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Fiscal Multipliers in Portugal: A Local Projections Approach

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Abstract

This study aims to quantify the fiscal multipliers in Portugal by employing the widely used SVAR model and highlighting the less commonly used Local Projections method. Additionally, this study applies the non-linear local projections method to account for the differences between expansion and recession periods. The results suggest that both SVAR and Local Projections approaches provide similar estimates, with both supporting a high and positive government consumption multiplier. Furthermore, the non-linear local projections method supports the Keynesian theory that fiscal multipliers are larger in recessions. Overall, findings show the importance of government consumption as a stimulus to overcome recessionary periods.

Keywords:

- Fiscal Multipliers
- Local Projections
- Structural VAR
- Regime Switching
- Expansion
- Recession
- Portugal

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1. Introduction

Fiscal policy is one of the main tools that governments can use to influence the state of the economy, promote growth, and reduce poverty. Through spending and revenues, governments can smooth the business cycles and ultimately, contribute to the society's quality of life. In order to efficiently do so, it is crucial that policymakers know and understand the extent to which a change in one of the fiscal variables impacts the economy in the actual moment and in the following periods.

Theoretically, there is no consensus with regards to the magnitude of these multipliers. Keynesian economic theory predicts high fiscal multipliers, arguing that an increase in government spending or a decrease in tax revenues should translate an increase of similar magnitude in the economy's aggregate demand, thus producing a positive and high multiplier. According to the same theory, higher multipliers are expected in situations of economic distress when compared to expansionary periods or "normal times" and spending multipliers are expected to be larger than revenue multipliers for both states of the economy. By contrast, Neoclassical economic theory supports lower values for fiscal multipliers arguing that agents are forward-looking, thus, understand that any fiscal stimulus in the current period will eventually be compensated by an increase in taxation. In this scenario, agents, when faced with a fiscal stimulus, chose to smooth their consumption, saving part of the increase in disposable income for future periods.

Furthermore, regarding differences in multipliers in periods of expansion and periods of recession, theory provides uncertain predictions. On one hand, the uncertainty characteristic of economic distress might lead households and firms to increase precautionary savings, thus reducing their marginal propensity to consume. Lower propensity to consume translates into lower size of multipliers. On the other hand, in recession periods, more agents face credit constraints. Providing liquidity to an economy, through increased spending or reduced taxation,

produces as much impact as the number of constrained agents.

Testing the different theories with empirical data for a particular economy is important for policymakers to be aware of the country specific evidence of multipliers since fiscal multipliers can vary substantially according to each country's specificities. As such, this paper aims to provide a reliable estimation of Portuguese fiscal multipliers that can be considered in future policy decisions.

The paper is organized as follows: Section 2 reviews the most relevant research papers in the matter of fiscal multipliers, including papers that consider different regimes, and highlights the main findings. Section 3 describes the methodology used in each of the three models estimated. Section 4 presents de data used. Section 5 presents the results for each of the three models. Section 6 presents the discussion and Section 7 provides the concluding remarks.

2. Literature Review

Literature on the fiscal multipliers and their size is extensive. Different authors apply different models and frameworks to the estimation of fiscal multipliers and derive different conclusions. It can be considered that there is no consensus in literature for the size and signal of fiscal multipliers.

One of the base research papers is by Blanchard and Perroti (2002). Authors use U.S. data to study the effect of government spending and taxes shock on output. As their main findings, they estimate a high and positive peak fiscal multiplier associated with an increase in government spending of 1.29 and a peak fiscal multiplier associated with an increase in taxes of -0.78. Moreover, this paper introduces the BP-approach as a type of identification to the SVAR model where contemporaneous relations between variables are pre-established according to economic theory or based on estimates from other studies. Many researchers followed this approach in the estimation of fiscal multipliers to rule out non-discretionary

changes the fiscal variables. Hamer-Adams and Wong (2018) are an example. They apply the same type of identification and use New Zealand data to estimate fiscal multipliers through a SVAR. They find a fiscal multiplier of 0.43 associated with shocks in government spendings and a fiscal multiplier of 0.24 associated with a fall in net taxes. The paper also estimates a more disaggregated model where government spending is disaggregated into public consumption and public investment and net taxes are separated into a taxes component and a transfers component. Overall, Spilimbergo, Symansky and Schindler (2009) show that government spending fiscal multipliers tend to range between 0.5 and 1.5 across different countries whereas signs and magnitudes of taxes fiscal multipliers are more controversial.

