete and Falokun (1994) in the case of Nigeria. A study by Wolde-Rufael (2008), however, failed to establish existence of a significant causal effect of budget deficit on money supply in Ethiopia.

[12] For a review of similar studies on developed capitalist economies not reviewed here to serve space, among others, see Catão and Terrones (2003) and Bassetto and Butters (2010); and, King and Plosser (1985).

In Tanzania, there exists a couple of studies on the relationship between budget deficits and inflation: Kilindo (1997), Solomon and de Wet (2004), Ndanshau (2010), Nyasebwa (2011) and Nyasebwa and Ndanshau (2012). However, only Solomon and de Wet (2004) explicitly and specifically tested the traditional hypothesis on nature of causality between budget deficit and inflation in Tanzania. Second, evidence in studies on Tanzania is mixed. Some established existence of a positive effect of budget deficits on inflation in Tanzania (Kilindo, 1997; Nyasebwa (2011).[13] Others, for example, Nyasebwa and Ndanshau (2012) failed to establish existence of a positive and statistically significant effect of budget deficit on inflation in Tanzania.

This paper complements in several ways previous studies on budget deficit-inflation nexus in Tanzania. First, it addresses head on the traditional hypothesis on the link between budget deficit and inflation by using Granger causality approach. Specifically, the paper tests the null hypothesis that budget deficit does not Granger case inflation in Tanzania; and, in relation, a null hypothesis that money supply does not Granger cause inflation is tested. Second, besides the use of pair-wise Granger causality test, the paper investigates empirically both short-run and long-run causality dynamics between inflation and budget deficit in Tanzania by using a Vector Autoregressive (VAR) model augmented with an error correction mechanism. Third, as if to carry out a post mortem of fiscal stabilization effect in Tanzania, the analysis is carried out for both pre- and post-fiscal stabilization period, *viz* 1967-1986 and 1987-2010. Fourth, the analysis nests into the estimation model hypotheses on other determinants of inflation in developing countries, specifically, money supply, output, and exchange rate. In this regard, empirical findings of this paper are expected to be greatly informative and policy relevant.

[13] For a brief review of the studies, among others, see Ndanshau (2010).

4. METHODOLOGY OF THE STUDY

4.1 Estimating Framework and Causality Test Technique

The basic estimation model that flows from the traditional theory on the nexus between budget deficit (bd) and inflation (Δp) is a bivariate equation system which, following Granger (1969) causality approach, reads as follows:

$$\Delta p_t = \phi_1 + \sum_{i=1}^{k} \alpha_{11} \Delta p_{t-i} + \sum_{i=1}^{k} \gamma_{12} bd_{t-i} + e_t$$

$$bd_t = \phi_2 + \sum_{i=1}^{k} \alpha_{21} \Delta p_{t-i} + \sum_{i=1}^{k} \gamma_{22} bd_{t-i} + u_t \qquad (1)$$

where the variables are in natural logarithm, k is the maximum lag length, and e as well as μ are additive stochastic error terms that, by assumption, are normally distributed with zero mean and a constant variance. The testable null hypotheses are two. One, that $\sum \gamma_{ij} = 0$ and $\sum \alpha_{ij} \neq 0$, that is, budget deficit (bd) does not Granger cause inflation (Δp). Second, there is an hypothesis that $\sum \alpha_{ij} = 0$ and $\sum \gamma_{ij} \neq 0$, implying that Δp does not Granger cause bd. Acceptance of either hypothesis will suggest existence of unidirectional causality between Δp and bd and, feedback between Δp and bd exists if $\sum \gamma_{ij} \neq 0$ and $\sum \alpha_{ij} \neq 0$. Alternatively, lack of causality between Δp and bd exists if $\sum \gamma_{ij} = 0$ and $\sum \alpha_{ij} = 0$, as it is in the Ricardian equivalency hypothesis.

The basic monetarist's hypothesis demands for an augmentation by key hypotheses from theoretical developments and stylized empirical evidence on the inflation-budget deficit nexus in and outside developing countries. From theoretical developments, first, the maintained hypothesis that the causality between budget deficits and inflation is

unidirectional is discounted in favour of bidirectional causality. As argued, an initial increase in money supply from monetization of budget deficits creates inflationary pressure that increases the government expenditure faster than government revenues such that authorities are forced to monetize further the budget deficits, that is, increase further the expansion in money supply (Aghevli and Khan, 1977: 390). Notable, therefore, the self perpetuating effect between fiscal deficits and inflation is impregnated in the two testable hypotheses: a) inflation Granger causes expansion in money supply; and, b) inflation Granger causes budget deficit, a presumed "middle rung" link in the "traditional" money-inflation nexus. According to Aghevli and Khan (1977), the "importance of the feedback from inflation to the expansion in money supply" is, however, more likely in the so-called hyperinflation countries of which Tanzania has never been one.

