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Primary balance dynamics and public debt sustainability in Kenya

William Irungu Ng'ang'a¹, Julien Chevallier², Simon Ndiritu³

Abstract:

This study investigates the extent to which primary balance reacts to exacerbate or mitigate the effects of macroeconomic shocks on total public debt in Kenya. Based on time series data from 1981 to 2015, Structural Vector Autoregressive model (SVAR) is used to evaluate the interrelationship between primary balance, real exchange rate, interest payment, and Gross Domestic Product. The main objective was to evaluate the interactive nature of primary balance and automatic stabilizers and its implication on debt sustainability. The findings are threefold: (i) The results confirm that primary balance reaction to shocks is consistent with maintaining a non-explosive debt position. (ii) Fiscal consolidation appears counterproductive as a response to debt management, as this may dampen growth and ultimately compromise overall macroeconomic stability, especially in the long run. (iii) The findings also establish that debt uptake is positively associated with long-run GDP growth suggesting that public debt plays a vital role in macroeconomic development in Kenya.

JEL Codes: H63; E62; F34

Keywords: Debt sustainability; SVAR; Public debt dynamics; Automatic stabilizers; Primary balance.

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1. Introduction

Public debt management is primarily based on how to sustainably finance economic objectives (International Monetary Fund (IMF), 2014). For a majority of developing economies, particularly in Africa, this demands to balance between financing the much-needed development agenda while maintaining a non-explosive debt path. Although the recent improvement in market sentiments and credit access reflects better macroeconomic fundamentals and growth prospects, the associated increase in debt uptake by developing countries raises concern over the return to unsustainably high debt levels, especially debt that does not translate into productive investment (UNEC, 2016). In the context of volatile global market conditions and an increasing debt appetite among developing countries, the need for a continuous assessment of debt sustainability remains a daunting but necessary task. (IMF, 2015).

The attractiveness of debt to finance Kenya's development agenda is boosted by the fact that the Debt sustainability analysis, (DSA), conducted by the International Monetary Fund (IMF) and the World Bank (WB) has consistently ranked Kenya a low risk to debt distress country, given their current level of debt and growth potential in the foreseeable future (Were, 2015; Mauro & Joly, 2015). Debt uptake is further fueled by the 'catching up' phenomenon, which justifies the mega infrastructure development policy agenda among developing countries (UNCTAD, 2015).

This increased debt uptake witnessed among developing countries, and the changes in the structure of public debt has flagged the need for policymakers to relook at public debt dynamics, over and above the DSA conducted by the IMF and the WB, while examining the debt position's vulnerability to both internal and external shocks (Were, 2015; UNCTAD, 2015).

Kenya's debt management landscape presents a unique case among developing countries. Unlike in most Sub-Saharan African countries, Kenya has never benefited from the debt relief under the Highly Indebted Poor Countries initiative and the Multilateral Debt Relief Initiative (MDRI). The country is considered a non-resource based low-income country that does not rely on resources such as oil or mineral exports to finance its fiscal policy (Konuki & Villafuerte, 2016).

While developing countries have been criticized for over-relying on the DSA to justify their public debt position, Mupunga & Roux (2015) and UNCTAD (2015) criticize the DSA methodology which they explain adopts a deterministic approach rather than a stochastic approach. Secondly, while informative, the DSA fails to adequately elaborate on the impact of second-round effects of on macroeconomic variables, such as the primary balance, exchange rate, interest rate and growth in an economy. Further, Mauro and Joly (2015) elaborate on how the baseline DSA analysis is often based on the assumption of desirable and sustained growth prospects and favorable fiscal dynamics.

Despite the lack of alternative models and literature interrogating the interaction among debt drivers, debt financing is and will remain a significant part of government policy given the recent achievement of low middle-income status, and the drive to improve social-economic welfare in the developing countries and upgrade the infrastructure facilities (UNCTAD, 2015; UNEC, 2016). In this regard, a decomposition of the debt drivers and an understanding the debt dynamics by the policymakers is of high importance (Pablo & Pienkowski, 2015). The recent establishment of a Debt directorate at the Ministry of Finance in Kenya further highlights the urgent need to dive

deeper into debt dynamics and the interaction of debt drivers to inform an evidence-based debt policy framework.

There are numerous regional empirical studies which primarily focus on the public debt - economic growth nexus and the proximate causes of rapid increase in public debt in the region (Ndikumana, 2003; Babu *et al.*, 2014; Ncube & Brixiova, 2015; Ndocirimpa, 2015). However, these studies fail to provide alternative methodologies of probing how the different debt drivers interact with each other, and how this interaction impacts the overall debt trajectory.

This study aims at addressing this literature gap by investigating the interactive nature between the primary balance and the automatic debt stabilizers, and examining whether primary balance reaction to debt dynamics acts to exacerbate or mitigate the effects of macroeconomic shocks on public debt in Kenya. Therefore, the main objective is to evaluate the role of the primary balance in guaranteeing public debt sustainability.

Time series data from 1981 to 2015 is used for the analysis. The methodology hinges on the Structural Vector Auto-Regressive model (SVAR) where the two identification procedures used in the analysis were adopted as per Melecky & Melecky (2011) and Pablo and Pienkowski (2015).

The main findings can be summarized as follows: First, the results demonstrate that primary balance reacts to macroeconomic shocks, in a manner that guarantees a non-explosive debt path, therefore consistent with ensuring a sustainable debt position. Secondly, while fiscal consolidation is necessary following expansionary periods, this appears counterproductive by dampening growth

in the long run. Lastly, the results show that an increase in public debt is positively associated with long-run GDP growth. This adds impetus to the argument that if well managed, public debt plays a crucial role in Kenya's macroeconomic development.

The rest of the study is organized as follows: Section 2 reviews the theoretical and empirical literature. Section 3 introduces the methodology, articulating the theoretical framework and the empirical specification of the model, and thereafter describes the dataset. Section 4 presents the findings, while Section 5 and 6 presents the sensitivity analysis, the conclusion and policy recommendations respectively.

2. Theoretical and empirical literature

This section first reviews the theoretical literature examining the interactions between numerous macroeconomic debt drivers, and the corresponding debt dynamics. Conventional theoretical literature heavily focused on overall debt burden dynamics and its intertemporal effect on the economy, with little attention being paid on the debt drivers (Barro, 1989; Blanchard & Perotti, 2002; Demmel, 2012). However, over the years, two main theoretical strands have continuously shifted focus to public debt drivers. These two schools of thought, presented below, are grouped into the normative and the positive perspectives of public debt (Blanchard & Perotti, 2002; Demmel, 2012).

2.1 A normative approach to public debt

This approach, attributed to David Ricardo and Robert Barro among other economists (Barro, 1989; Demmel, 2012), argues from the classical standpoint that the government is a social planner whose aim is to maximize social welfare.

The normative approach demonstrates that distortions in the economy emerge when fiscal planners set the tax rate, while not factoring in the state of the economy, i.e., whether the economy is undergoing a state of upswing or downswing. The resulting surpluses and deficits in the primary balance are therefore a by-product of cyclical movements or shocks to the economy. In this case, an accumulation of public debt which is necessary to accommodate the periodic fiscal deficits should be repaid during periods of tranquility and upswings in the business cycle (Barro, 1989; Demmel, 2012).

