University of Economics in Katowice

Journal of Economics and Management

e-ISSN 2719-9975 ISSN 1732-1948 Vol. 43 • 2021

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Doris Syombua Philip

https://orcid.org/0000-0003-0574-0895

Department of Economics and Social Sciences
Faculty of Economics
University of Nairobi, Nairobi, Kenya
dorissyombua@gmail.com

Budget deficit-macroeconomic variables nexus in Kenya

Accepted by Editor Ewa Ziemba | Received: July 31, 2020 | Revised: May 3, 2021; June 30, 2021 | Accepted: July 5, 2021 | Published: July 29, 2021.

Abstract

Aim/purpose – The aim of this paper was to establish the nexus between a budget deficit and selected macroeconomic variables in Kenya. This adds to the existing literature while the methodology and choice of the econometric tools used improve the predictability of the link between a budget deficit and macroeconomic variables. The results are relevant to policy makers as they may help improve understanding of budget deficit management.
Design/methodology/approach – The study used time series data for the period from 1976 to 2018 and employed the Vector Autoregression model reinforced by the Keynesian Mundell–Fleming framework.
Findings – The impulse response function derived from the vector autoregression model revealed that shocks from both interest rate and exchange rate had a positive impact on budget deficit. External debt servicing and current account deficit shocks had a negative impact on the budget deficit.
Research implications/limitations – Interest rate and exchange rate policies remain key in reducing the growth of the budget deficit. Policies on external debt servicing, such as timely payment of debts and prudent investment of borrowed funds, will also reduce the budget deficit.
Originality/value/contribution – The study employed transmission mechanism which involves multiple equations to establish the nexus between a budget deficit and macroeconomic variables in Kenya.

Keywords: budget deficit; selected macroeconomic variables, Kenya.
JEL Classification: H60, H62, H68.

Cite as: Philip, D. S. (2021). Budget deficit-macroeconomic variables nexus in Kenya. *Journal of Economics & Management*, *43*, 270-292. https://doi.org/10.22367/jem.2021.43.13

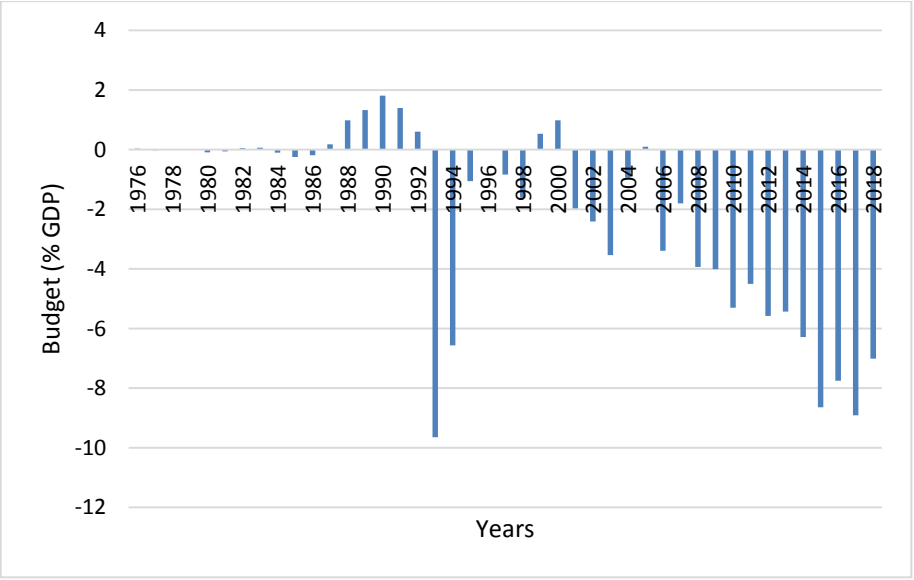
1. Introduction

The budget deficit can generally be defined as a situation whereby a government spends more than it earns. There are three main economically meaningful ways of determining budget deficit which include conventional budget deficit; primary budget deficit; and operational budget deficit (Blejer & Cheasty, 1991; International Monetary Fund [IMF], 2014). The conventional budget deficit is the difference between the revenue which includes grants and cash outlays which include interest payment and noninterest payments but exclude amortization payments. It is the widely accepted definition of budget deficit by the IMF and World Bank (IMF, 2014). The primary budget deficit is similar to the conventional budget deficit only that it excludes interest payment in its cash outlays. The primary budget deficit is mainly used to measure how current actions of the government can affect debt sustainability. The operational budget deficit, however, includes interest rates which are adjusted for inflation and is commonly used in the fiscal analysis in the measurement of fiscal sustainability (Blejer & Cheasty, 1991).

According to Kenya's Vision 2030 and Kenya's Budget Policy Statement (BPS) 2021/22, Kenya aims to attain an annual GDP growth rate of 7.0% by 2021 and achieve a 3.6 percent budget deficit by 2024/25. According to Kenya's Vision 2030 and BPS 2021/22,this can only be achieved if the nation maintains macroeconomic stability through factors such as increasing national savings, maintaining sustainable fiscal deficits, reducing unemployment, maintaining stable exchange rate, a keen check on the volatility of inflation and interest rate. A detailed study on a budget deficit and macroeconomic variables nexus is therefore essential in coming up with fiscal policy formulations which are critical to the achievement of macroeconomic stability (IMF, 2018a; Kenya Vision 2030, 2007; Republic of Kenya, 2021).