Second, Montiel (1989) and Sargent and Wallace (1981) as well as Leviatan and Piterman (1986) share a view that factors typically related to fiscal imbalance, for example, high growth in money supply and depreciation of domestic currency by devaluations dominates inflation process. In regards to devaluation of currency to solve balance of payment problems, this is considered inflationary because it bears a direct cost-push effect on domestic prices, especially in the import dependent developing countries. In the less developed countries (LDCs), in particular, output compression, and both food and oil prices, are additionally considered to bear an upward increase in prices but over the short-run period. Notable, however, inflationary pressure from either devaluation or monetization of budget deficits would also lead to an appreciation of the real exchange rate, and vice versa (Mundell, 1963; Fleming, 1962). In this context, endogeneity of the real exchange rate and its dependence on inflation is also theoretically a plausible testable hypothesis, that is, inflation

Granger causes appreciation of the exchange rate. However, according to the Ricardian equivalence theory, the effect of budget deficits on the exchange rate and also inflation could be neutral (Barro, 1989). Granted, monetization of budget deficits would neither "Granger cause" inflation nor cause appreciation of the real exchange rate.

Developments over the traditional theory and empirical literature on inflation are including in the analysis first, by including in (1) an equation that captures the endogeneity of money supply, a practice in some of the previous studies by, for example, Habibullah, Gheah and Baharom (2011) and Chinobi and Igwe (2010).[14] On theoretical and empirical grounds, the scheme of equation in (1) should also include an equation for exchange rate. However, the exchange rate is excluded in the analysis because it was fixed in a larger part of the sample period; and, there lacks adequate data for the exchange rate premium that has, in many cases, been used as its proxy measure. Second, following Engle and Granger (1987) as well as Granger (1986) representation theorem, a Vector Error Correction Model (VECM) schema is used instead to accommodate short-run dynamics in the causality between budget deficit and inflation.[15] Granted, the following system of equation is estimated,

$$\Delta p_t = \phi_{11} + \sum_{i=1}^{k} \alpha_{1i} \Delta p_{t-i} + \sum_{i=0}^{k} \gamma_{1i} \Delta bd_{t-i} + \sum_{i=0}^{k} \psi_{1i} \Delta m_{t-i} + \varsigma_1 D + \omega_1 ec_{t-1} + \varepsilon_{1t}$$

$$\Delta bd_t = \phi_{21} + \sum_{i=0}^{k} \alpha_{2i} \Delta p_{t-i} + \sum_{i=0}^{k} \gamma_{2i} \Delta bd_{t-i} + \sum_{i=0}^{k} \psi_{2i} \Delta m_{t-i} + \varsigma_2 D + \omega_2 ec_{t-1} + \varepsilon_{2t}$$

$$\Delta m_t = \phi_{31} + \sum_{i=0}^{k} \alpha_{3i} \Delta p_{t-i} + \sum_{i=0}^{k} \gamma_{3i} \Delta bd_{t-i} + \sum_{i=0}^{k} \psi_{3i} \Delta m_{t-i} + \varsigma_3 D + \omega_3 ec_{t-1} + \varepsilon_{3t} \qquad (2)$$

[14] This is also consistent with monetarists theoretical view in the quantity theory, and specifically so, the debate on the neutrality of money. Others, for example, Metin (1998) included instead the real rate of economic growth. Pre tests indicated that exchange rate has an effect on budget deficits and inflation rate. Nevertheless, it is included in the analysis because its adverse effect on the VAR results.

[15] The VEC approach is in several ways superior than the traditional Granger causality test: a) it gives the nature of the causal budget deficits-inflation nexus over the short-run and long-run period; and, b) the ECM "allows causality to emerge even if the coefficients of the lagged differences of the explanatory variables are not jointly significant" (Anoruo and Ahmad, 2001: 242).

where the variables are as already defined and ec_{t-1} is a one period lagged error correction terms from cointegrating equations, ε_{1t}, ε_{2t} and ε_{3t}, that are additive, independent and normally distributed with a zero mean and a constant variance, that is, rate $iid(0, \delta^2)$. Over the long–run, causality between endogenous and exogenous variables is bench-marked on coefficient of the error correction terms (ec_{t-1}). Long-run causal effect of budget deficit and money supply exist if $\omega_1 \neq 0$ and is statistically significant while $\omega_2 = \omega_3 = 0$. Bi-directional long-run causality among the endogenous would exist if $\omega_1 = \omega_2 = \omega_3 \neq 0$. Over the short-run, Granger causal effect exists if either parameter estimates of the lagged variables in the estimated equations are statistically significant at the conventional test levels. A dummy variable (D) has been included in the estimation of the VAR model to capture structural break noted in Exploratory Data Analysis (EDA) results possibly occasioned, among others, by pro-active fiscal and monetary policies implemented to stabilize the economy since 1995 (Maliyamkono and Mason, 2006).

4.2 The Variables, Data Sources and Type

The basic estimation model has four main variables: inflation rate (Δp), budget deficit (bd), money supply (m) and nominal exchange rate (er). Inflation rate is measured as the first difference of the logarithm of consumer price index (CPI). The measures of budget deficits that exist in literature are diverse and controversial.[16] Nonetheless, budget deficit is measured here as cash based government expenditure net of total tax revenues. Some commentators consider this as "more or less economically relevant measures of deficit" (Easterly and

[16] Different measures of budget deficits have been put to use. The conventional measure used here, which is synonymous to the public sector borrowing requirement, is criticized in the literature) effect of government expenditure on real economic activity; b) possible feedback between expenditure, income and tax revenues; and, c) sources of financing. See Tanzi (1993) and Blejer and Cheasty (1991).