To this end, Barro's theory, which is also referred to as the "tax smoothing theory," holds that public debt has a neutral effect on the economy. These temporary changes in the public debt position have no real impact on the economy, and therefore prices as well as taxes, are distribution-neutral. This argument is closely linked to the Ricardian equivalence argument, which holds that deficit and taxes are equivalent methods of financing public debt. According to Barro (1989) and the normative school of thought, debt does not influence real wealth, interest rates, inflation or capital formation. Therefore, the sole purpose is to act as a store of value and provide the government with greater flexibility in the intertemporal management of public finances.

2.2 A positive approach to public debt

The positive approach is also referred to as the “public choice school of thought” (Demmel, 2012). This public choice approach argues that the size and allocation of public expenditures are driven by myopic and self-willed political behaviors. This short-termism approach contradicts the altruistic social welfare objective presented in the normative approach and presents the politician’s primary interest as that of securing their re-election and maintaining power. To this end, the short-term fiscal needs of voters and spending pressures from different social groups play a significant role in determining the size of fiscal expenditure (Demmel, 2012).

Therefore, the positive approach presents two angles to fiscal policy management challenges. First, frequent changes in governments with different fiscal preferences negates the commitment to predecessors’ debt management policies, and this encourages a myopic approach to public debt management. Secondly, the existence of decentralized governments may further undermine the ability to take unified decisions, and therefore further promoting a short-term approach towards debt sustainability (Demmel, 2012).

The main contribution of the positive argument is that, by politicians adopting a myopic short-term approach to managing public finances, fiscal indiscipline can creep in, leading to an explosive debt path, which culminates into an unsustainably large public debt position and subsequent inflationary pressures in the economy (Demmel, 2012).

2.3 Debt sustainability analysis

The Debt Sustainability Analysis (DSA) framework, uses the standard debt accumulation model, to present a criterion for evaluating the debt trajectory while analyzing the first-order interactions among the different drivers of debt, namely primary balance and other macroeconomic variables such as interest rates, exchange rates, inflation and growth (IMF, 2015).

The standard debt accumulation framework presents debt sustainability as the ability to maintain a non-explosive debt–GDP ratio over a given period, and argues that this is guaranteed as long as the growth of income exceeds the cost of borrowing, subject to the condition that the primary balance is either positive or zero (Blanchard & Perroti, 2002; Pablo & Pienkowski, 2015).

Standard debt accumulation framework can be presented as follows:

$$\Delta d = d(r - g) - pb \tag{1}$$

Let the quantum spread be defined as the product of debt (d) and interest rate-growth($r-g$) differential [$d(r - g)$] less the primary balance(pb). In this regard, GDP and interest rate spreads are referred to as automatic stabilizing factors, while debt sustainability pegs on the quantum spread dynamics on one hand and the level of primary balance on the other (Blanchard & Perroti, 2002; Pablo & Pienkowski, 2015).

Debt sustainability dynamics can be summarized as follows:

$$\left\{ \begin{array}{l} \text{If } d(r - g) = P; \Delta d = 0 \quad \text{Debt - GDP ratio remains constant} \\ \text{If } d(r - g) > P; \Delta d < 0: \quad \text{Debt - GDP ratio is falling} \\ \text{If } d(r - g) < P; \Delta d > 0: \quad \text{Debt - GDP ratio is rising} \end{array} \right.$$

The dynamics presented above dictates that the quantum spread has to be equal to or greater than the primary balance to guarantee a non-explosive debt–GDP path.

2.4 Empirical literature

To save space, Table 1A (in the Appendix) summarizes the relevant empirical studies focusing on public debt drivers, public debt dynamics and public debt sustainability. This table summarizes the nature and scope of the existing literature, the methodology, findings and application of the numerous studies. The literature reviewed demonstrates that a vast majority of regional research, on public debt sustainability, primarily focuses on the debt drivers or the debt–economic growth nexus. Despite most studies finding evidence of a sustainable debt path, few studies have explored public debt vulnerability to macroeconomic shocks and how public debt drivers interact with each other. This study is anchored on the standard debt accumulation framework and aims at contributing to the debate by evaluating how the primary balance and automatic debt stabilizers interact to determine the debt trajectory.

3. Methodology and data

This section describes the methodology that will be used and is organized as follows. First, the theoretical framework is presented, and thereafter the empirical model specification is unveiled. Lastly, the data types, measurements, and variables description are introduced.

3.1.Theoretical framework

The theoretical model is anchored on the standard debt dynamics equation as presented in Equation (1) above (Blanchard & Perroti, 2002; Oscar & Turgul, 2013; Pablo & Pienkowski, 2015). For an open economy, the evolution of government debt can be expressed as:

$$D_t^d + D_t^e = (1 - \alpha)(1 + i_t^d)D_{t-1}^d + (\alpha)(1 + i_t^f)ex_t D_{t-1}^e - Pb_t + \mu_t \quad (2)$$

where D_t^d represents domestic debt at time t-i $\forall i 0,1$

D_t^e represents external debt at time t-i $\forall i 0,1$

i_t^d represents nominal interest rate on domestic debt

i_t^f represents nominal interest rate on external debt

ex_t represents the nominal exchange rate at time t

Pb_t represents the primary balance at time t

μ_t represents the error term which includes other factors not included in the model

$\alpha = \frac{ex_t D_{t-1}^e}{D_{t-1}}$ is the ratio of external debt (D_{t-1}^e)to total debt (D_{t-1}) at time t-1

External debt is defined as foreign-denominated debt issued domestically and abroad and is therefore linked to the exchange rate. Equation (2) is further adjusted for inflation by dividing it through by $(1 + \pi)$ such that:

$$D_t^d + D_t^e = \frac{(1-\alpha)(1+i_t^d)}{(1+\pi)} D_{t-1}^d + \frac{\alpha(1+i_t^f)}{(1+\pi)} \varepsilon_t D_{t-1}^e - P_t + \mu_t \quad (3)$$

Let $i_t^w = (1 - \alpha)i_t^d + \alpha i_t^f$ be the effective interest rate estimated as the weighted average of the domestic and external interest rate on debt. The following equation unfolds:

$$D_t = \left[\frac{(1+i_t^w) + \alpha(1+i_t^f)\varepsilon_t}{(1+\pi)} \right] D_{t-1} - P_t + \mu_t \quad (4)$$

Recall that $GDP_t = GDP_{t-1}(1+g)$, where g represents the growth rate. Dividing the equation by GDP yields:

$$\frac{D_t}{GDP_t} = \left[\frac{(1+i_t^w) + \alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)} \right] \frac{D_{t-1}}{GDP_{t-1}} - \frac{P_t}{GDP_t} + \mu_t \quad (5)$$

Let $\frac{P_t}{GDP_t} = pb_t$, $\frac{D_{t-1}}{GDP_{t-1}} = d_{t-1}$ and $\frac{D_t}{GDP_t} = d_t$. Subtracting d_{t-1} from both sides yields:

$$\Delta d_t = \left[\frac{(1+i_t^w) + \alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)} - 1 \right] d_{t-1} - pb_t + \mu_t \quad (6)$$

Introducing $1 = \frac{1+g}{1+g}$ into the coefficient of d_{t-1} in Equation (6) yields:

$$\left[\frac{(1+i_t^w) + \alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)} - \frac{1+g}{1+g} \right] = \frac{(1+i_t^w) - \pi(1+g) - g + \alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)}$$

Equation (6) can be further decomposed into:

$$\Delta d_t = \frac{(1+i_t^w) - \pi(1+g)}{(1+\pi)(1+g)} d_{t-1} - \frac{g}{(1+\pi)(1+g)} d_{t-1} + \frac{\alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)} d_{t-1} - pb_t + \mu_t \quad (7)$$

Equation (7) is the debt dynamics representation estimated in this study. This equation presents that changes in the debt-to-GDP ratio are driven by changes associated with real interest rates dynamics $\left(\frac{(1+i_t^w) - \pi(1+g)}{(1+\pi)(1+g)} \right)$, real GDP growth dynamics $\left(\frac{g}{(1+\pi)(1+g)} \right)$, real exchange rate dynamics $\left(\frac{\alpha(1+i_t^f)\varepsilon_t}{(1+\pi)(1+g)} \right)$, the ratio of primary balance to GDP (pb_t), and other factors (Buckle *et al.*, 2010; Oscar & Turgul, 2013).

