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Asymmetric effects of fiscal policy on inflation in Kenya

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ABSTRACT

This study investigates the asymmetric effects of fiscal policy on inflation (INF) in Kenya using data for the period from 1991 to 2021. The study differs from previous studies by applying the non-linear autoregressive distributed lag (NARDL) modeling to capture asymmetric dynamics. The study identified a long-run equilibrium and cointegrating relationship among the study variables, with the findings indicating the existence of asymmetric long-run effects of public debt (PD) and government spending (GS) on INF. A positive relationship between increases in PD and INF in the short-run is also established, while decreases in PD are found to increase INF in both the long-run and short-run. Increases in GS raise INF, while decreases in tax revenue (TR) reduce INF in the long-run. Output gap has a persistent positive relationship with INF, while interest rate negatively affects INF. As such, the study recommends that policymakers should prioritize fiscal measures, especially government expenditure by ensuring that any additional spending does not cause inflationary pressures. The government should also regulate PD by ensuring that its levels align with the objective of INF control.

IMPACT STATEMENT

Governments use fiscal policy tools such as spending and taxation to influence macroeconomic performance. However, Kenya's government has been unable to maintain a sustainable fiscal policy due to an imbalance between government expenditures and revenues. In recent years, government spending has consistently exceeded its revenues, resulting in the need to borrow in order to finance its fiscal targets, creating a burden of debt accumulation. This has made it more difficult to finance essential public services and hindered the achievement of the medium term plan's (MTPs) targets for the realization of the Kenya's Vision 2030. This study examines the asymmetric effects of fiscal policy on inflation in Kenya using the non-linear autoregressive distributed lag (NARDL) modelling to provide a better understanding of Kenya's inflation. This helps to inform the policymakers on decision making and careful approach to the fiscal policy strategies.

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SUBJECTS
Macroeconomics; Econometrics; Economics

1. Introduction

Governments use fiscal policy tools, such as taxation and government spending (GS) to influence macroeconomic performance (Kim et al., 2021). Fiscal policy instruments affect the economy through their effects on aggregate demand, consequently affecting economic growth. Due to its potential to stabilize the economy, fiscal policies have found relevance across various economic contexts worldwide and are employed to stabilize prices, to address market failures, to protect vulnerable groups and to promote income distribution (Benimana, 2020). Fiscal policies are also used as countercyclical measures to smooth out fluctuations of the business cycles.

In recent times, the global economy has experienced fluctuations in inflation (INF) rates that have been associated with the 2007/2008 global financial crisis, geopolitical tensions and the COVID-19 pandemic (Jałtuszyk, 2022). In response, countries employed fiscal policy to ensure macroeconomic stability in the wake of the economic shocks that arose following such events. For instance, during the global financial crisis, most countries implemented contractionary fiscal policies to manage price stability (Sriyana & Ge, 2019). Amid the COVID-19 pandemic, fiscal policies were adapted to prioritize healthcare

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services across the world by lowering tax rates on medical items (Armantier et al., 2021; Chakraborty & Thomas, 2020). However, some countries, such as the United States of America, Canada and the United Kingdom engaged in large fiscal measures to stimulate consumer demand but ended up exacerbating inflationary pressures due to the mismatch between the rising demand and the constrained supply chains (de Soyres et al., 2023). This underlines the fact that fiscal policies need to be adequately managed to avoid unintended inflationary consequences (Asandului et al., 2021).

Attainment of fiscal policy objectives is a complex task that is often impeded by tax collection difficulties and also by challenges that arise when attempting to balance the need to stimulate output growth while at the same time controlling INF (Georgantopoulos & Tsamis, 2011). Tax collection difficulties in Sub-Saharan Africa are significant and have undermined the ability of countries to finance their expenditures. For instance, Kenya has been unable to maintain a sustainable fiscal policy and this has hindered long-term economic stability and development (Mathu et al., 2018).

1.1. Fiscal policy performance in Kenya

In achieving the Kenya's Vision 2030[1], Kenya targets an INF rate of below 5% (Wanjiku, 2013). However, despite Kenya's INF rate steadily declining from 26.2% in 2008 to 14.0% in 2011 and 6.1% in 2021, the 5% target has not yet been achieved. In recent years, Kenya's GS has consistently exceeded its revenues, resulting in the need to borrow externally and domestically in order to finance its expenditure targets, thereby creating a debt burden (Muguro, 2017; Ndonga, 2014). During the period between 1991 and 1995, Kenya's tax revenue (TR) grew by 25% while government expenditure rose by 27.3% (Kansiime et al., 2021). As shown in Figure 1, this increase in government expenditure, resulted in a period of high INF rates that reached 46% in 1993. Moreover, from 2000 to 2007, government expenditure as a percentage of GDP increased from 9.97% to 14.0%, while TR relative to expenditures rose significantly between 2002 and 2008 (Muguro, 2017). As a result, there was a decrease in public debt (PD) that averaged 49% between 2003 and 2007. The decrease in PD was accompanied by a rise in INF during this period, reaching a peak of 26.24% in 2008 (Maingi, 2017).