As depicted in Figure 1, the country experienced both a budget deficit and surplus between 1976 and 1994; the deficit was, however, minimal. From 1995 to 2018, the country recorded budget deficits throughout the years except for the year 2000. From the year 2013 onwards, the budget deficit was widening; with the highest budget deficit being recorded in the year 2016 of about 8.91 as a percentage of GDP. This situation is of great concern to the economy (Central Bureau of Statistics, 1976-2007; Kenya National Bureau of Statistics, 2008-2018).

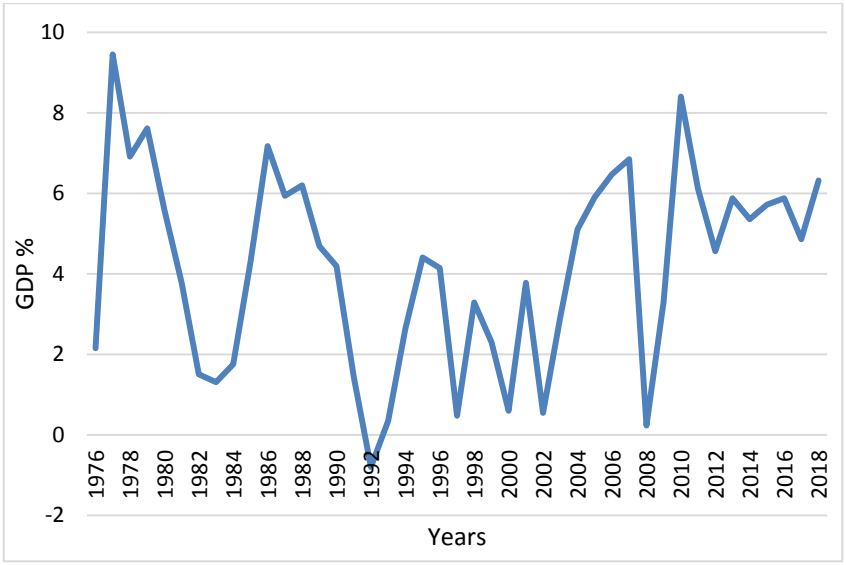
Figure 1. Development of yearly values of budget deficit (BD) in Kenya, 1976-2018



Source: Kenya National Bureau of Statistics (1976-2018).

The average GDP growth rate was 6.34% between the years 1976 to 1980. The economy performed worst between the years 1992 to 2002 with an average growth rate of 1.98%. The growth rate was however stagnating at a range of 5.3% to 5.8% from 2013 to 2016. The economy, on the other hand, recorded a significant growth of 6.3% in 2018.General elections, post-election violence, drought, withdrawal of funds by the IMF and World Bank, and excessive government intervention in the market characterized the worst performing years (Central Bureau of Statistics, 1994; 1998; 2003; Kenya National Bureau of Statistics, 2009-2017). Figure 2 indicates the Kenya's real GDP growth rate for the period of 1976-2018.

Figure 2. Annual real GDP growth rate (1976-2018)



Source: World Economic Outlook Data (IMF, 2018b).

There has been a concern that the current budget deficit might be unsustainable for the economy. For instance, the IMF (2016) pointed out that Kenya's public debt in which the budget deficit was the major contributor was moving toward unsustainable levels; Osoro (2016) provided empirical evidence that a budget deficit beyond 4% of GDP is unsustainable for the Kenya's economy. As a result, the national treasury aims to maintain a budget deficit of 3% as from 2021/2022 (Republic of Kenya, 2021).

Several studies based explicitly on Kenyan context looked at the link between a budget deficit and economic growth only (M'Amanja & Morissey, 2005; Musyoka, 2013; Okelo, Momanyi, Othuon, & Aila, 2013; Osoro, 2016). From the economic literature, it is evident that the link between a budget deficit and GDP is not direct but it is through various transmission mechanisms which involve other macroeconomic variables. This study, therefore, adds to the existing literature by examining the link that exists between a budget deficit and selected macroeconomic variables, such as GDP, interest rate, current account, inflation, exchange rate, and debt service on external debt. This was done by empirically establishing the impact of the shocks from the macroeconomic variables on the budget deficit. The choice of the variables was based on the theoretical literature that explains how the budget deficit is interlinked with the aforementioned variables.

The general objective of this study was to investigate the budget deficit--macroeconomic variables nexus in Kenya. Specifically, the study sought to establish the impact of impulse shocks of the selected macroeconomic variables on the budget deficit.

The paper is structured in five sections. Following this introduction, section two focuses on the review of literature, section three describes the methodology used in the research work, section four presents the empirical findings. Finally, section five gives conclusions and policy implications.

2. Literature review

2.1. Theoretical literature

The theoretical literature presents transmission mechanisms and the linkages that exist between a budget deficit and other macroeconomic variables.

2.1.1. Keynesians approach to budget deficit

Keynesians believe that resources are not fully employed and that consumers are short-sighted and face liquidity constraints. This approach postulates that an increase in budget deficit implies increased government expenditure hence an increase in production. Increased production increases aggregate demand which leads to increased output. This practice was widely helpful during the Great Depression and Recession experienced between the period of 1929-1933 and 2007-2009, respectively, as it revived the economy (Hussain & Haque, 2017).