Schmidt-Hebbel, 1993:217). Notable, however, while use of the ratio of budget deficit scaled by GDP is "the standard practice of scaling fiscal deficit by GDP," it is considered not to be theoretically appealing as "fiscal deficit scaled by narrow money, where the latter stands for the size of the inflation tax base" (Catão and Terrones, 2003: 4). Granted, robustness of basic results is explored by analysis of the causality between inflation and ratio of budget deficit to three monetary aggregates officially monitored for policy in Tanzania, *viz*, narrow ($M1$), broad ($M2$), and base money ($M0$). These are officially monitored by the BOT and M2 used in monetary programming. The nominal exchange rate (ER) is the domestic purchase price of a unit of dollar of the United States of America (USA), that is, US$.

The analysis is based on annual time series data for the period 1967-2010. The data were obtained from two sources, *viz*, CD-Rom of the International Financial Statistics (IFS) produced by the IMF and publications of the Bank of Tanzania (various).[17] To avert possible spurious regression results from use of non-stationary data, the Dickey and Fuller (1979) and Kwiatkowski, Phillips, Schmidt and Shin (1992) (KPSS) unit root tests implemented in Cottrell and Lucchetti's (2011) GETL (Gnu Regression, Econometrics and Time-series Library) were employed. Finally, the Engel and Granger (1987) two step cointegration test was used.

5 EMPIRICAL RESULTS

5.1 Descriptive Statistics of the Data

The descriptive statistics in Table 2 show that the mean and median of all variables, save for the inflation rate (Δp), are almost equal. This finding suggests lack of a serious outlier

[17] According to Osoro (2000) fiscal data in Tanzania exhibit "wide unexplained divergences even when official publications are used. As a result, the extent of their reliability is not always clear (p. 1).

problem in variables of interest. The skewness statistics also in Table 2 indicate that all variables, serve for money supply ($m2$), are slightly skewed to the right, that is, have slightly long tails to the right (Mukherjee, White and Wuyts, 1998: 81). More generally, it could be argued that all variables are almost symmetrically distributed. In addition, on account of the kurtosis statistics, which equal 3 for a normal distribution, the measures of budget deficits (bd) and money supply ($m2$) are about normally distributed. The kurtosis statistic suggests inflation (Δp) and exchange rate (er) have thinner tails than normal distribution, and bd_M2 has heavier tail than normal distribution.[18]

Table 2: Descriptive Statistics of the Variables in Level (in logarithm)

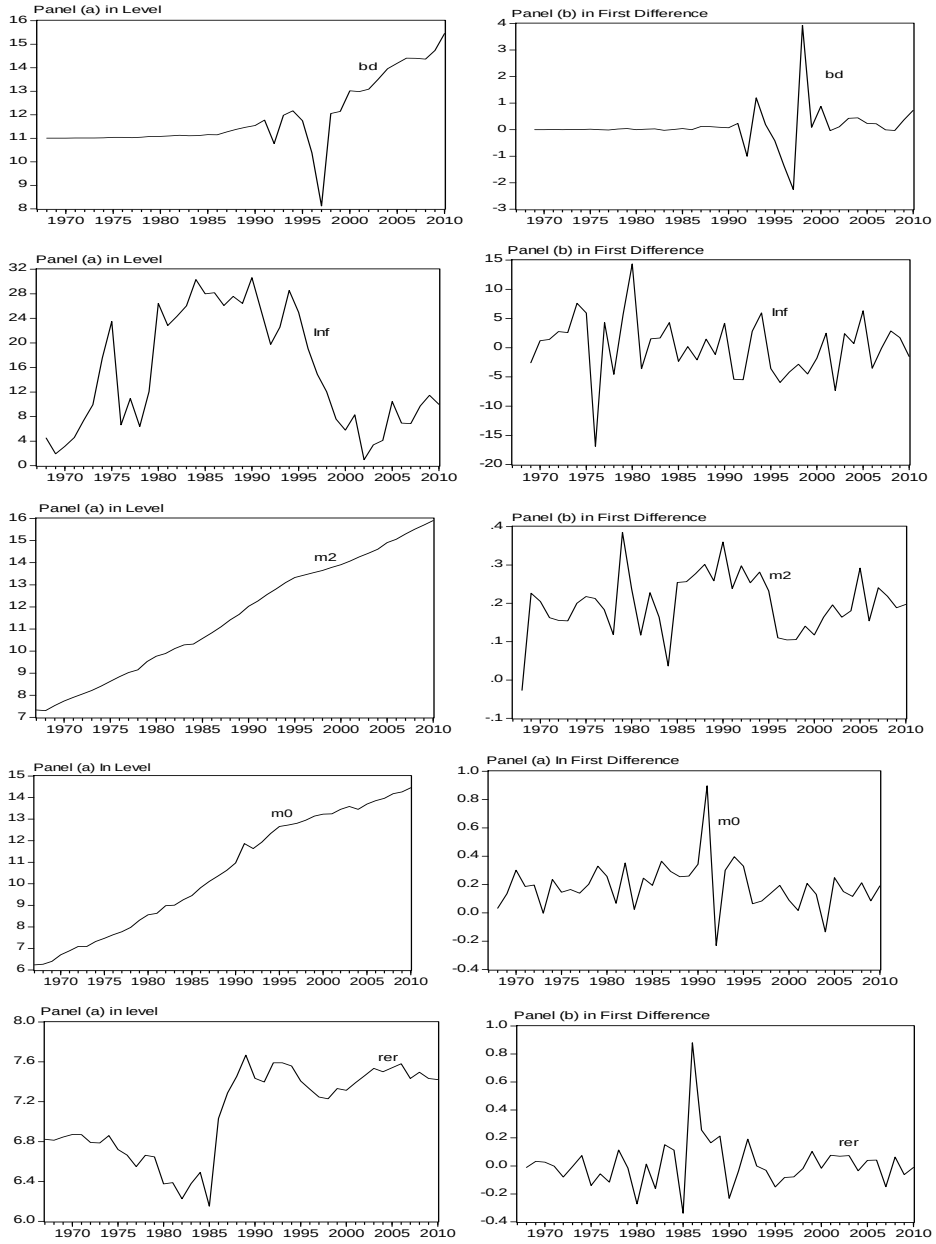
	bd	bd_y	bd_M1	bd_M2	bd_H	Δp	$m2$	$m1$	$m0$	er
Mean	11.89	-1.2	0.63	0.25	1.28	15.31	11.64	11.25	10.61	4.55
Median	11.15	-1.83	0.15	-0.19	1.00	12.06	11.66	11.32	10.62	5.26
Maximum	15.46	2.04	3.90	3.69	4.74	30.62	15.90	15.32	14.46	7.28
Minimum	8.12	-7.24	-4.99	-5.42	-4.69	1.00	7.31	7.10	6.27	1.94
Std. Dev.	1.44	2.10	1.84	1.91	2.02	9.55	2.63	2.53	2.68	2.18
Skewness	0.61	-0.2	-0.29	-0.2	-0.3	0.18	-0.04	-0.06	-0.12	-0.10
Kurtosis	3.48	2.87	3.56	3.29	3.20	1.49	1.68	1.67	1.52	1.23
Jarque-Bera	3.09	0.55	1.17	0.45	0.73	4.33	3.12	3.17	4.01	5.66
Probability	0.21	0.76	0.55	0.80	0.69	0.11	0.21	0.20	0.13	0.06
Observations	43	43	43	43	43	43	43	43	43	43

