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Empirical Investigation on the Relationship among Kenyan Public Debt, Tax Revenue and Government Expenditure

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Abstract

Public debt and tax revenue are used in the financing of government expenditure programs with the ability of boosting social welfare. The contrast is that public debt is used to finance the budget deficit gap resulting from shortfall in tax revenue. This study sought to investigate the links between public debt, tax revenue and government expenditure over 1960 and 2011 using data obtained from economic surveys of the Kenya National Bureau of Statistics. A Vector error correction model, Cholesky forecast error variance decomposition, and dynamic forecasts are employed in the study. The results for the vector error correction model indicate that for the public debt and government expenditure equations, about 36 percent of deviations from the long run equilibrium is corrected in the next period compared to approximately eight per cent for the tax revenue equation. The short run model shows that the size of government expenditure has a debt increasing effect while the size of tax revenue has a debt decreasing effect. Using Cholesky forecast error variance decomposition, impulse response functions show that public debt responded positively to the innovations in both tax revenue and government expenditure in the long run. The forecasts pointed to continued growth in these variables.

Key words

Public debt, tax revenue, government expenditure, budget deficit

JEL Codes: H63, H68, H71, H76

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1. Introduction

Public debt accumulation raises two major issues as regards fiscal deficit finance – debt overhang and loan repayments. Debt overhang is the disincentives to investments due to the threat from high debt so that a lot of resources are channelled to repaying debt. Investors will become sceptical to undertake any investments in a country which might harm future growth prospects. That is, when investment is discouraged/reduced/negatively affected, the main possible outcome is reduced growth both in the present time and in future since a lower capital stock today and in future would reduce the size of the economy from what it would be, all else equal. On the other hand, debt (the principal amount) must be repaid at some time/point as well as interest on debt. In particular, interest payments will either need increase in tax rates hence raising tax burdens, or increase inflation whenever debt monetization is resorted to. Thus, increased efforts into repayment of debt lead to misallocation of resources, increases in poverty, as well as reduction in economic growth since a lot of emphasis is placed on debt and interest repayment rather than improving the general state of the economy.

Budget deficits also create various trade-offs between various variables. For example, for the case of growing budget deficits as well as growing public debt, the most likely solution would be to cut government expenditure, raise taxes or both ways in order to achieve sustainability. In the present period, a huge reduction in government expenditure or rise in taxes would be highly desirable to be able to spread these changes with time. All in all, public debt is not the only means to finance the deficit, other ways exist, for example seignorage. But either way used, reducing budget deficits is contractionary in the short run resulting to increasing unemployment and reducing output (Labonte, 2012). So government or relevant authorities need to examine these trade-offs carefully in devising policies aimed at reducing the deficits. Public debt, tax revenue and government expenditure are therefore closely interrelated and not easily separable. Both public debt and tax revenue are used to finance government expenditure projects say on infrastructure, social sectors, among others broadly classified based on their recurrent or/and development aspects that are vital ingredients in stimulating demand therefore increasing output and reducing unemployment. While both public debt and taxes represent shift of resources from the private into the public sector, one distinctive feature between these components of government finances is that taxes are usually seen as necessary transfers yet public debt are transfers that are voluntary in nature.

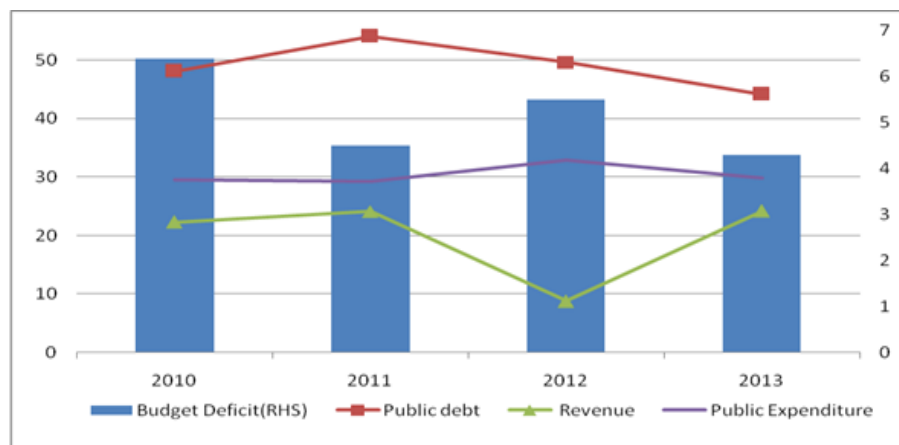
Thus, when public debt and taxes are to be chosen by the public, the public usually chooses public debt financing. The reason is that raising taxes to finance government expenditure is usually socially undesirable hence the reason to resort to

public debt. Also, public goods have characteristics of non-exclusion (practically impossible to exclude a person from enjoying them, say public road or public health facility) so that people even opt for reduction in taxes as the free rider problem comes to play. The choice of debt financing has to do with low political cost associated with it. And it is this reason that even politicians run huge budget deficits prior to obtaining elected offices knowing the public has fiscal illusion — overestimating the benefits accruing in the present period and underestimating the costs associated with future tax burdens.

1.1. Trends in public debt, tax revenue and government expenditure

In nominal terms, public and publicly guaranteed debt and its components (domestic and external debt) sustained an upward trend between 2011 and 2012 to stand at Kshs. 1.6 trillion. The composition was 52.6 % domestic debt in comparison to 47.4 % external debt. It is good noting that debt was financing a budget deficit of Kshs. 117.8 billion and Kshs. 181.5 billion in 2011 and 2012, respectively. As a percent of GDP, even though public debt declined by 20.4 % with its respective components following cue, the decline in external debt, however, is so pronounced at 10.7 % compared to that of domestic debt at 5.8% and shows government debt restructuring policy towards more long term domestic debt components. Government debt management strategy is also meant to cushion the risks associated with use of external debt instruments and short term debt instruments. This policy is bearing fruit with Treasury bonds consisting 80.9 % of total domestic government debt securities (Kshs. 687 billion in 2012, an increase of Kshs. 91.2 billion from 2011), while treasury bills inclusive of Repurchase orders (Repos) consisted 19.1 % of total government securities in 2012. In addition the 10 year as well as 30 year Treasury bond rose by 0.8 % in this period. At the same time, interest repayment on domestic debt rose by Kshs. 14 billion while interest accumulated on external debt rose by Kshs. 0.7 billion with external debt principal repayment amounting to 34.7 billion and debt service ratio (DSR) rose from 5.1% to 5.25%.

Government revenue inclusive of grants increased to 734.4 billion in 2012 from 679 billion in 2011. As a percent of GDP, this was an increase of 1.7% and on account of growth in both tax and non-tax revenue sources by Kshs. 74.5 billion (12.7%) and Kshs. 7 billion, respectively. And even with their positive growth, both tax and non-tax revenue remained below their projected levels on account of depressed economic activity and special revenue policies meant to reduce the cost of living for example, reduced excise duty on selected fuels. However, the share of government revenues in total GDP declined from 24.6 % to 22.3 % in the same period.



Source: Republic of Kenya and Central Bank of Kenya (CBK)

Figure 1. Budget deficit, Public debt, Tax revenue and Government expenditure (Percent of GDP)

Finally, expenditure as well as net lending rose to Kshs. 915.9 billion in 2012 from Kshs. 817.1 billion in 2011. While recurrent expenditure rose by Kshs. 57.6 billion to settle at Kshs. 639.1 billion, development expenditure rose by Kshs. 41.2 billion to settle at Kshs. 276.8 billion, yet both components remained below their projections of Kshs. 697.5 billion and Kshs. 385.4 billion, respectively. And in recent times there has been increased investments into infrastructure development in line with vision 2030 on creating a suitable environment for business and investment that saw the a share of development expenditure in total expenditure rise by approximately 4.9 % from 28.8 % to 30.2 % with that of recurrent expenditure declining by 1.9 %. The graph shows the current trends in these variables.

