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Abstract

Using data on the Mozambican economy from 2001Q1 to 2019Q3, the study analyzes the effect of fiscal policy shocks on real GDP, inflation and interest rates using a structural vector autoregressive (SVAR) model. The identification of the fiscal shocks is done using two methods, namely, the recursive approach and sign restrictions.The results show that a positive spending shock leads to an increase in real GDP, which accelerates inflation and, in response, the interest rate rises. Accordingly, 1.00 Metical (Mozambican local currency) increase in public expenditure, results in 19 cents increase in real GDP, one and a half year after the shock.On the other hand, the response of a positive tax (revenue) shock on real GDP, shows counter-intuitive results to Keynesian theory in the medium term, i.e., increasing tax revenue leads to higher real GDP. The positive tax revenue shock, has a zero or negative multiplier only in the impact period. In the medium term, the real GDP response to the positive tax revenue shock (revenue increase) is positive, i.e, it does not reduce the level of the output. A year and a half after the shock, the cumulative tax revenue multiplier reaches 38 cents.

JEL Classification: E62, C32, C50
Keywords: fiscal policies, SVAR, multipliers, recursive identification, sign restriction.

1. Introduction

The effects of monetary policy on economic activity finds consensus in the economic literature. However, this is no longer the case when it comes to the effects of fiscal policy decisions on the economy (Perotti, 2002). For Keynesians, increases in public expenditure or tax cuts, increase aggregate demand directly and, indirectly, through an increase in disposable income and private consumption. In contrast, neoclassicals argue for an ineffective role of fiscal policy on the economy, as do Ricardians, who believe that fiscal shocks do not generate significant positive results on the economy.

The recent global crisis stemming from the COVID-19 pandemic and the use of fiscal stimuli for economic recovery has revived the interest of central banks, policymakers and academia, on the role of fiscal policy in macroeconomic stabilization. As Khalid and Satti (2016) note, fiscal policy is considered the most active tool for macroeconomic stabilization.

In Mozambique, the importance of public spending in boosting aggregate demand is recognized, with the state considered the largest employer and largest buyer of goods and services domestically. However, to the best of our knowledge, empirical studies that analyze the effect of fiscal policy shocks on the main macroeconomic variables in Mozambique are still scarce. The magnitude of fiscal multipliers in Mozambique is not known, nor the dynamics that real GDP, prices and interest rates follow over a time horizon after a fiscal shock impacts the economy. The present study is a contribution to the literature on this subject.

Thus, the main objective of this study is to estimate the effect of fiscal policy shocks (public expenditure and tax revenues) in Mozambique on certain macroeconomic variables, namely real GDP, inflation, and interest rates.

The study uses data on public expenditure, real GDP, Consumer Price Index (CPI), tax revenues and 91-day treasury bill interest rates from 2001Q1 to 2019Q3, and relies on a structural autoregressive vector (SVAR) with two methods of identifying fiscal shocks (recursive approach and sign restrictions), to map the effect of fiscal policies on real GDP, inflation and interest rates.

The results show that, positive public expenditure shocks have an expansionary impact on Mozambique's real GDP, a conclusion in line with Keynesian theory. The increase in real GDP, results in higher inflation, and in reaction, the interest rate increases. However, the cumulative multiplier of public

expenditure is small. The results also show that, the effect of a positive (increase) tax revenue shock seems counter-intuitive to Keynesian thinking, i.e., an increment in tax revenue also increases real GDP.

Besides the introduction, the study consists of five more chapters. The second chapter presents, in two sections (the theoretical framework and empirical evidence), the literature review relevant to the topic at hand. The third chapter, goes through the study methodology and, the fourth, refers to the data analysis. The fifth chapter interprets the results of the study and, conclusions and policy implications are presented in the sixth and final chapter.

2. Literature Review

2.1. Theoretical Framework

According to Ly (2014), over several years, different arguments have been put forward to justify the use or not of fiscal policy as an economic policy tool. Indeed, the analysis of the effect of fiscal policies on economic activity is a topic that follows the evolution of macroeconomic research and remains a current topic for theoretical and empirical research and policymakers.

Keynes (1935) was the precursor of Keynesian theoretical foundation that gives importance to fiscal policies (public spending and tax revenues) to regulate the dynamics of business cycles, from the income distribution and by the effect of the fiscal multiplier. The standard Keynesian model argues that, consumers react to positive public spending shocks by increasing private consumption and thereby GDP. The expansion of economic activity, results in higher inflation.

However, in the late 1970s, as Ly (2014) mentions, the neoclassical theory, whose view is founded on the idea that fiscal policy has an ineffective role in regulating the economy, came to prominence again because of the depression experienced in developed economies, characterized by the cohabitation between a high level of unemployment and inflation. At the time, increasing public spending, considered by Keynesians as the most important tool to stimulate growth and employment, proved ineffective.

Like the neo classicals, the theoretical defenders of Ricardian equivalent (Barro 1974), state that the role of fiscal policy in the real economy is equally ineffective. For the Ricardians, any reduction in current taxes immediately induces an increase in private savings in the same proportion. Therefore, the fiscal impulse does not generate significant positive results. In this case, inflationary pressure does not occur.

However, Ly (2014) recalls that, this theory relies on assumptions that are difficult to materialize, namely, infinite horizon, lump-sum taxation, risk-free environment and absence of liquidity constraints.

Beside the three theories that discuss the role of fiscal policy on economic activity, there is a fourth, called anti-Keynesian tax effects. According to Giavazzi and Pagano (1990), there are anti-Keynesian and non-linear effects of fiscal policy on the behavior of private agents when an increase in tax revenues arising from tax increases (instead of inducing a slowdown in economic activity, as predicted by Keynesians) affects positively the real economy by increasing private consumption. Similarly, a reduction in tax revenues can have a recessive impact on the economy through a reduction in private consumption.

The channels mentioned by some authors, which justify the counter-intuitive effects of restrictive fiscal policies are, the demand, supply and psychological channels:

- ✓ Demand channel: according to Giavazzi and Pagano (1990), consumers consider today´s tax increases as a future tax reduction. Consequently, they may reduce their savings and increase their spending today, thus stimulating economic activity;

- ✓ Supply channel: for Ly (2014), the composition of the fiscal adjustment influences the formation of agents' expectations on the supply side. For example, a fiscal tightening policy aimed at reducing government arrears, will be more effective in promoting economic growth.

- ✓ Psychological threshold: according to Sutherland (1997), at moderate debt levels, fiscal policy results in traditional Keynesian effects. Current generations of consumers discount future taxes because they may not be alive at the time of the next debt stabilization program. However, when public debt reaches extreme values, current generations of consumers know that there is a high probability that they will be alive when the next stabilization program is implemented. Then, a fiscal deficit can have a contractionary effect on consumer spending in these situations.

Therefore, in the theoretical literature one finds divergent positions regarding the effects of fiscal policies on economic activity.

2.2 . Empirical Evidence

The table below summarizes empirical studies that have analyzed the effect of tax policy shocks on economic activity, highlighting the methodology, the variables used in the study, and the main findings.