Research papers that use Portuguese data present fiscal multipliers in line with the international multipliers. In their paper, Bova and Klyviene (2019), use Portuguese data from 1995 to 2017 apply the BP approach to a SVAR model. Findings translate into large government consumption multipliers and negligible impacts of shocks in transfers and in public investment on output. Government consumption multipliers increase from 0.18 in the first quarter to 0.84 in the sixth quarter highlighting the importance of disposable income to the transmission mechanism of fiscal policy. By contrast, Afonso and Sousa (2009) find, through the estimation of a Bayesian Structural Vector Autoregression model, a negative government spending multiplier, thus, pointing towards relevant of crowding-out effects that negatively impact private consumption and investment. Moreover, Pereira and Wemans (2013) find negative and persistent multipliers associated with tax increases, with narrative and SVAR approaches.

Furthermore, several scholars have estimated fiscal multipliers based on regime-switching models in order to differentiate the impact of fiscal shocks in situations of expansion and situations of recession, thus, testing the Keynesian theory that predicts more efficacy of fiscal policies during periods of recession. Auerbach and Gorodnichenko (2012) uses a STVAR model (STAR but allowing for differences in contemporaneous responses) and shows greater

fiscal multipliers for scenarios of recession. Facing a government spending shock, they predict an impact multiplier of 0.17 in a scenario of expansion and a multiplier of 2.11 in a scenario of recession, for the U.S. For Portugal, Castro et. al. (2013) applied a Dynamic Stochastic General Equilibrium model to measure the effects on Portuguese output of fiscal consolidations and estimates the fiscal multipliers under tow different economic scenarios: "normal times" and "crises times". Results show that first year multipliers can double from expansion to recession periods. For a decrease in government spending the authors estimate a first-year multiplier of -1 if the economy is in "normal times" and a first-year multiplier of -2 in a scenario of severe financial frictions. One year ahead, effects are also larger for recession periods. Authors show that discretionary shocks in taxes have also more impact in recessions but differences to multiples in expansionary situations are not as high. Overall, although there is little consensus in the sign and magnitude of multipliers, literature seems to agree that, under recessions, fiscal multipliers are greater and thus, fiscal policy seems to be more effective.

More recently, researchers started to apply the Local Projections framework, presented by Jordà (2005) as an alternative to the other estimation methods for impulse response functions and fiscal multipliers. Hamer-Adams and Wong (2018) after applying the SVAR, apply the linear Local Projections to estimate government consumption multipliers and conclude that Local Projections multiplier estimates are usually greater than SVAR multiplier estimates. Moreover, the Local Projections approach can also incorporate different regimes. The paper by Kinda, Lengyel and Chahande (2022) applies the regime-switching Local Projections to estimate the cumulative fiscal multipliers in normal times and in the years following the Covid-19 health crisis.

This thesis is a pioneer in estimating the Local Projections with regime switching to estimate the fiscal multipliers in Portugal.

3. Methodology

This study models the dynamic impact of discretionary fiscal policy changes on the macroeconomic conditions, this is, the responses of macroeconomic variables to discretionary shocks in fiscal variables. To do so, three different models are estimated: a Structural VAR model, a Linear Local Projections model and a Non-Linear Local Projections Model. In all models, fiscal and macroeconomic variables are considered and included as endogenous variables. The fiscal variables include: public consumption, public investment, public transfers and taxes. The macroeconomic variables include: output, inflation rate and interest rate.

