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An Empirical Analysis of the Effects of Fiscal Deficit on Inflation Kenya

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Abstract
A key objective of macroeconomic policies is to foster high economic growth while maintaining low and stable rate of inflation. The relationship between public sector deficits and inflation is one of the important but controversial issues in both academic and empirical literature. Maintaining a stable inflation plays an important role in determining the growth rate of output. The main objective of this paper is to investigate the effects of fiscal deficit on inflation in Kenya based on quarterly data for the period 1996q1-2017q2. The results indicate no evidence of causal effect on either direction between inflation and fiscal deficit in Kenya. This is mainly attributed to how fiscal deficit is financed in Kenya. Deficit is financed through domestic and foreign debts due to restrictions of central bank's financing of deficits. Existence of a well-developed financial market for government securities and good international rating has facilitated smooth debt uptake. It is however observed that the continuous increase in both domestic and foreign debts above the growth rate of the economy may eventually reach an unsustainable levels and the government would have no alternative but to resort to seigniorage to meet its debt obligations. Growth of the economy, exchange rate depreciation, monetary policy stance and money supply are found to be the key determinants of inflation in Kenya during the period of study.
Keywords: Fiscal Policy, Monetary policy, Fiscal Deficit, Inflation, Money Supply

1. Background and Motivation

Rising fiscal deficits accompanied by escalating public debt has become an issue of major concern to policy makers all over the world. This arises from the need to understand the relationship between the fiscal deficits and other macroeconomic variables thereby attracting major debates in theory as well as empirical work.

The fiscal deficit problems in Kenya started after the global oil crises in 1973/74 though it decreased during the coffee booms of 1976/77 and 1986. Except for the period 1992/93 during Kenya's multiparty elections, the deficit remained largely low. However, since the new government formed in 2002, expansionary fiscal policy has been pursued, largely driven by need for increased infrastructural investments, provision of health care and universal primary education. A fiscal stimulus was implemented in 2008-2010 to counter the economic downtown from the negative global financial crisis and effects of 2007/08 post-election violence financed through domestic borrowing. The four-tire general election in 2013 ushered in devolution with two levels of government, the national and the county governments further increasing government's expenditures.

Decline in tourism and exports of primary products whose prices are volatile in the world markets reduced growth in the revenues. In fact, during the period 2000/01-2016/17, total government revenue and expenditure grew at an average rate of 12.9 and 16.1 percent, respectively, thereby resulting in rising deficits. Government revenue has remained stagnant and sticky, at an average of 18 percent of GDP and cover about 70 percent of total expenditure (World Bank, 2014). This depicts Kenya's low tax collections, largely depending on income taxes and Value Added Tax (VAT), which contribute about 40 and 25 percent of total revenue, respectively (World Bank, 2014). However, expenditure increased from 22.5, 25.6 to 27.5 percent of GDP during 1999/00, 2013/14 and 2016/17 fiscal years, respectively. As a share of GDP, Kenya's fiscal deficit rose from a balanced budget during 2004/05 fiscal year to 8.9 percent in 2016/17 fiscal year. The increased pressure on the fiscal deficit emanates from increased security spending and new infrastructure projects by Jubilee government on Standard Gauge Railways (SGR), roads and energy.

The key objective of the central bank of Kenya is to maintain stability in the general level of prices. Inflationary episodes in Kenya have however, at times persisted even with monetary aggregates being within targets and monetary policy tools at work (Were et al., 2013).Price stability is necessary for fostering investment and economic growth. However, inflation stabilization should be a concern of not only central bank but also the fiscal authority. While Kenya managed to reduce fiscal dominance, Adam et al. (2010) notes that fiscal indiscipline had started to re-emerge after the global financial crisis in 2008. How fiscal policy relates to inflation, therefore, becomes important. The inflation-deficit relationship became evident after the 1992 general election that resulted in huge deficits that was financed by money printing following the aids embargo by WB and IMF. The current high deficits and fluctuating inflation rekindles their relationship for Kenya. This study seeks to establish the effects of fiscal deficits on inflation dynamics in Kenya. This is important because, fiscal policy stance has implications on the price stabilization efforts of monetary policy.

2. Review of Literature

The main theoretical basis for inflation determination is the Quantity Theory of Money (QTM). QTM evolved from the Irving Fisher's (1911) equation of exchange and re-stated by Milton Friedman (1963) as:

$$M\,V = P\,Y \quad (1)$$

where, Y represents real output, P is the average price level of commodities, M is stock of money supply and V is velocity of circulation of money (M). By applying a log operator and first difference to (1) results in

$$p = m + v - y \quad (2)$$

where p is the rate of inflation while y, m and v are growth rates of output and money stock, and velocity of circulation of money supply, respectively. The static version of QTM assumes that v and y are constants (stable) and money growth has no effect on real output implying that a given change in the rate of money growth induces an equal change in the rate of inflation (Friedman, 1956). This conception was summarized by Friedman (1963) that "inflation is always and everywhere a monetary phenomenon". Accordingly, since the central bank has control over money supply, QTM considers it the responsibility central bank to stabilize inflation. However, the dynamic version of the QTM model assumes that the velocity (v) is constant while the fiscal policy (government) determines the growth rate of output, y such that

$$m = p + y. \quad (3)$$

Equation (3) forms the basis for monetary targeting framework by central banks. Central banks therefore set money supply equal to the estimated money demand that is consistent with the targeted rate of inflation rate and real GDP growth. The dynamic version of QTM implies that inflation will result whenever growth of money supply is higher than the growth in economy. This is usually the case when the central bank finances fiscal deficit through money creation, resulting in a faster growth in money supply and consequently, inflation.