Table 1: Summary of empirical studies using SVAR to analyze tax effect shocks

Authors	Methodology and variables	Main Conclusions
Blanchard and Perotti (2002)	Mixed SVAR / event study of 3 variables: public expenditure, taxes and GDP, for the US.	✓ Positive public spending shocks have a positive effect on GDP; ✓ Positive tax shocks have a negative effect on economic activity; ✓ Multipliers of public spending and taxes are small, close to 1.
Perotti (2002)	Panel SVAR of five variables: GDP, GDP deflator, public spending, net revenue and interest rate, for 5 countries (USA, West Germany, UK, Canada and Australia).	✓ The effects of fiscal policy on GDP and its components are positive; ✓ Tax multipliers tend to be negative and reduced; ✓ Shocks to government spending have significant effects on the real interest rate, but with uncertain signs.
Mountford and Uhlig (2002, 2009)	SVAR of 10 variables for the US (GDP, private consumption, total government expenditure, total government revenue, private residential investment, private non-residential investment, interest rates, adjusted reserves, commodity producer price index, and the GDP deflator) using sign restrictions.	✓ Surprise deficit-financed tax cut is the best fiscal policy to stimulate the economy. Multiplier of an additional $5 of GDP, for each dollar of cut in government revenue, that occurs 5 years after the shock; ✓ Deficit spending weakly stimulates the economy; ✓ Investment falls in response to increased taxes and public spending; ✓ Multipliers associated with a change in taxes are larger than those associated with changes in spending.
Baum and Koester (2011)	SVAR of 3 variables for Germany: government	✓ Public spending shock produces a short-run fiscal multiplier of about 0.70;

	spending, government revenue and GDP.	✓ Fiscal multiplier from tax increases is -0.66; ✓ Fiscal spending multipliers are larger in times of negative output gap, but have a limited effect in times of positive output gap.
Caldara and Kamps (2016)	SVAR of 5 variables for the US (government spending, net taxes, real GDP, GDP deflator and short-term interest rate) using four methods: ✓ Recursive approach; ✓ SVAR; ✓ Signal Constraints; and ✓ Event Study Approach.	✓ Real GDP, real private consumption and real wages increase to a public spending shock; ✓ Divergent results on the effects of tax shocks; ✓ Difference in results were attributed to differences in the size of automatic stabilizers estimated or calibrated for different identification approaches.
Mirdala (2009)	Panel SVAR for 6 countries (Czech Republic, Hungary, Poland, Slovakia, Bulgaria and Romania), with 5 variables (government spending, real GDP, inflation, tax revenues and short-term interest).	✓ After public spending shock, real GDP increases; ✓ After the initial tax revenue shock, the response of real output is non-Keynesian, for Czech Republic, Hungary, Slovak Republic, Bulgaria and Romania. Real output increases after the tax revenue shock (with different intensity and durability).
Akpan and Atan (2015)	SVAR of 5 variables for Nigeria (government spending, real output, inflation rate, real interest rates and private investment).	✓ Responses of real output and inflation are asymmetric depending on the component of public spending used as fiscal stimulus to stabilize the economy; ✓ Positive shock to public spending on social and community services has a persistent significant positive impact on private consumption and real output, but at the expense of higher inflation in the short run;

		✓ Response of real output to tax shocks is persistently negative, albeit insignificant.
Khalid and Satti (2016)	SVAR of 3 variables for Pakistan: public expenditure, tax revenues and GDP.	✓ Government spending at the aggregate level increases GDP; ✓ Tax revenue shock affects economic activity in opposite way; ✓ Multipliers of government spending are larger than that of tax revenues.
Haque (2016)	SVAR of 3 variables for Bangladesh: public expenditure, tax revenues and GDP.	✓ Tax expenditure shocks increase GDP on impact, but the effect is statistically insignificant in the period after the shock; ✓ Positive tax shocks have a negative effect on GDP on impact, but insignificant in the period after the shock; ✓ Fiscal policies on spending and taxes have a limited effect and can´t be used for long run purposes.
Restrepo (2020)	SVAR in panel for 8 Latin American countries (Brazil, Chile, Colombia, Dominican Republic, Republic, Mexico, Paraguay, Peru, and Uruguay), with 3 variables: public expenditure, tax revenues, and GDP.	✓ Public spending shocks increase GDP, and tax revenue shocks act in the opposite way; ✓ Cumulative public spending multipliers range from 0.47 to 1.89; ✓ Cumulative tax multipliers range from -0.36 to -3.03.

A number of studies have tested for non-Keynesian tax effects for developing countries, using methodologies other than SVAR. Among these, Tanimoune et al (2008) share evidence on the existence of "unconventional" fiscal effects for West African Economic and Monetary Union (WAEMU) countries. In their study, they concluded that above a debt-to-GDP ratio of 83%, public interventions become anti-Keynesian (fiscal increments become expansive).

The analysis by Tanimoune et al (2008) shows that, the supply channel was the main explanation for this, since, for these economies, fiscal adjustment often means reducing state payment arrears. Following a similar analysis, Patillo et al (2002) also confirm the non-linear effects of external debt in developing

countries. The first explanation is consistent with the supply channel, i.e., higher debt discourages investment.

In summary, several empirical studies that analyze responses of macroeconomic variables to fiscal shocks bring, in general, conclusions in line with Keynesian thinking, that is, positive public expenditure shocks generate expansionary effects on economic activity and tax shocks (increments) generate negative effects.

Regarding fiscal multipliers, Ilzetzki et al (2011) found that for developing countries, the GDP response to increased government consumption is negative on impact. The multiplier is smaller than that estimated for high-income countries.

In developing countries, GDP increases in response to a shock in government spending only with a lag (from 2 to 4 quarters). Fiscal policy differs in developing countries not only in its effect, but also in its execution, as increases in government consumption are much more transitory (dissipating after approximately 6 quarters), in contrast to highly persistent public expenditure shocks in high-income countries (Ilzetzki et al, 2011).

Compiling the literature, one finds studies that analyze the effects of fiscal policy shocks on macroeconomic variables in Mozambique, following different methodologies than the SVAR proposed in the present study. In fact, Garrine (2019), in his study on Analysis of the Effects of Public Spending on Economic Growth in Mozambique (2002-2016), using the Ordinary Least Squares (OLS) method, concluded that a 1% increase in public spending per capita leads to an expected 0.23% increase in GDP per capita. A 1% increase in per capita investment in economic areas leads to an increase in expected GDP per capita by 0.396%; and a 1% increase in per capita investment in social areas leads to an increase in expected GDP per capita by 0.247%.

On the other hand, Nhabinde (2013), also using the Ordinary Least Squares method, in his study on Assessing the Impact of HIV/AIDS on Economic Growth in Mozambique concluded that, a variation in government spending in the health sector by 1% led to an increase in real GDP by 0.09%.

3. Methodology

In recent years, vector autoregressive (VAR) models have become major econometric tools to assess the effects of monetary and fiscal policy shocks on economic activity.

As Mountford and Uhlig (2002) point out, modern macroeconomics takes the economy as a dynamic and stochastic system, which can be understood by analyzing the responses to present and past random shocks. Seen from this perspective, the VAR has become one of the most suitable empirical tools for analyzing macroeconomic dynamics, and many researchers have successfully applied this methodology, in particular, for analyzing the effects of monetary policy shocks.

The present study analyzes the effect of fiscal policy shocks (public expenditure and tax revenues) on economic activity in Mozambique, using a SVAR with quarterly data from 2001Q1 to 2019Q3.

Note that, fiscal policy can vary as a result of two factors, namely (i) discretionary policy actions (e.g., changes in tax rates and by increasing public expenditure), and (ii) endogenous changes that reflect the cyclical dynamics of economic activity.

The SVAR-based analysis is performed by isolating the impact of discretionary changes in fiscal policy on economic activity, eliminating for this purpose the variation due to cyclical economic conditions. The interest is to understand the response of real GDP, inflation and interest rate after an exogenous fiscal shock affects the economy.

In this study, the identification of the fiscal shocks associated with the model, is carried out using two methods: (i) recursive approach (contemporaneous restrictions); and (ii) sign restriction.

3.1. Identification using Recursive Approach

This methodology uses the recursive Cholesky decomposition of the variance-covariance matrix of the model residuals, and takes into account the causal ordering of the variables. The VAR model is represented by the equation (1) below:

$$A_0 Y_t = A(L) Y_{t-1} + B\varepsilon_t \quad (1)$$

$$E(\varepsilon_t) = 0, \quad E(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon} = I, \quad E(\varepsilon_t \varepsilon_s') = [0] \quad (2)$$

It´s assumed that, the structural disturbances ε_t are uncorrelated with each other, that is, the variance-covariance matrix of the structural disturbances $\sum_{\varepsilon}$ is the diagonal.

Where:

- Y_t is a vector (nx1) of the endogenous macroeconomic variables;
- A_0 represents the matrix of contemporaneous relationships among the endogenous variables;
- $A(L)$ is a matrix with lagged elements, of dimension L, representing the impulse-response functions of shocks on the elements of Y;
- B is a matrix of dimension (nxn) that captures the linear relationship between structural shocks and errors in the reduced form of the autoregressive vector; and
- ε_t is a vector (nx1) of structural shocks that are independent of each other.