Given these trends, to be able to offer any policy prescriptions towards controlling and consequently reducing budget deficit as well as resulting public debt and associated problems, it is necessary to understand the relationship between public

debt, tax revenues and government expenditure. The optimal strategy for debt reduction depends on the optimal policy embraced for budget deficit reduction which in principle entails either expenditure reduction or an increase in tax revenue. How then might public debt respond to the choice of an expenditure cut in reducing the budget deficit, all else equivalent? This is the question this study posed. It sounds reasonable to predict that public debt would reduce. However, in the last half of 2012 and part of 2013, expenditure cuts proved ineffective in developed nations particularly in the Eurozone (Grauwe and Yuemei, 2013; Aheara, 2012; Grauwe and Yuemei, 2012; Kiguel, 2012) as it led to slow economic growth, low tax revenues, deflation and consequently rising public debt in countries such as Greece, Spain, and Ireland. Upon this background, it is evident that the effects of expenditure cuts (or tax increases) may not be straight forward, and the study sought to empirically contribute to the debate. This paper contributes to this debate by investigating the relations between public debt tax revenue and government expenditure over 1960-2011.

This study is important in the following ways. First, this study brings additional knowledge to the field of government finance in Kenya specifically concerning the relationship between public debt, tax revenue and government expenditure. Given that previous studies are few, for example Gharthey (2012) and Kanano (2006) and with the recent studies devoting rather to explore economic growth and government expenditure, for instance Kipkosgei (2011) and Kibe (2009), it is evident that this study bears great significance in contributing to the literature on Kenya that has a bearing on future research. This is useful to researchers and scholars interested in pursuing further research on the relationship between public debt, tax revenue and government expenditure and/or related issues, as a source of reference. Secondly, to policymakers especially those in government and other public policy institutions if the finding of this study is anything to go by it will shape the reactions in terms of implementing both relevant and appropriate policies in the short and long run geared towards addressing budget deficit and associated debt problems.

Third, this study examined the relationship between public debt, tax revenue and government expenditure over 1960-2011. To the best of the author's knowledge, there was no single study in this perspective done in Kenya. A related study was that of Kanano (2006) and Gharthey (2012). However, Kanano studied the determinants of government expenditure growth over 1980-2004 while Gharthey examined the relationship between tax revenue and government expenditure for Kenya, Ethiopia and Nigeria, and not the relationship between public debt, tax revenue and government expenditure per se.

This study period is 1960 – 2011. This period is important because a number of events occurred that had a direct or indirect effect on public debt, tax revenue or government expenditure. The government implemented expansionary fiscal policies particularly between 1974 and 1985. These policies, however, had their own problems as budget deficits rose rapidly even a decade later. Public debt problems could thus be traced into this period. Other notable events include the oil crisis in 1972/1973, free primary education in 2003, the post-election violence of 2007/2008 and the global financial crisis of 2008. Furthermore, the Kenyan vision 2030 was designed during this period. The rest of this study is organized as follows: section two presents literature review, section three presents the methodology, section four presents the results while section five presents the summary conclusions and policy implications.

2. Literature review

Previous empirical studies show that public debt displays a positive and significant relationship with government expenditure. These include Kanano (2006) who studied the determinants of government expenditure growth over 1980-2004 in Kenya. Using a log linear model estimated using ordinary least square (OLS), the author found out that internal debt was the only variable that was significant at 5% and 10% levels of significance. Internal debt had a negative impact on government expenditure growth. External debt, according to this author did not exhibit any statistically significant effect on government expenditure. The author concluded that debt overhang hypothesis was significant in Kenya.

Cassimon and Campenhout (2007) studied fiscal response on debt relief in 28 highly indebted poor countries (HIPC) over 1991-2004. Using a panel VAR model they found out that debt relief increased the revenues collected by the government and encouraged growth in both recurrent and development spending with a lag of one year. This, according to the authors was evidence of debt overhang hypothesis. Based on this finding, increasing government expenditure arose majorly due to increasing revenues that resulted after debt relief. In addition, contrary to debt relief, they stated that rising government expenditure may be due to wasteful expenditure including corruption. In relation to this study, when public debt repayments (principal and interest) are done away with, revenues are channelled to financing government expenditure causing a rise in government expenditure.

Fosu (2007) studied external debt servicing in 35 Sub-Saharan African (SSA) countries including Kenya, Madagascar and Senegal over 1975–1994. Using a seemingly unrelated regression (SUR) based on random effects model the author found out that external debt service moved resources away from the social sectors — including education and health with a partial

elasticity of 1.5. This implied reduction of the overall budget to the sector by around a third with R-square ($R^2=0.597$). In relation to this study, an increase in public debt especially external debt would increase the debt servicing charges and affect the social safety net. This would imply high expenditure as taxation is usually relied upon as a source of revenue.

Nyamongo and Schoeman (2007) in a study of a panel of 28 African countries over 1995-2004 using a Cobb Douglas utility function and testing for panel pool ability found this to be true only in health and economic services with 10% and 1% levels of significance respectively meaning debt is channelled to these sectors. Also, Bilbiie *et al.* (2008) employed a log linear model nested in vector autoregression (VAR) and a dynamic stochastic general equilibrium model (DSGE) using two U.S. samples (1957-1979 and 1983-2004). They found that the degree of deficit finance increased from 0.17 in sample 1 (1957-1979) to 0.64 in sample 2 with standard errors of 0.999 and 0.235, respectively which showed greater reliance on debt to finance government spending. However to the first sample (1957-1979), the opposite was reported to which the authors attributed to wider private access to asset markets, active monetary policy and greater degree of deficit finance.

On a study of 111 developing countries in Africa, South America, Asia and Europe over 1984-2004, Shonchoy (2010) used country specific fixed effect model and random effects model. After correcting for panel heteroscedasticity, serial correlation and correlation of errors using the Feasible Generalized Least Square (FGLS) and Prais—Winsten transformation to obtain efficient and consistent regressor estimates, the author found that in both balanced and unbalanced datasets the coefficient of debt service was statistically insignificant at 1%, 5% and 10% levels of significance. The author concluded that public debt burden may not have a direct impact on government expenditure so that it would be appropriate for developing Nations to use taxation to finance public debt burden which is fast compared to cutting pre-planned expenditure.

Greiner *et al.* (2011) analyzed the sustainability of fiscal policy for selected European countries including France, Germany and Portugal. The primary surplus was regressed on a vector of z (containing net interest payments on public debt relative to GDP and a variable reflecting the business environment) and public debt. They found that fiscal policies in the countries under consideration were sustainable. They suggested that governments should take corrective actions due to rising debt ratios by increasing the primary surplus ratio. They stated that compliance with the intertemporal budget constraint implies that either public spending must decrease with rising public debt ratio or the tax revenue must increase. They argue that for real world economies it is not a rise in the tax revenue but a decline in public spending that generates primary surpluses. This is because public investment (expenditure) can be reduced most easily. Finally they argue that in the long-run high debt ratios may have negative repercussion for the growth rates of economies.

Christie and Rioja (2012) explored how variations in the composition and financing of government expenditures affected economic growth in the long-run. Specifically, they analysed how public investment spending funded by taxes or borrowing affected long-term output growth. They developed a dynamic macroeconomic model to analyse the objectives of the study. The model was then calibrated to reflect economic conditions for the seven largest Latin American economies during 1990-2008. They found that, where tax rates were not already high, funding public investment by raising taxes increased long-run growth. If existing tax rates were high, then public investment (expenditure) was only growth-enhancing if funded by restructuring the composition of public spending. They conclude that using debt to finance new public investment compromises growth, regardless of the initial fiscal condition. They also showed that in funding productive expenditure, the better strategy was always to raise taxes rather than increase debt independent of whether the economy had high or low existing debt stock. Issuing debt particularly when debt was high was harmful to long run growth. The simulations showed that in the steady-state, new debt issue financing of government expenditure led to less public investment in the long run and a lower level of public capital stock because a larger share of public spending was redirected to future debt servicing. On the other hand, productive government expenditures financed by raising taxes increased the long-run growth rate so long as the optimal tax level had not been exceeded.