The QTM conception however, came under attack by the proponents of Fiscal Theory of Price Level (FTPL) that showed that fiscal policy stance has effects on inflation. The first and less strict version of FTPL by Sargent and Wallace (1981) described the interaction between monetary and fiscal policy as a "game of chicken", in which the agent who moves first dictates his rules on the other. Sargent and Wallace (1981) showed that even in a pure monetarist economy, unbounded fiscal policy inhibits the ability of the monetary policy to control inflation. When fiscal authority moves first, it independently sets its budgets, announces current and future deficits and surpluses and hence determines the amount of revenue to be raised through bond sales and seignorage to maintain government budget constraint. It is the rise in money supply as a result of the fiscal policy stance that causes a rise in inflation The second version, developed independently by Leeper (1991), Sims (1991, 1997, 2001) and Woodford (1994, 1995, 2001) had more stronger implication that inter-temporal government budget constraint determines price level. The implication is that the price level is determined by the ratio of the initial debt levels and the discounted value of the government budget constraint. Woodford (1994) identified two regimes, Ricardina and non-Ricardian regimes. In the Ricardian regime (monetary dominance), the central bank has full control over inflation through changes in money supply. However, in Non-Ricardian regime (Fiscal dominance), the equilibrium prices have to adjust to ensure government solvency.

Doughty (1991) notes that fiscal policy affects monetary policy and inflation at two levels: First, in the short run, fiscal policy interacts with elements of monetary policy transmission mechanism. Second, fiscal policy can influence the long run sustainability of monetary policy. As such, despite the independence of the central bank, fiscal policy sets in the environments in which monetary policy operates and hence its effectiveness may be severely constrained.

The Keynesian frameworks explain inflation as emanating when the aggregate demand exceeds the aggregate supply at full or near full employment levels. Keynes (1936) shows the role of government in stabilizing the economy by increasing boosting aggregate expenditure (by reducing taxes and shifting to deficit financing) during recessions and adopting contractionary fiscal policy during economic booms. Aretis (1979) and Atkinson (1991) however, note that financing the deficit by means other than seignorage have crowding out effect on private sector. Buiter (1977) and Servan (1998) on the contrary observe that increased government expending have crowd-in effect that ensures increased private capital stock in the long run. Kopits (2001) notes, however that expansionary fiscal policy emerging economies is usually accompanied by many inefficiencies, wastage, and corruption and hence the crowding-out may outweigh the crowding-in effect.

Fujiki (2001) reviewed theoretical relationship between fiscal deficits and inflation and the institutional arrangement regarding central bank and government budget making. He noted that central bank independence controlled the possibility of government incentives to trigger unanticipated inflation while the budgeting institution acted as constraint to government spending. Sargent (1986) attributes the end of hyperinflation largely to establishment of an independent central bank that reduced political pressure on the central bank to monetize government debt continuously.

There is substantial empirical literature on relationship between inflation and deficit in both developed and developing countries. In Pakistan, Shabbir and Ahmed (1994), and Agha and Khan (2006) find a positive and significant relationship between budget deficits and inflation, and an indirect relationship between budget deficits

and money supply in Pakistan. However, a later study by Mukhtar and Zakaria (2010) find no significant long-run relationship between inflation and budget deficits. Instead, inflation was related to money supply, yet no causal relationship was found between the money supply and budget deficit. These results are consistent with studies by Altıntas, Çetintas and Taban (2008) and Aksoy (2010) for the case of Turkey which conclude that money supply have short run effect on inflation but fiscal deficit has neither short run nor long run effects on inflation. Similarly, Tiwari et al. (2011) finds no significant relationship between fiscal deficits and inflation, apart from the indirect relationship stemming from the money supply.

In a panel of 23 emerging countries for the period 1970-2000, Catao and Torrones (2003) uses ARDL model and scaling budget deficit by M1 rather than the standard approach of scaling by GDP. Their results show evidence of a significant relationship between inflation and deficit among the high inflation and developing countries but not among the low-inflation advanced countries. Similar results were later confirmed by Lin and Chu (2013) for a sample of 91 countries for the period 1960-2006. In a panel of selected Asian countries Fakher (2016) used the pooled mean group estimation-based error correction model to study the effect fiscal deficit, import index, interest rate, money supply, real GDP and exchange rate on inflation. The study concludes that fiscal deficit, money supply and GDP growth are important determinant of inflation in the sample countries.

In the sub-Saharan region, Zuze (2015) finds no such relationship for Zimbabwe while Anayochukwu (2012) finds a positive and significant relationship in Nigeria for the period 1970-2009. Bwire and Nampewo (2014) used pairwise Engel-Granger causality and VECM for the period 1999q4-2012q3 in Uganda and finds that fiscal deficit triggers a rise in rates of inflation in the long run but not in the short run. Tanzania has mixed result on relationship between inflation and deficit. While Kilindo (1997) and Nyasebwa (2011) find a positive relationship, Nyasebwa and Ndanshau (2012) fail to establish existence of a positive and statistically significant effect of budget deficit on inflation in Tanzania.