3.1 Model 1

A standard VAR model is described as follows:

$$Y_t = T_0 + \sum_{i=1}^{\rho} T_i Y_{t-i} + U_t \quad (1)$$

Where Y_t is a vector of endogenous variables, T_0 is a vector of constants, T_i is a matrix of coefficients and U_t is a vector of reduced form residuals. The observed data encompasses both discretionary and non-discretionary changes of the fiscal variables. This translates the presence of the so-called automatic stabilizers. Automatic stabilizers produce changes in the fiscal variables as an automatic response to changes in the economic conditions, as an example, transfers of unemployment benefits might increase because government decides to increase the value of the benefit per unemployed person, but also because unemployment has risen to higher levels and more people are entitled to the benefit. The latest scenario illustrates the effect of automatic stabilizers.

To overcome this problem, the discretionary changes of fiscal policies must be separated from the effect of automatic stabilizers. This paper uses a Structural VAR model following the

B-P approach (Blanchard and Perotti 2002). B-P identification strategy imposes restrictions on the vector of reduced form residuals in order to derive a vector of structural shocks, thus, restricting the effect of the automatic stabilizers. The model assumes the following linear relation:

$$AU_t = BE_t \tag{2}$$

where A is the matrix representing the contemporaneous relations between each reduced form residual, B is the matrix representing the contemporaneous relations between the structural shocks, and E is the vector of structural shocks.

The contemporaneous elasticities are exogenous and chosen according to economic theory. Literature was considered to choose the elasticities, particularly (Bova and Kyviene 2020).

In matrix A, the elements highlighted in red were set to zero because fiscal variables are assumed not to respond to one another within the same quarter. If annual data was used instead, this assumption would be verified. The elements highlighted in blue are set to zero and define the ordering of the macroeconomic variables. Interest rate is defined first, followed by inflation and then by output. Coefficients highlighted in green were set based on (Bova and Kyviene 2020)' calculations which followed the OECD elasticities estimation approach. The elasticities of fiscal variables to interest rate were all set to 0. The elasticity of public consumption and public investment to output are also set to 0 ($a_{cy} = a_{Iy} = 0$), while the elasticities of transfers and taxes to output are set to -0.4 and 0.8 respectively (a_{try}= -0.4 and a_{txy} = 0.8). With respect to inflation, the elasticity of public consumption is set to -0.5 ($a_{c\Delta p}$ = -0.5), the elasticities of both public investment and transfers are set to -1 ($a_{I\Delta p} = a_{tr\Delta p}$ = -1) and the elasticity of taxes is set to 0.15 ($a_{tx\Delta p}$= 0.15),

$$AU = \begin{bmatrix} 1 & -a_{ci} & -a_{ctr} & -a_{ctx} & -a_{cy} & -a_{c\Delta p} & -a_{ci} \\ 0 & 1 & -a_{Itr} & -a_{Itx} & -a_{Iy} & -a_{I\Delta p} & -a_{Ii} \\ 0 & 0 & 1 & -a_{trtx} & -a_{try} & -a_{tr\Delta p} & -a_{tri} \\ 0 & 0 & 0 & 1 & -a_{txy} & -a_{tx\Delta p} & -a_{txi} \\ -a_{51} & -a_{52} & -a_{53} & -a_{54} & 1 & -a_{y\Delta p} & -a_{yi} \\ -a_{61} & -a_{62} & -a_{63} & -a_{64} & -a_{65} & 1 & -a_{\Delta pi} \\ -a_{71} & -a_{72} & -a_{73} & -a_{74} & -a_{75} & -a_{76} & 1 \end{bmatrix} \begin{bmatrix} u_t^c \\ u_t^I \\ u_t^{tr} \\ u_t^{tx} \\ u_t^y \\ u_t^{\Delta p} \\ u_t^i \end{bmatrix} \quad (3)$$

$$BE = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & 0 & 0 & 0 \\ b_{21} & b_{22} & b_{23} & b_{24} & 0 & 0 & 0 \\ b_{31} & b_{32} & b_{33} & b_{34} & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix} \begin{bmatrix} e_t^c \\ e_t^I \\ e_t^{tr} \\ e_t^{tx} \\ e_t^y \\ e_t^{\Delta p} \\ e_t^i \end{bmatrix} \quad (4)$$