Between 2008 and 2012, there was an overall increase in Kenya's PD due to a 4.6% increase in government expenditure, compared to a 0.2% decrease in TR (as a percentage of GDP) (Muguro, 2017). INF rates rose to 14% in 2011 from 3.9% in 2010 (Kairanya, 2016). From 2013 to 2015, the government's expenditure outpaced the growth in TR by 1.7%, largely due to the introduction of devolution and the allocation of funds to new infrastructural projects. However, both government expenditure and TR have since declined, with government expenditure reaching 24.6% in 2020 as TR reached 16.8%. Following subdued revenue growth and an expansive budget, the government has been forced to widen the budget deficit and borrow more to meet its budgetary needs, resulting in PD becoming a key source of budget financing in Kenya, consequently causing a rise in PD to 68.1% in 2021, with INF reaching 6.1% (Kiriga & Chemnyongoi, 2020).

Empirically, economists and policymakers have shown great interest in determining the extent to which fiscal policy variables affect INF (Nuru & Gereziher, 2022). Accordingly, most empirical studies have focused on symmetric[2] effects arriving at mixed findings, with a few studies appearing to examine the phenomena

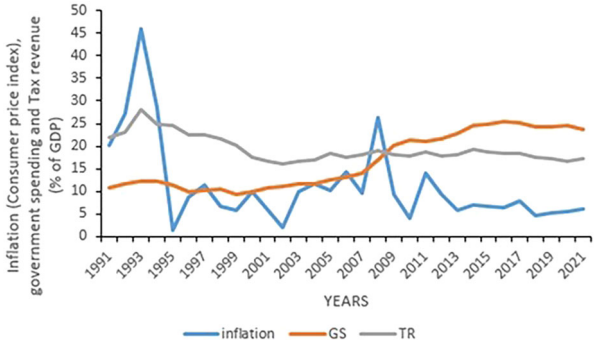

Figure 1. Trends in Kenya's inflation rates, government spending (GS) and tax revenue (TR). Source: Author's Compilation using Data from the World Development Indicators database o the World Bank and Kenya National Bureau of Statistics (KNBS).

of asymmetry[3]. Most recent studies (Asandului et al., 2021; Nuru & Gereziher, 2022; Sriyana & Ge, 2019; Zeng & Yue, 2022; Tahir et al., 2022) have, however, argued that the treatment of the effects of fiscal policy on INF rates could be asymmetric, and the symmetry assumption could be the reason behind the conflicting findings. Assuming linearity between economic variables can obscure the true nature of their relationships, resulting in potentially unreliable findings due to the prevalence of non-linear relationships (Bussiere, 2013).

The few existing studies on asymmetry, however, have largely been centered around developed nations (see e.g. Afonso & Sousa, 2012; Zeyneloğlu & Koenig, 2017; Hallerberg et al., 2007; Zeng & Yue, 2022; Asandului et al., 2021; Tsuchiya, 2016; Tahir et al., 2022), while developing countries such as Kenya have limited studies on asymmetric effects of fiscal policy on INF. With such fiscal policy significance coupled with conflicting empirical findings and the need to uncover the underlying non-linear relationships, there is a need for further empirical investigation.

This study, therefore, examines the asymmetric effects of fiscal policy on INF rates in Kenya. Specifically, the study aims to determine the asymmetric effects of TR, GS and PD on INF in Kenya, using the non-linear autoregressive distributed lag (NARDL) modeling. The NARDL approach to error correction and cointegration not only introduces non-linear adjustment into the analysis process but also helps in determining whether the effects of fiscal policy on INF are symmetric or asymmetric in both the short-run and long-run. This study's findings highlight an important observation regarding the presence of an asymmetric long-run effect of both negative and positive changes in PD and GS on INF in Kenya. The findings emphasize the importance of incorporating asymmetry when examining the effects of fiscal policy.

The study is organized in the following structure. Section 2 presents a literature review that links fiscal policy variables and INF. Section 3 presents the data set and regression model employed. In Section 4, the study discusses the results, while Section 5 presents the conclusions of the findings.

2. Literature review

This study's theoretical literature draws on fiscal theory of price level (FTPL), Demand-pull INF and cost-push INF. Rising INF rates could result from improper execution of economic policies, which can serve as a significant factor in generating inflationary pressures within an economy. FTPL suggest that, the level of prices is influenced by fiscal policy, particularly the government budget constraint and the nominal value of the outstanding government debt (Urquhart, 2022). Consequently, the Keynesian demand-pull theory INF implies that INF results from GS increases or tax reductions. If these policies lead to an increase in aggregate demand in an economy, they can have a demand-pull effect on INF. As such, prices rise as consumers compete for limited goods and services, resulting in inflationary pressures (Udoh & Kokoette, 2023). Cost-push INF occurs when production costs rise, which is passed on to consumers in the form of higher prices by businesses. Fiscal policy influences cost-push INF through taxation, subsidies and supply side policies which may in turn influences the production costs (Otto and Nenbee, 2011). These concepts help analyze how fiscal policy decisions interact with various economic conditions, leading to different magnitudes of inflationary pressure.

The vast body of recent empirical on the effects of fiscal policy on INF yields mixed results. Atan and Effiong (2021) examined the effects of fiscal policy on INF in Nigeria, focusing on the critical limit hypothesis. The findings revealed that, increases in government expenditure were not inflationary but insignificant. Consequently, they suggest increasing government expenditure as the critical limit has not been reached. In contrast, Udoh and Kokoette (2023) established that increases in recurrent expenditure positively influences INF, whereas increases in government's capital investment leads to a reduction in INF. The study investigated fiscal policy and INF in Nigeria from 1986 to 2021, employing the ARDL methodology. Their results also revealed that, increases in TR leads to long-run reduction in INF, whereas TR reductions result in long-run increases in INF. The study recommended implementing a carefully planned fiscal strategy to effectively manage inflationary pressures in Nigeria.