In Kenya Ndung'u (1995) investigated the link among deficit, inflation and money supply on one hand and money supply and inflation on the other. The study finds that budget deficit affects growth of monetary base and money supply affects interest and hence inflation. Studies on monetary determination of inflation in Kenya point to monetary expansion as the key variable (Mwega and Killick, 1990; Ndung'u, 1994; Adam et al. 1996; and Durevall and Ndung'u, 2001).

The literature reviewed shows that there is no consensus on the empirical relationship between deficits and inflation both in the developed and developing economies. While some studies show positive relationship between inflation and deficits, others find non-existence of such a relationship. Additionally, for those finding positive relationship, there is no consensus as to the effects, in the short run, long run or both. In addition, there is no current empirical work for Kenya despite the worrying deficits and public debt levels. This study, therefore, bridges this gap for the Kenyan case by using the most current data and recent estimation methods.

3. Theoretical Framework

Deficit-inflation link emanates from the government budget constraint described as follows

$$G_t + \frac{D_{t-1}}{p_t}(1+r_{t-1}) = TR_t + \frac{M_t - M_{t-1}}{p_t} + \frac{D_t}{p_t} + \Delta R, \tag{4}$$

Where G_t is government expenditure (except current debt repayments), $D_{t-1}/P_t\,(1+r_{t-1})$ is the discounted value of the real stock of accumulated government debt in the previous period with maturity value in the current period (t) (that is, not rolled-over), TR_t is total revenue, $(M_t-M_{t-1})/P_t$ is the change in money supply (seigniorage revenue) expressed in real terms, D_t/P_t represents domestic and external borrowing in the current period, while ΔR is the change in reserves. Rearranging equation (4) to have fiscal deficit on the left hand side (LHS) and sources of financing in the right hand side of the equation yields

$$g_t - \tau_t + \frac{D_{t-1}}{p_t}(1+r_{t-1}) = \frac{M_t - M_{t-1}}{p_t} + \frac{D_t}{p_t} + \Delta R. \tag{5}$$

The LHS represent the fiscal deficit comprising of budget deficit ($G_t - TR_t$) and the outstanding real government debt. The RHS represent the different sources of deficit financing; changes in the money supply (seigniorage), issuance of government debt instruments and the drawdown of reserves. Following Fischer (1989), we define seigniorage as the amount of new money created in the economy by the central bank as

$$S = \frac{M_t - M_{t-1}}{p_t}.$$

By introducing the term $(-\frac{M_{t-1}}{p_{t-1}}+\frac{M_{t-1}}{p_{t-1}}),$ S is expanded into

$$S=\Delta m+\frac{p_t(M_{t-1})-p_{t-1}(M_{t-1})}{p_t(p_{t-1})}. \quad (6)$$

Defining $\pi=(p_t-p_{t-1})/p_{t-1}$ and $m=M_{t-1}/p_t$, equation (6) is decomposed into seigniorage and inflation tax base

$$S=\Delta m+\pi m \quad (7)$$

Substituting equation (7) into equation (5) and making π the subject of the formula yields

$$\pi=\left\{\frac{\left[g_t-\tau_t+\frac{D_{t-1}}{p_t}(1+r_{t-1})\right]-\left[\frac{D_t}{p_t}+\Delta R+\Delta m\right]}{m}\right\} \quad (8)$$

Since the numerator is the Fiscal Deficit (FD), inflation is expressed as a function of fiscal deficit as follows

$$\pi=f\left(\frac{FD}{m}\right)$$ which is simplified to

$$\pi=FD_t\frac{P_t}{M_t^s} \quad (9)$$

where *M/P* is money supply.

Unlike the conventional measure of scaling deficit by GDP, Catao and Terrones (2003) show that dividing fiscal deficit by narrow money allows the specification to capture the nonlinear relation. Dividing the numerator and denominator in equation (9) by GDP yields the conventional measure of fiscal deficit and the size of the inflation tax base respectively.

Since fiscal deficit is scaled by the stock of money, inflation will rise (fall) once the ratio of fiscal deficit to GDP widens (Shrinks), or the ratio of the narrow money to GDP shrinks (expands) or a combination of the two. Because the demand for money is a negative function of inflation, the size of inflation tax base will be lower (higher) as inflation is higher (lower). Catao and Terrones (2003) note that inflation tax base shrinks with rising inflation requiring a faster increase in money supply and inflation to finance a given debt. Similar specification has been adopted by Metin (1998).

4. Empirical Model

The empirical estimation of effects of fiscal deficit on inflation is achieved by regressing inflation on the fiscal deficit as a ratio of GDP or broad money as the exogenous variable.

Thus, the basic baseline empirical model would be;

$$\text{infl}_t=\alpha+\beta_1 fd_t+\varepsilon_t \quad (10)$$

where *inf* is the inflation rate, *fd* represents fiscal deficit, α is the autonomous level of inflation, coefficient β measures the response of inflation to changes in fiscal deficit while ε_t is the stochastic error term. To make the model realistic we also include other variables. Changes in money supply and exchange rate are added to account for the effect money growth and exchange rate fluctuations on inflation respectively. Output growth is an important determinant of inflation in Kenya (Were, 2013). We account for economic growth by including real GDP growth in the model. In addition, monetary policy stance determines the levels of inflation in the country. As such, Central Bank Rate (CBR) is included a measure of monetary policy stance.