In this study, the vector Y_t of endogenous variables in the model is composed of five elements, namely, government expenditure (g, which includes public consumption and investment and excludes interest payments), real GDP (y), consumer price index (cpi), tax revenues (t, which excludes net transfers), and interest rates on 91-day short term Treasury bills (given by i).

The choice of these variables were made with reference to similar studies in this area. In this model, five exogenous shocks are assumed to determine the endogenous variables - public expenditure shock (ε_g), demand shock (ε_y), inflation shock (ε_p), tax revenue shock (ε_t) and monetary policy shock (ε_i). However, the interest of the study rests on the two fiscal shocks, namely, the public expenditure and tax revenue shocks.

Equation (1) above cannot be estimated directly based on an OLS, because, it violates an important condition of estimation: the regressors are correlated with the error term. Therefore, the SVAR must be estimated indirectly, from a VAR in reduced form.

Estimation in the reduced form, aims to obtain the structural model, SVAR, which isolates the exogenous shocks from the regressors. After identifying the purely exogenous shocks, the SVAR allows tracing the dynamics of the variables included in the model, after one of these shocks impacts the economy.

To obtain the reduced form of the VAR model, equation (1) is multiplied by an inverse matrix A_0^{-1}, as shown in equation (3) below:

$$Y_t = A_0^{-1}A(L)Y_{t-1} + A_0^{-1}B\varepsilon_t = C(L)Y_{t-1} + u_t \quad (3)$$

Where $C(L)$ is the matrix representing the relationship between variables in lagged values and u_t is an nx1 vector of normally distributed shocks (shocks in reduced form) that are not correlated with the regressors but may be correlated with each other.

$$E(u_t) = 0, \qquad E(u_t u_t') = \sum_u = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} & \sigma_{14} & \sigma_{15} \\ \sigma_{21} & \sigma_1^2 & \sigma_{23} & \sigma_{24} & \sigma_{25} \\ \sigma_{31} & \sigma_{32} & \sigma_1^2 & \sigma_{34} & \sigma_{35} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_1^2 & \sigma_{45} \\ \sigma_{51} & \sigma_{52} & \sigma_{53} & \sigma_{54} & \sigma_1^2 \end{bmatrix}, \qquad E(u_t u_s') = [0], \qquad \forall_t \neq S \quad (4)$$

Equation (3) reveals the relationship between VAR disturbances in the reduced form u_t and structural disturbances ε_t, which is given by:

$$u_t = A_0^{-1}B\varepsilon_t \qquad \text{ou} \qquad A_0 u_t = B\varepsilon_t \quad (5)$$

In equation (5), some variables can be observed, representing the reduced form of the VAR model, in which the term u_t represents linear combinations of the structural shocks ε_t. From equation (5), the problem of identifying structural innovations arises.

The identification process (recursive) used in this method, recognizes at first the structural fiscal shocks (public expenditure shock e_t^g and tax revenue shock e_t^t), based on the recursive Cholesky decomposition, of the variance-covariance matrix of the VAR residuals.

The Cholesky decomposition defines the matrix A_0 (equation 6) as a lower triangular matrix and the matrix B (equation 7) as an identity matrix of dimension n.

The identification of the fiscal shocks occurs in the identification process of matrix A_0, based on restrictions imposed on the matrix (based on economic intuition).

The process of identifying the A_0 matrix implies that some structural shocks have no contemporaneous effects on some endogenous variables in the model, given the order of the endogenous variables.

The basic assumption behind the method is that, fiscal policy requires some time (at least one quarter) to react to changes in the state of the economy (Ilzetzki et al, 2011).

On the other hand, with respect to matrix B, the elements on the diagonal represent the variance of structural shocks, while, the rest outside the diagonal are set to zero. Thus, equation (5) can be presented as follows:

$$A_0 u_{t=} \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^y \\ u_t^p \\ u_t^t \\ u_t^i \end{bmatrix} \quad (6)$$

$$B\varepsilon_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^g \\ \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^t \\ \varepsilon_t^i \end{bmatrix} \quad (7)$$

In the study, the variables are arranged as follows: government expenditure, real GDP, CPI, tax revenues and interest rate. The arrangement of the variables reveals the following relationships among them:

- ✓ Public expenditure do not respond contemporaneously to shock of any other endogenous variable in the model;
- ✓ Real output does not respond contemporaneously to inflation, tax revenue and interest rate shocks, and is only affected contemporaneously by the public expenditure shock;
- ✓ Inflation does not respond contemporaneously to tax revenue and interest rate shocks, but is affected contemporaneously by public spending and real output shocks;
- ✓ Tax revenues are affected contemporaneously by public spending shocks, real output, and inflation shocks, but do not respond to the interest rate shock; and
- ✓ Interest rates are affected contemporaneously by shocks to all endogenous variables in the model.

However, the (contemporaneous) relationships listed above are only valid for the first period (initial quarter), and beyond this period, all variables can be affected by any other shock in the model. Indeed, the basic assumption of this method is that, fiscal policy requires at least one quarter, to react to changes

in the state of the economy (Ilzetzki et al, 2011). Therefore, the exogenous structural shock, can be isolated from the discretionary effect of fiscal policy and the cyclical effect in this period.

After estimating the VAR, one can obtain the impulse-responses, which plot the evolution of a variable of interest over a time horizon after an initial shock affects the model.

3.2. Identification using Sign Restrictions Approach

To test the consistency of the results obtained based on the recursive methodology, the study resorts to another approach for the identification of the fiscal shocks, in this case, the sign restriction.

This method follows the study of Mountford and Uhlig (2002), whose solution was to find a procedure that relies less on the instantaneous reactions of the tax variables, as is usually done in the identification of a traditional VAR. In this case, the fiscal variables respond to fiscal policy shocks after some period, restricting the impulse-responses by imposing a particular signal for up to four quarters after the shock.

Unlike the recursive approach, the sign constraint does not require that the number of shocks be equal to the number of variables, and it does not impose linear constraints on the contemporaneous relationships between the reduced form of the VAR and the structural disturbances. In this methodology, restrictions are imposed directly on the type of responses to the shocks. Using sign restriction, four shocks can be identified, namely, a business cycle shock and a monetary policy shock (these first two being non-fiscal shocks), a public expenditure shock and a tax revenue shock. These two constitute fiscal policy shocks, of interest to the study.

In identifying shocks based on the sign constraint, following section 2.1 of the recursive identification above, the relationship between disturbances in the reduced form u_t and structural shocks ε_t is given by $u_t = B\varepsilon_t$, (equation 5) with $E(u_t u_t') = \sum_u$ e $E(\varepsilon_t \varepsilon_t') = \sum_\varepsilon = I$.

The term ε_t is a vector of dimension m, with $m \leq k$, i.e., unlike recursive identification, it´s not necessary to identify as many shocks as the number of variables. In the case of the present study, four shocks are identified using the sign restrictions approach, even though there are five variables in the estimated VAR model. To implement the sign restrictions approach, we decompose the matrix C into two components, $C = BQ$, where B is the lower triangular Cholesky factor of $\sum_u$ and Q is an orthogonal matrix with $QQ' = I$.

$$C = BQ; \qquad QQ' = I; \tag{8}$$

Before the fiscal shocks, we identify the non-fiscal ones, namely the business cycle shock and the monetary policy shock, to filter their effect on the fiscal shocks.

Following the approach of Mountford and Uhlig (2009), we impose the following sign restrictions on the impulse responses:

- ✓ A business cycle shock is defined as one that simultaneously moves GDP and tax revenues in the same direction for four quarters after the shock. According to Mountford and Uhlig (2009), the constraint that, in the business cycle shock, revenues increase with GDP, should be emphasized. This is the main identification assumption for tax policy shocks: when output and government revenues move in the same direction, it is basically assumed that this is due to some improvement in the business cycle that generated the increase in tax revenue, not the other way around.

- ✓ A positive monetary policy shock raises interest rates and drives prices down, for four quarters after the shock.