Ferrara et al. (2021) utilized the US data and SVAR modeling to study the effects of fiscal policy on real exchange rates and INF. Their findings indicated that an increase in government expenditure causes inflationary effects. Similarly, Zhang (2022) investigated the dynamics of global INF in response to China's GS and found that significant increases in GS increase consumer prices. However, Jørgensen and Ravn (2022) conducted a study on the US economy focusing on the inflationary response to GS shocks

using SVAR modeling and their findings revealed that prices do not rise following positive GS shocks, instead the response is negative.

Olaoye et al. (2022) analyzed how PD influences macroeconomic indicators like INF and exchange rates across 25 Sub-Saharan Africa economies using a panel threshold model. Their findings indicate that PD significantly increases the INF rate. The study suggested that, governments in SSA, should adhere to a debt limit set at 60.59% of GDP. However, selecting the appropriate threshold can be challenging, and inappropriate thresholds may lead to biased estimates and incorrect inferences. Aimola and Odhiambo (2021) found similar results in relation to the effect of PD on INF in Ghana the period 1983–2018. The literature also looks into how fiscal policy affects different macroeconomic variables asymmetrically.

Using a NARDL model, Sriyana and Ge (2019) examined how Indonesian fiscal policy affected INF. From their results, INF responds to fiscal variables asymmetrically both in the long-run and short-run. Similar findings emphasizing the presence of asymmetric impacts have been reported in a number of studies on INF in different countries, including India and Iran (Ajaz et al., 2016; Falahi & Hajamini, 2017). In a related study, Aimola and Odhiambo (2022) used the NARDL model to determine whether the effects of PD in Ghana were symmetric or asymmetric from 1978 to 2019. The NARDL regression model results revealed that increases in PD corresponded to inflationary increases, thereby establishing asymmetric dynamics. These study findings highlight the importance of governments to approach increases in PD with caution to control INF rates. Asandului et al. (2021) investigated the asymmetric impacts of fiscal policy on economic activity and INF in 12 European post-communist nations. From the Pooled Mean Group estimation, fiscal policy tool displayed negative effect on both INF and GDP in the long-run. However, the short-run effects were not statistically significant. Furthermore, the NARDL estimation indicated that fiscal policy influenced INF.

3. Econometric model and data

3.1. Econometric model

3.1.1. Theoretical framework

This study adopts the New Keynesian theory by Roberts (1995), which posits that, INF depends on expected INF in the next period and the output gap. The New Keynesian model is represented as;

$$\pi_t = \beta E_t[\pi_{t+1}] + \alpha Y_t + \varepsilon_t \tag{1}$$

where π_t is the INF rate at time t, $\beta E_t[\pi_{t+1}]$ is the expected INF in the next period. Y_t is the output gap which is the measure of economic growth based on the Hodrick–Prescott (HP) filtered real GDP, while α is the coefficient of the output gap. The proponents of this theory also argue that, fiscal policy influences aggregate demand which in turn affects INF (Gali, 2015). Therefore, by incorporating government expenditure, TR and PD into the original model, the study can explore how fiscal policy decisions, government interventions and INF dynamics interact within the New Keynesian paradigm. Therefore, Equation (1) is rewritten to produce an expression of INF that features fiscal policy variables as follows;

$$\pi_t = \beta E_t[\pi_{t+1}] + \alpha_1\ GS_t + \alpha_2\ TR_t + \alpha_3 PD_t + \alpha_4\ Y_t + \mu_t \tag{2}$$

where α_1, α_2, , α_3, and α_4 are the coefficients of GS, TR, PD and output gap, respectively. Therefore, modifying Equation (2), the new model is represented as follows;

$$INF_t = \alpha_0 + \alpha_1\ GS_t + \alpha_2\ TR_t + \alpha_3 PD_t + \alpha_4\ Y_t + \mu_t \tag{3}$$

where INF_t represents the INF rate at time t. TR_t, GS_t, and PD_t are TR, GS, and PD at time t. The study further introduced logarithms to the models since the study will be dealing with growth changes in variables. Logarithmic transformation is helpful in dealing with skeweness as it transforms skewed data into a more symmetrical form, which makes it easy to identify patterns and trends in the study variables. It also helps to solve post diagnostic problems like heteroscedasticity, by stabilizing the variance (Yusuf & Mohd, 2023; Ogun, 2021).