In view of the above, equation **(10)** is modified to yield the estimable equation as

$$\text{infl}_t=\beta_0+\beta_1 fd_t+\beta_2 money_t+\beta_3 exrate_t+\beta_4 rGDP_t+\beta_5 CBrate+\varepsilon_t, \quad (11)$$

where *money*, *exrate*, *rGDP and CBrate* are growth in money supply, real exchange rate, growth of real GDP and central bank rate respectively. The coefficients β_2, β_3, β_4 and β_5 measure the percentage change in inflation rate due to changes in growth in money supply, exchange rate, growth in real GDP, and central bank rate respectively.

Apart from the baseline model, two other different models are then estimated based on two approaches to

measurement of fiscal deficit; first, overall deficit ratio to GDP and, second, overall deficit share to narrow money for robustness check.

5. Estimation Method

In assessing the deficit-inflation relationship, authors have used various econometric approaches including Vector Autoregressive (VAR) and the Vector Error Correction Model (VECM) frameworks. This study uses a different and more recent Autoregressive Distributed Lag (ARDL) approach by Pesaran and Shin (1998); Pesaran, Shin, and Smith (2001), and Pesaran and Pesaran (2009) to determine the short run and long run relationship between inflation and deficit.

A few advantages make ARDL approach more preferred over other approaches. First, ARDL approach controls for endogeneity problems as well as correcting for residual serial correlation (Catão and Terrones, 2005; Tang, 2006). Second, ARDL allows estimations irrespective of their order of integration of the variables in the model (that is, I(0), I(1) or a mixture of the two) (Pesaran and Shin, 1999; Pesaran et al., 2001; Nkoro and Uko, 2016). The approach therefore, avoids testing and classifying variables as I(1) or I(0) associated with other standard methods like the Johansen cointegration techniques. ARDL is however not applicable when there are I(2) variables. Third, unlike the conventional approaches, ARDL variables can take different optimal lags in a single reduced form equation to estimate long run and short run relationships (Nkoro and Uko, 2016). Finally, the ARDL approach is also appropriate for small samples of 30 to 80 observations by using Narayan (2005) critical values for small sample (Nkoro and Uko, 2016).

The general form of ARDL model is as follows

$$Y_t = C_0 + \sum_{i=1}^{p} \delta_i Y_{t-i} + \sum_{i=0}^{q} \beta_j^{'} X_{j,t-i} + \varepsilon_t, \qquad j=1,2,\ldots,k, \tag{12}$$

where Y_t is endogenous variable of lag order p, C_0 is a constant, $X_{j,t}$ is a vector of exogenous variable of lag order q, and ε_t represents the error term which is N(0,δ^2).

ARDL estimation is preceded by cointegration test establishes if variables in the model exhibit a meaningful long run relationship. This is important because if no such a relationship exists, then there is no basis for inferences, based on the standard distribution (Nkoro and Uko, 2016). This study uses the Pesaran and Shin (1995) and Pesaran et al. (1996) bound test procedure because it is applicable whether variables are I(0), I(1) or mixed. To test for cointegration, the estimation Equation (11) is formulated in terms of first difference and first lag of variables as follows:

$$\Delta \text{infl}_t = \beta_0 + \sum_{i=1}^{p} \delta_i \Delta \text{infl}_{t-i} + \sum_{i=0}^{q_1} \beta_{1i} \Delta rGDP_{t-i} + \sum_{i=0}^{q_2} \beta_{2i} \Delta money_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} \Delta exrate_{t-i} + \sum_{i=0}^{q_4} \beta_{4i} \Delta fd_{t-i} +$$

$$\sum_{i=0}^{q_5} \beta_{5i} \Delta CBrater_{t-i} + \varphi \text{infl}_{t-1} + \alpha_1 rGDP_{t-1} + \alpha_2 money_{t-1} + \alpha_3 exrate_{t-1} + \alpha_4 fd_{t-1} + \alpha_5 CBrate_{t-1} + \varepsilon_t, \tag{13}$$

where β_0 is a constant term and Δ is the first difference operator. The parameters φ and α_j are the long run multipliers whereas δ and β_{ij} represent short run relationship. p, q_1, q_2, q_3, q_4 and q_5 are the optimal lags for the respective variables. Cointegration test involves testing the null hypothesis that all the long run coefficients in Equation (13) equal zero.

The test statistic has a non-standard F-distribution that depends on whether variables included in the ARDL model are I(1) or I(0), the number of regressors, and whether the ARDL model contains an intercept and/or a trend. The calculated F-statistics are compared with the lower and upper bound critical values computed by Pesaran et al. (2001) that assume all variables are I(0) and I(1), respectively. If sample size is small, the calculated F-statistics are compared with Narayan (2005)[1] critical values. When the calculated F-statistic is greater than the upper bound critical values, the null hypothesis of no cointegration is rejected, concluding that the variables are cointegrated and vice versa if estimated F-statistic is smaller than the lower bound critical values. If the computed F-statistic falls between the upper and lower bounds, the results are inconclusive and use is made of the unit root test and applied appropriately.