Banerjee (2013) used a dynamic general equilibrium closed economy model to compute the dynamic Laffer curves for Portugal, Ireland, Greece and Spain for different categories of taxes. The author showed that under reasonable parameterization, tax rates for consumption and labor could be changed. All the economies were located to the left of the Laffer peaks for the income tax and potentially would be able to absorb marginal increase in tax rates. Thus this provided an avenue for generating much needed resources to tackle the primary deficit in the short run which along with structural changes led expenditure cuts would give the right strategy mix that could bring down debt to sustainable levels. Stegarescu (2013) studied the long-term nexus between expenditure composition and sub-national government debt levels. Panel data for 10 West-German states over 1974-2010 was used. Pooled OLS regressions were used in the estimation. The debt-to-GDP ratio was regressed on the composition of state and local government expenditure, while controlling for a separate level effect of total expenditure and, alternatively, socio-economic and political factors, as well as for fixed time and state effects. The author found out that larger shares of government consumption expenditure were associated with lower debt.

The level of total expenditure was found to have a debt increasing effect. The author recommended a reform of the tax sharing and equalization system, including larger tax autonomy of the federal states.

Kaur *et al.* (2014) studied debt sustainability at the state level in India. Data was collected from the Handbook of Statistics of the Indian Economy from the reserve bank of India. Data covered the period 1980-81 to 2012-13 for 20 Indian states. Variables considered were the stock of government debt, government expenditure and revenues. Panel data was used. Data was converted to real forms by logarithm transformation. Testing for unit roots, they found tax revenue and government expenditure to be each I (1). Pedroni and Kao panel cointegration tests revealed cointegration in the series. Generalised least square technique with cross section Seemingly Unrelated regression (SUR) with a correction for first order autoregressive error term was used for estimation. The models were then adjusted for the heteroskedasticity using white cross-section standard errors and covariance method. They found that the estimated fiscal policy response function indicated that the primary fiscal balance in Indian states responded in a stabilising manner to the increase in debt. This together with evidence of cointegration, to the authors meant prevailing debt levels was sustainable in the long run. Disaggregated level analysis, however, showed that some states still showed signs of fiscal stress and increasing level of debt burden. The authors advised that in line of falling revenue due to slowdown in economic growth, checks in expenditure to avoid increased reliance on borrowing was necessary.

Empirical literature shows that the relationship between public debt, tax revenue and government expenditure has gained immense concern especially in the present period where most countries across the globe are facing mounting pressure due to ballooning fiscal deficits and debt. In addition, while the relationship between public debt and government expenditure still has very scant literature. With the exception of Kanano (2006), most studies on government expenditure in Kenya have not focused on the relationship between public debt, tax revenue and government expenditure. For instance, while Njeru (2003) examined foreign aid and its implications on government expenditure, Kibe (2009) and Kipkosgei (2011) concentrated on government expenditure in relation to economic growth. The study therefore contributed to the literature by bringing recent evidence about the relationship between public debts, tax revenue and government expenditure in Kenya.

3. Methodology of research

3.1. Theoretical Framework

This study adopted the present value borrowing constraint (PVBC) developed earlier by Hamilton and Flavin (1986) combining insights from Kremers (1989), Wilcox (1989), Bohn (1998), Ghatak (2001), Bohn (2005), Sampaio (2005), Sampaio and Lima (2005), Valesco (2005), Jayawickrama (2006) and Oshikoya and Tarawalie (2009), among other studies.

The basic idea underlying the present value borrowing constraint (PVBC) like in the Ricardian Equivalence Hypothesis (Ricardo, 1951) is that a government cannot run budget deficits forever. Such a policy that entails running a permanent deficit (excluding interest payments) is infeasible under the PVBC as it would imply making promises to creditors that a surplus would arise in future to make up for today's deficits. As observed by Hamilton and Flavin (1986), such a strategy would not stimulate aggregate demand because in the event that debt should be repaid, the tax hikes imposed to make this possible would involve huge distortionary effects on the private economy in terms of dead weight losses. Further, Sampaio and Lima (2005) observed that the interpretation of this constraint is weak in terms of fiscal policy restrictions. Therefore, a more standard approach would mean that government would run budget deficits in some periods which would be compensated for by running budget surpluses at a later date.

The present value borrowing constraint (PVBC) usually begins with the government budget constraint of the form:

$$s_t + r_t b_{t-1} = b_t - b_{t-1} \quad (1)$$

In the specification, s_t is the budget surplus (excess tax revenue over government expenditures). The definition of government expenditure above excludes interest payments on debt. Further, r_t is the return on government debt (interest rate) in period t and b_t is government debt in period t . Equation 1 asserts that whenever a government runs a budget surplus equal to zero, then the rate of growth in government debt would equal the rate of return on debt, meaning that debt would grow more slowly than the return on debt. In the event that the government runs a budget deficit, however, the rate of growth in debt would exceed the return on debt.

Rearranging equation 1 by collecting like terms (b_{t-1}) and making b_t the subject, the government debt accumulation equation is:

$$b_t = (1 + r_{t-1})b_{t-1} - s_t \quad (2)$$

Where, r_{t-1} refers to the ex-post real interest rate. For purposes of converting the variables into their present values, a discount factor is necessary. Denoting q_t as the real discount factor from the present time (t) back to time zero, then its

expression becomes $q_t = \prod_{j=0}^{t-1} (1 + r_j)$, $t = 1, 2, \dots$. Thus in time zero ($t=0$), $q_0 = 1$. In addition, q_t is strictly a function of interest rates ($r_{i,t} = 0, 1, \dots, t-1$) that are known in period t (present time). Each variable discounted to time zero can thus be obtained using q_t .

Equation 2 becomes $q_t b_t = q_{t-1} b_{t-1} - q_t s_t$. Furthermore, letting $B_t = q_t b_t$ and $S_t = q_t s_t$ be the discounted present values of government debt and the budget surplus in their respective orders that occur from period t back to period zero, it is possible to write $B_t = B_{t-1} - S_t$. The above equation is solved by recursive forward substitution as in (but not limited to) Jayawickrama (2006), Abeyasinghe and Jayawickrama (2006) and Sampaio and Lima (2005) to obtain:

$$B_t = B_{t+N} + \sum_{j=1}^N S_{t+j} \quad (3)$$

As noted also by Hamilton and Flavin (1986) and Sampaio (2005), expression 3 should not be a source of controversy as it is an outcome of a few accounting manipulations. In principle, the main emphasis and of economic interest in terms of empirical analysis is what agents or creditors expect to occur to the first term on the right hand side when N gets large (when it tends to infinity).

Conventionally, as N tends to infinity, then it follows that the discounted value of government debt (its present value) would in turn equal to the discounted sum of future budget surplus (excluding interest payments). This argument is specified as:

$$B_t = \lim_{N \rightarrow \infty} B_{t+N} + \sum_{j=1}^{\infty} E_t S_{t+j} \quad \lim_{N \rightarrow \infty} E_t B_{t+N} = 0 \quad B_t = \sum_{j=1}^{\infty} E_t S_{t+j} \quad (4)$$

Equation 4 is the present value borrowing constraint (PVBC). Thus a government that runs budget deficits in some periods would be expected to run sufficiently large budget surpluses at a later date in order to offset the accumulated debt.