Regarding matrix B, the off-diagonal elements colored in red are set to 0 to define the ordering of fiscal variables decisions. Public consumption decisions are taken first, followed by decisions on public investment, then by decisions on transfers and lastly by decision on taxes. Details about the choice and construction of elasticities can be found in Appendix A.

After estimating the SVAR, impulse response coefficients are calculated by expressing the VAR equation in form of a VMA equation.

3.2 Model 2

The local projections model proposed by Jordà (2005) is used in this paper as an alternative method to estimate the impulse response functions and the fiscal multipliers. However, the local projections method does not solve the identification problem. In order to rule out the effect of automatic stabilizers and calculate the structural impulse response function, one still needs to adopt an identification strategy. This paper uses an exogenous series with the structural shocks, this is, already identified shocks that restrict automatic stabilizers.

The structural shock series used is derived from Model 1 following the linearity condition described in (2).

The model estimates several equations by OLS, one for each horizon considered in the impulse responses. Impulse responses are directly estimated using OLS regressions:

$$Y_{t+h} = \alpha^h + \beta_h shock_t + \emptyset x_t + u_{t+h}^h, \qquad h = 0,1,\dots,H-1, \tag{5}$$

where α^h denotes the constant, x_t is a vector of lags of the Y variables, and $shock_t$ is the identified shock variable. The coefficient β_h corresponds to the response of Y at time $t+h$ to the shock variable at time t. The impulse responses are the sequence of all estimated β_h.

It becomes clear that each coefficient of a certain impulse response is calculated independently through a separate equation. This constitutes an advantage when compared to impulse responses driven from VAR models. Jordà (2005) argues that the local projections approach provides a more robust estimation when compared to VAR since it directly estimates each coefficient whereas VAR models use an iterated procedure that might compound the error.

3.3 Model 3

The local projections approach can be easily adapted to incorporate different regimes. This paper uses the non-linear local projections approach to model the dynamic impact of fiscal policy changes in macroeconomic variables in periods of recession and in periods of expansion, separately.

The simplest approach is to include a binary variable that determines the different regimes. However, because such approach consumes degrees of freedom, this paper follows Auerbach and Gorodnichenko (2012) by using a logistic function to calculate the state probability, thus, using all the available information. The logistic function is defined as follows:

$$F(z_t) = \frac{exp(-\gamma z_t)}{1 + exp(-\gamma z_t)} \quad (6)$$

where z_t is the standardized switching variable and γ is a scalar indicating the speed at which one goes from one regime to the other. GDP growth rate is the switching variable considered to define the regimes. The values for the transition function are calculated at lag 1 of the switching variable to rule out contemporaneous policy actions regarding whether the economy is in expansion or in recession. To differentiate between the two regimes, the lagged endogenous variables (y_{t-p}) are multiplied with the values of the transition function at t − 1 where:

$$Regime\ 1 = \left(1 - F(z_{t-1})\right) * y_{(t-p)} \quad (7)$$

$$Regime\ 2 = F(z_{t-1}) * y_{(t-p)} \quad (8)$$

Note that when the value of the switching variable is greater, the transition function presents lower values, representing an expansion. By the same token, when switching variable presents lower values, it translated in higher values of the transition function, thus, representing a recession. It becomes clear that Regime 1 translates the scenario of expansion and Regime 2 translates the scenario of recession.