Fiscal policy shocks (public spending and tax revenues) are identified only by the impulse-response constraint of the fiscal variables.

- ✓ A public spending shock is defined as one in which public spending increases for four quarters after the shock; and in the tax revenue shock, revenues increase for four quarters, with no additional restrictions on any other variable. These strict restrictions for four quarters are intended to rule out transitory shocks to fiscal variables in which, for example, public spending increases at the time of impact but declines after two quarters.

Table 2: Sign restrictions in the identification of fiscal policy shocks

Fiscal Policy Shocks	G	Y	CPI	T	i
Public Expenditure	+				
Fiscal Revenues				+	

Non-Fiscal Shocks					
Business Cycle		+		+	
Monetary Policy			-		+

Source: adapted from Mountford and Uhlig (2002).

In Table 2 above, the "+" sign means that the impulse response of the variable in question is restricted to the positive sign for four quarters after the shock, including the impact quarter. Similarly, the "-" sign indicates a negative response and a blank entry indicates that no restriction was imposed.

The statistics for the fiscal shocks are obtained from median impulse-response of the fiscal shocks. Following the procedure of Blanchard and Perotti (2002), Mountford and Uhlig (2002), Caldara and Kamps (2005), the fiscal multiplier is given by the following formula:

Multiplier = (GDP Response / Fiscal Shock) / Average share of the fiscal variable on GDP in the sample period.

4. Data

The variables used in the study to estimate the SVAR are, government expenditure; real GDP; CPI; tax revenues and interest rates on short term treasury bills (91 days).

Similar to studies in this area, such as Mountford and Uhlig (2002, 2009), Blanchard and Perotti (2002), the variable "public expenditure" is defined as government consumption and investment in order to isolate changes in government spending from automatic changes over the business cycle. Thus, it does not include transfer payments, which almost certainly vary automatically in an anti-cyclical fashion.

Time series on government spending and revenues are obtained from quarterly state budget execution reports for the period 2000 to 2020. Data on CPI and real GDP are obtained from the National Statistics Institute (INE). Interest rate statistics are obtained from the Bank of Mozambique. The database is provided in the appendix.

Public expenditure, tax revenues, and GDP are denominated in real and per capita terms. With the exception of the interest rate, all variables used in the model were seasonally adjusted and log-transformed.

The time series were tested for unit root using Augmented Dickey-Fuller and Phillips-Perron test. All variables have unit root at the level (except public expenditure by Phillips-Perron), therefore I(1), and in the first difference, the null hypothesis of unit root was rejected (appendix, table 3).

With quarterly data, a vector autoregressive model with 4 lags is estimated, based on the Likelihood-Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC) and Hannan-Quinn information criterion (HQ) lags order selection criteria (appendix, table 5).

The model stability tests indicated that the estimated system is non-explosive, that is, the impact of the shocks on the variables decreases until it dissipates after a certain period. Details of the results of the data treatment are given in the appendix.

5. Results

The results are presented in two subsections, following the two methods used for the identification of fiscal shocks, namely, contemporaneous (recursive identification) and sign restrictions.

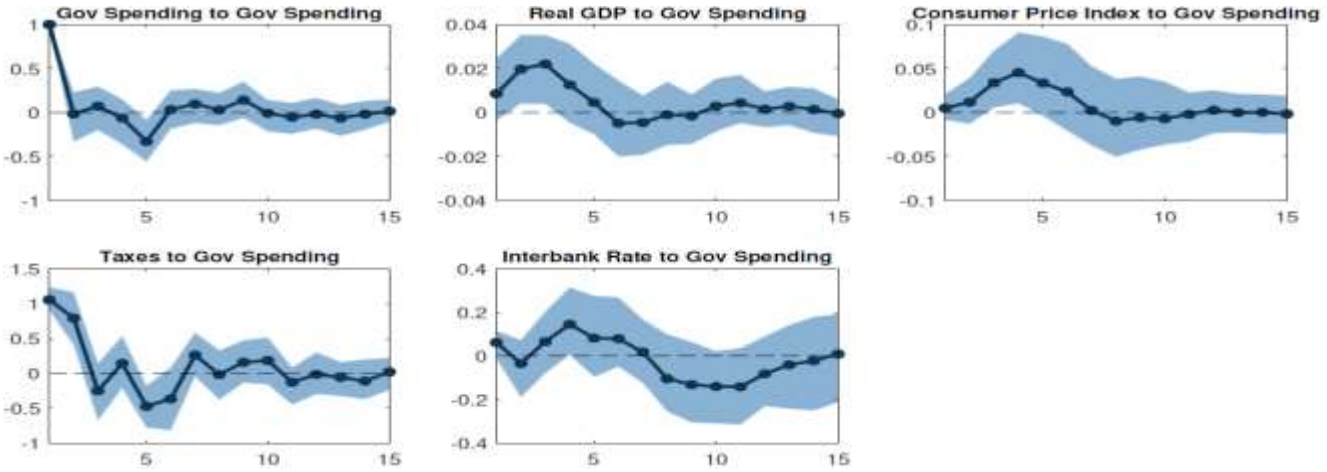
5.1. Results based on Recursive Identification

5.1.1. Public Expenditure Shock

A positive public spending shock results in an expansion of real GDP, which occurs for about 5 quarters after the shock, after which the effect dissipates (figure 1). The peak in real GDP growth is observed in the 3rd quarter, when it reaches more than 0.022%. With the increase in real GDP, inflation accelerates for six quarters, peaking at 0.05% in the fourth quarter after the shock, and dissipating by the 7th quarter. With higher inflation, the real interest rate shows an upward trend beginning in the 2nd quarter.

Figure 1: Public Expenditure Shock

Gov Spending; Real GDP; Consumer Price Index e Taxes in percentage | *3 month interest rate* in percentage points.



5.1.2. Positive Tax Revenue Shock

Figure 2 below shows the path of the variables after a positive (increase) tax revenue shock impacts the model. The response of the variables shows counter-intuitive effects to Keynesian theory: real GDP increases (it was expected to decrease) and peaks at 0.019% in the third quarter, with the effect of the shock dissipating starting in the 6th quarter.

The expansion of real GDP in response to a positive tax revenue shock may be associated with reforms that have been taking place in Mozambique's tax system since 1998, which generated positive impacts on tax collection, and consequent expansion of public spending. Indeed, since 1998, the country's tax policy and tax administration have been affected/subjected by reforms, most notably:

- Introduction in 1998 of the Value Added Tax; Tax on Specific Consumption, ICE (1998); the Corporate Income Tax, IRPC (2002); and Personal Income Tax, IRPS (2002);
- Creation of the *Lei de Bases do Sistema Tributário*, LBST (2002); Law of the Tax Legal System, LOJT (2006); and creation of the Tax Authority, AT (2006);
- Introduction of Simplified Corporate Tax, ISPC (2009); and
- Revision of the Code of Fiscal Benefits, CBF (2009).