3.2. Empirical model specification

The empirical model is anchored on Equation (7) and presented as a system of equations (Blanchard & Perroti, 2002; Melecky & Melecky, 2011).

Let Y_t represent a vector of five variables, namely the change in debt-to-GDP ratio (Δd_t), the GDP growth (g_t), the primary balance as a ratio of GDP (Pb_t), the real interest payment Int_t and the real exchange rate (re_t), with t as the time period. Therefore:

$$Y_t = \begin{pmatrix} \Delta d_t \\ g_t \\ Pb_t \\ Int_t \\ re_t \end{pmatrix} \text{ and the residual vector is given by } \mu_t = \begin{pmatrix} \mu_{\Delta d_t} \\ \mu_{g_t} \\ \mu_{Pb_t} \\ \mu_{Int_t} \\ \mu_{re_t} \end{pmatrix}$$

The study introduces a structural vector autoregressive equation (SVAR) in matrix notation:

$$CY_t = \gamma \sum_{i=1}^{\rho-1} Y_{t-i} + \mu_t \quad (8)$$

$$\text{Let } cy_t = \alpha \sum_{i=2}^{\rho-1} y_{t-i} + v_t \quad (9)$$

Where $y_t = Y_t - Y_{t-1}$; $y_{t-i} = Y_{t-i} - Y_{t-i-1}$ and $v_t = \mu_{it} - \mu_{t-1}$

Equation (9) can be presented in the ARMA form such that:

$$cy_t = \alpha \sum_{i=1}^{\rho-1} y_{t-i} + B\varepsilon_t \quad (10)$$

Where $B\varepsilon_t = v_t$ and $\varepsilon \sim I.I.D(0, I)$.

Using lag operators:

$$cy_t = \Gamma(L)y_t + B\varepsilon_t \Rightarrow cy_t - \Gamma(L)y_t = B\varepsilon_t \Rightarrow A(L)y_t = B\varepsilon_t \quad (11)$$

Where $A(L) = (C - \Gamma(L)) = A_0 - A_1L - A_2L^2 - \dots - A_\rho L^\rho$

From Equation (11), the vector of endogenous variables (y_t) can be expressed as:

$$y_t = A(L)^{-1}B\varepsilon_t \quad (12)$$

Equation (12) represents a structural VAR with ε_t as the structural shocks (Buckle *et al.*, 2010; Oscar & Turgul, 2013). Given that A_0 is not diagonal, the equation is not identified, and the error terms are contemporaneously correlated. However, an identified reduced form equation can be estimated such that:

$$y_t = c^{-1}\Gamma(L)y_t = c^{-1}B\varepsilon_t \quad (13)$$

The random stochastic residual $c^{-1}B\varepsilon_t$ can be estimated from the residual of the estimated unrestricted VAR e_t such that $c^{-1}B\varepsilon_t = e_t$.

This implies that:

$$c^{-1}B\varepsilon_t \hat{c}^{-1} = e_t \hat{e}_t = c^{-1}B\hat{c}^{-1} \quad (14)$$

Since $\varepsilon_t \hat{e}_t = I$. The Cholesky decomposition identification scheme for the structural VAR is written in the form:

$$A\varepsilon_t = Be_t \text{ as } \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{pmatrix} \varepsilon_{\Delta d_t} \\ \varepsilon_{gt} \\ \varepsilon_{pb_t} \\ \varepsilon_{int_t} \\ \varepsilon_{ret} \end{pmatrix} = \begin{bmatrix} \alpha_{11} & 0 & 0 & 0 & 0 \\ 0 & \alpha_{22} & 0 & 0 & 0 \\ 0 & 0 & \alpha_{33} & 0 & 0 \\ 0 & 0 & 0 & \alpha_{44} & 0 \\ 0 & 0 & 0 & 0 & \alpha_{55} \end{bmatrix} \begin{pmatrix} e_{\Delta d_t} \\ e_{gt} \\ e_{pb_t} \\ e_{int_t} \\ e_{ret} \end{pmatrix} \quad (15)$$

Where ε_t refers to the reduced-form shocks and e_t represents structural shocks.

The main identification assumption imposes a diagonal structure on the matrix A, and the identification for the short-term restriction model is adopted from Melecky and Melecky (2011). In this case, growth rate, primary balance, interest payment, and exchange rate responds to the debt–GDP ratio contemporaneously, while debt–to–GDP ratio responds to changes in the macroeconomic variables after one lag. Primary balance contemporaneously responds to the debt–GDP ratio and growth rate, but real interest rate contemporaneously responds to the debt–GDP

ratio, the growth rate, and the primary balance. The exchange rate is ordered last in the Cholesky decomposition and assumed to be genuinely endogenous. Melecky and Melecky (2011) document that these assumptions are logical to the extent that the automatic stabilizers (real interest rates and real exchange rates) quickly respond to changes in macroeconomic conditions as compared to other policy variables.

For robustness long-run restrictions are adopted following Pablo & Pienkowski (2015), Buckle *et al.*, (2010) and Ekanayake (2012). Blanchard and Quah (1989) demonstrated the importance of having long-run restrictions in the estimation of the model parameters.

Therefore, this study adopts the following long-run restrictions: First, public debt is assumed to have a permanent effect on all the variables under consideration. This assumption is informed by the fact that a developing country, faced by little resources and targets to meet development goals, tends to rely on debt financing heavily. In this regard, changes in debt may significantly affect both real and nominal variables given the dominance of the public sector in the economy (IMF, 2014). Secondly, for the same reason, it is assumed that primary balance has a permanent effect on its innovation and all variables except the nominal exchange rate. The growth rate is assumed to have a permanent effect on its innovation, primary balance, and interest payment but not on debt (Pablo & Pienkowski, 2015; Melecky and Melecky, 2011; Buckle *et al.*, 2010). Interest payment and exchange rate are assumed only to have a permanent effect on their own innovations. This assumption is informed by the fact that nominal variables tend to have a short-run effect compared to real variables (Ekanayake, 2012; Buckle *et al.*, 2010). Therefore, the long run restriction matrix is given as:

$$\begin{bmatrix} a_{11} & 0 & a_{13} & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & 0 & 0 & 0 & a_{55} \end{bmatrix} \quad (16)$$

3.3. Estimation procedure

The structural VAR was estimated based on the short-run restrictions specified in equation (15) and (16) respectively. The stationarity test was conducted using the Augmented Dickey-Fuller test, Phillip-Perron test, and breakpoint unit root test. Diagnostic tests conducted include invertibility test to check for stability condition, lag length determination, serial correlation test, and heteroskedasticity test. The Impulse response functions, variance decomposition and coefficients of both the short-run and long-run restriction models were used to address the study objectives.