As in Model 2, non-linear local projections approach does not solve the identification problem and external identified structural shocks derived from Model 1 are incorporated to in this model to account for economic stabilizers. The structural impulse response functions are then calculated considering the structural shocks and the different regimes. Different impulse responses are calculated for each regime.

4. Data

The sample data consists in quarterly data from 1999:1 to 2019:4, excluding the covid-19 pandemic periods. All three models use the same endogenous variables.

Public consumption is sourced as final consumption expenditure of the general government. Public investment is defined as gross capital formation of general government. Data for transfers is defined as subsidies and data for taxes is computed according to Bova and Kyviene (2020), this is, by adding taxes on production and imports to taxes on income and to net social contributions. All these fiscal data is extracted from the Eurostat database. Output is defined and real GDP at market prices, also from Eurostat. Inflation and interest rates are both from OECD database. Inflation rate is calculated as the annual growth rate of CPI index with 2015 as base year and interest rate is defined as the long-term interest rate associated with the 10-year government bonds.

All data is seasonally adjusted and fiscal variables are deflated using the 2015 CPI index. Moreover, log-specifications are using for the fiscal variables. The switching variable used in Model 3 is obtained as the growth rate of real GDP at market prices from Eurostat, it's standardized and specified as a moving average of order eight. The descriptive statistics of all variables used in this paper and the corresponding graphs can be found in the Appendix B.

Unit roots and cointegration tests are performed to understand the relationship among variables. The augmented Dickey-Fuller test performed in both log-leves and first differences of variables shows that all the endogenous variables included are integrated of order 1, at the 5% confidence level. As, such it is possible to perform the Johansen's test for cointegration. Results show that endogenous variables are cointegrated with 3 cointegrating vectors, meaning that there are 3 linear combinations of the variables that are stationary. Details on the results of unit root and cointegration tests can be found in Appendix C.

5. Results

This section presents the response of macroeconomic variables to shocks in each of the fiscal variables. Results of Model 1 are first presented, followed by results of Model 2 and results of Model 3. In all models, variables are scaled such that shocks of fiscal variables are of 1 ppt of GDP, GDP responses are interpreted as a percent change, allowing GDP response to be interpreted as Fiscal Multipliers. Responses of both inflation and interest rate are interpreted as percentage points change. For each model, four charts are presented to illustrate the responses of the different macroeconomic variables to each shock. GDP's responses are colored in blue, inflation's responses are colored in red and interest rate's responses are colored in green. Plots of all impulse response functions and the corresponding confidence bands can be found in Appendix F.

Note that, for each shock, the contemporaneous response of output depends solely on the shock whereas the contemporaneous response of inflation depends on the shock and on the contemporaneous reaction of output and the contemporaneous response of interest rate depends on the shock and on both the contemporaneous reactions of output and inflation, as specified in matrix A.

5.1 Model 1

A VAR model of order 2 was selected, in light of the Akaike criteria. Autocorrelation plots of the VAR residuals are presented in Appendix D and show, with 95% confidence, that residuals are not serial correlated, thus a lag order of 2 is appropriate to the data. The following results were obtained through the VAR estimation and are illustrated in Figure 1.

Facing an increase in public consumption of 1 ppt of GDP, GDP increases on impact by 0.82 %. The effect of the shock fades quickly and turns negative during the 2nd year, with a fiscal multiplier of -0.11. Inflation's response is negative on impact, with a coefficient of -0.2