The increased income can have two effects; first, it can lead to increased demand for imported goods leading to current account deficit. This will happen if the economy has no capacity for expansion to increase output to absorb the increased liquidity within its borders. Second, the increased income raises transaction and precautionary demand for money but reduces speculative demand for money. If interest rates are responsive, the decreased demand for the speculative demand for money leads to high-interest rates which bring about competition between the public and private sector crowding out private investments (Romer, 2005).

Mundell (1968) and Fleming (1962) extended the Keynesian IS-LM framework based on the assumptions of small open economy, free capital mobility except in the cases of capital controls and flexible or fixed exchange rate

regime. Since the budget deficit occurs when government's expenditure exceeds its revenues, the increased expenditure is regarded as expansionary fiscal policy. Due to the existence of transaction cost, capital is not always perfectly mobile (Romer, 2005).

According to the Mundell–Fleming framework, the budget deficit has a positive effect on output, interest rates, and capital inflow under imperfect capital mobility. However, the exchange rate appreciates under high capital mobility causing the current account deficit but it depreciates under low capital mobility. The budget deficit has no effect on the macroeconomic variables in a floating exchange rate and perfect capital mobility (Romer, 2005).

2.1.2. Ricardian equivalence approach to budget deficit

According to this theory, there is no difference between a government increasing its expenditure through deficit-financing by having a current tax cut or by taxing its citizens now. This is because it has to increase tax in future to repay the debts as there is no 'free lunch' in government. The theory was later affirmed and advanced by Barro (1989) and Buchanan (1976) on the basis of the rational expectation theory; individual rationality makes consumers, despite the increased expenditure, consume less now and save more for the future as they can foresee the possibility of tax increase in future.

Due to the foresightedness nature of the current generation, individuals will save more for the future payment of their debts and consume less now. In the current period, the increased government expenditure is offset by the low consumption while in the future period the increased consumption from the savings made is offset by the increased taxation. Budget deficit does not therefore affect macroeconomic variables (Barro, 1989; Eigbiremolen, Ezema, & Orji 2015).

2.1.3. Neoclassical approach to budget deficit

The theory is built based on three assumptions; first, consumers are assumed to operate in inter-temporal periods with the periods associated with lending and borrowing. Second, the consumers are assumed to have a finite lifespan and last, the markets are assumed to clear at all the periods (Bernheim, 1989).

A budget deficit implies a tax shift to the future generation. As a result, there is an increase in present consumption. This leads to reduced savings and

hence investments which brings about reduced output. In a small open economy, the increased expenditure does not lead to changes in interest rates. It can however lead to increased foreign borrowing causing currency appreciation and hence a current account deficit due to increase in imports (Bernheim, 1989).

2.2. Empirical literature

This section looks at the various previous empirical literature on a budget deficit and other macroeconomic variables. The literature is systematically reviewed according to methodological approaches and empirical models used.

By use of a comprehensive review of the literature, theories and empirical studies on a budget deficit and macroeconomic variables, Saleh & Harvie (2005) found that an increased budget deficit generally leads to a current account deficit and an increase in interest rates. These results were consistent with the Keynesian theory. Musyoka (2013), Okelo et al. (2013) and Osoro (2016) sought to establish the effect of the budget deficit on economic growth using a simple ordinary least squares (OLS) method. Musyoka (2013) study for the period of 2003-2012 found a negative relationship between a budget deficit and GDP for the Kenyan economy which was contrary to Okelo et al. (2013) results. Following Khan & Senhadji (2016) further investigated the budget deficit threshold and found that a budget deficit that is beyond 4% of GDP is unsustainable for the Kenyan economy. These studies applied a simple OLS equation which could not establish the effect of each of the variables on the budget deficit.

By use of ARDL approach, M'Amanja & Morrisey (2005) found that both unproductive expenditure and non distortionary tax had no effect on output in Kenya for the period of 1964-2002. Aworinde (2013) generally revealed a positive relationship between a budget deficit and current account deficit, and inflation in several African countries using panel data for the period of 1980-2009. For the Kenyan case, the ARDL results however revealed that the current account had a negative impact on the budget deficit. Nkrumah, Orkoh, & Owusu (2016) found GDP to have a negative impact on the budget deficit in Ghana for the period of 2000 to 2015. Although these studies could explain the effect of some variables, such as current account and GDP, the impact of other variables, such as interest rate, exchange rate, inflation, and external debt servicing, could not be established. This was due to the choice of the model and variables used.

However, Chi-Chi & Ogomegbunam (2013), Hussain & Haque (2017), Osoro, Gor, & Mbithi (2014), and Rana & Wahid (2017) applied Vector Error Correction Model (VECM) and a cointegrating equation to analyze how macro-

economic variables and a budget deficit are related. Chi-Chi & Ogomegbunam (2013) found a statistically positive relationship between the budget deficit and inflation in Nigeria for the period of 1981-2012. According to these authors, interest rates, however, exhibited a negative impact on the budget deficit. In contrast, Rana & Wahid (2017) found that the budget deficit had a negative impact on GDP in Bangladesh for the period of 1981-2011. This was also consistent with Hussain & Haque (2017) study in Bangladesh for the period of 1993/1994-2015/2016 using World Bank data. However, using a different data set from the Bangladesh Bureau of Statistics (BBS), Hussain & Haque (2017) found that the fiscal deficit had a positive impact on economic growth. The same results were also found by Osoro et al. (2014) in Kenya for the period of 1963-2012 and were consistent with the Keynesian absorption view. Although the econometric model used in these studies was quite appropriate, the studies were silent on the effect of the exchange rate and external debt servicing on the budget deficit. Hussain & Haque's (2017) research though provided centrally results while the studies not based on the Kenyan data could not be exclusively applied on Kenyan context.