3.2. Model Specification

The model adopted in this study borrowed heavily from the presentation of Abeyasinghe and Jayawickrama (2006) and also Jayawickrama (2006). Budget surpluses (S_t) in equation 4 refer to those surpluses used to offset the accumulated debt stock. Such series of surpluses are unobserved. Adopting rational expectations (Sargent, 1978; Campbell and Shiller, 1987; Hansen and Sargent, 1980), and assuming all information available at a given time (t) to policy makers, they would be able to form expectations about the discounted sum of future budget surpluses. This is presented as follows:

$$S_t = \sum_{k=0}^{\infty} \rho^k E_{t+k} S_{t+k} = \sum_{k=0}^{\infty} \rho^k E_t (Z_{t+k} + w_{t+k}) \quad (5)$$

$\rho = 1/(1+r)$, $Z_t = \alpha' X_t$, where, α refers to an $(n \times 1)$ vector of constants and X is a vector of relevant informational variables that is known to both the government and the public. Further, w_t is an unsystematic information variable available only to the government with the property $E_t w_{t+k} = 0$. The present formulation allows for both stationary as well as non-stationary series of variables. In this context, Z_t is assumed to be stationary even though it may well be a near unit root process that S_t may display.

Assuming Z_t has an infinite order moving average representation denoted $Z_t = \Psi(L) e_t$, the Wiener-Kolmogorov prediction formula (Hansen and Sargent, 1981) can be employed as in Abeyasinghe and Jayawickrama (2006) and Jayawickrama (2006) to obtain

$E Z_{t+k} = \sum_j \psi_j L^{j-k} e_t$, ($j = k, k+1, \dots, \infty$) Using an autoregressive representation of the form $\phi(L) Z_t = e_t$ proposed by Hansen and Sargent (1980), equation 3.5 is specified as:

$$\sum_{k=0}^{\infty} \rho^k E_t Z_{t+k} = \phi(\rho)^{-1} \left[1 + \sum_{j=1}^{p-1} \left(\sum_{k=j+1}^p \rho^{k-j} \phi_k \right) L^j \right] Z_t \quad (6)$$

Given that there is no interest in the nonlinear parameter, 3.6 is re-specified as:

$$\sum_{k=0}^{\infty} \rho^k E_t Z_{t+k} = \left[\lambda_0 + \sum_{j=1}^{p-1} \lambda_j L^j \right] Z_t \quad (7)$$

Recall condition 4 in the definition of the PVBC which states that $(\lim_{N \rightarrow \infty} E_t B_{t+N} = 0)$. Thus, replacing $Z_t = a'X_t$ and redefining the respective parameters, it is possible to write;

$$D_t = \sum_{i=1}^{p-1} \beta'_i X_{t-i+1} + \varepsilon_t \quad (8)$$

Note that although equation 8 and 4 which is the present value borrowing constraint (PVBC) might not be different, the present formulation disaggregates the components of the budget surplus to allow a larger information set in explaining the debt equation. However, with the standard definition of the budget surplus, this formulation can easily be adopted to explain the relationship between public debt, tax revenue and government expenditure. Further in equation 8, ε_t is assumed to be a well behaved stochastic disturbance term. For purposes of understanding the relationship between public debt, tax revenue and government expenditure, a VECM framework was more appropriate. The VECM was specified as:

$$\Delta W_t = V + \alpha \beta' W_{t-j} + \sum_{i=1}^{p-1} \Gamma_i \Delta W_{t-i} + \varepsilon_t \quad (9)$$

The first component is the error correction components in levels while the second component on the RHS of equation 3.9 is the VAR component in first differences. W_t is a vector of variables. Γ matrix captures the short-term adjustments among the variables at the i th lag. β' is the matrix of cointegrating vectors and α is the speed of adjustment parameters. The elements of the α matrix relate also to the weak exogeneity. j is the lag structure. V is a vector of constants and ε_t is a vector of white noise error terms.

3.3. Data

This study utilized annual time series data over 1960–2011, for Kenya. Data was obtained from economic surveys of the Kenya National Bureau of Statistics from 1960 to 2013. Because the data was available in fiscal years, it was converted to calendar years by splicing. Splicing involved constructing long time series of economic variables through piecing/linking together short heterogeneous series (Fuente, 2013). To obtain data in calendar years, those observations that were in fiscal years were averaged. All variables were converted into their real values through dividing their respective nominal values by the consumer price index (CPI). Use of the CPI was justified because the variables estimated fell on the expenditure side of the economy. *Public debt* was defined as total outstanding borrowing by the government less currency and measured in Kenyan shillings. *Tax revenue* was defined as total government income due to taxation and measured in Kenyan shillings. *Government expenditure* was defined as total money spends by the government less interest payments and measured in Kenyan shillings.

4. Results and Discussions

4.1. Descriptive Statistics

The sample consisted 52 observations over 1960-2011. Table 1 in the appendix presents the descriptive statistics.

Table 1. Descriptive Statistics: Public debt, tax revenue and government expenditure

Variable	Observations	Mean	Std. Dev	Minimum	Maximum
Public Debt	52	213218.9	308543.6	-9032.1	1160538.0
Tax Revenue	52	103824.7	160399.1	639.9	647356.6
Government Expenditure	52	143568.6	222854.2	1006.2	885490.2

It is apparent from the table that the level of public debt in magnitude was generally higher compared to the respective variables of tax revenue and government expenditure. This was particularly evident from the year 1994 to end of the study period, which is consistent in the observations of both the mean and the dispersion (standard deviation). The converse was true for the tax revenue variable which had a mean and standard deviation of KES 103824.7 million and KES 160399.1 million, respectively. A graphical representation showing the trend in the series over the study period is found in figure 1A in the appendix.

Drastic movements were evident in the data. Most movements were associated with either years which had had general elections or those years around the elections. For public debt particularly, drastic movements were evident between 1977 and 1978, where public debt rose in the range of 5%. Between 1991 and 1992, there was a sharp decline in public debt with the level going flat into 1993. Perhaps this could be once again attributed to election cycles or either aid freezes or structural adjustment programs (SAPs). Thereafter, although public debt assumed an upward trajectory, there was evidence of moderate fluctuation type growth between: 1995-1996; 2000-2001; and 2005-2006.

On the government expenditure side, prior to 1980, even though this curve widened at a faster rate than that for tax revenue, both curves remained smooth without those movements that captured attention. There was a sharp increase in both tax revenue and government expenditure in 1994. The growth in tax revenue moderated into 1996 but that in government expenditure persisted two years on. No much activity can be reported for the tax revenue curve for the remainder of the study period except an upward trajectory. For government expenditure, however, a decline of about 58% - also the highest in the study period was recorded over 1998-1999. Nonetheless, growth in the variable picked up a year later but a little lower than the decline. At the end of the study period, the levels of all variables were higher compared to those over the whole study period.

An interesting trend in the study period was that the rate of growth in public debt was lowest in comparison to the other two variables (tax revenue and government expenditure) and about two times lower than that in government expenditure. This would imply that although the growth in public debt is being seen as alarming, it reflects fast growth in government expenditure outpacing the growth in tax revenue. It might well reflect the narrow tax base in the economy or inefficiencies in tax administration characterised by tax evasion. On this basis therefore, the budget deficit has to be financed by further accumulation of public debt.

4.2. Time Series Properties

To determine the underlying orders of integration for public debt, tax revenue and government expenditure series, the Augmented Dickey Fuller (ADF) and Philips Perron (PP) unit root tests were conducted. The results for the ADF and the PP unit root tests are reported in table 4.2. For the ADF unit root test, four lags were selected based on the Akaike Information Criterion's minimum value. One per cent level of significance was used. The ADF unit root test indicated that with an intercept only, public debt was the only variable that was non stationary at level.