3.1.2. Empirical model

The model in log-log form is as follows;

$$LnINF_t = \alpha_0 + \alpha_1 LnTR_t + \alpha_2 LnGS_t + \alpha_3 LnPD_t + \alpha_4 LnY_t + \mu_t \tag{4}$$

where $LnINF_t$, $LnGS_t$, $LnTR_t$, $LnPD_t$ and LnY_t[4] are logarithmic transformations of INF, GS, TR, PD and output gap at time *t*, respectively. α_0 Is a constant, α_1, α_2, α_3 and α_4 are the parameters to be estimated, whereas μ_t is the error term. Equation (4) describes the long-run relationship between INF and fiscal policy variables. To incorporate their short-run effects too, Equation (4) is rewritten in its error correction form by formulating an ARDL (p, q) model with 'p' and 'q' representing lags of the dependent and independent variables, respectively (Bahmani-Oskooee & Arize, 2020). The study also introduced real interest rate (IRATE) into the model. An increase in interest rates reduces the demand for money, as people prefer to invest in high yielding assets. This shift decreases the amount of money held, effectively reducing money supply which can lead to lower INF. However, when interest rates reduces, money held for speculative purposes increases, and thus increases money supply which could cause a rise in the level of prices (Belongia & Ireland, 2015). Therefore, the ECM equation is obtained as follows;

$$\Delta INF_t = \alpha_1 + \sum_{i=1}^{p} \alpha_{2i}\Delta INF_{t-i} + \sum_{i=0}^{q1} \alpha_{3i}\Delta TR_{t-i} + \sum_{i=0}^{q2} \alpha_{4i}\Delta GS_{t-l} + \sum_{i=0}^{q3} \alpha_{5i} \Delta PD_{t-i} + \sum_{i=0}^{q4} \alpha_{6i}\Delta Y_{t-i} + \sum_{i=0}^{q5} \alpha_{7i}\Delta IRATE_{t-i} + \varphi_i ECM_{t-1} + \mu_t \quad (5)$$

where ECM_{t-1} is the lagged error correction term from the long-run equation while φ_i is its corresponding coefficient.

The ECM version of the ARDL model is given by:

$$\Delta LnINF_t = \alpha_1 + \sum_{i=1}^{p} \alpha_{2i} + \Delta LnINF_{t-i} + \sum_{i=0}^{q1} \alpha_{3i}\Delta LnTR_{t-i} + \sum_{i=0}^{q2} \alpha_{4i} + \Delta LnGS_{t-i} + \sum_{i=0}^{q3} \alpha_{5i}\Delta LnPD_{t-i} + + \sum_{i=0}^{q4} \alpha_{6i}\Delta LnY_{t-i} + \sum_{i=0}^{q5} \alpha_{7i} LnIRATE_{t-i} + \varphi_1 LnINF_{t-1} + \varphi_2 LnTR_{t-1} + \varphi_3 LnGS_{t-1} + \varphi_4 LnPD_{t-1} + \varphi_5 LnY_{t-1} + \varphi_6 LnIRATE_{t-1} + \mu_t \quad (6)$$

where α's represent the short-run parameters, φ's are the long-run regression coefficients. For Equation (6), changes in fiscal policy exhibit symmetric effects on INF. If presumed that the effects of increased fiscal policy variables differ from those of decreased fiscal policy variables, it introduces the possibility of asymmetry. Therefore, the study employs the NARDL model by Shin et al. (2011), which is an extension of the ARDL model proposed by Pesaran et al. (2001). The NARDL takes into account the non-linear adjustments into the effect of fiscal policy on INF in both the short-run and long-run (Alsamara et al., 2017). Following Asandului et al. (2021), the technique decomposes the fiscal policy variables only into their negative and positive changes. Following Shin et al. (2011) approach, the partial sum approach is conducted as follows;

$$POS_t = X_t^+ = \sum_{j=1}^{t} \Delta LnX_t^+ = \sum_{j=1}^{t} \max\ (\Delta\ LnX_j, 0) \quad (7)$$

$$NEG_t = X_t^- = \sum_{j=1}^{t} \Delta\, LnX_j - = \sum_{j=1}^{t} \min\ (\Delta\, LnX_j,\ 0) \quad (8)$$

where $X_t = (TR_t,\ GE_t,\ PD_t)$. Going back to Equation (6), we replace LnGS, LnTR and LnPD with their respective negative and positive changes from Equations (7) and (8). Therefore, the transformed model is represented as:

$$\Delta LnINF_t = \alpha_1 + \sum_{i=1}^{p} \alpha_{2i}\Delta LnINF_{t-i} + \sum_{i=0}^{q1} \alpha_{3i}\Delta LnTR_{t-i} + + \sum_{i=0}^{q2} \alpha_{4i}\Delta LnTR_{t-i} - + \sum_{i=0}^{q3} \alpha_{5i}\Delta LnGS_{t-i} + \sum_{i=0}^{q4} \alpha_{6i}\Delta LnGS_{t-i} - + \sum_{i=0}^{q5} \alpha_{7i}\Delta LnPD_{t-i} +_+ \sum_{i=0}^{q6} \alpha_{8i}\Delta LnPD_{t-i} - + \sum_{i=0}^{q7} \alpha_{9i}\Delta LnY_{t-i} + \sum_{i=0}^{q8} \alpha_{10i}\Delta LnIRATE_{t-i} + \varphi_1 LnINF_{t-1} + \varphi_2 LnTR_{t-1} +_+ \varphi_3 LnTR_{t-1} - +\varphi_4 LnGS_{t-1} +_+ \varphi_5 LnGS_{t-1} - +\varphi_6 LnPD_{t-1} + \varphi_7 LnPD_{t-1} - +\varphi_8 LnY_{t-1} + \varphi_9 LnIRATE_{t-1} + \mu_t \quad (9)$$

where Δ is the first difference, LnGS, LnTR, LnPD, LnIRATE and LnY are the logarithmic transformations of government expenditure, TR, PD, interest rate and output gap, respectively. Shin et al. (2011) proposed the bounds test for examining the long-run relationship using the *F*-test and comparing the