Notes: The variables are in natural logarithm.

In general, the descriptive statistics suggest that variables in level are about normally distributed, a condition for efficient parameter estimates.

[18] According to Gujarati (2003) the JB test is an asymptotic, or large sample, test (p. 148). A sample of 43 observations covered by this study is not large. See Gujarati (2003, p. 253).

Figure 1: Plot of the Logarithm of Variables in Levels and First Difference



The plots in Figure 1 suggest existence of a trend in all variables and also some outliers as well as structural breaks, particularly shift in policy regime in the country after launch of the World Bank and IMF supported ERPs in 1986, liberalization of the financial sector in 1991, and BoT's revert from direct to indirect monetary policy regime in 1995. This

could be taken to suggest that the mean of variables have been changing such that the log-level variables may not be stationary. Notable, however, the plots suggest that the variables are time invariant in their first differences, that is, they are likely first difference stationary. The EDA is complemented by more formal unit root tests.

5.3 Choice of the VAR Lag Length

Granger causality test demands *a priori* selection of the lag length so as to avoid establishment of spurious causality or spurious absence of causality. While selection of the lag structure is characterized by several approaches, the automatic lag selection method in GETL was used; and, on the basis of the BIC,[19] one lag (starred) is the maximum order of the VAR for estimation with and without a cognizance of a structural break.

Table 5: Choice of VAR Lag Length

lags	loglik	p(LR)	AIC	BIC	HQC
1	-102.164		6.008*	6.648*	6.238*
2	-96.368	0.237	6.173	7.196	6.540
3	-94.015	0.859	6.514	7.921	7.019
4	-83.140	0.010	6.417	8.209	7.060

Notes: The asterisks indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike information criterion, BIC = Schwarz Bayesian criterion and HQC = Hannan-Quinn criterion.

5.2 Unit Root and Cointegration Test Results

The ADF and KPSS test results reported in Table 3 show that, save for the price level (p), all log-level variables are non-stationary but all are first difference stationary at the 1 percent

[19] The other statistics, that is AIC and HQP also put at one the order of the VAR. It should be noted, however, that the SIC is the preferred criteria because it is known to be relatively stronger consistent estimator of the lag length. For details, see Clarke and Mirza (2005).

level of significance test--- for ADF in EViews with or without an intercept or both intercept and a deterministic trend. The ADF test in GETL showed, however, that the p was stationary at the 10 percent test level. The KPSS test results only fail to reject the hypothesis that the inflation rate (Δp) is stationary. Since inflation is the first difference of the price level used in the analysis, the general consensus is that the variables of the estimation model are first difference stationary and integrated of order one (I(1)).