3.4. Data

The model was estimated using time series data from 1981 to 2015. Table 1 below summarizes the description and measurement of variables used in the study. Notably, data on real interest rate payable on public debt was not available. Therefore the study used interest rate burden as a proxy for the interest rate.

Table 1: Description of Data

Variable	Unit	Description	Source
Gross domestic product	US Dollar	Measured in US dollars at 2017 market prices.	WDI
Inflation	Ratio	Percentage change in Consumer Price Index.	CBK

Total debt/GDP	Ratio	Total debt as a ratio of GDP	WDI
Interest payment/GDP	Ratio	Total interest payment as a ratio of GDP	WDI
Exchange rate	KES/USD	Domestic currency/US Dollar	CBK
Primary balance/GDP	Ratio	Estimated as fiscal balance as a ratio of GDP less interest payment as a ratio of GDP	WDI
GDP growth	Ratio	Annual GDP growth	WDI

WDI represents the World Bank Database

CBK Central Bank of Kenya

Data for total debt to GDP ratio, inflation rate, and interest rate were sourced from the World Development Indicators (WDI) and the Central Bank of Kenya (CBK). Primary balance data was estimated as the fiscal balance as a ratio of GDP less interest payment as a ratio of GDP. Interest burden estimated as interest payment as a ratio of GDP was used as a proxy for the interest rate.

Table 2A (in the Appendix) contains a summary of statistics for the period under investigation. The results show that the total debt-to-GDP ratio averaged 50 percent with a standard deviation of 11. GDP growth averaged 7.2 percent with a standard deviation of 13 percent. However, it is worth noting that the rate of growth was slightly higher than changes in the debt-to-GDP ratio. Notably, the average primary balance to GDP ratio stood at -3.76 with a standard deviation of 2.97. Figure 1 displays the annual trend of the primary balance over the years.

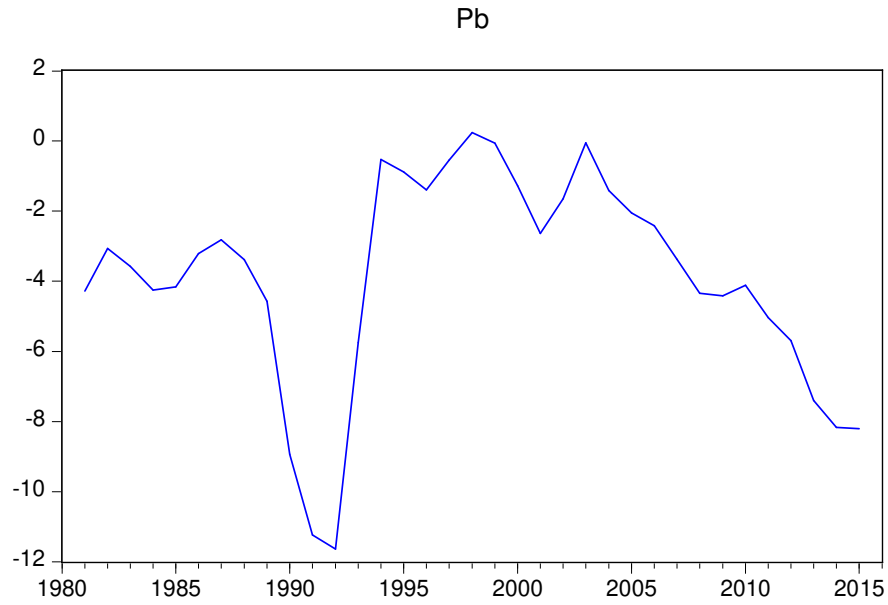


Figure 1: Trending primary-balance to GDP ratio from 1981 to 2015

4. Empirical results

4.1. Pre-estimation and Diagnostic tests

Stationarity test generated using the Augmented Dickey-Fuller (ADF) test is reported in Table 2.

Table 2: Stationarity Test

Augmented Dickey-Fuller Test				
		Test statistic	P-Value	Conclusion
Debt–GDP ratio	Level	-2.423	0.1428	Not stationary at level. Integration of order one $I(1)$
	1 st Diff	-5.545	0.000***	
GDP	Level	-0.396	0.883	Not stationary at level. Integration of order one $I(1)$
	1 st Diff	-6.149	0.000***	
Primary Balance	Level	-3.107	0.0357**	Stationary at level. Integration of order one $I(0)$
Exchange Rate	Level	-0.376	0.9028	Not Stationary at level Integration of order one $I(1)$
	1 st Diff	-5.39	0.000***	
Interest payment/GDP	Level	-0.737	0.825	Not stationary at level. Integration of order one $I(1)$
	1 st Diff	-4.8705	0.000***	

Other measures used to countercheck Stationarity include unit root test with breaking point and Philip-Perron tests. The results were consistent with the reported ADF test. However, it is worth noting that breaking point tests for primary balance and debt to GDP ratio show that the breaking point dummy was significant during the debt crisis period. In this regard, a dummy was introduced to provide for this period such that:

$$\text{Dummy} = \begin{cases} 1, & \text{period from 1991 to 1999} \\ 0, & \text{otherwise} \end{cases}$$

Table 3 below contains the summary statistics for lag selection.

Table 3: Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-108.1828	NA	0.001411	7.624700	8.087276	7.775488
1	-52.96474	85.49900	0.000209	5.675145	7.294163*	6.202904
2	-19.18207	41.41102*	0.000141*	5.108520	7.883979	6.013251*
3	8.884962	25.35086	0.000184	4.910648*	8.842548	6.192349

Note: AIC: Akaike information criteria; FPE: Final prediction Error; SC: Schwarz Information criteria; LR: Sequentially Modified LR test; HQ: Hannan-Quinn Information Criteria

The results in table 3 show that up to three comparative statistics choose two lags. However, given the relatively small sample data used for analysis, the underlying unrestricted VAR was estimated using one lag, as implied by the SC test.

4.2. Regression results

This section presents the regression analysis and post-estimation tests conducted to determine the reliability of the model. The primary objective is to evaluate the interaction between the different debt drivers in Kenya and to examine how primary balance responds to shocks imposed on the automatic debt stabilizers. First, Impulse response and variance decomposition were estimated using short-run restriction model specified in section 3.2 (SVAR estimates presented in table 5A in the appendix). Secondly, the SVAR model based on the long run restriction as specified in section 3.2 is reported. Figure 2 shows the IRF's capturing the response of primary balance to shocks on total debt, GDP growth, interest, and exchange rate.