On establishing existence of a long run relationship, the following ARDL model is estimated by OLS to obtain the long run parameters. The optimal lag length is determined by Akaike Information Criteria (AIC).

$$\text{infl}_t = \beta_0 + \sum_{i=1}^{p} \lambda_i \text{infl}_{t-i} + \sum_{i=0}^{q_1} \beta_{1,i} \Delta rGDP_{t-i} + \sum_{i=0}^{q_2} \beta_{2,i} \Delta money_{t-i} + \sum_{i=0}^{q_3} \beta_{3,i} exrate_{t-i} + \sum_{i=0}^{q_4} \beta_{4,i} fd_{t-i} + \sum_{i=0}^{q_5} \beta_{5,i} cbr_{t-i} + \upsilon_t \tag{14}$$

The long-run coefficients and constants are then obtained as follows:

[1] Pesaran et al. (2001) critical values are only relevant for a large sample size of between 80 and 1000. Narayan (2005) provides critical values for a small sample size ranging from 30 to 80 observations.

$$\theta_j = \frac{\beta_{j,0} + \beta_{j,1} + \ldots + \beta_{j,qj}}{1 - \left(\sum_{i=1}^{p} \lambda_i \right)} \qquad \forall \text{ j= 2, 3,…, k (Exogenous variables)} \qquad (15)$$

$$\theta_0 = \frac{\beta_0}{1 - \left(\sum_{i=1}^{p} \lambda_i \right)} \qquad (16)$$

An Error Correction Model (ECM) is then specified to incorporate the short run and long run information by adding residuals from the long-run equation. The ARDL-based ECM is expressed as

$$\Delta infl_t = \delta_0 + \sum_{i=1}^{p-1} \lambda_i \Delta infl_{t-i} + \sum_{i=0}^{q_1-1} \delta_{1i} \Delta lrGDP_{t-i} + \sum_{i=0}^{q_2-1} \delta_{2i} \Delta money_{t-i} + \sum_{i=0}^{q_3-1} \delta_{3i} \Delta exrate_{t-i} + \sum_{i=0}^{q_4-1} \delta_{4i} \Delta fd_{t-i} + \sum_{i=0}^{q_5-1} \delta_{5i} \Delta CBrate_{t-i} + \psi ECT_{t-1} + \mu_t \qquad (17)$$

where ψ is the speed of adjustment parameter and Error Correction Term (ECT) is the residuals obtained from the long-run Equation (14). The loss of one degree of freedom (q_j-1) results from differencing the series once. ECT shows how much of the previous disequilibrium from the long run is corrected in the current period. A negative coefficient of the ECT shows convergence to the long run equilibrium after a shock while a coefficient of the ECT that equals zero implies absence of long run relationship (Nkoro and Uko, 2016).

6. Data description and sources

The study uses quarterly for the period 1996q1 to 2017Q2 mainly determined by availability of consistent quarterly data series. Table A1 provides a description of the variables.

7. Estimation Results

The Granger causality test provides the preliminary evidence of the deficit-inflation link in Kenya. Table 1 reports the results.

Table 1: Results of Pairwise Granger-causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
INFL does not Granger Cause DEFICIT_GDP	85	0.00613	0.9939
DEFICIT_GDP does not Granger Cause INFL		0.44017	0.6455
DEFICIT_M1 does not Granger Cause INFL	85	0.63438	0.5329
INFL does not Granger Cause DEFICIT_M1		0.05460	0.9469

Source: Author's computation in Eviews 10 package
***, **, * indicate significance at 1%, 5%, and 10%, respectively

The results suggest that the null hypothesis that the budget deficit does not granger-cause inflation cannot be rejected, for both measures of fiscal deficit implying that fiscal deficit cannot be used to predict future values of inflation. Similarly, the null hypothesis of no causality from inflation to fiscal deficit is not rejected. The results suggest that inflation does not influence the level of fiscal deficit in Kenya and fiscal deficit does not influence inflation as well.

Table 2: Results of Bound Test to Cointegration

			Pesaran/Shin/Smith (2001) Critical Values				
			95%		90%		
Model	**Variables**	**F-statistic**	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**Cointegration**
Baseline	Inflation| Deficit_GDP	**3.981**	5.06	5.93	4.135	4.895	Absent
Model 1	Inflation| Deficit_GDP, Exrate, rGDP growth, Central bank rate, Money	**10.791**	2.62	3.79	2.26	3.35	Present
Model 2	Inflation| Deficit_M1, Exrate, rGDP growth, Central bank rate, Money	**9.584**	2.62	3.79	2.26	3.35	Present

Source: Author's model estimates in Stata 14
Critical values for the case of restricted intercept and no trend

The results in Table 2, shows no evidence of existence of a long run relationship between fiscal deficit and inflation in the baseline model. However, when the control variables are added to the variant models, the results show existence of a long run relationship among inflation, two different measures of fiscal deficit, real exchange rate, growth of money supply, central bank rate and real GDP growth thereby allowing for the estimation of the long run parameters of the models.