Table 3: ADF Unit Root Test Results for the Variables of the Model

	ADF				
	with intercept		**with intercept and trend**		**KPSS**
Variable	**Level**	**First Difference**	**Level**	**First Difference**	**Level**
p	-1.326	-1.903	-1.829	-1.972	1.180
Δp	-1.903	-6.996*	-1.972	-7.106*	0.265
bd	-1.033	-7.763*	-2.505	-7.854*	0.792
$m1$	0.121	-5.576*	-1.776	-5.503*	1.201
$m2$	0.412	-5.713*	-2.747	-5.597*	1.202
$m0$	-0.660	-7.518*	-1.162	-7.543*	1.194
bd_y	-1.74	-7.467*	-1.877	-7.540*	0.858
bd_M0	-1.89	-7.366*	-1.687	-7.530*	0.817
bd_M1	-2.029	-7.778*	-2.172	-7.882*	0.798
bd_M2	-1.995	-7.727*	-2.210	-7.821*	0.793
er	-0.074	-4.924*	-2.622	-4.858*	1.132

Notes: a) The statistical test per McKinnon's (1990) critical values are: *=1%.
b) The KPSS critical values are thus: 0.352=10%, 0.472=5%, and 0.721=1%.

The nature of cointegration of the variables of the estimation model was explored by using Engle-Granger (1987) two-step procedure in GETL applied to the system of equations

in (1) and (2) for different measures of budget deficit (bd) and both money supply ($M1$, level ($M2$) and the base money ($M0$).[20]

Table 4: Engle-Granger Cointegration Test Results

Dependent variable	ADF (with intercept)	ADF (with intercept and a deterministic trend)	Order of Integration
$\Delta p \mid bd$	-1.717	-2.245	I(1)
$bd \mid \Delta p$	-1.640	-3.636 ***	I(0)
$\Delta p \mid bd_y$	-1.606	-3.071	I(1)
$bd_y \mid \Delta p$	-2.000	-3.832**	I(0)
$\Delta p \mid bd_y,\ m1$	-2.656	-2.596	I(1)
$\Delta p \mid bd_y,\ m2$	-2.722	-2.558	I(1)
$\Delta p \mid bd_y,\ m0$	-3.447	-3.491	I(1)
$bd_y \mid \Delta p,\ m1$	-3.453	-4.200 **	I(0)
$bd_y \mid \Delta p,\ m2$	-3.635***	-4.105 ***	I(0)
$bd_y \mid \Delta p,\ m0$	-2.952	-4.093 ***	I(0)
$\Delta p \mid bd_M1$	-1.504	-2.445	I(1)
$bd_M1 \mid \Delta p$	-2.360	-3.510 ***	I(0)
$\Delta p \mid bd_M2$	-1.680	-2.464	I(1)
$bd_M2 \mid \Delta p$	-2.480	-3.579 ***	I(0)
$\Delta p \mid bd_M0$	-1.135	-2.882	I(1)
$bd_M0 \mid \Delta p$	-1.956	-3.650 ***	I(0)

Notes: *, **, ** stands for 1%, 5% and 10% critical value in McKinnon's (1990) critical values.

[20] There are several other procedures but the Engle-Granger approach was used because it is the simplest and most efficient. The other common test for cointegration in contemporary literature is that associated with Johansen and Juselius (1990) and Johansen (1991) which is suitable for large rather than small samples as used in this study. Pesaran, Shin and Smith (2001) have also innovated a cointegration test based on unbound autoregressive distributed lag (ARDL) schema. The procedure has not been tried here because it also requires a relatively larger sample of observations.

Results in Table 4 suggest existence of cointegration amongst budget deficits, inflation and money supply; and, there is only one way causality that runs from inflation and either money supply ($m1,\ m2$) and the monetary base ($m0$), irrespective of how budget deficit and money supply are measured. Given existence of cointegration between the variables and the fact that the level variables were individually $I(1)$, it follows that there exists at least one way causality in variables of the equation system, and, that an estimation of a Granger type VAR or a VECM in the scheme of equations in (2) in level would not lead to spurious regressions results.

5.4 The Bivariate Causality Test Results

Table 5 presents bivariate Granger causality test for the inflation-budget deficit and money supply nexus by using different measures of budget deficit and monetary aggregates. The results accept at the conventional test level the hypothesis that budget deficits as a ratio of the GDP (bd_y) does not Granger cause inflation. These results apply to all other money based measures of budget deficit used in the analysis. Instead, the hypothesis that inflation does not Granger cause budget deficit, where the latter is measured as the ratio of the GDP (y), is rejected at 10 percent test level. The hypothesis is also rejected at 10 percent significance test level when the budget deficit is deflated by the monetary base (bd_m0) but not the rest of the monetary aggregates used in the analysis (Table 5). Table 5 also shows that the hypothesis that inflation does not Garnger cause inflation is significantly rejected when budget deficit is deflated by the monetary base ($m0$) but not the other measures of money, $m1$ and $m2$. According to the basic results in Table 5, causality between inflation and budget deficit is unidirectional, and it runs from the former to the latter. Furthermore, results fail to reject the

Table 5: F-Test Statistics for Pair-wise Granger Causality Tests for Inflation—Budget Deficit Nexus