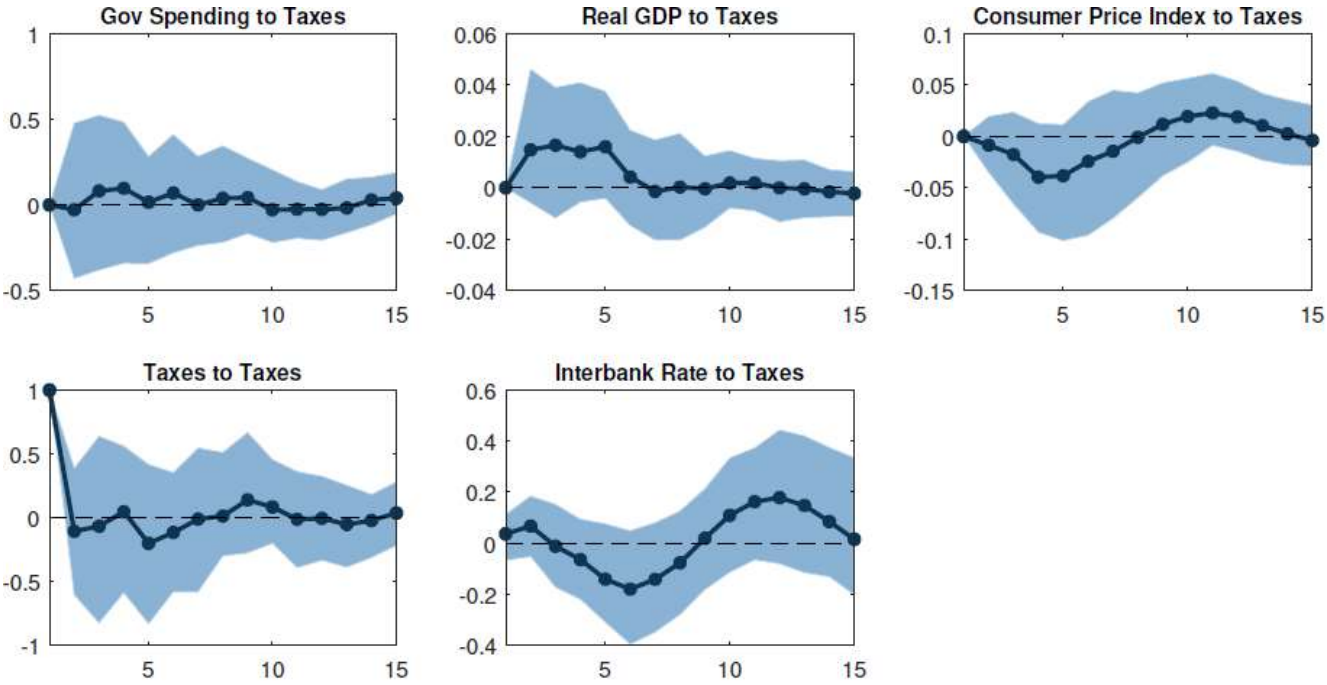
According to the Mozambique Tax Authority (2018), these reforms have contributed to increased efficiency in tax collection, based on: (i) improved administration of the main direct and indirect taxes; (ii) broadening the tax base; and (iii) combating tax evasion.

However, after a positive tax revenue shock, the dynamics of inflation and the interest rate are different, when compared to the path resulting from a public spending shock. Prices do not respond to the

expansion of real GDP, a fact that occurs only from the 8th quarter on. And faced with lower expected inflation, the interest rate follows a downward trend starting in the 2nd quarter.

Figure 2: Tax Revenue Shock

Gov Spending; Real GDP; Consumer Price Index e Taxes in percentage | *3 month interest rate* in percentage points.

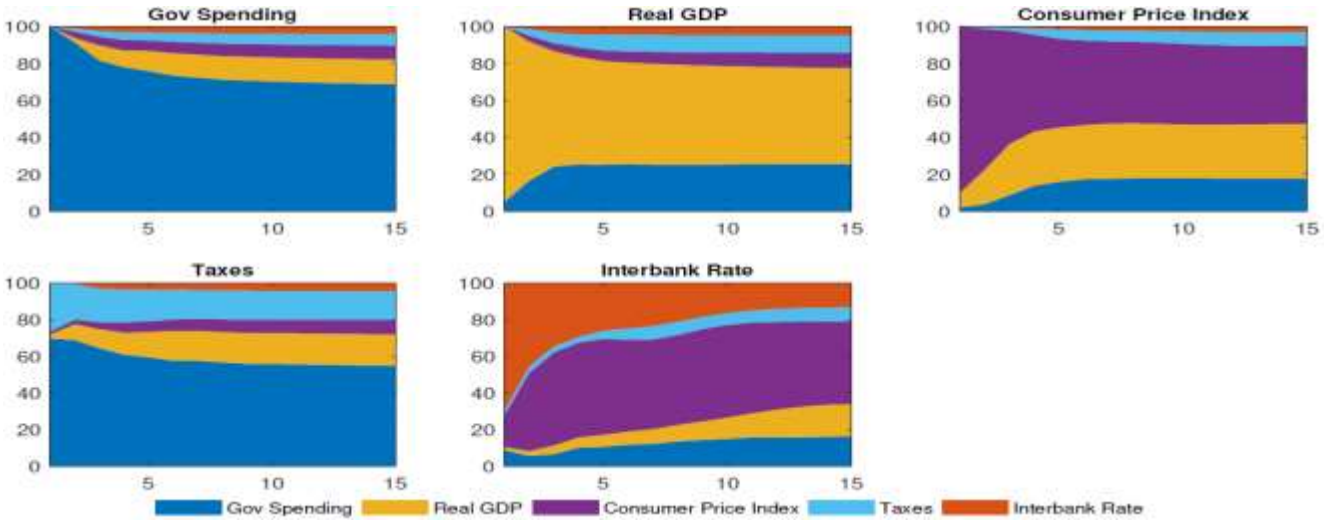


5.1.3. Variance Decomposition

The variance decomposition determines how much of the variance in the forecast error of each of the variables is explained by exogenous shocks to the other variables in the system, and shows how this importance evolves over time.

Based on figure 3, the decomposition of real GDP shows that, starting in the third quarter, more than 50% of the variance in the forecast error of real GDP is explained by a unit shock in real GDP. Starting in the same period, about 25 percent of the variance in the forecast error in real GDP is explained by government spending and about 10 percent is explained by taxes.

Figure 3: Variance Decomposition (%)



For prices, starting in the 5th quarter, about 40% of the variance in the CPI forecast error is explained by a unit shock to the CPI; about 25% of the variance in the CPI forecast error is explained by the unit shock to real GDP, and about 20% in the CPI forecast error is explained by public spending.

For the interest rate, the results show that, starting in the 4th quarter, more than 40% of the variance in the interest rate forecast error is explained by the CPI, less than 20% is explained by real GDP, and about 15% is explained by public spending.

For tax revenues, the decomposition shows that more than 50% of the variance in the forecast error of revenues is explained by public expenditure; about 15% is explained by real GDP and another 15% by tax revenues.

5.2. Results based on Signal Restrictions

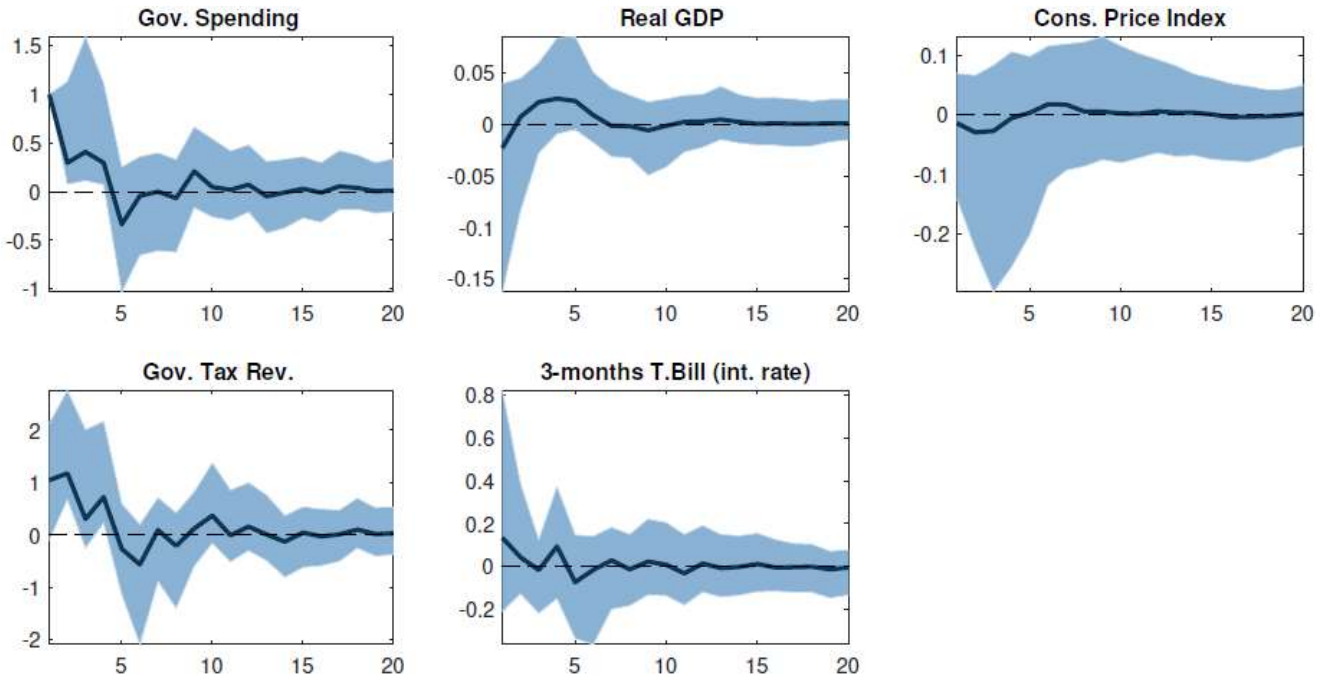
5.2.1. Public Expenditure Shock

To test the consistency of the results obtained with recursive identification, the study uses a second method to identify the fiscal shocks. Using sign restriction, four shocks were identified, being initially two non-fiscal shocks (business cycle and monetary policy) and two fiscal shocks of interest to the study, namely, public expenditure and tax revenues.