7.1 Estimations of Long Run Elasticities

Having confirmed the existence of long run relationship in model 1 and 2, the long-run impact of the explanatory variables on inflation dynamics in Kenya are estimated. The intuition is that by controlling for other possible effects on inflation, the long run impact of fiscal deficit on inflation can be estimated using the ARDL approach. The a priori expectation is that high fiscal deficits exert an upward pressure on inflation in the long run. The appropriate lags of the estimation models were selected automatically by the system after specifying the maximum lags based on the AIC criterion. The results of estimation of the long-run elasticities are reported in Table 3.

Table 3: Long run Estimates: Dependent Variable is Inflation Rate

	Model 1	Model 2
Variables	ARDL(4,0,1,1,2,0)	ARDL(2,0,1,1,0,0)
Deficit_GDP	-0.0034	
	(0.703)	
Deficit_M1		-0.0096
		(0.300)
Exrate	-0.0118	-0.0296
	(0.681)	(0.440)
rGDP growth	-0.5008*	-0.9529***
	(0.054)	(0.004)
Central bank rate	-0.0393**	-0.0483**
	(0.014)	(0.028)
Money	-0.0851	-0.2919
	(0.733)	(0.425)

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively Probability values in parenthesis.

The estimation results in Table 3 show no evidence of causal effect of fiscal deficit on inflation in Kenya. Both measures of fiscal deficits have a negative but statistically insignificant coefficient at the conventional level of significance. This implies that in the long run rises in the fiscal deficits does not result in inflationary pressures as dictated by theory. This calls for careful interpretation and further interrogation especially with regard to the structure of the economy.

The coefficients of money supply are statistically insignificant and have unexpected negative signs. This is inconsistent with the QTM that postulates a positive and significant effect of growth of money supply on inflation (Friedman, 1956). The implication is that money supply has not grown fast enough as to cause inflation in Kenya. As expected, growth of real GDP is associated with a decline in rates of inflation as indicated by the negative and statistically significant coefficients in both models. The implication is that, an increase in national output reduces pressure on the general prices of goods and services hence inflation falls. The results suggest that a percentage point rise in GDP is associated with a 0.5 and 0.95 percentage point decline in inflation in the long run in models 1 and 2 respectively. Similarly, the coefficient of the central bank rate is negative and statistically significant. This indicates potency of monetary policy in stabilizing inflation in Kenya (Table 3). The long run coefficients of exchange rate in both models are, however, not statistically significant and bear an unexpected negative sign

contrary to theory that predicts that exchange rate depreciation results in higher inflation as the foreign inflation is transmitted into domestic prices. Mwase (2006) finds similar inverse and significant relationship for Tanzania and attributes it to increase in competition, higher productivity, and tighter monetary policy implemented in Tanzania since the late 1990s.

7.2 Short-run Estimation

Table 4: Short Run Estimates: Dependent Variable is Inflation Rate

	Baseline Model ARDL(3,0)		**Model 1 ARDL(4,0,1,1,2,0)**		**Model 2 ARDL(2,0,1,1,0,0)**	
Panel A. ECM estimates						
Variables	Coefficient	P-value	Coefficient	p-value	Coefficient	p-value
D(Infl(-1))	0.9206***	0.000	0.2868***	0.001	0.2214**	0.018
D(Infl(-2))	-0.1162	0.449	0.14843*	0.084		
D(Infl(-3))	-0.1858	0.100	0.3373***	0.000		
D(deficit_GDP)	-0.0006	0.904	-0.0016	0.209		
D(deficit_M1)					-0.0036	0.298
D(exrate)			0.1661**	0.016	0.2473***	0.000
D(Cbrate)			-0.0322***	0.005	-0.0374***	0.004
D(rGDP)			-0.3676***	0.001	-0.3551***	0.001
D(rGDP(-1))			-0.2104*	0.070		
D(Money)			-0.0414	0.731	-0.1087	0.421
Constant	0.0296***	0.000	0.1181*	0.094	0.1450**	0.046
ECT(-1)			**-0.4861*** **	**0.000**	**-0.3726*** **	**0.000**

Panel B: Diagnostic Tests			
	Baseline Model	**Model 1**	**Model 2**
R-squared	0.6214	0.8486	0.7867
Adj. R-squared	0.6023	0.8169	0.7553
F-statistic	20.32(0.000)	26.74(0.000)	27.06(0.000)
D-W test stat.	1.711366	1.692214	1.967676
BG LM test	3.122 (0.077)	2.891(0.089)	0.071(0.789)
BP Hete. test	0.07(0.788)	0.01(0.995)	0.28(0.596)
Normality test	2.81(0.245)	1.92(0.383)	3.93(0.140)
Ramsey RESET	0.34(0.7996)	.27(0.292)	1.26(0.297)
CUSUM/CUSUMSQ	Stable	Stable	Stable

Source: Author's model based estimations using Stata 14 package

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively Probability values in parenthesis.

To understand the short run dynamics, an ECM was estimated by including the Error Correction Term (ECT). Table 4 presents the short run estimates. The coefficient of fiscal deficit is however statistically insignificant implying no causal effect of deficits on inflation in the simple model. The results indicate statistically significance of coefficient of lagged inflation of 0.921 implying a high level of inflation persistence in the short run. Model 1 shows the effect of fiscal deficit on inflation after adding appropriate control variables and deficit is scaled by nominal GDP. Model two has the same variables but the deficit is scaled by money supply (M1).