statistic with the upper critical value (I (1)). Specifically, a greater statistic indicates the presence of a long-run cointegrating relationship, regardless of the integration order. Whereas a lower *F*-statistic implies no evidence of cointegration. However, if the F-statistic lies within the critical bounds, cointegration results are considered inconclusive (Bahmani-Oskooee et al., 2021). In the existence of cointegration, the study proceeds to estimate the Wald test to assess the statistical difference in how INF responds to negative and positive changes of fiscal policy variables. To determine the most suitable lag length for cointegration, the Akaike Information Criteria (AIC) is used in the study. However, before conducting NARDL modeling, it is important to verify the order of integration of the variables. For the application of the NARDL, the variables should be integrated of order one or a mix of order zero and order one. This study employed the Zivot and Andrews (2002) unit root test, which accounts for a single structural break to examine the order of integration of the variables. To check the stability of residual coefficients in the model, various diagnostic tests were performed. These include tests for autocorrelation, heteroskedasticity, specification error and stability test.

3.2. Data

Annual time series data covering the period between 1991 and 2021, was used for the study. The Consumer Price Index (CPI) is used as a measure of inflation (INF), GS, public debt (PD) and TR were measured as percentages of GDP. Data on INF and GS were sourced from the World Development Indicators database of the World Bank. Data on TR and PD were extracted from Kenya National Bureau of Statistics (KNBS). The variables were measured in Kenyan Shilling (Ksh Millions) and subsequently converted to percentage of GDP by dividing their values by the total GDP of the corresponding year. Expressing the variables as a percentage of GDP takes into account the changes in the performance of the economy (Onofrei et al., 2022). Information on accessibility of data has been provided in the data availability statement section. Table 1 presents the study variables, their measurements and sources of data.

4. Results and discussions

This section presents the research findings of the study and the discussions.

4.1. Unit root test

Zivot and Andrews (2002) developed a unit root that accounts for a structural break, at both the intercept and trend. In Table 2, 2009, 2010, 2003 and 2008 represent the structural break points. The results indicate that INF, TR and output gap are stationary at first difference. On the other hand, GS, PD and real interest rates are stationary at levels.

4.2. NARDL regression model

To determine the most suitable lag length for cointegration, the AIC is employed. From Table 3, the lag length of 2 is optimal lag as indicated by the AIC.

Therefore, the model is constructed using a lag structure of (2, 2, 0, 2, 1, 2, 2, 1, and 2), which was determined to be the most effective and efficient choice for this study.

4.2.1. Short-run and long-run results

Table 4 presents the empirical results of the NARDL regression model. The findings indicate that the previous level of INF has a significant positive effect on the current level of INF, implying INF persistence. A positive relationship between output gap and INF was also established, implying that a 1% increase in output gap increases INF by 0.05% at the 1% significance level. Interest rates show a positive effect on INF, whereby a 1% increase in interest rates cause INF to fall by 0.99%. The findings also show a positive relationship between INF and GS, whereby a 1% positive change in GS increases INF by 6.38%. These results align with those of Sriyana and Ge (2019), Ferrara et al. (2021), Zhang (2022), Jørgensen and Ravn (2022) and Udoh and Kokoette (2023). However, the findings are contrary to the findings of

Table 1. Study variables and description of measurements.

Variable name	Description of measurement	Code	Sources	Expected relationship	
				Prior sign	Reference
Inflation	Consumer price index (CPI)	INF	World Development Indicators database of the World Bank	Inflation is expected to respond positively (+) to increases in GS, PD and reduction in tax revenue	Ferrara et al. (2021); Olaoye et al. (2022); Udoh and Kokoette (2023)
Tax revenue	Tax revenue as a percentage of Gross domestic product (GDP)	TR	Kenya National Bureau of Statistics	Increases in taxes is expected to reduce inflation (−), reduction in taxes increases inflation (+)	Udoh and Kokoette (2023)
Government spending	Government spending (including interest payments) as a percentage of GDP	GS	World Development Indicators database of the World Bank	Positive changes in government spending increases inflation (+), negative changes in government spending is expected to reduce inflation (−)	Sriyana and Ge (2019); Atan and Effiong (2021); Zhang (2022)
Public debt	Total public debt as a percentage of GDP	PD	Kenya National Bureau of Statistics	Positive changes in public debt increases the rate of inflation (+), negative changes in public debt is expected to reduce inflation (−)	Romero and Marin (2017); Urquhart (2022); Aimola and Odhiambo (2022)
Control variables					
Output-gap	Expressed as a percentage	Y	Generated using the Hodrick – Prescott filter with GDP data obtained from World Development indicators database of the World Bank	Increase in the output-gap increases inflation rates	Bhatti et al. (2021)
Interest rate	Expressed as a percentage	IRATE	World Development indicators database of the World Bank	Interest rate is expected to have a negative relationship with inflation	Abubakar and Gani (2013)

Source: Author's Compilation.

Table 2. Unit root test results.

Variable	*t*-Statistic	Break year	Decision
INF	−11.3006***	2009	I (1)
PD	−3.6388**	2010	I (0)
TR	−5.2449***	2003	I (1)
GS	−2.7523***	2008	I (0)
Y	−5.3570**	2003	I (1)
IRATE	−5.7184***	2003	I (0)

Notes: INF, GS, PD, TR, Y and IRATE represents inflation, government spending, public debt, tax revenue, output gap and interest rate, respectively. Y is the output gap which is the measure of economic growth based on the Hodrick – Prescott (HP) filtered real GDP. The significance levels ** and *** correspond to 5% and 1%, respectively.