Table 2. ADF and PP Unit Root Test Results: Public debt, tax revenue and government expenditure

Variable	Level			First difference		
	PD	GR	GE	PD	GR	GE
ADF	2.52	4.36	4.74	-1.07	-	-
ADF (with trend)	0.74	4.05	4.12	-2.67	1.49	-0.37
PP	4.58	6.69	6.31	-29.34*	-25.12*	-49.97*
PP (with Trend)	2.02	6.33	5.31	-32.51*	-40.18*	-59.01*

Key: PD - Public debt, GR - Tax revenue, GE - Government expenditure, ADF - Augmented Dickey Fuller, PP - Philips Perron. Asterisk indicates the coefficient is statistically significant at 1 percent level of significance. At first difference, the series for public debt remained non stationary that could question the lag selection procedure. Contrary to the case for intercept, all the series under study were non stationary at levels when considered with trend. At first difference (with the exception of the tax revenue series) most series became stationary. This meant that with the trend, public debt and government expenditure were integrated order one or, were each I (1).

The results for the ADF unit root tests needed deeper insight. This could point to a problem in the lag selection procedure. And because of this, it was justified to proceed and test these series for their orders of integration using the PP unit root test. This was especially so in light of the argument put forward by Pierre (1989) and Sjo (2008) that in the presence of unusual circumstances the conventional ADF unit root test would be invalid, for example in the presence of an explosive unit root (Suresh et al., 1999). Also, the PP unit root test is reported to be particularly robust to any heteroscedasticity in the

error term. Moreover, the user does not need to specify the number of lags (Rothe and Sibbertsen, 2005) for this test. The Newey – West selected three lags For the PP unit root test with default lags. For all cases, none of the variables were stationary at levels. They, were however stationary or I (0) at first difference. This meant they all had one unit root each.

As all variables were integrated of order one (I(1)), ordinary estimation techniques were going to be invalid due to the existence of one or more equilibrium relationships among them. Further, since more than two variables were being analysed, the Engle and Granger test of cointegration was in practice invalid. To estimate what and how many equilibrium relationships existed, this study adopted the Johansen and Juselius (1988, 1995) cointegration technique. Results for the Johansen cointegration test are presented in table 4.3. Three lags were selected for the test. The AIC lag selection criterion was used as it yielded minimum value (68.77). One percent level of significance was used. Both the trace and the maximum eigenvalue test statistics indicated two cointegrating equations.

Table 3: Johansen Cointegration Test Results

Trend: constant Sample: 1963 -2011			Number of observations = 49 Lags = 3			
Max Parms	Eigenvalue	Statistic	Trace Critical Value	1% Max Stat	Critical value	1% Rank
0	21	.	109.04	35.65	63.86	25.52
1	26	0.73	45.17	20.04	42.91	18.63
2	29	0.58	2.26*	6.65	2.26	6.65
3	30	0.05				

AIC = 68.77 SBIC = 69.89 HQIC = 69.19. Asterisk indicates a coefficient is statistically significant at 1 % level of significance

4.3. Distribution and other Diagnostic Test Results

Before accepting the results for the specification, it was necessary to test the significance of the model. The tests conducted included the VECM stability test, the LM test for serial correlation and the Jargue Bera test for whether the residuals came from a sample that followed normal distribution. The results for the VECM stability test are presented in table A1 in the appendix. The eigenvalue stability condition in the VECM showed that the eigenvalues of the companion matrix were inside the unit circle, and the real roots were far from one (1). This was in support of the view that the number cointegrating equations in VECM was well specified. The Langrange multiplier (LM) test was used to test presence of serial correlation. The Langrange multiplier (LM) test for autocorrelation on the residuals of order five indicated that at 1 percent level of significance, the null hypothesis of serial correlation could not be rejected. All p-values were lower than the 0.01 rejection level. Following Achen (2000) and Keele and Kelly (2006), who noted that serial correlation could be eliminated by inclusion of additional lags, more lags were added in an effort to eliminate serial correlation. However this was insignificant as it was only at lag six that serial correlation hypothesis could be rejected when the order of the LM test was increased to six. These results were not presented as they were insignificant.

The study proceeded to test the residuals for normal distribution. The Jargue-Bera test (Jargue Bera, 1981) was used. The null hypothesis that the residuals followed normal distribution was tested against the alternative that the residuals were not normally distributed. The results indicated that the null hypothesis of normally distributed residuals was rejected at 1 percent level of significance. This could be attributed to high fluctuations in the data in the calendar years of 1992, 1999, 2002, 2006, 2008 and 2009. These results are not reported. The errors from the cointegrating relationships were plotted to establish how they behaved. The plots are presented in figure A2 in the appendix. The plots revealed that the errors fluctuated around zero prior to 2000. The errors from the first cointegrating equation assumed a negative trend form 2001 and never returned to zero. For the second cointegrating equation, the errors decline from 2001 to between 2002 and 2003 where they assume an upward trend. The trend however reverts, with the errors declining further before showing a slight increase into the end of the study period.

4.4. Estimation Results

VECM Results

Having conducted these diagnostic tests in the study, the estimation results on the relationship between public debt, tax revenue and government expenditure are presented. Results for VECM are reported in table 4.

Table 4. Results for Vector Error Correction Model (VECM)

Coefficients	Dependent variables		
	Public Debt	Tax Revenue	Government Expenditure
Adjustment Parameters, α_i			
α_1	-0.3576** (0.01)	-0.0749** (0.01)	-0.3615** (0.01)
α_2	4.5635** (0.02)	-0.2322 (0.58)	4.0368* (0.00)

P-values are in parentheses. An asterisk denotes a coefficient is statistically significant at 1 percent level of significance. Double asterisk indicates a coefficient is statistically significant at 5% level of significance. All values reported were rounded to four decimal places. Five lags (similar to what was used in the Johansen cointegration test) were selected based on the AIC (Akaike, 1974) value of 66.97. All coefficients on the first speed of adjustment parameter (α_1) were negative (as expected) and less than one. Moreover, the coefficients were all statistically significant at either 1 or 5 percent levels of significance. This implies that deviations from the long run equilibrium are corrected in the next year by the size of the coefficient. For the public debt and government expenditure equations, about 36% of these deviations are corrected in the next period in comparison to eight percent in the tax revenue equation. The first speed of adjustment coefficient for the tax revenue equation was however low implying slow adjustment to the long run equilibrium. The β coefficients in the first cointegrating equation indicated equilibrium relationships between public debt and government expenditure. The β coefficients in the second cointegrating equation pointed to equilibrium relations between tax revenue and government expenditure which could possibly be the budget deficit relation.

The short run variations in the VECM model were examined. Results for the short run VECM model are presented in table 5.

Table 5. Results for VECM Short run model

	Public Debt	Tax Revenue	Government Expenditure
First lag of public debt	0.67* (0.00)	0.14 (0.00)	0.16 (0.11)
Second lag of public debt	-0.42 (0.06)	-0.01 (0.82)	0.21** (0.05)
Third lag of public debt	0.28 (0.19)	-0.08 (0.08)	0.06 (0.60)
Fourth lag of public debt	0.01 (0.96)	-0.14** (0.02)	0.28** (0.03)
First lag of tax revenue	-5.14* (0.00)	-0.78** (0.02)	-2.44* (0.00)
Second lag of tax revenue	-3.09** (0.02)	-0.45 (0.11)	-2.13* (0.00)
Third lag of tax revenue	-1.67 (0.12)	0.45** (0.04)	-0.13 (0.80)
Fourth lag of tax revenue	-2.99** (0.01)	-0.58** (0.02)	-2.57** (0.00)
First lag of government expenditure	2.48** (0.03)	-0.22 (0.36)	0.99 (0.08)
Second lag of government expenditure	2.30** (0.01)	0.02 (0.94)	0.76 (0.10)
Third lag of government expenditure	1.50** (0.02)	0.13 (0.35)	0.35 (0.25)
Fourth lag of government expenditure	0.80** (0.03)	0.08 (0.30)	-0.12 (0.51)
F-statistic	4.72* (0.00)	2.19 (0.09)	6.22* (0.00)
R-squared	0.74	0.94	0.88
D-Watson	1.54	1.63	1.98

P-values are in parentheses. An asterisk indicates a coefficient is statistically significant at 1 percent level of significance. Double asterisk indicates a coefficient is statistically significant at 5% level of significance. The sign between government expenditure and public debt suggests that the level of total government expenditure has a debt increasing effect which is consistent with Stegarescu (2013). This also suggests that intertemporal budget constraint compliance requires that government expenditure decrease with rising public debt as pointed out by Greiner, Koller and Semmler (2011). Only the coefficient on the third lag of tax revenue is statistically insignificant although it is negative. This implies that despite higher tax revenues being able to shield against increased borrowing, uncertainty surrounding general elections downplays this role.