Kosimbei (2011) employed the Variance Decomposition Analysis (VDA) generated from Vector Autoregression Model (VAR) models to investigate how a budget deficit influences other macroeconomic variables. The study found that variations in the growth in the budget deficit were due to its own shocks (100%) in the first year. This significantly reduced to 61.79% in the tenth year with 7.82%, 9.02%, 5.79%, 3.67%, 1.60%, and 1.12% of the variations in the growth of treasury bills, money supply, private investment, private consumption, current account, and GDP respectively explaining the variations in the growth of the budget deficit in Kenya for the period of 1963-2007. Eigbiremolen et al. (2015) derived Impulse Response Functions (IRF) from VAR models to ascertain how a budget deficit responds to shocks. The study found out that a shock in GDP had a positive impact on the budget deficit for the first ten years but the effect changed to negative after the 10th year. Similarly, a one deviation shock in an interest rate had a negative impact on the budget deficit for the first eleven years which turned to positive afterward in Nigeria for the period of 1970-2012. The econometric tools used in Kosimbei (2011) and Eigbiremolen et al. (2015) studies seemed appropriate to establish the nexus between a budget deficit and other macroeconomic variables. Kosimbei (2011) was, however, silent on how shocks emanating from other variables influence a budget deficit while Eigbiremolen et al. (2015) studies were based on Nigerian context.

2.3. Overview of theoretical paradigms, econometric tools and results reported in the literature

A number of observations can be drawn from the theoretical and empirical literature previously reviewed in this study. From the theoretical literature, there are mixed views on the relationship between a budget deficit and macroeconomic variables. This notwithstanding, there is evidence that there is a link between a budget deficit and most of macroeconomic variables.

Based on the empirical literature, most of the studies found explicitly on Kenya, such as Okelo et al. (2013), Osoro, et al. (2014), and Musyoka, 2013, focused on the impact of a budget deficit on either GDP, current account or interest rate. This could be attributed to the choice of the econometric tools which were insufficient to give the desired predictability of the nexus between the macroeconomic variables. Although Kosimbei (2011) employed more advanced econometric tools (VAR model) in determining the relationship between a budget deficit and macroeconomic performance, the study was silent on the impact of the macroeconomic shocks on a budget deficit. This study adds on to the work of Kosimbei (2011) by establishing the impact of macroeconomic variable shocks on a budget deficit using more recent data from 1976 to 2018.

3. Research methods and procedure

3.1. Theoretical framework and model specification

The research studied the nexus between a budget deficit and other selected macroeconomic variables using time series data for the period between 1976 and 2018.The study adopted the Keynesian Mundell–Fleming framework and Vector Autoregression (VAR) model as the relationship between the variables could easily be traced through this framework. Further, the framework is suitable to the Kenyan economy as it is built on a small open economy, flexible exchange rate, and imperfect capital mobility which applies to the Kenyan context (Kosimbei, 2011).

From the framework, the link between a budget deficit and macroeconomic variables can be explained using the product market, money market and balance of payment (BOP) market equilibrium. The planned expenditure is assumed to be equal to the sum of the planned domestic expenditure and net exports in an open economy.

$$E = E(Y, i - \pi^e, G, T) + NX(Y, Y^*, e\,{}^{p\,*}\!/_{p}) \quad (1)$$

where: $0 < EY < 1$, $Ei - \pi e < 0$ and $EG > 0$, $ET < 0$, and E is the expenditure, EY` is slope of expenditure due to a unit change in income, EG is slope of expenditure due to a unit change in government expenditure, and ET is slope of expenditure due to a unit change in tax. Y is the domestic income, Y^* is the foreign income, T is tax, G is the government expenditure, $i - \pi e$ – real interest rate, NX is the net exports, and ep/p^* is the real exchange rate.

The definition and measurement of the variables is further discussed in section 3.1.

At equilibrium:

$$Y = E \quad (2)$$

Substituting equation (1) into equation (2):

$$Y = E\,(Y, i - \pi e, G, T) + NX(e\,p^*/p, Y, Y^*) \quad (3)$$

In the case of a high real exchange rate, foreign goods become more expensive than domestic goods. As a result, the purchase of domestic goods by both domestic residents and foreigners increases hence expenditure is an increasing function of the real exchange rate.

$$Y = E(Y, i - \pi e, G, T, e\,p^*/p) \quad (4)$$

Equation (4) is therefore the IS equation showing the product market equilibrium.

The money market equilibrium requires the demand and supply of money to be equal at a given price level. The money demand is a decreasing function of interest rates but an increasing function of output.