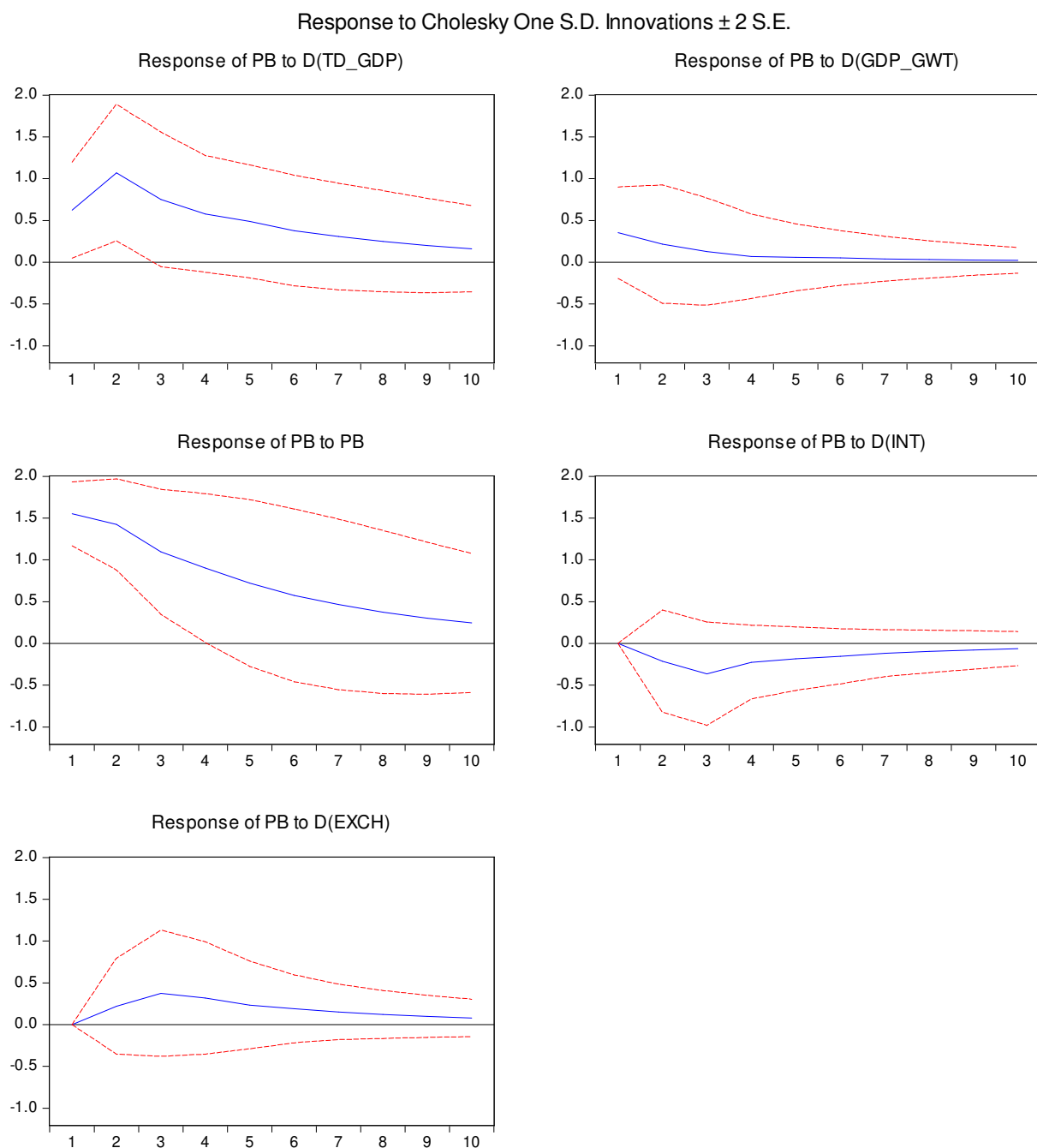


Figure 2: Impact of other system variables on Primary Balance:

Note: $D(td_gdp)$ represents changes in total debt changes as a ratio of GDP; $d(Int)$ represents changes in interest, $D(exch)$ represents a change in exchange rate, $D(gdp_GWT)$ represents GDP growth, Pb represents primary balance.

The main objective was to evaluate the interactive nature of primary balance and the automatic debt stabilizers and its implication on public debt sustainability. Figure 2 shows that following a shock to the total debt, the impact on the primary balance gradually dissipates after two periods. Besides, a positive shock to GDP growth initially leads to improvement in the primary balance, but the effect is neutralized relatively faster compared to shocks to public debt.

Variance decomposition presented in table 3A (see appendix) shows that total debt has a significant and incremental impact on the primary balance of up to 54 percent over a ten-period horizon. These findings map out evidence that the fiscal policy agent reacts to an increase in debt level by adjusting the primary balance to guarantee a non-explosive public debt.

The response of primary balance to shocks on both interest payments and exchange rate suggests that the primary balance in Kenya is sensitive to an increase in interest burden and worsening exchange rate dynamics. However, an important caveat to note is that this study uses interest burden as a proxy and not real interest rate.

Structural VAR estimates were used to estimate long-run parameters based on the long run restrictions specified in section 3.2 equation 16. Table 4 below presents the extract of the structural coefficients and relevant diagnostics. (See table 4A in the appendix for comprehensive results).

Table 4: Extract of Structural VAR Coefficients based on long-run restrictions.

Debt-to-GDP ratio	GDP Growth	Primary Balance	Interest/GDP	Exchange Rate
10.42***	0	5.59***	0	0
0.064***	-0.012	-0.055***	0	0
-8.95***	3.84***	-4.32*	0	0
0.01***	-0.001***	0.003***	0.02***	0
3.95***	0	0	0	4.28***
Log likelihood		-75.17542		
LR test for over-identification:				
Chi-square (1)	3.1651827		Probability	0.075224

The estimated output shows that all variables are significant at 10 percent level or above except GDP growth shocks. Notably, public debt has a significant adverse effect on primary balance, while GDP growth has a positive impact on primary balance. The implication is that the reduction of total debt and GDP growth has a permanent and desired effect on fiscal position.

It is worth noting that an improvement in primary balance would lead to a permanent increase in public debt and dampen GDP growth. Therefore, the evidence implies that fiscal consolidation may hinder growth in the long run. This claim is supported by the response of GDP to shocks on debt and primary balance (see figure 1A in the appendix).

It can be observed that an increase in public debt leads to a sharp increase in GDP growth in the initial periods, but the effect dissipates and becomes negative after the third period. Further, the response of growth to a shock on primary balance is positive, but the effect is reversed after two periods.

These results confirm the findings by Babu *et al.* (2014) that a fiscal consolidation effort implemented through an increase in taxes and reduction of government expenditure may hurt GDP growth in the EACs' region. Therefore, results from both long run and short run restriction models imply that the determination of a desirable level of primary balance, demands to balance between the need to ensure sustained economic growth while guaranteeing a non-explosive public debt.

5. Sensitivity Analysis

For robustness, coefficients for both the short run restriction model and long-run restrictions were estimated. Diagnostic tests were conducted, and the appropriate model was chosen for analysis. Both the long-run restriction model and short-run restriction model results were consistent as reported. Table 5 provides a summary of the short run restriction model based on the Cholesky decomposition as specified in equation 15. (See comprehensive results in table 5A in the appendix)

Table 5: Extract of Structural VAR Coefficients based on short-run restrictions.

Debt-to-GDP ratio	GDP Growth	Primary Balance	Interest/GDP	Exchange Rate
5.54***	0	0	0	0
0.01***	0.102***	0	0	0
-0.15***	-3.44	1.55***	0	0
-0.0003***	0.0004	0	0.0025***	0
0.4***	-5.08	-0.64	-547.02**	3.61***
Loglikelihood --73.5928				

6. Conclusion and policy recommendations

This study aims at investigating the interaction between primary balance and automatic debt stabilizers and how this interaction impacts the public debt trajectory. The estimated structural vector autoregressive model specification is anchored on the standard debt accumulation framework. Time series data from 1981 to 2015 was used for analysis with total debt to GDP ratio, interest payment on the debt, real exchange rate, primary balance and GDP growth as the endogenous variables.