Case	Null Hypothesis:	F-statistic	P-Value
1	Budget deficit (bd_y) does not Granger Cause inflation	1.459	0.246
	Inflation does not Granger cause budget deficit (bd_y)	2.645	0.085***
2-1	Budget deficit (bd_y) does not Granger cause money supply (M1)	0.137	0.872
	Money supply (M1) does not Granger cause budget deficit (bd_y)	0.575	0.567
	Budget deficit (bd_y) does not Granger cause money supply (M2)	0.656	0.525
	Money supply (M2) does not Granger cause budget deficit (bd_y)	0.287	0.752
	Budget deficit (bd_y) does not Granger cause money supply (M0)	3.166	0.054***
	Money supply (M0) does not Granger cause budget deficit (bd_y)	0.436	0.650
2-2	Money supply (M1) does not Granger cause inflation	3.010	0.062***
	Inflation does not Granger cause money supply (M1)	0.972	0.388
	Money supply (M2) does not Granger cause inflation	2.251	0.120
	Inflation does not Granger Cause money supply (M2)	0.909	0.411
	Money supply (M0) does not Granger cause inflation	1.303	0.284
	Inflation does not Granger cause money supply (M0)	3.457	0.039**
3	Inflation does not Granger Cause budget deficit (bd_m1)	2.077	0.140
	Budget deficit (bd_m1) does not Granger cause inflation	1.207	0.311
	Inflation does not Granger Cause budget deficit (bd_m2)	1.912	0.162
	Budget deficit (bd_m2) does not Granger cause inflation	1.199	0.313
	Budget deficit (bd_m0) does not Granger cause inflation	1.387	0.262
	Inflation does not Granger cause budget deficit (bd_m0)	2.546	0.092***

Note: Figures in parentheses are p-values.

hypothesis that budget deficit as a ratio of the GDP Granger causes the narrow and broad measures of money supply, and vice versa. Even though, the results reject at 10 percent, the hypothesis that budget deficit does not Granger cause monetary base ($m0$), is a measure of seigniorage.

Results in Table 5 do not reject the hypothesis that money supply, measured by the narrow money ($m1$) and the monetary base ($m0$), does not Granger cause inflation. According to results, the effect on inflation of both $m1$ and $m0$ is unidirectional and thus, consistent with the traditional theory. Incidentally, however, the broad money ($m2$), traditionally used as the basis of monetary policy programming in the country, lacks the hypothesized causal effect on inflation. It should be noted that results in Table 5 reject the argument by Catão and Terrones (2003) that scaling of budget deficit by money balances instead of income is superior because there does not exist unidirectional or bidirectional causality between the inflation and the ratio of budget deficit to the narrow and broad measures of money supply. Instead, the results point to existence of causality effect from inflation to the ratio of the budget deficit to the monetary base ($m0$), that is, bd_m0.

5.5 The VECM Results

The VECM estimation results in Table 6, first, show that the estimated coefficients for the error correction term (ec_{t-1}) in the basic equation system with budget deficit scaled by the GDP is statistically insignificant in the equation estimated for inflation but statistically significant at 1 percent test level in the equation for budget deficit only. This is inconsistent with the traditional theory and empirical findings in some of the previous studies in Tanzania

and other developing countries, for example, Solomon and de Wet (2004) in Tanzania; and Onwioduokit (1999) and Folorunso and Abiola (2000) in the case of Nigeria.[21] Notable, however, is that lack of causal effect of the budget deficit on inflation in Tanzania appears consistent with some fundamentals in the country during the sample period. These are: a) external finance of budget deficit dominated such that monetization of budget deficits was quite limited, particularly so since the mid-1980s; b) available anecdotal evidence shows and reveals dominance of external finance in the finance of budget deficits during the sample period; and, c) but in relation to the existence of unidirectional and/or bidirectional causality between budget deficit and inflation has, in most cases, been an affair in high and hyperinflation countries during high inflation episodes (Fischer, Sahay and Vegh, 2002; Catão and Terrones, 2003).

Table 6: VAR Results of the Basic Inflation-Budget Deficit Nexus in Tanzania

	ec_{t-1}	Δbd_y_{t-1}	Δp_{t-1}	Dum	$Constant$	R^2	D-W	
Δp	-0.002 (0.003) -0.595	0.001 (0.010) 0.1420	0.689 (0.109) 6.337 ***	0.056 (0.027) 2.117 **	0.013 (0.016) 0.7901	0.769	2.111	
Δbd_y	-0.167 (0.053) -3.162 ***	-0.011 (0.253) -0.042	-5.183 (1.672) -3.100 ***	0.852 (0.409) 2.081 **	-0.011 (0.253) -0.042	0.310	2.092	

Note: a) The asterisks stands for statistical test significance levels: *=10%, **= 5%, and ***= 5%.
b) Figures in parentheses are t-statistics.

[21] The differing results could be attributed to differing granger causality test methods put to use. For example, Olusoji and Oderinde (2011) used Toda and Yamamoto (1995) method while others used simple granger method.

The coefficient of the ec_{t-1} in the budget deficit equation is, however, statistically significant at 1 percent test level; and, its magnitude suggests that adjustment to equilibrium is only about 17 percent per annum, a very low speed indeed. Significance of the coefficient of ec_{t-1} suggests that inflation Granger cause budget deficit over the long-run period. This finding, coupled with lack of a long-run effect of budget deficit on inflation established by this study, suggests existence of a unidirectional long-run causal effect of inflation on budget deficit in Tanzania during the period under study. However, it is notable that the short-run parameter estimates in the basic system of equation suggest that an effect of inflation on budget deficit is negative and statistically significant at the 1 percent test level but is not contemporaneous. This finding is consistent with the expected adverse effect of inflation on budget deficits and, more so, empirical evidence in previous studies. Suffice it to note that the significant negative short-run effect established by this study is inconsistent with most previous studies, among others, on SSA by Olusoji and Oderinde (2011) and Egwaikhide, Chete and Falokun (1994), Asogu (1992) and Busari (2007).