FEVD Results

Next was to conduct impulse response functions (IRF) analysis. Impulse response functions indicate how a system would respond to exogenous shocks. Impulse response functions aid in examination of whether exogenous shocks have a positive or negative effect on the other variable in the system, or how long it will take for the effect of that variable to work through the system (Brooks, 2002; Mpofu, 2009). For the IRF, however, there's controversy as to whether the series in a VAR need to be stationary. Those against differencing argue in favor of loss of significant information related to co-

movements in data. The study adopted the Cholesky forecast error variance decomposition (FEVD) procedure. 11 steps (years) were used. The graphical representation of the results for FEVD is presented in figures A3 through A7 in the appendix. The graphs were important in establishing the whether the response to shocks was positive or negative. Generally, exogenous shocks to tax revenue and government expenditure have a permanent effect on public debt.

From the graphs for the IRFs, public debt responded positively to the innovations in both tax revenue and government expenditure. In the short run, however, the response to shocks in tax revenue is very minimal but is evident in the long run. A detailed interpretation is discussed under table 4.4. Similarly, response of public debt to government expenditure shocks is neutral at first (in year three to four). Thereafter public debt responds positively to exogenous shocks in government expenditure. Finally, public debt responds positively to its own shocks up to about year one (short run). Thereafter the effect of a shock is negative into the long run. The tabular representation of the results for the FEVD is reported in table 6. The results of the FEVD analysis based on the VECM provide much useful information on the evolution of the public debt, tax revenue and government expenditure-relationship in Kenya over time. Generally, public debt seems to have had a highly dominant position in the Kenyan public finance system. Over the whole sample period the forecast error variance of the public debt is almost completely attributable to exogenous shocks from the public debt side, both in the short and the long-run.

Table 6. Results for Forecast Error Variance Decomposition (FEVD)

Step	impulse = gr response = pd	imp = ge res = pd	imp = pd res = gr	imp = pd res = ge	impulse = pd response = pd
0	0	0	0	0	0
1	0	0	0.288	0.001	1
2	0.004	2.4e-06	0.262	0.002	0.996
3	0.006	0.002	0.152	0.015	0.992
4	0.017	0.012	0.109	0.014	0.972
5	0.033	0.017	0.317	0.180	0.949
6	0.035	0.029	0.301	0.291	0.936
7	0.104	0.027	0.302	0.309	0.870
8	0.158	0.035	0.437	0.423	0.807
9	0.347	0.035	0.356	0.316	0.618
10	0.426	0.045	0.381	0.387	0.529
11	0.441	0.047	0.431	0.460	0.512

Key: pd-public debt gr-tax revenue ge-government expenditure

Innovations in both tax revenue and government expenditure do not explain the forecast error variance in public debt up to year two. From the third year however; public debt responds positively by 1 % to exogenous shocks on tax revenue. In the long run, about 35% to 44% of the increase in forecast error variance in public debt is explained by the exogenous shocks to tax revenue. For government expenditure, its innovations are at first neutral to the variance in public debt. In the long term, the eleventh year, 5 % of the variance in public debt, is explained by the shocks to government expenditure. Tax revenue responds positively to exogenous shocks to public debt in the short run and the long run. Innovations in public debt explain 29% and 26% of the forecast error variance in tax revenue in the first and the second years respectively. In years three and four, innovations in public debt explain about 15% and 11% of the variance in tax revenue respectively. In the long run, innovations in public debt explain about 44% of the variance in tax revenue-in the eighth year. Similarly, innovations in public debt explain the forecast error variance of government expenditure in the long run. An exogenous shock on public debt explains 39% and 46% of the forecast error variance in government expenditure in years ten and eleven, respectively. Innovations in public debt explain 100% of its own forecast error variance in the short term. In the long term it explains about 51% of its own variance.

VECMs that display cointegration produce forecasts with variables both at levels and at first difference. In this study, two types of forecasts were computed. These were the dynamic forecasts and the out of sample forecast. Dynamic forecasts were used to compare the predicted values to those observed in the study period. In comparison, the out-of-sample forecast was used to compare the growth of the width of the confidence interval to the forecast period. The results for the dynamic forecasts are presented in figure A8 in the appendix. The levels for tax revenue and government expenditure predicted by the model were slightly lower than that observed throughout the sample period, 2001-2011. There was however an exception in the year 2006 when the forecasted figure was above that observed. In the case of public debt, the predicted figure was equal to the observed figure over 2004-2006, otherwise the predicted values were above those observed in most years. The out of sample forecast was then computed. The out-of-sample forecast for 2011 through 2030

is presented in figure A9 in the appendix. The width for the confidence interval increased with the forecast period, as was expected. The forecasts pointed to continued growth in these variables. Public debt responds positively to exogenous shocks in tax revenue over the long run. This is consistent with studies by Shonchoy (2010) and Greiner, Koller and Semmler (2011). Particularly, for real world economies the degree of public debt service necessitates a means to finance it. For developing nations like Kenya, public debt burden may not have a direct impact on government expenditure. Resort to taxation as a means to finance the public debt burden is fast and more appropriate compared to cutting pre-planned government expenditure.

5. Conclusions

The study sought to understand the relationship between public debt, tax revenue and government expenditure in Kenya over the sample period 1960-2011 inspired by budget deficits and public debt. The specific objectives in the study were the relationship between public debt and tax revenue and the relationship between public debt and government expenditure. The study used VECM since ordinary estimation techniques were invalid due to cointegration. The tests conducted to test the significance of the model included the VECM stability test, the LM test for serial correlation, and the Jarque Bera test for normality in the residuals. As required in the VECM literature, the components of the VECM including results for impulse response functions (IRF) employing the Cholesky forecast-error variance decomposition (FEVD) and the dynamic forecasts were also evaluated. The study concludes that public debt responds to both tax revenue and government expenditure particularly in the long run. Public debt responds positively to shocks from the government expenditure side particularly over the long run. In addition, the size of government expenditure has a debt increasing effect. This finding coincides with findings of Kanano (2006), Cassimon and Campenhout (2007), Nyamongo and Schoeman (2007) and Bilbie *et al.* (2008). However, it contrasts with results of Shonchoy (2010) who asserts that public debt burden may not have a direct impact on government expenditure so that it would be appropriate for developing Nations to use taxation to finance public debt which is fast compared to cutting pre-planned expenditure.

In regard to the relationship between public debt and tax revenue, the study concludes that public debt responds to tax revenue. Specifically, for the short run model, public debt responds negatively to a change in tax revenue and the coefficient is statistically significant. Public debt responds positively to shocks on tax revenue particularly over the long run. Evidence of response in the long run could imply gaps in the implementation of government fiscal policies in the economy since such policies take time to filter through the economy. This study has shown that understanding the relationship between public debt, tax revenue and government expenditure is important if any policy decisions on solving the budget deficit and public debt have to be reached. Also, the study has established that public debt, tax revenue and government expenditure move closely together such that any policy decision should be designed in such a manner that it affects the variables together. To reduce public debt, fiscal authorities should enhance measures that increase tax revenues. These include sealing tax loopholes for example tax evasion. This is because negative and statistically significant coefficients were found on most lagged terms of tax revenue in the short run VECM model. This means a KES 1 million increase in tax revenue leads to a decline in public debt in the range of KES 3 million and KES 5 million in the short run.