Table 3. Results for the lag length selection.

Lag	Log L	LR	FPE	AIC	SC	HQ
0	−53.69094	NA	2.86e-06	4.263639	4.549111	4.350910
1	126.6217	270.4690	1.02e-10	−6.044409	−4.046103*	−5.433507
2	185.6130	63.20495*	2.93e-11*	−7.68[6644*]	−3.975503	−6.552111*

*indicates lag order selected by the criterion.

Olayungbo (2013) and Atan and Effiong (2021). The positive linkage between increases in GS and INF is in line with the demand-pull INF theory, which posits that expansionary fiscal policy increases aggregate demand. This increase in aggregate demand eventually leads to rise in price levels.

The findings also suggest that previous increases in PD have inflationary effects. Notably, for every 1% increase in the previous period's PD, current INF rates rise by 3.16%. Decreases in PD result to increases in INF rates as well. Quantitatively, 1% decrease in PD increases INF by 3.02%. However, these results are contrary to those of Nguyen (2015), Romero and Marin (2017), Aimola and Odhiambo (2021, 2022) and Olaoye et al. (2022).

Table 4. Results of the NARDL regression model.

Short-run coefficients			
Variable	Coefficient	Std. Error	*t*-Statistic
D(LnINF(-1))	0.416969	0.081618	5.108766***
D(LnGS_POS)	6.384188	1.563992	4.081982***
D(LnGS_POS(−1))	−5.099335	1.439010	−3.543641***
D(LnGS_NEG)	−0.118071	2.854854	−0.041358
D(LnPD_POS)	1.827508	1.623321	1.125783
D(LnPD_POS(−1))	3.157516	1.091505	2.892811**
D(LnPD_NEG)	−3.019640	1.114438	−2.709564**
D(LnTR_POS)	1.559644	3.565684	0.437404
D(LnTR_POS(−1))	3.968720	2.246504	1.766620
D(LnTR_NEG)	2.188787	3.359874	0.651449
D(LnIRATE)	−0.999439	0.507695	−1.968580*
D(LnIRATE(−1))	2.046165	0.482388	4.241741***
D(LnY)	0.045455	0.023962	1.896934*
CointEq(−1)	−1.126995	0.148626	−14.311063***
Long-run coefficients			
Variable	**Coefficient**	**Std. Error**	***t*-Statistic**
LnGS_POS	0.526062	0.510237	1.031014
LnGS_NEG	−0.055511	1.344679	−0.041282
LnPD_POS	−0.461754	0.353232	−1.307227
LnPD_NEG	−1.419674	0.509894	−2.784256**
LnTR_POS	0.133937	1.517855	0.088241
LnTR_NEG	4.442687	0.854097	5.201618***
LnIRATE	−1.626369	0.242580	−6.704472***
LnY	0.021371	0.010875	1.965024*
C	7.725580	1.052296	7.341641***

Note. LnGS, LnTR, LnPD, LnY and LnIRATE are the logarithmic transformations of government spending, tax revenue, public debt, output gap and interest rates, respectively. The significance levels *, ** and *** correspond to 10%, 5%, and 1%, respectively.

Table 5. Results of the NARDL bound test.

Test statistic	Value	*K*
F-Statistic	12.17522	8
Critical value bounds		
Significance	I (0) Bound	I (1) Bound
10%	1.95	3.06
5%	2.22	3.39
2.50%	2.48	3.7
1%	2.79	4.1

Note. I (0) and I (1) represent the lower and upper critical bounds, respectively.

In the long-run, decreases in PD were also found to increase the level of INF, implying that the short-run effects persist into the long-run. The results also indicate that 1% decrease in TR leads to a reduction in the level of INF by 4.44%. Decreases in TR can lead to cuts in GS, which lowers the aggregate demand and subsequently the level of prices. Just like the short-run findings, interest rates have a long-run negative relationship with INF. Output gap shows a consistent positive relationship with INF. The error correction term points to a long-run equilibrium relationship among the variables, as evidenced by the negative and significant coefficient. However, the error correction term of −1.13 implies that the correction process is oscillatory in nature and will decay and adjust to the equilibrium value in the long-run (Narayan & Smyth, 2006).

4.2.2. Cointegration results

The bounds test for identifying asymmetrical cointegration is determined based on the lags selected by the AIC. This test employs the *F*-statistic, and according to Table 5, the *F*-statistic value is greater than the upper critical value (I (1)) at all significance levels. This provides evidence of a cointegrating relationship among the variables.

4.3. Asymmetry test

The study then proceeds to estimate the Wald test to examine the statistical differences in the response of INF to the negative and positive changes in fiscal policy variables, in both the long-run and short-run.

Table 6. Wald test results.

Long-run		
Variable	Statistic	Decision
LnPD_POS and LnPD_NEG	−2.6058**	Presence of asymmetry
LnGS_POS and LnGS_NEG	3.1578**	Presence of asymmetry
LnTR_POS and LnTR_NEG	−0.6546	No asymmetry
Short-run		
D(LnTR_POS) and D(LnTR_NEG)	1.0462	No asymmetry
D(LnGS_POS) and D(LnGS_NEG)	−1.986320*	Presence of asymmetry

Note. The significance levels *, and ** correspond to 10% and 5% respectively.