Results in Table 6 also show that the shift in policy regime, measured by the dummy variable (D), has a significant effect on budget deficit. The positive sign on parameter estimates for the structural break suggests an increase in inflation from economic reforms, a finding not unfounded in view of price controls and pent-up demand that existed prior to launch of economic reforms and fiscal indiscipline, tax evasions and tax exemptions that existed between the mid-1980s and the mid-1990s.

Table 7: VAR Results on Inflation-Budget Deficit Nexus in Tanzania, by Different Scales

	M1			M2			M0		
Variables	Δp	Δbd_y	$\Delta m1$	Δp	Δbd_y	$\Delta m2$	Δp	Δbd_y	$\Delta m0$
$Constant$	-0.308	-8.618	-0.356	-0.355	-9.645	-0.225	-0.505	-10.622	1.731
	(0.162)	(2.620)	(0.321)	(0.175)	(2.762)	(0.266)	(0.313)	(5.205)	(1.016)
	-1.901 c	-3.289 a	-1.110	-2.026 c	-3.492 a	-0.846	-1.612	-2.041 b	1.703 c
Δbd_y_{t-1}	0.006	-0.054	0.0185	0.007	-0.037	0.017	0.007	-0.056	0.005
	(0.009)	(0.151)	(0.018)	(0.009)	(0.149)	(0.014)	(0.010)	(0.166)	(0.032)
	0.5449	-0.361	1.003	0.7159	-0.250	1.159	0.736	-0.338	0.169
Δp_{t-1}	0.580	-5.904	-0.222	0.582	-5.706	-0.106	0.710	-2.334	0.714
	(0.108)	(1.754)	(0.215)	(0.107)	(1.683)	(0.162)	(0.094)	(1.568)	(0.306)
	5.352 a	-3.365 a	-1.032	5.450 a	-3.390 a	-0.652	7.520 a	-1.488	2.332 b
Δm_{t-1}	0.082	-1.144	0.030	0.058	-1.877	0.155	-0.061	-1.642	-0.330
	(0.085)	(1.375)	(0.168)	(0.110)	(1.727)	(0.170)	(0.049)	(0.811)	(0.158)
	0.9635	-0.832	0.177	0.5302	-1.087	0.9313	-1.254	-2.025 c	-2.087 b
Dum	0.097	.563	0.153	0.101	1.587	0.101	0.072	0.481	0.032
	(0.035)	(0.563)	(0.069)	(0.034)	(0.535)	(0.052)	(0.023)	(0.383)	(0.075)
	2.795 a	2.775 a	2.220 b	2.967 a	2.965 a	1.965 c	3.136 a	1.256	0.432
ec_{t-1}	-0.035	-1.019	-0.057	-0.042	-1.195	-0.043	-0.014	-0.291	0.043
	(0.018)	(0.297)	(0.036)	(0.021)	(0.327)	(0.031)	(0.008)	(0.137)	(0.027)
	-1.908 c	-3.426 a	-1.567	-2.041 b	-3.659 a	-1.359	-1.677	-2.118 b	1.594
R^2	0.801	0.340	0.177	0.797	0.363	0.209	0.788	0.261	0.331
D-W	2.081	2.247	1.892	2.113	2.299	1.975	2.207	2.225	2.109

Note: a) The asterisks stands for statistical test significance levels: a=1%, b= 5%, and c= 10%.
b) Figures in parentheses are t-statistics.

Table 7 presents the VECM results for the equation system (2) that include money supply ($m1,\ m2$) and the monetary base ($m0$) to control for some arguments and empirical findings over the traditional inflation-budget deficits nexus. First, the results show that all estimated coefficients of ec_{t-1} in price equations with $m1$ and $m2$ are negative as expected and statistically significant at least at the 10 percent test level, and the coefficient is wrongly

signed and statistically insignificant in the equation of $m0$. This finding suggests that budget deficit and money supply bear a long-run causal effect on inflation over the long-run period. The coefficients of ec_{t-1} in the price equation with $m1$ and $m2$, respectively suggest that only 3.5 percent and 4 percent of short-run disequlibrium is corrected over the long-run period. This is unexplainably very small.

The coefficient of ec_{t-1} in all budget deficit equations with control for money supply and the monetary base are negative as expected and statistically significant at the 5 percent test level and above. Notable, however, the magnitudes (in absolute terms) are unexplainably very large in budget equation with $m1$ (1.019) and $m2$ (1.195) and low in the case of the $m0$ (0.291). The coefficients of ec_{t-1} suggest that adjustment of short-run disequilibrium in budget equation with money supply is cleared over the long-run period; and, only about 29 percent is cleared over the long-run in the budget equation with monetary base.