Fiscal discipline and fiscal consolidation is necessary in the wake of the levels of budget deficits and public debt. This can be achieved by prioritising expenditure on key sectors that have the potential of boosting the overall productivity of the economy in the long run. This study found that the coefficients of government expenditure that explained public debt in the short run VECM model were positive and statistically significant. A cut of KES 1 million in government expenditure leads to a decline in public debt of between KES 1 million and KES 2.5 million. In addition, in the long run public debt responds positively to positive shocks from the government expenditure side. In light of devolution that is under implementation government expenditure may continue to stay above government revenue and continue to pose a threat on fiscal deficits and public debt. Future research to establish whether the findings of this study hold in the face of devolution is recommended.

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Appendices

Table A1. Eigenvalue stability condition

Eigenvalue	Modulus
1	1
0.8740169 + 0.3762147i	0.951548
0.8740169 - 0.3762147i	0.951548
-0.1353427 + 0.9177048i	0.927631
-0.1353427 - 0.9177048i	0.927631
0.2772741 + 0.8730082i	0.915983
0.2772741 - 0.8730082i	0.915983
-0.6755261 + 0.5443591i	0.867561
-0.6755261 - 0.5443591i	0.867561
-0.4140733 + 0.733528i	0.84233
-0.4140733 - 0.733528i	0.84233
-0.814884 + 0.1187002i	0.823484
-0.814884 - 0.1187002i	0.823484
0.3907655 + 0.6308599i	0.742079
0.3907655 - 0.6308599i	0.742079

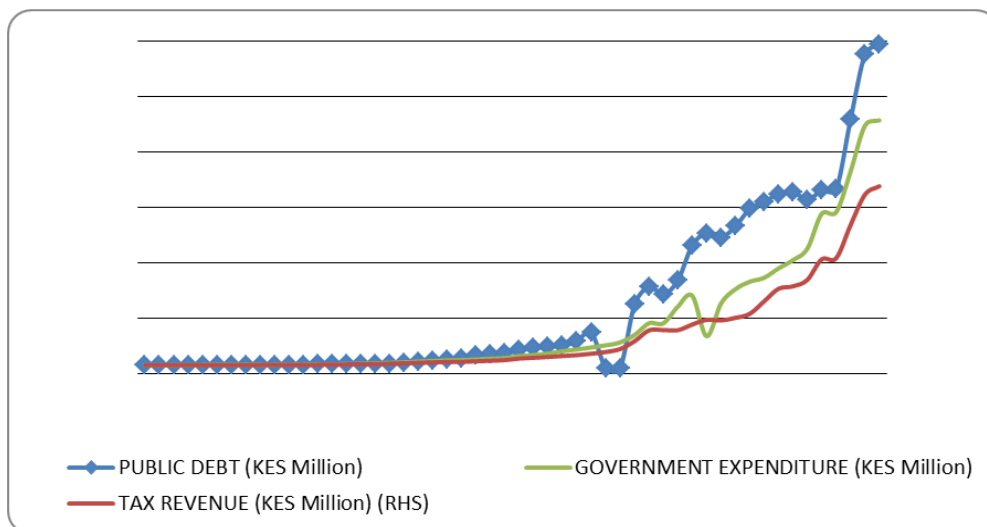
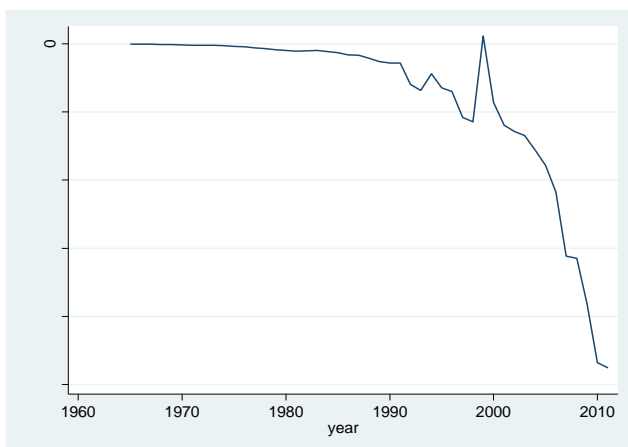


Figure A1. Trends in Public debt, tax revenue and government expenditure, 1960-2011

Cointegration equation 1



Cointegration equation 2

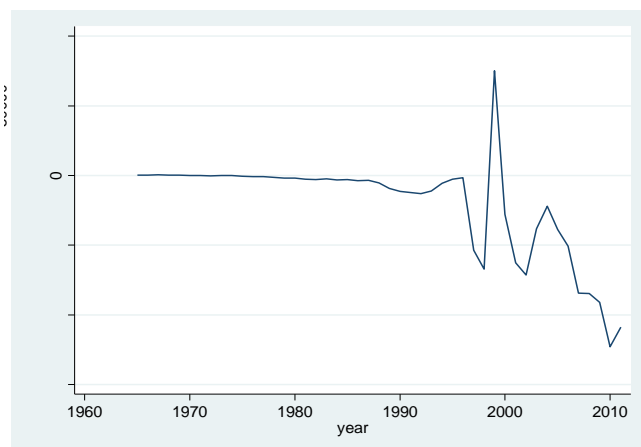


Figure A2. Residual plots for cointegration equations

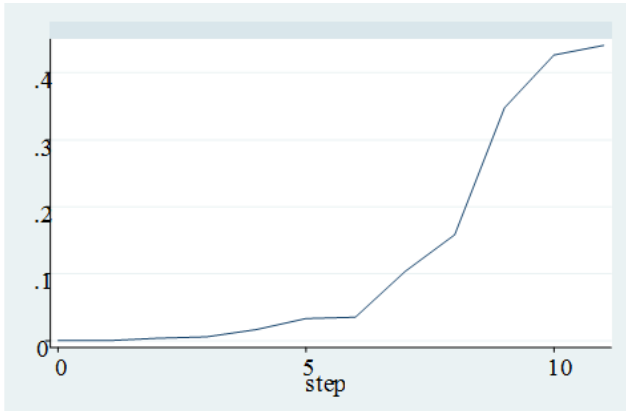


Figure A3. Graph for response of public debt to innovations in tax revenue



Figure A4. Graph for response of tax revenue to innovations in public debt

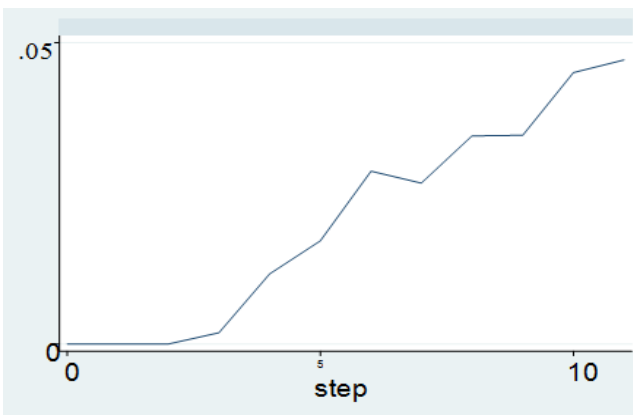


Figure A5. Graph for response of public debt to innovations in government expenditure