The coefficients of lagged error correction terms (ECT_{t-1}) have the expected negative sign and are statistically significant at 1 percent level of significance thereby confirming existence of long-run relationship among the models variables. The ECT for model 1 and model 2 are however low at 0.4861 and 0.3726 respectively. This suggests that for each model, the deviation of inflation from its long run equilibrium is corrected at a speed of 49 and 37 percent in each quarter. The results show positive and significant coefficients of the lagged inflation indicating presence of inflation inertia.

The effect of money supply on inflation is not statistically significant at 5 percent level of significance in booth models suggesting that money supply is not an important determinant of inflation in Kenya in the short run. This is inconsistent with Were et al. (2013) who find positive and significant effects of lagged money supply on inflation in Kenya although the result turned negative and less significant on including interest rate to the equation. The results are also contrary to, among others, Kilindo (1997) and Mbongo (2014), and Bwire and Nampaso (2014) for the cases of Tanzania and Uganda, respectively that find a positive relationship between deficit and inflation.

Table 4 shows that growth in real activity as measured by the growth rate of real GDP is associated with a statistically significant decline in inflation at 1 percent level of significance. The significant negative coefficients of real GDP indicate importance of the supply side factors on inflation dynamics of Kenya. This result confirms

the findings of strong deflationary effect of real output in Kenya (Were and Tiriongo, 2012; Were et al., 2013). Being an agricultural economy, an increase output also reflects, a rise in agricultural output thereby reducing the upward pressure on food prices[2] as well as increasing supply of raw materials especially to the agricultural-based industries (Were et al., 2013). Akhtaruzzaman, (2005) makes similar conclusions for the case of Bangladesh, an agricultural dependent economy.

The coefficient of the real exchange rate has the expected positive sign and is statistically significant at the conventional levels in both models. Being a net importer, depreciation of the exchange rate implies higher prices for the imports. Were et al. (2013) finds insignificant coefficient for Kenya using quarterly data while Nyasebwa and Ndanshau (2012) find positive relationship in Tanzania.

Central bank rate bears a negative and significant coefficient indicating the potency of monetary policy in stabilizing inflation. Garcia et al. (2015) note that the monetary policy stance was largely tight for the period 2008-2012 helping to maintain lower inflation.

The results pass the respective diagnostic tests as shown in the table 4 Panel B. Model stability of the models was evaluated by using the CUSUM and CUSUMSQ (Appendix Figures A1-A3).

8. Discussions of the Empirical Results

The results show no evidence of causal effect of deficits on inflation in Kenya both in short and long run. This requires careful interpretation because it does not necessarily mean that high and persistent deficit is not inflationary. Inflation in Kenya is largely supply side driven especially by food and fuel prices (Were et al., 2013). In particular, food accounts for the highest proportion (36 percent) in the overall CPI indicating the importance of food prices on inflation dynamics in Kenya. Since the liberalization of the economy in Kenya, many reforms were undertaken to make CBK more effective in monetary policy management by increasing its independence. Cukierman (1992) notes that the independence of central banks is important because it mitigates against inflationary tendencies of governments. The effects of fiscal deficit on inflation may therefore, have been subdued by the more "responsible" monetary policies undertaken with guidance from international institutions like WB and IMF over the last decade (Nikolaos and Constantinos, 2013). Garcia et al. (2015) note that during the period 2008-2014, the economy was characterized by loose fiscal policy accompanied by a tight monetary policy.

As noted earlier, the amendment of the Central Bank Act in 1996 restricted the CBK from financing fiscal deficits through seigniorage, and hence an increase in money supply in the economy. This is the key link between fiscal deficit and inflation especially in the developing countries with low developed financial sector (Easterly and Schmidt-Hebbel, 1993). Due to this restriction, fiscal deficit in Kenya is financed through the domestic and external debt thanks to a relatively developed financial sector. The availability of a market for the government securities ensures that the government is able to access finances easily and seamlessly to finance its operations. Debt financed deficit are not inflationary since it does not involve new money creation in the economy (Dornbusch et al., 1990; Easterly and Schmidt-Hebbel, 1993; Ishaq and Mohsin, 2015). Lack of money creation to finance deficits in Kenya may therefore have reduced the deficit inflation link. In addition, the effects of fiscal deficit on inflation may have been transmitted indirectly through higher domestic interest rates. As noted by among others, Aretis (1979), and Atkinson (1991), increased public debt results in higher domestic rates of interest and hence crowding out effect on the private sector.

Sargent and Wallace (1981) argues that fast rising borrowings may raise the real rate of interest above the real income growth resulting in, even larger future borrowings that would threaten solvency. They note that the solvency constraint would eventually force the government to resort to monetize the debt to meet its obligations and hence inflation. This is a possible and dangerous position Kenya can find itself in if the current levels of deficits and public debt are not significantly reduced.

9. Conclusions

The effect of fiscal deficit on inflation has been analyzed using ARDL model. The study finds no significant effect of deficit on inflation both in the long and short run. Inflation is mainly seen to emanate mainly from the supply side factors. Lack of evidence of effect of fiscal deficit on inflation is attributed to a more strong and improved independence in monetary management. In addition, restriction of deficit financing through seigniorage removes the main link between inflation and deficit. The fast rising fiscal deficit has resulted in fast rising public debt putting raising concerns about its sustainability.