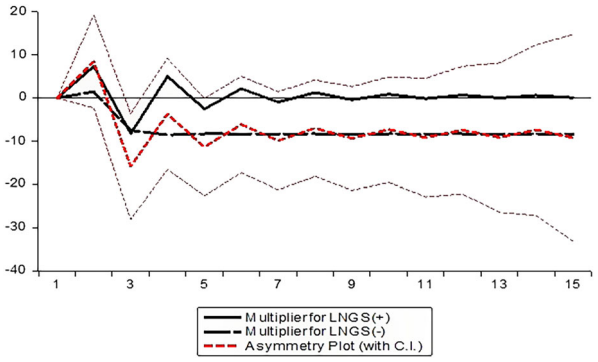

Figure 2. Dynamic multiplier of government spending (GS) on inflation.

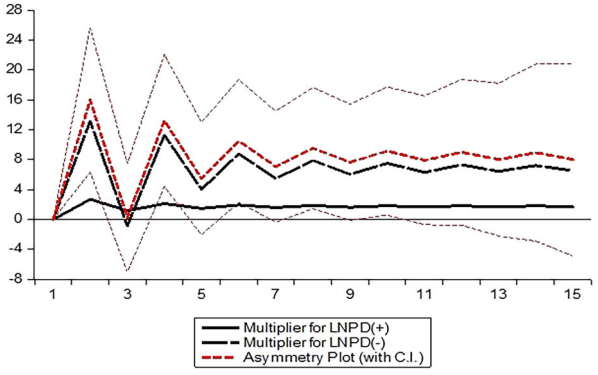

Figure 3. Dynamic multiplier of public debt (PD) on inflation.

As illustrated in Table 6, there exists a statistical difference in the response of INF to positive and negative changes in PD and GS in the log-run. That is, the positive effects of PD and GS have a significantly different effect from the negative effects. Positive changes in GS have a greater effect in increasing INF compared to increases caused by negative changes in GS. Similarly, negative changes in PD increases INF more than the positive changes in it. In the short-run, the effects of GS are asymmetric while the effects of TR are symmetric. Based on the findings, assuming linearity between economic variables can obscure the true nature of their relationships, resulting in potentially unreliable findings due to the prevalence of non-linear relationships (Bussiere, 2013). As a result, the findings highlight the significance of taking asymmetry into account when analyzing the effects of fiscal policy. The existence of asymmetric effects of fiscal policies on INF can be due to factors, such as liquidity constraints and the tendency of consumption, investment and prices to adjust downwards (Bhat & Sharma, 2020). This rigidity might result to inflationary patterns since the levels of consumption, investment and even prices remain persistently high despite the reduction in GS.

Figures 2 and 3 present graphs of dynamic multiplier effects, demonstrating the effects of positive and negative changes in GS and PD on INF. The positive and negative plots on the graph depict an asymmetric curve, showing adjustments of INF at different periods.

Table 7. NARDL diagnostic test results.

Problem	Test	*F*-Statistic	*p* Value	Conclusion
Serial correlation	Breusch – Godfrey LM test	2.5812	0.1762	No serial correlation
Heteroscedasticity	Breusch – Pagan – Godfrey	1.8771	0.1825	There is no heteroscedasticity
Specification error	Ramsey RESET	1.1175	0.3256	The model is well specified

Source: Author's Computation.

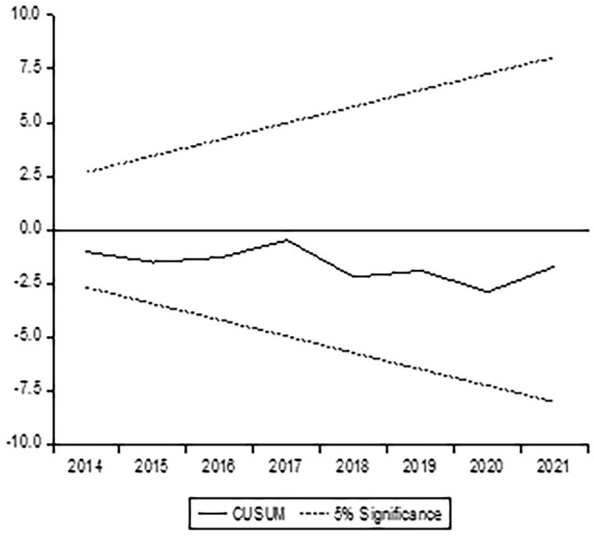

Figure 4. CUSUM test plot.

4.4. Diagnostic tests

To evaluate the reliability of residual coefficients, various diagnostic tests are performed. Breusch–Godfrey Lagrange Multiplier (LM) is used to determine if the residuals of the regression model exhibit serial correlation. The findings reveal no evidence of serial correlation at all the levels of significance. Additionally, the study employed the Breusch–Pagan–Godfrey test to examine heteroscedasticity. From the results in Table 7, we fail to reject the test's null hypothesis and conclude that the residuals are homoscedastic. To prevent over- or under-fitting of the data, which could result in poor performance, the Ramsey's RESET test is used to examine presence of specification errors in the model (Lotfi et al., 2022). Since the *p* value of 0.3256 exceeds all the significance levels, the null hypothesis of a well-specified model is accepted. The results are summarized in Table 7.