The equation of money market equilibrium (the LM curve) is depicted as:

$$\frac{M}{P} = L(i, Y) \quad (5)$$

where: $L_i < 0$ and $L_Y > 0$

With an open economy and imperfect capital mobility, the flow of capital is the sum of the difference between domestic and foreign interest rates which is sensitive to changes in interest rates and the exogenous capital flow:

$$KA = z(i - i*) + k \quad (6)$$

To attain balance of payment equilibrium, the sum of the capital flows and net exports should be equal to zero:

$$KA(z(i-i*)+k))+NX(e\frac{P*}{P},Y,Y^*,G,T,i-\pi e)=0 \quad (7)$$

This can further be written as:

$$-KA(z(i-i*)+k))=NX(e\frac{P*}{P},Y,Y^*,G,T,i-\pi e) \quad (8)$$

Assuming that net exports are the only component of the planned expenditure affected by the exchange rate, equation (4) can be rewritten as:

$$Y=E(Y,\ i\text{-}\pi e,\ G,\ T)+NX(Y,\ i\text{-}\pi e,\ G,\ T,\ e\frac{P*}{P}) \quad (9)$$

Substituting equation (8) into (9), equation (9) can also be written as:

$$Y=E(Y,\ i\text{-}\pi e,\ G,\ T)-KA(z(i-i*)+k) \quad (10)$$

where: *M/P* is the real money supply, *KA* is the capital flow, πe is the expected rate of inflation, L is the liquidity, $i*$ is the foreign interest rate, *k* is exogenous capital flows and *z* is the interest-sensitive capital flow component.

By extending equation (10) into the VAR framework, each of the variables can influence and be influenced by the other variables. Following Hussain & Haque (2017) and Eigbiremolen et al. (2015), the VAR model is depicted as:

$$\begin{aligned}
y_{1,t} &= \propto_{10} + \sum_{j=1}^{p} \alpha_{11} y_{1,t-j} + \sum_{j=1}^{p} \propto_{12,}\ y_{2,t-j} + \cdots + \sum_{j=1}^{p} \propto_{1k,}\ y_{k,t-j} + \ \mu_{1t} \\
y_{2,t} &= \propto_{20} + \sum_{j=1}^{p} \alpha_{21} y_{1,t-j} + \sum_{j=1}^{p} \propto_{22,}\ y_{2,t-j} + \cdots + \sum_{j=1}^{p} \propto_{2k,}\ y_{k,t-j} + \ \mu_{2t} \\
&\quad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots \\
y_{k,t} &= \propto_{k0} + \sum_{j=1}^{p} \alpha_{k1} y_{1,t-j} + \sum_{j=1}^{p} \propto_{k2,}\ y_{2,t-j} + \cdots + \sum_{j=1}^{p} \propto_{kk,}\ y_{k,t-j} + \ \mu_{kt}
\end{aligned} \quad (11)$$

With the parsimonious form of the model as:

$$y_t = \propto + \sum_{j=1}^{p} \prod_j y_{t-j} + \mu_t \quad (12)$$

where:

$y_t = (y_{1t}, y_{2t}, \ldots y_{kt})$ is the list of the variables of interest, $\prod_j = \begin{bmatrix} \alpha_{11.j} & \alpha_{12.j} & \cdots & \alpha_{1k.j} \\ \vdots & & \ddots & \vdots \\ \alpha_{k1.j} & \alpha_{k2.j} & \cdots & \alpha_{kk.j} \end{bmatrix}$ is the coefficient matrix, $j = 1\ldots. p$ are $K*K$ matrices, $y_{t-j} = y_{1,t-1,}\ y_{2,t-1,} \ldots y_{k,t-1}$, is the list of the lagged variables, and $\mu_t = \mu_{1t,}\ \mu_{2t,} \ldots \mu_{kt}$ is the disturbance term.

In this study, the selected macroeconomic variables of interest include budget deficit, GDP, current account, interest rate, exchange rate, inflation, and external debt service as guided by the literature and theoretical framework. All the variables are treated as symmetric and they are therefore all included in the model.

3.2. Data definition, source and measurement of variables

The study used annual time series secondary data covering the period of 1976-2018. The source of the data was the World Bank Development Indicators (WDI) for all the variables except for the budget deficit which was obtained from the Kenya Statistical Abstracts. Data from WDI are compiled from internationally recognized national uses using data available at country level. The data on budget deficit are obtained from Kenya's National Treasury and Office of Controller of Budget. Real domestic product (RGDP), Inflation (INF), and interest rate (INT) were measured in terms of their annual percentage growth rate. Budget deficit (*BD*), current account (*CA*), and external debt servicing (*EDS*) were measured as percentage of GDP while Exchange rate (*EXC*) was measured in terms of Kenya shilling per US dollar on an annual basis.

3.3. Non-stationarity test

Presence of nonstationary time series leads to spurious and inconsistent results (Gujarati, 2014). The test is therefore carried out to ensure that the results are consistent and meaningful. The main advantage of the ADF test is that it maintains the validity of the test by ensuring that the error terms are white noise. The PP test is also preferred because of its ability to test for stationarity without adding parameters and it also takes account of serial correlation and heteroske-

dasticity (Gujarati, 2014; Kosimbei, 2011). The ADF and PP test equations are given by equation (14) and (15):

$$\Delta Y_t = \alpha + \beta t + \rho Y_{t-1} + \sum_{i=2}^{m} \delta i \Delta Y_{t-1} + \mu_t \quad (13)$$

$$\Delta Y_t = \alpha + \beta_t + \rho Y_{t-1} + \mu_t \quad (14)$$

where: α is the constant term, m is the maximum number of lags specified, β_t is the trend and μ_t is the error term.