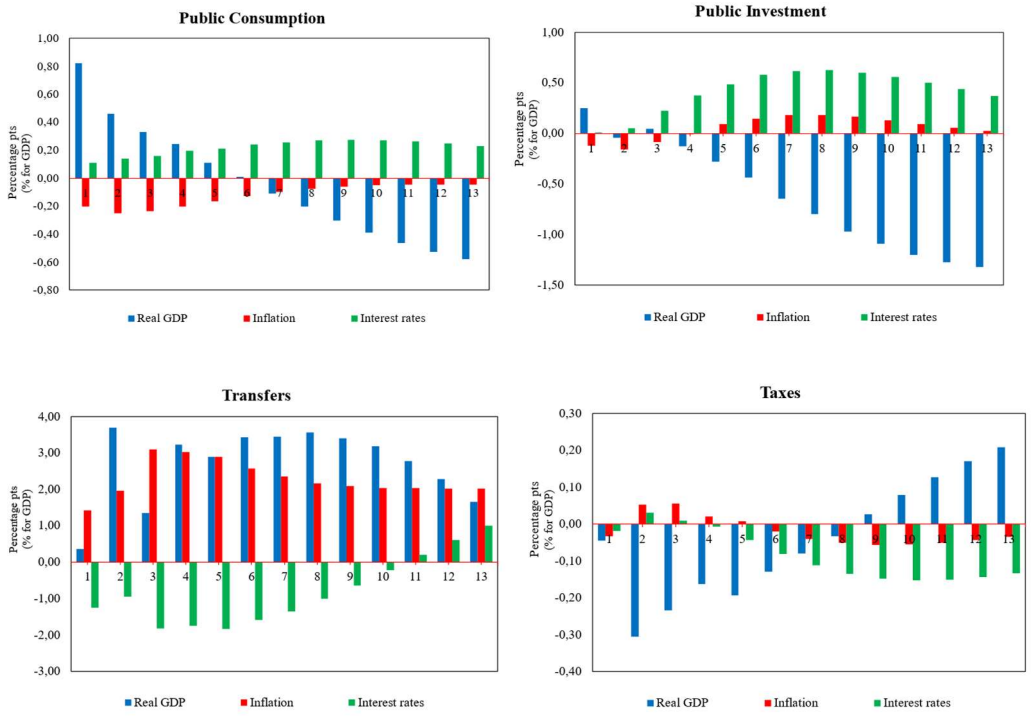
ppts. Its response remains negative throughout the period considered but quickly converges to higher values, where it seems to stabilize for the longer term. Differently, interest rate presents a slight inverse U-shaped response function, increasing 0.11 ppts on impact and peaking in the second quarter of the second year (quarter 10) with an increase of 0.32 ppts.

Moreover, a discretionary increase in public investment worth 1 ppt of GDP produces a positive contemporaneous impact on output of 0.25 %. However, this response immediately turns negative in the 2nd quarter and increases in magnitude in subsequent periods (except for the 3rd quarter), with impacts of -0.28 % after 1 year and -0.97 % after 2 years. Facing the same shock, both inflation and interest rate present inverted U-shaped responses. Inflation presents a negative on-impact response of -0.12 ppts whereas interest rate presents a smaller contemporaneous response of 0.01 ppts. Both peak after 8 quarters with a response of 0.183 and 0.627 ppts, respectively.

Furthermore, an increase in transfers of 1 ppt of GDP leads to a contemporaneous reaction of GDP of 0.36 %. In the 2nd quarter, its response increases to 3.7 % and remains positive during the entire period considered. Facing the same shock, inflation's response presents a contemporaneous response of 1.42 ppts, peaking in the 3rd quarter with a reaction of 3.09 ppts and stagnating in the end of the period considered. Regarding interest rate, its initial reaction is negative, -1.25 ppts and it is followed by an upward trend that eventually reaches positive values.

An increase in taxes revenue of 1 ppt of GDP leads to a negative on-impact reaction of -0.044 % of GDP. This multiplier eventually becomes positive after 2 years. Differently, inflation presents a small contemporaneous response of -0.03 ppts but positive responses in two subsequent quarters of 0.05 and 0.06, respectively. With regards to the interest rate response, it is overall negative (except for 2nd and 3rd quarters) and increasing in magnitude until 10th quarter. The contemporaneous response is of -0.02 ppts and the 2-year response is of -0.15 ppts.