The coefficient of ec_{t-1} in the monetary aggregate equations is statistically insignificant at the conventional test levels, and it is wrong signed in the equation for the monetary base. This suggests lack of a long-run effect of budget deficit and inflation on money supply during the sample period. The results in Table 8 show existence of a significant inflation inertia over the short-run period. Moreover, the results show that causal effect of inflation on budget deficit is negative and very statistically in the equation system with m1 and m2 but not the m0. Also, the results show that inflation does not granger cause money supply over the short-run period. Inflation, however, appears to have a short-run causal effect on monetary base. It is also evident in Table 8 that the coefficients of one period lagged money supply (m1 and m2) are not statistically significant, a finding which suggests that money supply does not Granger cause budget deficit and inflation over the short-run

period. The estimated coefficient of the one-period lagged monetary base in the budget deficit equation is, however, statistically significant at the 10 percent test level, and also is statistically significant at the 5 percent test level in the monetary base equation. This suggests that monetary base Granger-cause budget deficit over the short-run period and is characterized by a regressive inertia.

Table 8: VECM Results on Inflation-Budget Deficit Nexus in Tanzania, by Different Scales of Money Supply

	M1		**M2**		**M0**	
Variables	Δp	Δbd_m1	Δp	Δbd_m2	Δp	Δbd_m0
$Constant$	0.028 (0.018) 1.521	0.759 (0.276) 2.752 a	0.025 (0.017) 1.497	0.638 (0.254) 2.513 b	0.0268 (0.020) 1.363	0.872 (0.302) 2.889 a
bd_m_{t-1}	0.003 (0.010) 0.2760	-0.046 (0.153) -0.300	0.004 (0.010) 0.3583	-0.027 (0.152) -0.178	0.004 (0.010) 0.417	-0.079 (0.154) -0.517
Δp_{t-1}	0.645 (0.117) 5.511 a	-5.301 (1.778) -2.982 a	0.645 (0.116) 5.534 a	-5.483 (1.752) -3.129 a	0.669 (0.115) 5.813 a	-5.008 (1.770) -2.829 a
Dum	0.066 (0.027) 2.418 b	0.887 (0.416) 2.136 b	0.067 (0.027) 2.449 b	0.946 (0.410) 2.309 b	0.0629 (0.028) 2.235 b	0.739 (0.428) 1.727 c
ec_{t-1}	-0.010 (0.010) -1.035	-0.496 (0.147) -3.382 a	-0.010 (0.010) -1.064	-0.529 (0.148) -3.568 a	-0.007 (0.008) -0.812	-0.367 (0.127) -2.894 a
R^2	0.774	0.321	0.774	0.336	0.771	0.282
D-W	2.066	2.115	2.067	2.121	2.092	2.064

Table 8 presents VECM results motivated by the argument by Catão and Terrones (2003) that scaling of budget deficit by money supply rather than the GDP is theoretically and empirically superior. On one hand, the results are quite consistent with the previous results for a number of reasons. First, the hypothesis that budget deficit does not Granger-

cause inflation over the long-run period is not rejected. The estimated coefficient of ec_{t-1} is also very small; and, this is consistent with a note by Enders (1995) that "absence of Granger causality for cointegrated variables additionally requires the speed of adjustment coefficient to be equal to zero (p. 367). Second, budget deficit is, as before, an insignificant determinant of inflation over the short-run and long-run periods. Third, inflation exerts short-and long-run effects on budget deficit. Fourth, shift in policy regime has a significant positive effect on both inflation and budget deficit, and lastly, on the basis of the coefficients of determination, the explanatory power from use of that innovation is marginally superior.

On the other hand, it is notable that constant terms estimated are relatively larger (in absolute terms) in equations estimated with the ratio of budget deficit to money supply ($m1$ and $m2$) and the monetary base with ($m0$). Also more significant, the coefficient of the error correction terms (ec_{t-1}) is relatively larger, suggesting a relatively higher adjustment of short-run equilibrium when budget deficit (bd) to $m1$ and *2* or the *0* is used. The negative sign on the coefficient of $_{-1}$ suggests existence of reversion to a stable equilibrium of short-term disequilibria between budget deficits and both money supply and inflation. The speed of adjustment to the long-run equilibrium ranges from 0.7 percent to 1 percent in the estimated inflation equations, and it ranges from 36 percent to 52.9 percent in the budget deficits equations.

6 CONCLUSION

The main purpose of this paper was to investigate empirically the nexus between budget deficits, money supply and inflation in Tanzania by using data for the period 1967-2010. The empirical results based on pair-wise Engel-Granger causality test only established existence

of a one-way causal effect of inflation on budget deficit and monetary base but not the other measures of money supply. Moreover, the results showed existence of a long-run causal effect of inflation on money supply, budget deficits and the monetary base. The results also showed existence of a significant inflation inertia and causal effect on budget deficit over the short-run period. Shift in monetary policy regime is also found to have caused significant effects on inflation and budget deficit. Innovation of the ratio of budget deficit to money balances as an alternative measure to the traditional budget deficit to income ratio was found to lack significant effect on results.

The results emphasize an importance of containing inflation to check its effect on budget deficit over the short- to the long-run periods. The results also suggest that the ratio of budget deficit to income provide a good basis for empirical studies and policy inferences. Notable, however, is that the findings and policy implications from the results are not foolproof but only indicative. Moreover, the effects on inflation of structural factors, such as rainfall, food prices, drought, oil price effect, and spillover into the country of global economic crises could not be modeled in either the estimated models. Further empirical test could thus complement the present effort.

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