3.4. Cointegration test

The cointegration test was carried out to establish whether there was a long run relationship between the variables (Gujarati, 2014; Johansen, 1988). Determination of existence of cointegration or otherwise was important in coming up with empirically meaningful modelling relationship. The main methods of carrying out the cointegration test were the Engle–Granger test and Johansen cointegration test. The Johansen test was more preferred in this study to the Engle––Granger test due to its ability to handle several cointegrating relationships (Gujarati, 2014; Johansen, 1988). The trace test equation of the Johansen test of cointegration is given by equation 16 with the null hypothesis of r cointegrating vectors and the alternative hypothesis being n cointegrating vectors:

$$Jtrace = -Ti = \sum_{i=r+1}^{n} ln(1 - \lambda t) \quad (15)$$

where: T is the number of observations, n is the number of possible cointegrating vectors and λ_t is the estimated eigenvalues.

3.5. Diagnostic tests

Diagnostic tests were carried out to affirm the accuracy, reliability and validity of the results. The normality test was performed using the Jarque–Bera test to ascertain whether the error terms were normally distributed (Gujarati, 2014). Stability test using the CUSUM test was also performed to ascertain whether the residuals had structural breaks (Stock & Watson, 1996). The test for serial autocorrelation used in this study was the Breusch–Godfrey (BG) LM test.

4. Research Findings and Discussions

4.1. Descriptive statistics

Descriptive statistics was carried to reveal the nature of the variables under study (Table 1). The average budget was about −2.1801% of the GDP while the maximum and the minimum was about 1.8113% and −9.649%, respectively. The standard deviation of about 3.189% of the GDP revealed a wide variation of the budget from the mean under the study period. This was consistent with the study introduction that there has been a persistent budget deficit in the country in the recent past.

Table 1. Summary statistics for the variables

Summary statistics	BD	CA	EDS	EXC	INF	INT	RGDP
Mean	−2.1801	−6.0299	1.5113	52.3295	12.0491	17.4960	4.1778
Median	−0.8375	−5.6405	1.2016	58.7318	10.2841	15.0468	4.4062
Maximum	1.8113	0.8885	5.8750	103.4104	45.9789	36.2400	9.4538
Minimum	−9.6494	−18.6798	0.1661	7.4202	1.5543	10.0000	−0.7995
Std. Dev.	3.1892	4.8550	1.0993	32.8176	8.2220	6.5395	2.4644
Skewness	−0.8595	−0.9808	1.5909	−0.1248	1.9964	1.3306	−0.1410
Kurtosis	2.5132	3.6146	6.9678	1.5018	8.3110	4.0219	2.2421
Jarque–Bera	5.7191	7.5709	46.3459	4.1330	79.0988	14.5596	1.1716
Probability	0.0573	0.0227	0.0000	0.1266	0.0000	0.0007	0.5567
Observations	43	43	43	43	43	43	43

Notes: BD – budget deficit, CA – current account, EDS – external debt servicing, EXC – exchange rate, INF – inflation, INT – interest rate, RGDP – real gross domestic product.

Source: Author's own study.

The budget was negatively skewed (−0.778) implying that this period was generally characterized by a budget deficit rather than a surplus. From the Jarque–Bera results, real GDP, exchange rate, and budget deficit variables were normally distributed as indicated by a probability of more than 0.05. This was also true for the variables whose kurtosis values are different from a range of approximately 0 and 3.The mean interest rate, inflation rate, and real GDP growth rate were about 17.4960%, 12.0491% and 4.1778%, respectively. As a percentage of GDP, external debt servicing and current account were about 1.5113% and −6.0299%, respectively, while the mean exchange rate was 52.3295.

4.2. Non stationarity results

To avoid spurious and inconsistent results, the unit root test was carried on all the variables. The ADF and PP test was carried out on all the variables. Both tests revealed that the budget deficit, current account, exchange rate, external debt servicing, and interest rate were nonstationary at levels. The real GDP and inflation were however stationary at levels as presented in Table 2.

Table 2. Unit root test results

		Variable	BD	EXC	CA	INT	INF	EDS	RGDP
ADF	level	intercept	−2.1688	−0.2934	−3.5460	−1.6138	−3.6676	0.8061	−3.7686
		trend & intercept	−3.6070	−2.1566	−3.5114	−1.4568	−3.8761	−0.2339	−3.7337
	1st difference	intercept	−6.8155	−5.9230	-−8.1698	−6.2461		−5.0101	
		trend & intercept	−6.7441	−5.8391	−8.0663	−6.3762		−5.2201	
		conclusion	bd(1)	exc(1)	ca(1)	int(1)	inf(0)	eds(1)	rgdp(0)
P	level	intercept	−2.0354	−0.3056	−3.5346	−1.7702	−3.7198	0.8061	−3.8600
		trend & intercept	−3.3943	−2.2505	−3.5014	−1.5351	−3.9328	−0.2097	−3.8240
	1st difference	intercept	−13.7574	−5.9043	−8.3443	−6.2606		−5.0099	
		trend & intercept	−15.3683	−5.8150	−8.2336	−6.3820		−5.2240	
		conclusion	bd(1)	exc(1)	ca(1)	int(1)	inf(0)	eds(1)	rgdp(0)

Source: Author's own study.