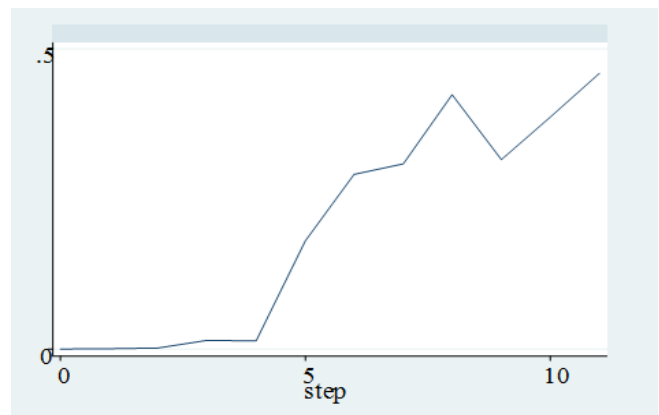


Figure A6. Graph for response of government expenditure to innovations in public debt

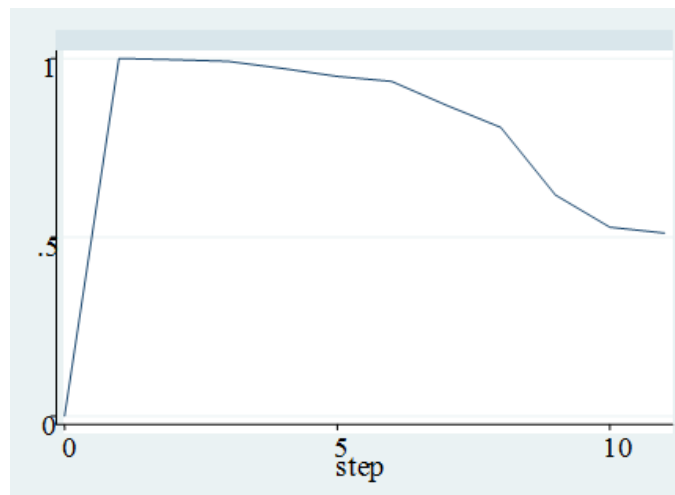
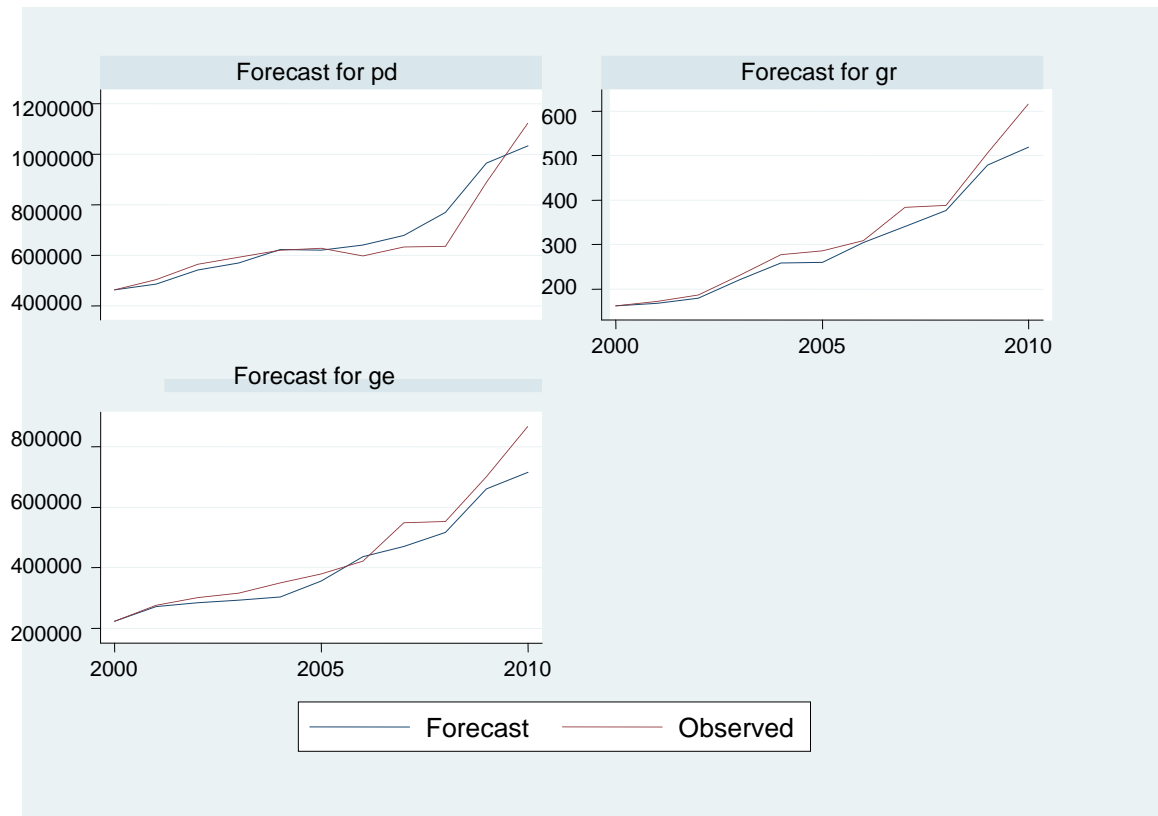
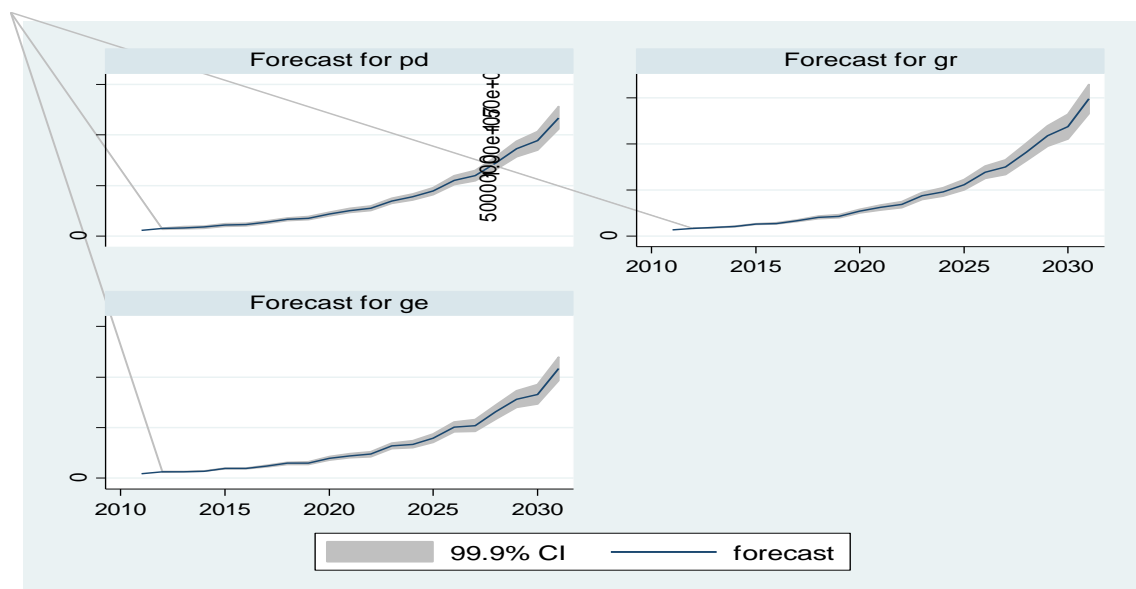


Figure A7. Graph for response of public debt to innovations in public debt



Note: Values for government revenue (gr) in the y-axis are in thousands.

Figure A8: Ex ante forecasts, public debt tax revenue and government expenditure components, 2001-2011



Note: The values for public debt (pd) and government expenditure (ge) on the y-axis lie between 0 and 3.00×10^7 and between 0 and 1.50×10^7 for tax revenue (gr).

Figure A9. Out-of sample dynamic forecasts, 2011-2030