When the sign restriction method is used, one observes that a positive public expenditure shock also results in an expansion of real GDP, which peaks at around 0.02% in the 3rd quarter. The effect of the shock on real GDP dissipates after the 6th quarter (see figure 4).

Figure 4: Variables' response to public expenditure shock

Gov Spending; Real GDP; Consumer Price Index e Taxes in percentage | *3 month interest rate* in percentage points.



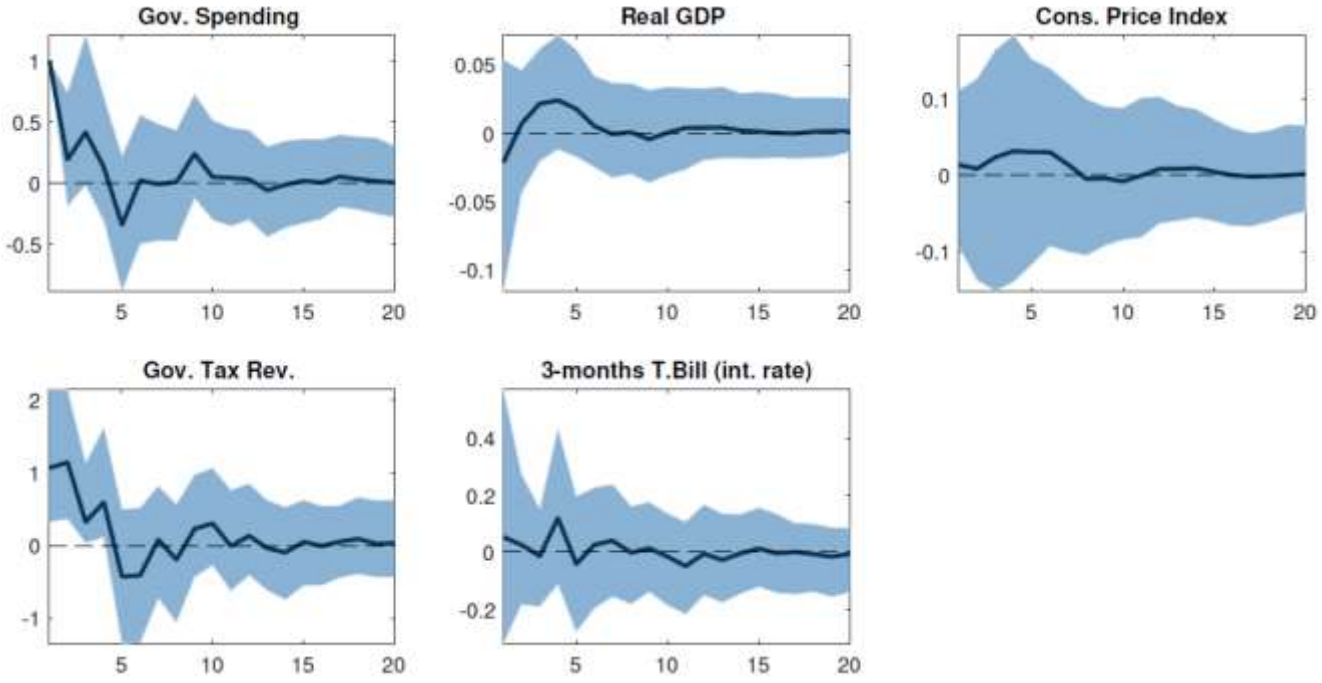
As real GDP expands, inflation follows a tenuous acceleration trend starting in the 2nd quarter, and in reaction to the inflation path, the interest rate increases timidly starting in the 2nd quarter after the shock.

5.2.2. Positive Tax Revenue Shock

The response of GDP to the positive (increase) tax revenue shock, as in the recursive identification, is counter-intuitive to Keynesian thinking. Real GDP expands after the shock, reaching a maximum of 0.03% after 3 quarters. The effect of the shock dissipates after the 6th quarter.

Figure 5: Variables' response to the tax revenue shock

Gov Spending; Real GDP; Consumer Price Index e Taxes in percentage | *3 month interest rate* in percentage points.



In this scenario, inflation assumes a timid increase starting in the second quarter and dissipates starting in the 6th quarter. In this scenario, the interest rate follows a slightly increasing path, from the 2nd to the 6th quarter after the shock.

Table 3 below summarizes the response of real GDP to fiscal shocks associated with the model and the fiscal multipliers obtained from the two methods of identifying the shocks.

Table 3: GDP Response to Fiscal Shocks

		Initial Response			Maximum Response	
		Fiscal Shock	**Real GDP**	**Multiplier on impact**	**Real GDP**	**Accumulated Multiplier**
Recursive Identification	Public Expenditure	1.0	0.01%	0.02	0.02% at Q3	0.18 until Q5
	Tax revenue (increase)	1.0	0.0%	0.00	0.02% at Q5	0.38 until Q6
Sign Restriction	Public Expenditure	1.0	-0.01%	-0.04	0.04% at Q3	0.19 until Q6
	Tax revenue (increase)	1.0	-0.02%	-0.08	0.04% at Q3	0.37 until Q6

Source: Author's estimates Multiplier = (GDP response / Fiscal Shock) / (Average share of Fiscal Variable on GDP)

It should be noted that, for the calculation of fiscal multipliers, in the sample period (2001Q1 to 2019Q3), the average weight of public expenditure to GDP, was 0.42 and the average weight of tax revenues to GDP was 0.20.

In the short run (initial response), the multiplier of the public expenditure shock lies between -0.08 and 0.02 on impact. However, in the medium term (maximum response), the cumulative GDP response multiplier to the public expenditure shock reaches 0.18 or 0.19, which occurs in the fifth or sixth quarter after the shock, i.e., an increase in public expenditure by 1 Metical (Mozambican currency), results in a cumulative real GDP increment of 18 or 19 cents after 5 or 6 quarters. The magnitude of the multiplier and the lag of the response in GDP varies depending on the methodology used to identify the fiscal shock.

The positive tax revenue shock contracts real GDP only in the short run, in the period of impact of the shock. Indeed, in the short run, the positive tax revenue shock, has a zero (0.0) or negative multiplier of -0.08, using respectively, recursive identification or sign restriction as the method of identifying the shocks. However, after six quarters, the cumulative multiplier reaches 0.37 or 0.38, i.e., real GDP increases by 37 or 38 cents, in response to an increase in tax revenues by 1 Metical, using respectively, sign restriction or recursive identification as the method of identifying the shock.

The results in the table indicate that in the medium-run, tax policies can stimulate economic activity in Mozambique. However, the multipliers turn out to be small, in line with the findings of Ilzetzki et al (2011).

Table 4 below summarizes the responses of other variables such as inflation and interest rates to shocks to public expenditure and tax revenues.