The lag length is also important in capturing the dynamics of a model. AIC was used to determine the optimal lag length of the model and it revealed that 4 lags were optimal. This was also consistent with HQIC and FPE as presented in Table 3.

Table 3. Optimal lag length

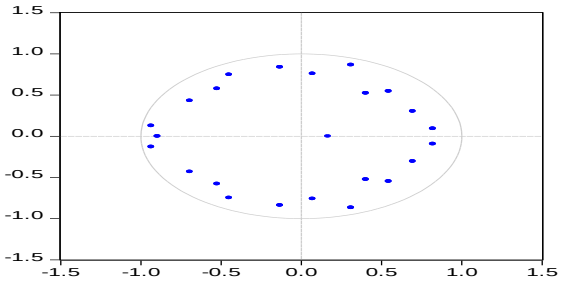
Lag	LL	LL LR	df	P	FPE	AIC	HQIC	SBIC
0		−620.957			532491	33.0504	33.1577	33.352*
1	−578.479	84.957	49	0.001	784830	33.3936	34.2523	35.8069
2	−522.169	112.62	49	0.000	701525	33.0089	34.6188	37.5338
3	−466.935	110.47	49	0.000	1.20E+06	32.6808	35.042	39.3173
4	−293.106	347.66*	49	0.000	14969.2*	26.1108*	29.2234*	34.859

Source: Author's own study.

4.3. Diagnostic test results

Diagnostic tests, such as a stability, normality, and serial correlation test, were carried out on the VAR estimate to determine how reliable and valid the model is. The stability test was based on the cumulative sum of the recursive residuals. The stability test by use of the CUSUM test indicated that the model was stable as the roots lied within the unit circle as presented in Figure 3. The results from this model were therefore meaningful and could be relied on.

Figure 3. Stability test results



Source: Author's own study.

The normality test by use of the Jarque–Bera test established that all the residuals of the variables were normally distributed as depicted in Table 4. The serial correlation by use of the Breusch–Godfrey LM test led to acceptance of the null hypothesis of no serial correlation. This therefore implied that there was no serial correlation between the residuals of different periods as presented in Table 5 (Hussain & Haque, 2017; Muli & Ocharo, 2018). The model was therefore reliable and valid to be used in establishing the nexus between a budget deficit and macroeconomic variables

Table 4. Normality test

Component	Jarque–Bera	Df	Prob.
1	0.500551	2	0.7786
2	0.507380	2	0.7759
3	0.985850	2	0.6108
4	1.018523	2	0.6009
5	0.620870	2	0.7331
6	1.970166	2	0.3734
7	0.440801	2	0.8022
Joint	6.044151	14	0.9654

Source: Author's own study.

Table 5. Breusch–Godfrey serial correlation LM test

Lag	LRE* stat	Df	Prob.	Rao F-stat	Df	Prob.
1	84.02194	49	0.0014	2.21265	(49, 45.0)	0.0040
2	45.24831	49	0.6260	0.859549	(49, 45.0)	0.6985
3	49.37502	49	0.4581	0.969936	(49, 45.0)	0.5431
4	58.58487	49	0.1641	1.241629	(49, 45.0)	0.2322

Source: Author's own study.

4.4. Cointegration test

The cointegration test was done to establish whether the relationship between the variables is long run. Using the Johansen cointegration test trace statistics, the results revealed that there were 2 cointegrating equations as depicted in Table 6.

Table 6. Johansen Cointegration Test using trace statistics

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.848146	186.1496	125.6154	0
At most 1 *	0.657241	108.8714	95.75366	0.0046
At most 2	0.482476	64.97152	69.81889	0.1146
At most 3	0.358340	37.96486	47.85613	0.3035
At most 4	0.245082	19.77327	29.79707	0.4383
At most 5	0.174516	8.246285	15.49471	0.4394
At most 6	0.009300	0.383065	3.841465	0.5360

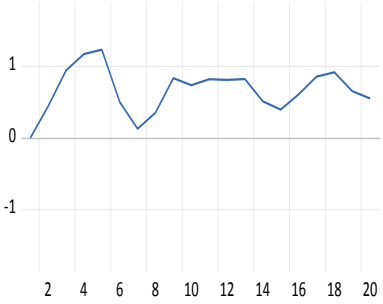
Source: Author's own study.

4.5. Impulse response function results

An impulse response function shows the effect of a one standard deviation shock on the lag of the variable itself and also on the lags of the other variables. The IRF results are generated from the restricted VAR as this takes care of explosion of the IRF estimates when there is cointegration (Hussain & Haque, 2017; Jang & Ogaki, 2001). A one standard deviation shock on interest rate has a positive impact on the budget deficit for over twenty years as presented in Figure 4. This is an expected scenario as increase in interest rates crowd out private investment. This gives the government a window to borrow so as to finance government projects thereby raising the budget deficit. A shock on GDP

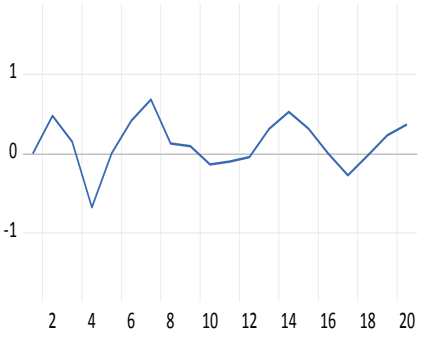
will have a mixed impact on the budget deficit for the entire period as indicated in Figure 5. In the first four years, the impact was, however, positive which is consistent with the Keynesian approach to a budget deficit. It is however crucial to have a proper mix between government investment, private investment and foreign direct investment as the economy continues to grow. This will reduce a budget deficit.