The results map out the first and second round interactions among the endogenous variables. Generally, the results evidence how the structural response of primary balance to system variables guarantees a non-explosive public debt path. This was demonstrated by the primary balance adjusting to the pre-shock level following an adverse shock to either of the other debt drivers.

The results also demonstrate that in the long run, fiscal consolidation might be counterproductive by dampening economic growth. While fiscal consolidation measures may be useful in the short run to ensure a stable debt trajectory, policymakers need to interrogate the mathematics of debt reduction further, to ensure sustainable economic growth.

In this regard, the following recommendations can be formulated. First, by mapping out the nature of second-round effects given shocks to each of the endogenous variables, the study recommends the use of this methodology as a framework to inform stress testing the impact of macroeconomic shocks on public debt sustainability.

Secondly, the results present evidence that the structural response of primary balance to adverse shocks on system variables guarantees a non-explosive public debt path. This highlights the critical role of primary balance as a tool for fiscal agents to guarantee debt sustainability. However, cognizant that the fiscal reaction is nonlinear, and is subject to fiscal fatigue at high debt thresholds, as proposed in the methodology adopted by Ghosh et al., (2013), this study recommends an assessment of marginal fiscal adjustment to trace out any evidence of fiscal fatigue in Kenya.

Lastly, given that in the long run, fiscal consolidation appears to dampen economic growth, the study recommends an urgent need for policymakers to re-examine the mathematics of debt reduction, to inform the delicate task at hand of balancing between maintaining a non-explosive public debt path while ensuring durable and sustained economic growth.

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Appendix

Table 1A: Summary of Empirical Studies

Summary of Empirical Analysis				
Authors	Sample	Objective	Methodology	Remarks
Ekanayake (2012)	Quarterly data from 1991Q1 to 2010 Q4.	To assess the level of debt and the fiscal effort required to maintain debt sustainability.	The study used a Structural Vector Autoregressive (SVAR) model to estimate the baseline debt levels and project debt dynamics given changes in output.	The results show that fiscal consolidation improves primary balance and reduces debt to output ratio over the medium term. The study also established that the annual growth of output by 8 percent might reduce debt to GDP level to 65 percent over the medium-term period if other macroeconomic variables are favorable.
Lledo & Poplawski-Ribiero (2013)	Compared data from 171 countries with 33 to 43 Sub-Saharan countries from 2004 to 2008.	To investigate economic and institutional constraints to fiscal policy implementation.	Used panel data analysis including the fixed effect model and system GMM. Key variables were fiscal implementation gap, the rule of law, government/institutional effectiveness.	It was established that fiscal policy implementation in Sub-Saharan Africa is not vulnerable to macroeconomic volatility compared to other low-income countries. The study also found that the adoption of realistic fiscal plans and improved governance are essential for fiscal sustainability.
Babu <i>et al.</i> (2014)	Sample from EACs using time series data from 1970 to 2010.	To examine the effect of external debt on GDP growth.	Used panel fixed-effect model to evaluate the impact of debt on investment and growth.	The study established a long-term relationship. However, the impact of automatic stabilizers was not investigated.

Mupunga & Roux (2015)	Sample from Zimbabwe using time series data from 1980 to 2012.	Identifying fiscal and macroeconomic variables that influence public debt.	A dynamic stochastic simulation method was used to estimate a fiscal reaction function and used to simulate public debt path from 2012 to 2030.	The study identified both automatic and market variables (GDP). Variables and methodology were adopted in this study.
Mafusire (2015)	Annual time series from 1986 to 2012 in Swaziland.	To establish the extent to which the financial crisis threatened fiscal policy sustainability in Swaziland.	The study used OLS estimates and plotted the primary surplus gap and tax gap indicator to show the trend above and below the long-run path. Key variables include debt, tax, growth rate, primary surplus, government expenditure, and interest rate.	It was established that revenue and tax adjustment were significant in the determination of fiscal policy sustainability in the short run. It was also shown that growth was significant in determining fiscal policy sustainability and financial crisis did not affect fiscal policy sustainability in Swaziland.
Akpan & Atan (2015)	Quarterly data from 1980Q1 to 2010Q1 in Nigeria.	To investigate the macroeconomic effects of fiscal policy shocks in Nigeria.	The study used Structural VAR with government expenditure as the policy variable and private investment, output, inflation and interest rates as macroeconomic variables.	The results show that public spending on productive categories improves investment and growth. The study also shows that the use of taxes to finance public spending is detrimental to the economy. However, the study did not provide for the automatic response of fiscal policy arising from the business cycle and other shocks.
Cuestas & Regis (2017)	Quarterly data from 1992Q1 to 2016Q1 in China.	To examine the debt dynamics and potential sustainability problems facing China.	The study used a mean-reverting approach by applying a battery of unit root testing taking into account nonlinearity and structural breaks stationarity of the debt evolution.	It was established that debt accumulation in China is non-stationary indicating that debt evolution in China is approaching unsustainable levels especially if expansionary fiscal policies persist.

Table 2A: Summary of Descriptive Statistics

	$debt_t$	g_t	Pb_t	Int_t	$Exch_{it}$
Mean	50.05	0.073	-3.767	0.016	51.37258
Median	49.71	0.062	-3.38	0.013	58.73
Maximum	82.01	0.378	0.245	0.04	100.3
Minimum	30.67	-0.299	-11.64	0.002	7.42
Std. Dev.	11.13	0.13	2.97	0.012	29.87
Skewness	0.81	-0.05	-1.02	0.218	-0.255
Kurtosis	3.94	3.96	3.729	1.632	1.507
Jarque–Bera	5.005	1.328	6.706	3.00	3.83
Probability	0.082	0.515	0.034	0.223	0.14
Sum	1701.877	2.467	-128.06	0.538	1921.69
Sum Sq. Dev.	4193.53	0.569	291.2	004	32138.66
Observations	34	34	34	34	34

$debt_t$ Represents total debt to GDP ratio; g_t represents GDP growth, Pb_t Primary balance as a ratio of GDP; Int_t interest payment as a ratio of GDP, $Exch_{it}$ exchange rate USD/KSHS

Table 3A: Variance Decomposition of Primary Balance

Period	Standard Error	Debt	Growth	Primary Deficit	Interest burden	Exchange rate
1	5.818799	17.34457	2.403429	80.25200	0.000000	0.000000
2	7.587142	32.96002	1.205483	65.53191	0.214929	0.087652
3	8.530536	42.96198	0.869875	54.92330	0.868676	0.376167
4	9.198829	48.71489	0.767785	48.19977	1.571803	0.745759
5	9.772235	51.87088	0.883666	44.12414	2.045512	1.075800
6	10.28455	53.53767	1.100046	41.76287	2.274003	1.325406
7	10.73055	54.31844	1.312854	40.51723	2.349070	1.502408
8	11.10052	54.54471	1.483857	39.99196	2.354174	1.625303
9	11.38992	54.44643	1.611567	39.89477	2.338571	1.708657
10	11.60187	54.20944	1.703655	39.99769	2.326710	1.762501

Table 4A: Structural VAR Estimates based on long-run restrictions based on equation (16).