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[2] Ndung'u (1995) notes that food and fuel prices account for about 60 percent of the overall inflation in Kenya

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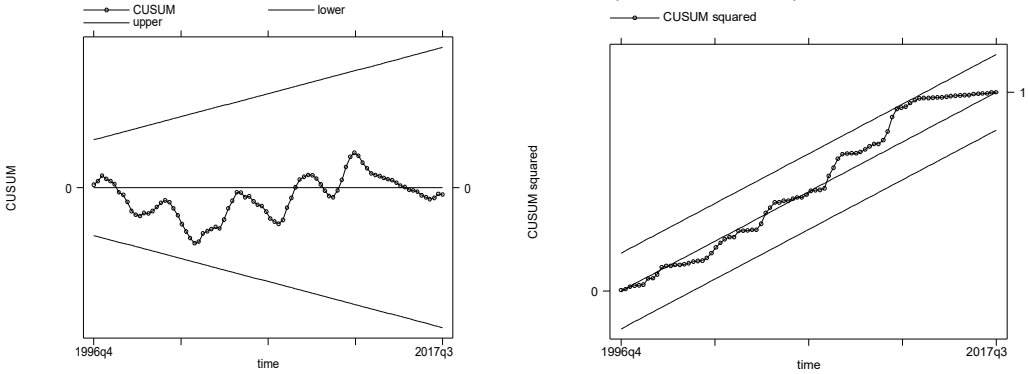
Appendices

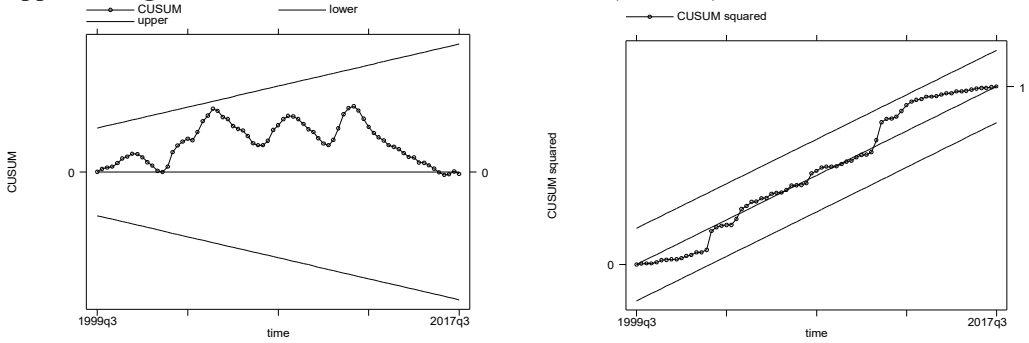
Table A1: Data Description and Sources

Variable	**Symbol**	**Description**	**Source**
Inflation	INFL	QOQ change in Consumer Price index (CPI). Feb 2009 is the base year	CBK
Fiscal Deficit	Deficit_GDP	Calculated as cash based seasonally adjusted government expenditure less total tax revenues as a ratio of nominal GDP	KNBS
	Deficit_M1	Calculated as cash based seasonally adjusted government expenditure less total tax revenues as a ratio of narrow money (M1).	KNBS
GDP growth	rGDP	Quarterly growth in real GDP	KNBS
Money supply	Money	Growth in M3 (M2+ FC deposits)	CBK
Exchange rate	Exrate	Change in quarterly average real effective exchange. Expressed in log form.	CBK

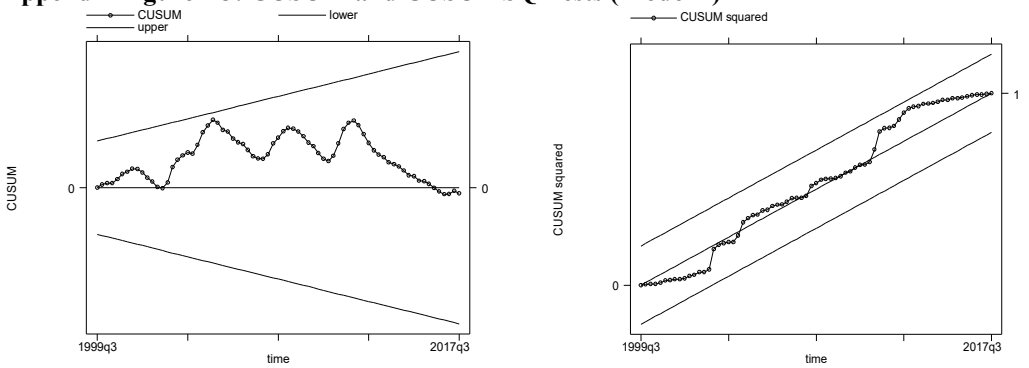
Appendix Figure A1: CUSUM and CUSUMSQ Tests (Baseline Model)



Appendix Figure A2: CUSUM and CUSUMSQ Tests (Model 1)



Appendix Figure A3: CUSUM and CUSUMSQ Tests (Model 2)



Sources: Author's model-based computations in Stata 14 package