Table 4: Inflation and Interest Rate Responses to Fiscal Shocks

	Fiscal Shock	CPI (Maximum/Minimum | Quarter)	Interest Rate
Recursive Identification	Public Expenditure	0.05% | Q4	0.2pp | Q4
	Tax revenue (increase)	-0.05% | Q4	-0.2pp | Q6
Sign Restriction	Public Expenditure	0.01% | Q6	0.15pp | Q8
	Tax revenue (increase)	0.04% | Q6	0.15pp | Q4

Source: Author's estimates

As a consequence of the expansion of real GDP due to fiscal shocks, inflation accelerates and peaks between 0.04% to 0.05% after 4 to 6 quarters. In response, the interest rate rises between 0.15 and 0.2 percentage points (see Table 4).

6. Conclusions and Policy Implications

The study estimates the effects of fiscal policy shocks (public spending and tax revenues) on real GDP, CPI, and the interest rate in Mozambique, based on a SVAR, using two methodologies for identifying structural shocks: the short-run constraints (recursive identification) and the sign constraint.

The results show that the cumulative multiplier of the response of real GDP to the public expenditure shock is 0.18 or 0.19, five to six quarters after the shock, that is, an increase in public expenditure of 1 Metical, results in an increase in real GDP of 18 or 19 cents, one and a half year after the shock. As a consequence of the increase in real GDP, inflation accelerates to between 0.01% and 0.05%, which peaks about 4 quarters after the shock. In reaction, the interest rate increases between 0.15 and 0.2 percentage points.

The magnitude of the cumulative public spending multiplier is in line with findings from studies for developing economies.

The positive tax revenue shock, has a zero or negative multiplier only in the impact period. In the medium term, the response of real GDP to the positive tax revenue shock (revenue increase) is counter-intuitive to Keynesian theoretical thinking. Instead of reducing the level of output, this shock increases real GDP. A year and a half after the shock, the cumulative tax revenue multiplier reaches 0.37 or 0.38.

This counter-intuitive response may be associated with reforms that have been taking place in the Mozambican tax system since 1998, which have contributed to improve the efficiency of tax collection (increasing tax revenues), reflected in the expansion of public expenditure, and the consequent positive impact on real GDP.

From the analysis we conclude that fiscal policies can be effective in stimulating economic activity in the medium term. On the contrary, in the short run, fiscal multipliers are negative or almost null, which reveals the ineffectiveness of fiscal policies to affect economic activity.

The analysis carried out in this study can be deepened by evaluating, for example, the fiscal policy scenario that can best stimulate the economy (deficit spending vs deficit-financed tax cuts vs balanced expansion of budget spending) or by evaluating the magnitude of fiscal multipliers due to certain factors that may affect them.

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APPENDIX

Table 5: Results of Unit Root Tests

Variables	ADF		Phillips-Perron	
	Nível	1ª Diferença	Nível	1ª Diferença
Public Expenditure	-0.97	-5.44*	-4.85	-21.34*
Real GDP	-1.67	-4.85*	-1.56	-13.41*
Consumer Price Index	1.03	-4.00*	0.70	-5.38*
Tax Revenues	2.72	-4.99*	-1.73	-32.37*
Interest Rate	-2.48	-5.50*	-2.24	-5.55*

Source: Author's calculation. *Significant at 5% level

Table 6: Johansen's Cointegration Test

Included observations: 66 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: Gov_Spending; Real_GDP; CPI; Tax_Rev; 3_Months_TBill
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.492556	125.1531	88.80380	0.0000
At most 1 *	0.456634	80.38065	63.87610	0.0011
At most 2	0.280793	40.12243	42.91525	0.0926
At most 3	0.179162	18.36848	25.87211	0.3197
At most 4	0.077696	5.338108	12.51798	0.5486

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 7: VAR Lag Order Selection Criteria

Endogenous variables: Gov_Spending; Real_GDP; CPI; Tax_Rev; 3_Months_TBill
Exogenous variables: C
Sample: 2001Q1 2019Q3
Included observations: 71

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1863.963	NA	5.03e+16	52.64684	52.80618	52.71020
1	-1509.521	648.9776	4.70e+12	43.36679	44.32285	43.74699
2	-1445.736	107.8062	1.59e+12	42.27425	44.02703*	42.97127
3	-1399.578	71.51246	9.02e+11	41.67825	44.22774	42.69210
4	-1350.243	69.48482*	4.79e+11*	40.99277*	44.33899	42.32346*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 8: Heteroscedasticity test of the VAR residuals

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Sample: 2002Q1 2019Q3
Included observations: 67
Joint test:

Chi-sq	df	Prob.
635.2837	600	0.1542

Figure 6: Non-Fiscal Shocks

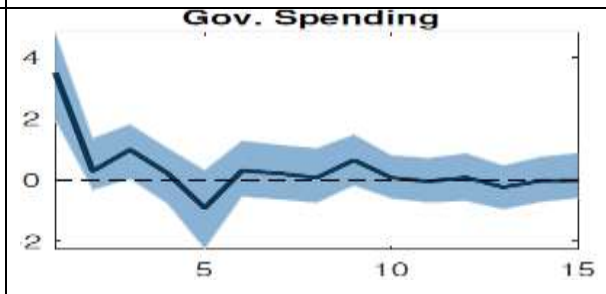
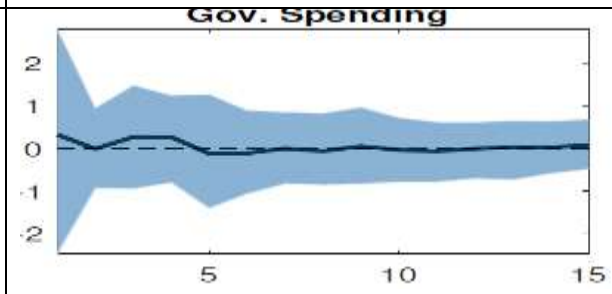
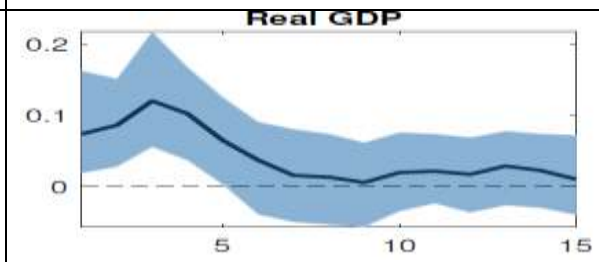
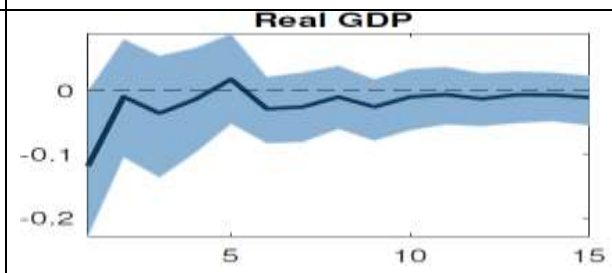
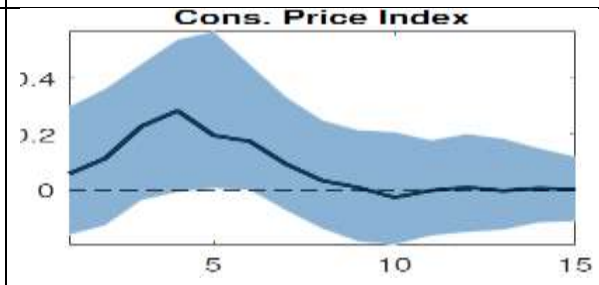
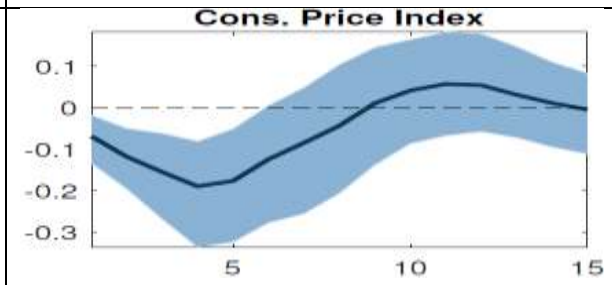
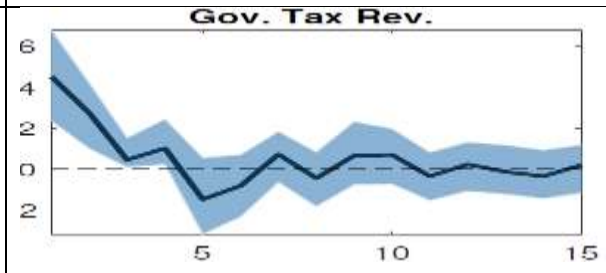
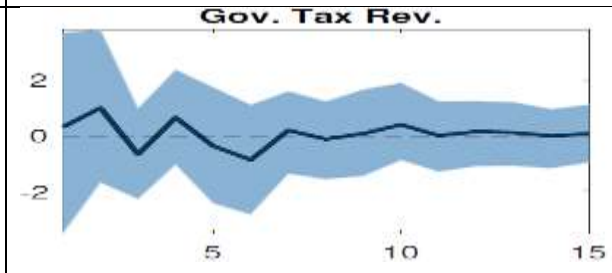
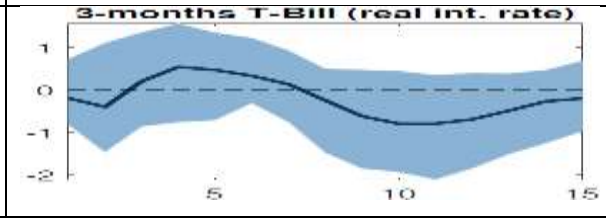
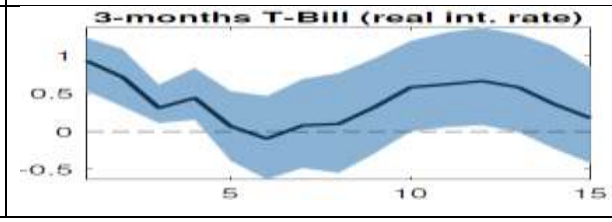
	Business Cycle Shock Response	Response to Monetary Policy Shock
G		
Y		
CPI		
T		
i		