Model: Ae = Bu where E[uu']=I

	Coefficient	Std. Error		
α_{11}	10.42***	1.92		
α_{21}	0.064***	0.016		
α_{31}	-8.95***	1.85		
α_{41}	0.01***	0.0012		
α_{51}	3.95***	0.89		
α_{22}	-0.012	0.03		
α_{23}	3.84***	0.50		
α_{24}	-0.001***	0.0004		
α_{31}	5.59***	2.082		
α_{32}	-0.055***	0.015		
α_{33}	-4.32*	2.33		
α_{34}	0.003***	0.001		
α_{44}	0.002***	0.0002		
α_{55}	4.28***	0.52		
Log likelihood	-75.17542			
LR test for over-identification:				
Chi-square(1)	3.1651827	Probability	0.075224	
Estimated A matrix:				
1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1
Estimated B matrix:				
1.592	-4.652	-0.434	2.256	-1.982
-0.044	0.053	0.087	-0.016	-0.035
1.485	-0.145	0.774	0.240	-0.260
0.001	-0.001	0.000	0.003	-0.001
-0.055	0.138	2.986	0.135	3.004

Table 5A: SVAR estimates based on short-run restrictions based on equation (15)

Model: $Ae = Bu$ where $E[uu'] = I$				
Restriction Type: short-run pattern matrix				
	Coefficient	Std. Error	z-Statistic	Prob.
α_{21}	0.01	0.003	3.41	0.0006
α_{31}	-0.15	0.057	-2.646	0.0081
α_{41}	-0.0003	9.77E-05	-3.194	0.0014
α_{51}	0.40	0.166	2.39	0.0169
α_{32}	-3.44	2.64	-1.307	0.1913
α_{42}	0.0004	0.004	0.086	0.9314
α_{52}	-5.08	6.30	-0.806	0.4203
α_{43}	0.00	0.0003	-1.394	0.1634
α_{53}	-0.64	0.42	-1.523	0.1276
α_{54}	-547.02	259.10	-2.111	0.0348
α_{11}	5.54	0.68	8.124	0.0000
α_{22}	0.102	0.013	8.124	0.0000
α_{33}	1.55	0.19	8.124	0.0000
α_{44}	0.0025	0.0003	8.124	0.0000
α_{55}	3.61	0.445	8.124	0.0000
Log-likelihood				
-73.5928				
Estimated A matrix:				
1.000000	0.000000	0.000000	0.000000	0.000000
0.010989	1.000000	0.000000	0.000000	0.000000
-0.15	-3.4439	1.000000	0.000000	0.000000
-0.00031	0.000364	-0.00038	1.000000	0.000000
0.397734	-5.07768	-0.63606	-547.023	1.000000
Estimated B matrix:				
5.538874	0.000000	0.000000	0.000000	0.000000
0.000000	0.102404	0.000000	0.000000	0.000000
0.000000	0.000000	1.550394	0.000000	0.000000
0.000000	0.000000	0.000000	0.002428	0.000000
0.000000	0.000000	0.000000	0.000000	3.61359

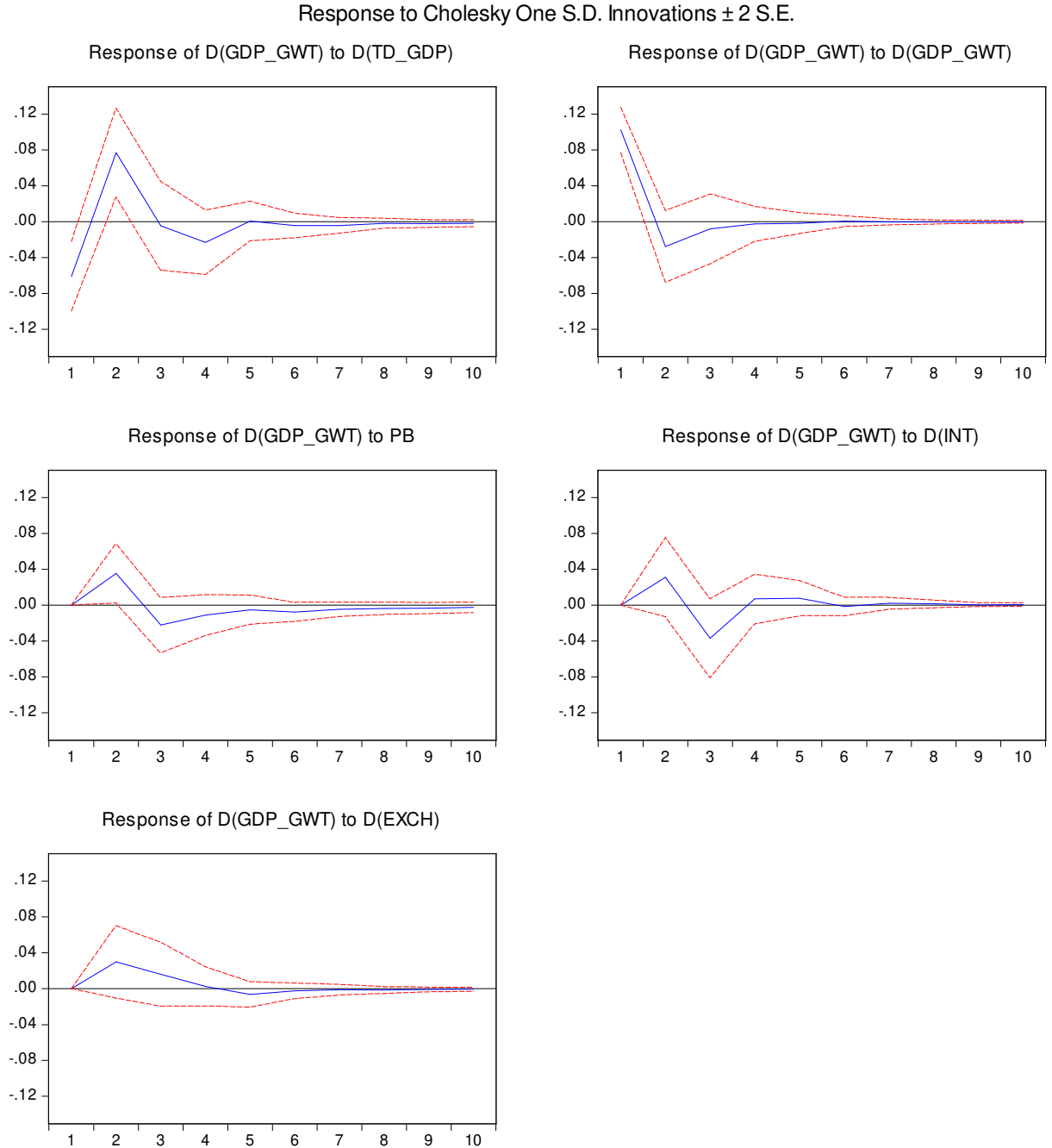


Figure 1A: Response of GDP growth to changes in other system Variables

(It is worth noting that GDP responds positively to shocks on debt and as expected to other system variables. Though GDP's growth initial response to Primary balance is positive, the effect quickly dissipates as further explained in section 4.2)