Figure 1 – Impulse responses SVAR model



5.2 Model 2

This method estimates the same response functions using a different estimator, as such, differences in the estimates might occur. Figure 2 illustrates the results, using 4 lags as controls.

Following a discretionary change in public consumption of 1 ppt of GDP, output presents a positive contemporaneous response of 0.86%. The positive impact is sustained in the following periods but eventually becomes negative in the 13th quarter. By contrast, inflation presents a negative on-impact response of -0.18 ppts, however, the overall positive trend turns the response positive and great in magnitude than its on-impact reaction, with a coefficient of 0.22 ppts in the 7th quarter. With regards to interest rate, the contemporaneous response is of 0.04 but falls to negative values until the 6th quarter. After that, an upwards trend of responses brings interest rate reactions to positive values.

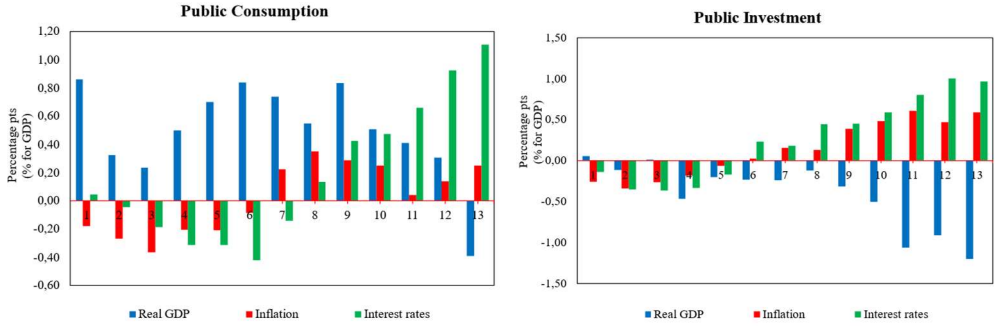
Moreover, an increase in public investment of 1 ppt of GDP, produces a positive impact on GDP in the 1st quarter of 0.06%. However, the GDP's response becomes negative in the

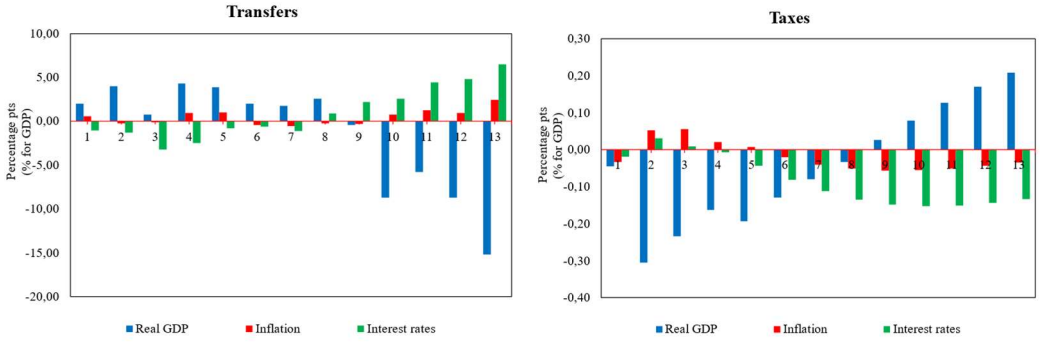
following period and remains negative following a downward trend in the subsequent periods considered. Both inflation and interest rate present a negative contemporaneous response of -0.26 and -0.14 ppts, respectively. Both present a positive trend of responses reaching positive values in the 6th quarter and presenting an after-2-year response of 0.39 and 0.45 ppts, respectively.

Furthermore, a discretionary change in tranfers of 1 ppt of GDP, GDP's contemporaneous response is of 1.54 %. Its dynamic positive response fades over time and eventually presents negative values. Inflation's contemporaneous reaction is negative of 0.058 ppts but in the following periods it presents a positive trend with some volatility. Finally, the on-impact response of interest rate is negative of -1.04 ppts and also presents a positive trend of responses in the subsequent periods, with a response of 2.20 ppts after 2 years.