Table 9: Database

	Gov. Spending	Real GDP	Cons. Price Index	Gov. Tax Rev.	3-months T-Bill (real int. rate)
t	**G**	**Y**	**CPI**	**T**	**i**
2001Q1	3,449.82	37,450.85	62.41	1,766.96	21.50
2001Q2	3,386.51	42,499.15	64.41	2,034.97	21.50
2001Q3	7,248.23	45,651.09	68.85	2,219.66	29.25
2001Q4	8,132.24	40,965.87	75.29	2,567.55	31.65
2002Q1	7,866.00	41,646.41	77.35	2,272.00	31.64
2002Q2	5,678.40	46,540.33	76.53	2,405.60	27.64
2002Q3	12,357.60	49,050.50	78.43	2,595.40	27.50
2002Q4	15,117.70	44,669.92	82.11	3,356.00	21.58
2003Q1	6,573.40	43,933.01	85.74	2,662.40	16.50
2003Q2	4,896.20	48,543.64	86.76	3,034.10	16.50
2003Q3	13,656.00	51,359.64	87.63	3,426.70	16.48
2003Q4	15,468.30	50,218.59	91.47	4,571.80	13.20
2004Q1	7,750.00	50,667.21	96.03	3,653.10	13.24
2004Q2	1,391.00	54,913.49	96.69	872.00	12.30
2004Q3	9,093.00	52,250.01	96.98	609.10	12.98
2004Q4	22,313.60	50,895.65	100.00	9,300.21	10.49
2005Q1	7,751.52	52,940.04	100.47	3,190.39	7.33
2005Q2	7,609.29	57,493.40	101.82	4,102.17	9.50
2005Q3	16,286.59	58,345.17	104.14	4,505.48	9.50
2005Q4	18,273.09	57,954.44	113.07	4,922.63	9.99
2006Q1	8,617.16	58,739.72	118.44	4,873.23	13.39
2006Q2	10,737.07	62,824.73	116.06	6,127.69	17.50
2006Q3	21,136.93	63,678.51	117.45	6,548.08	15.50
2006Q4	24,354.07	60,925.73	122.26	5,765.00	15.99
2007Q1	10,362.00	63,388.24	126.16	6,046.00	15.99
2007Q2	13,723.00	67,531.86	127.10	7,884.00	14.80
2007Q3	24,416.00	66,773.59	128.63	7,831.00	14.66
2007Q4	31,463.00	66,478.67	137.05	7,549.00	14.75
2008Q1	13,990.00	68,774.31	145.01	7,033.00	13.50
2008Q2	14,235.32	72,760.95	145.53	10,188.90	13.50
2008Q3	31,008.48	72,063.11	149.05	9,710.19	13.95
2008Q4	34,392.09	68,739.02	153.25	10,164.92	14.01
2009Q1	16,170.13	72,678.45	154.47	7,528.93	10.84
2009Q2	19,326.08	77,072.36	150.12	10,038.32	10.85
2009Q3	38,792.58	76,753.96	151.03	12,279.60	9.59
2009Q4	46,405.28	73,765.17	156.71	11,719.45	9.50
2010Q1	20,663.70	79,034.35	166.37	10,871.30	9.49
2010Q2	22,698.71	82,385.93	172.75	14,106.87	12.46
2010Q3	45,526.60	80,839.00	174.12	15,487.92	13.22
2010Q4	51,597.88	78,091.93	184.04	16,108.37	14.67
2011Q1	26,323.44	85,538.18	189.30	14,870.60	16.36
2011Q2	32,851.87	86,754.57	190.03	17,926.48	16.45
2011Q3	58,750.07	86,635.79	191.52	18,393.49	14.28
2011Q4	69,218.70	84,223.99	195.34	17,078.07	11.80
2012Q1	25,137.66	90,342.29	196.52	16,044.17	8.37
2012Q2	39,509.19	93,611.67	194.35	27,513.15	4.21
2012Q3	50,275.31	92,835.71	194.48	16,044.17	3.00
2012Q4	81,813.00	91,063.62	199.27	25,041.33	2.59
2013Q1	22,448.29	98,003.09	204.92	20,942.08	2.81
2013Q2	42,264.13	100,783.68	203.78	26,472.92	4.36
2013Q3	69,654.48	99,189.21	203.28	26,019.77	5.11
2013Q4	104,895.59	96,148.23	206.32	34,107.96	5.23
2014Q1	34,340.54	106,575.81	211.07	36,505.25	5.22
2014Q2	56,720.61	110,014.81	209.40	31,517.61	5.34
2014Q3	80,786.51	105,630.07	207.81	26,165.03	5.39
2014Q4	121,354.24	101,242.39	210.31	40,817.62	5.37

2015Q1	34,303.94	106,208.09	217.63	26,244.09	5.46
2015Q2	53,338.43	119,973.82	212.26	31,624.30	5.59
2015Q3	95,158.98	115,235.17	213.47	35,682.07	5.58
2015Q4	105,377.48	109,969.11	232.49	30,333.95	7.52
2016Q1	48,837.87	113,973.06	246.69	26,090.45	10.27
2016Q2	35,219.99	126,293.40	252.77	33,336.27	12.13
2016Q3	129,416.53	118,590.05	268.77	38,070.48	17.34
2016Q4	56,894.53	109,515.09	287.53	40,996.31	24.15
2017Q1	37,341.01	119,834.94	299.90	33,474.71	24.76
2017Q2	51,130.30	130,878.23	298.52	50,111.90	25.23
2017Q3	96,871.20	120,247.09	297.69	71,827.10	24.74
2017Q4	132,374.80	114,914.62	303.77	89,627.30	23.75
2018Q1	45,938.96	125,829.51	309.05	43,188.45	16.75
2018Q2	58,051.84	138,224.10	311.64	47,963.54	16.09
2018Q3	97,299.46	124,947.47	312.24	49,961.30	14.35
2018Q4	51,878.90	114,124.72	314.48	47,487.30	13.47
2019Q1	54,767.20	130,445.87	319.59	45,216.10	13.34
2019Q2	64,914.90	142,167.46	318.81	51,997.80	13.30
2019Q3	58,334.80	126,406.93	318.50	49,961.30	11.90

Source: MEF. (2000 - 2020). State Budget Execution Report and Bank of Mozambique