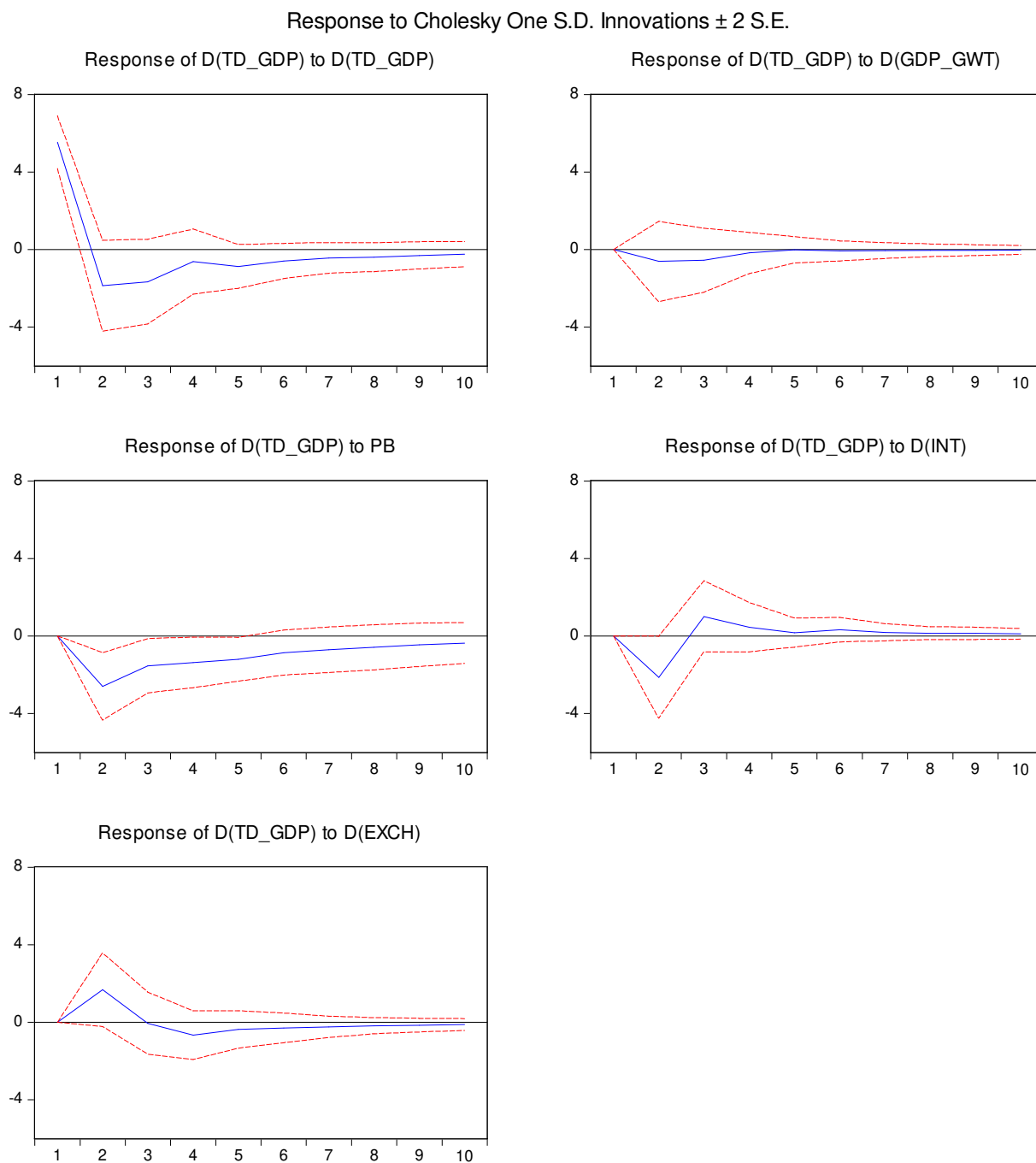


Figure 2A: Response of debt to other system variables

(Debt responds as expected following shocks on other system variables)

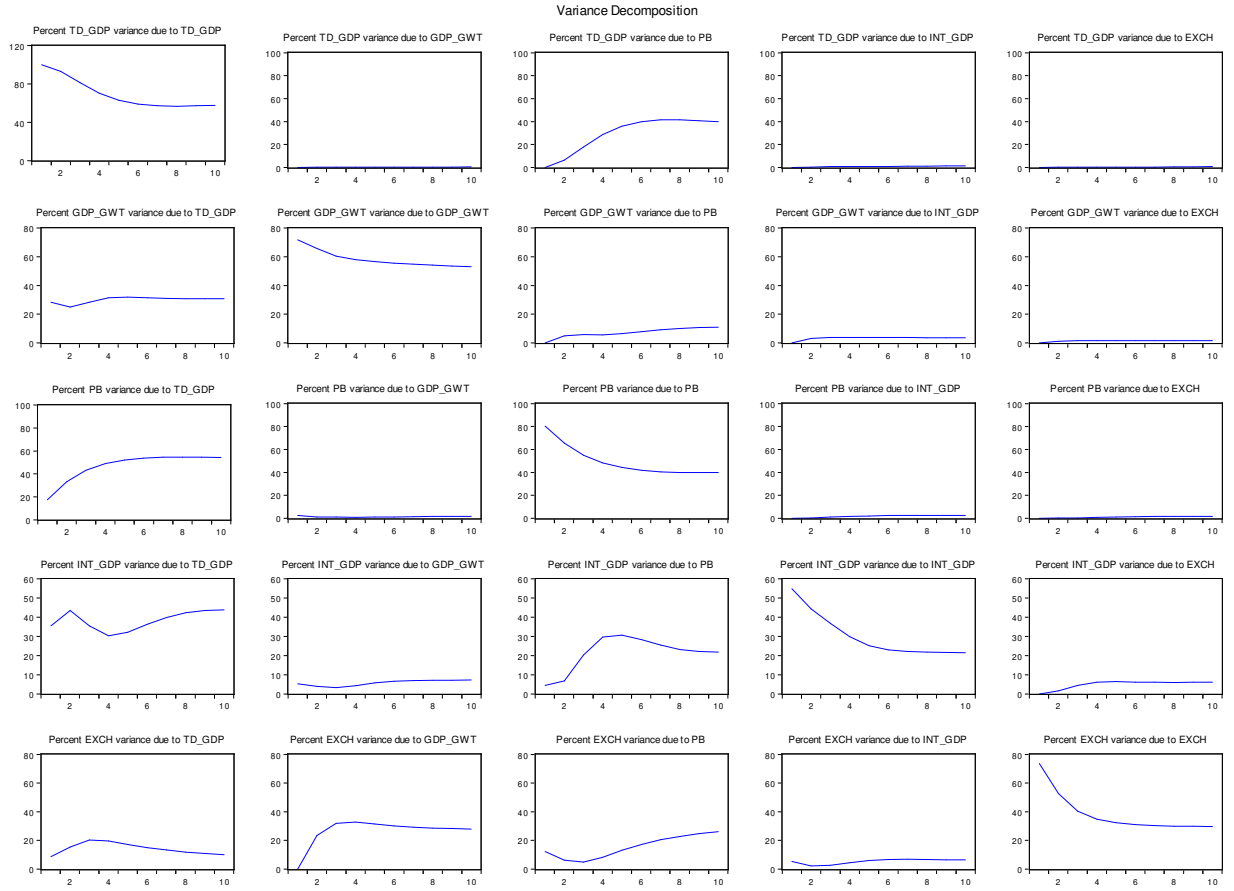


Figure 3A: Summary of Variance decomposition