Figure 4. Response of BD to INT shock



Source: Author's own study.

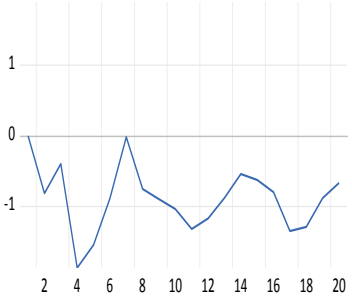
Figure 5. Response of BD on RGDP shock



Source: Author's own study.

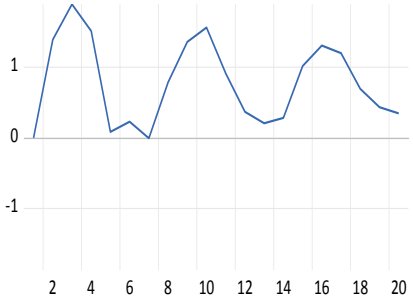
A one standard deviation shock on external debt service will have a negative effect on the budget deficit for the entire period as indicated in Figure 6. This can imply that prudent investment of initially borrowed funds to projects that can service the debts and proper debt management policies can reduce the budget deficit. From Figure 7, a shock on the exchange rate will have a positive impact on the budget deficit for the twenty years. Currency depreciation makes external borrowed funds expensive. This calls the need for maintaining a stable exchange rate.

Figure 6. Response of BD to EDS shoc



Source: Author's own study.

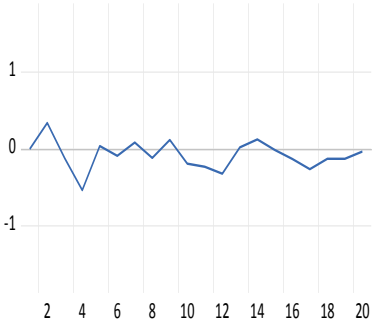
Figure 7. Response of BD to EXC shock



Source: Author's own study.

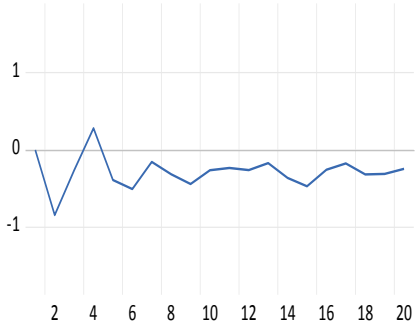
A one standard deviation shock in inflation will have a positive impact on the budget deficit for the first three years.From the third year onwards, the impact will be mixed as indicated in Figure 8. The current account shock will generally have a negative impact on the budget deficit for the entire period as depicted in Figure 9. This emphasizes the need for increasing domestic production and exports.

Figure 8. Response of BD on INF



Source: Author's own study.

Figure 9. Response of BD on CA



Source: Author's own study.

5. Conclusions

5.1. Research findings and contribution

The overall objective of this study was to establish the nexus between the budget deficit and macroeconomic variables in Kenya. Specifically, the study sought to establish the impact of the selected macroeconomic variables shocks on the budget deficit. The main question of interest was; how does a budget deficit respond to exogeneous impulse shocks emanating from other macroeconomic variables?

The study employed the restricted VAR model which was used to derive the impulse response functions. The IRF results showed that shocks from the interest rate and exchange rate had a positive impact on the budget deficit. This was consistent with the Keynesian approach to a budget deficit but contrary to Chi-Chi & Ogomegbunam (2013) who found out that interest rate shocks have a negative impact on a budget deficit. Shocks emanating from the current account had a negative impact on the budget deficit which is consistent with the Neoclassical approach to a budget deficit and Aworinde (2013) study. Similarly, external debt servicing had a negative impact on the budget deficit. All these shocks lasted for more than twenty years.

The study contributes to the existing literature by examining how shocks emanating from various macroeconomic variables impact on a budget deficit; specifically for the Kenya context. The results are of great importance to researchers in finding out whether these results are applicable to other developing countries where a similar study is yet to be carried out. For the policy makers, the study findings can inform in designing policies geared toward reducing a budget deficit in a country.

5.2. Practical implications

The study recommends the need to come up with policies that stimulate private investment in the event a country experiences interest rate shocks. This will narrow government's window to borrow and also reduce cases of crowding out effect of private investment. The study also recommends the Central Bank of Kenya to always endeavor to implement monetary policies that can reduce exchange rate volatility. For a country to be in a position to service its external debts and avoid situations whereby borrowing is used to pay an existing debt, prudent investment of borrowed funds and careful design of external debt management policies are of great importance. This will help the national treasury to achieve its target of reaching a budget deficit of 3.6% by 2024/2025. These findings are also useful to other third world countries who have been facing persistent budget deficit over time.

5.3. Research limitations and future work

The study tackled the link between a budget deficit and various macroeconomic variables only. It would be of interest that future studies establish the nexus between a total debt level and other macroeconomic variables.

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