4.5. Stability test

To evaluate the stability of the NARDL modeling estimates, the Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) tests developed by Brown et al. (1975) were used in the study. The null hypothesis of the tests is a statement of a stable long-run and short-run estimate. Figure 4 demonstrates a stable model since CUSUM line's plot lies within the 5% significance level. Further, the CUSUMQ graph is used to examine the model's stability condition in Figure 5, where the line indicates that the model is stable at the 5% significance level.

5. Conclusion

The study investigates the asymmetric effects of fiscal policy variables on INF in Kenya using the NARDL modeling. From the findings, there is a long-run cointegrating equilibrium relationship. The findings of the NARDL model indicated that increases in PD in the short-run lead to a rise in INF. Increases in PD could result to increased debt interest payments, which may in turn lead to an increase in GS. As part of the GS is directed toward repaying these debt interests, it could crowd out private investments, due to higher

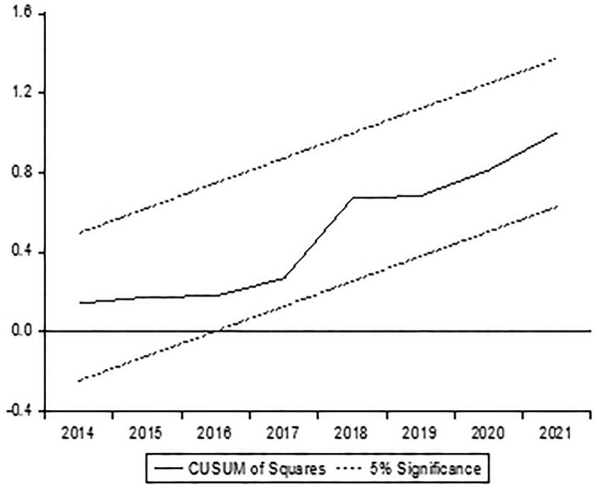

Figure 5. CUSUM of squares test plot.

demand for credit in the financial market. This makes it more expensive for businesses to borrow money for investment, leading to shortages in supply for goods and services in the long-run (Yusuf & Mohd, 2021a, 2021b). Consequently, the imbalance between demand and supply could lead to an increase in prices in the economy. Therefore, in this regard, the study recommends that the government should regulate PD by ensuring that its levels align with the objective of price stabilization so as to control the level of INF.

Furthermore, the findings indicate a positive effect of the reductions in PD on INF in both the long-run and short-run. This indicates that a reduction in PD might alleviate crowding in effect, thereby allowing increased private investment that may in turn result to increased aggregate demand levels and consequently a rise in INF. The positive relationship between increases in GS and INF is well defined by an expansionary fiscal policy, which results to increased aggregate demand, consumer spending and business investment, thereby giving rise to inflationary pressures. Decreases in TR reduce the level of INF in the long-run while interest rates have a negative relationship with INF. A positive relationship was also established between output gap and INF in both the short-run and long-run, this happens when the economy operate above its capacity causing increased demand for goods and services which could in turn push up the level of prices. Therefore, the study recommend that policymakers prioritize fiscal measures especially GS. To reduce inflationary pressures, the government should ensure efficient debt management strategies and that any additional spending does not cause inflationary pressures in the economy.

Given the evidence of long-run asymmetries in the effects of GS and PD on INF in this study, the results suggest that asymmetry should be accounted for when examining how fiscal policy affects macroeconomic factors. Thus, for future research, it is recommended that studies explore whether disaggregated GS components, such as recurrent expenditure, capital expenditure and transfer payments, exhibit asymmetric effects on INF. Additionally, further studies should also be conducted to examine whether domestic debt and external debt display asymmetrical effects similar to total PD in Kenya. The studies can also extend to other countries whose economic characteristics are identical to Kenya.

Disclosure statement

There is no potential conflict of interest in this study.

Author contributions

Judy Jemutai initiated the conception and design of the study, did data collection, data analysis, Interpretation of results and prepared a draft manuscript. Moses Mutharime Mwito conceptualized the study, helped in data analysis, reviewed the manuscript and approved of the final version to be submitted. Paul Mugambi Joshua conceptualized the study, reviewed the manuscript and approved the final version to be submitted to Cogent Economics and Finance.

Notes

1. Kenya's long-term development blueprint, Vision 2030, was launched in 2008 and implemented using a five-year medium-term plan. The first plan, MTPI 2008–2012, aimed to promote higher and sustainable economic growth, while the second plan, MTPII 2013–2017, focused on transforming Kenya and the third plan, MTPIII 2018–2022, focused on transforming lives (Kerubo,2023).
2. Symmetry implies that if a unit decrease in fiscal policy variable influences the inflation rate by a certain percentage, then a unit increase in fiscal policy will influence inflation by the same percentage (Abdel-Latif & Mishra, 2016).
3. Asymmetry is the statistical difference in the response of dependent variable to positive and negative changes in independent variables.
4. Given some values of the output gap are negative, a constant of 1 was added across to make all the values positive in order to introduce natural logarithms.

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Data availability statement

The data used in the study is available on the World Development Indicators database of the World Bank https://databank.worldbank.org/source/world-development-indicators. Kenya National Bureau of Statistics (https://www.knbs.or.ke), and can also be obtained from the corresponding author upon request.

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