The model also finds a negative on-impact response of GDP of -0.04% to a discretionary shock in taxes. After 2 year, the impact is becomes positive. With regards to inflation, the initial response is minor, -0.003 ppts, but increases in the two subsequent periods to 0.05 and 0.09 ppts, respectively. This points towards the existence of lags in the response of inflation to discretionary changes in taxation. Finally, with respect to interest rate, it presents 0.03 ppts reaction in the contemporaneous period, followed by a peak of 0.16 ppts in the 2nd quarter, but turning into negative responses from 5th quarter onwards.

Figure 2 – Impulse Responses of Linear Local Projections Model





5.3 Model 3

Model 3 produces different impulse response functions for each regime, thus, enabling the comparison of macroeconomic variables' responses in scenarios of expansion and scenarios of recession. Recall that regime 1 translates the scenario of expansion and regime 2 translates the scenario of recession. The plot of Regime 2 probability, $F(z_t)$, can be found in Appendix E. Results regarding the scenario of expansion and scenario of recession are represented in Figures 3 and 4, respectively.

A discretionary shock of 1 ppt of GDP in public consumption has an impact on GDP in both regimes. In regime 1, GDP presents a contemporaneous reaction of 0.65%, however, in regime 2, GDP's contemporaneous reaction is greater, 1.24%. In the 2nd quarter, in both regimes GDP's response increases in absolute value. It more than doubles in regime 1, reaching 1.80% and becomes negative in regime 2, to -1.87%. Facing the same shock, inflation's contemporaneous response is negative for both regimes with a decline of -0.3 ppts for regime 1 and a decline of -0.2 ppts for regime 2. In the 2nd quarter, again, in both regimes, inflation's response increases in absolute value. While for regime 1, the response stays negative at -0.77 ppts, for regime 2, it becomes positive to 0.45. In the subsequent periods, regime's 1 response of inflation presents more volatility and regime's 2 presents a downward trend after a peak in the 8th quarter. Furthermore, the response of interest rate to the same shock is of -0.29 ppts for regime 1 and of -0.01 for regime 2. In the following few quarters, the impact increases in

magnitude for regime 1, reaching its peak of -0.85 ppts in the 4th quarter, whereas for regime 2, it reaches a peak of positive response in the 3rd quarter of 0.64 ppts. After that, response stays negative for regime 1 and is volatile between negative and positive values for regime 2.

All in all, for regime 1, response of GDP is generally positive in the first few quarters whereas responses of inflation and interest rate are negative. By contrast, for regime 2, response of GDP presents negative initial values (2nd quarter) whereas inflation and interest rate have overall positive responses in the first quarters. This point towards a very different, even contrary, responses of GDP for scenarios of economic expansion vs scenarios of economic recession.

For a shock of 1 ppt of GDP in public investment, GDP's contemporaneous response for regime 1 is of -0.52% and for regime 2 is of -0.69%. Although in both regimes contemporaneous reaction of GDP is negative, in the 2nd quarter, regime 1 presents a positive response of 1.70% whereas regime's 2 response keeps a negative and larger response. In the following periods, GDP's response to this shock remains negative for both regimes. The on-impact reaction of inflation to this shock is of opposite signs for the two regimes. For regime 1 inflation's contemporaneous reaction is of -0.19 ppts and for regime 2 is of 0.86 ppts. For the following periods, inflation's response for regime 1 is overall negative until the 10th quarter and for regime 2, its response is positive until the 10th quarter. With regards to interest rate, its contemporaneous response presents a value of -0.1 ppts for regime 1 and 0.61 ppts for regime 2. After the initial reaction, interest rate's response increases within the year for regime 1 and decreases within the year for regime 2. After the 10th quarter, responses diverge in sign: regime 1 presents high and positive responses whereas regime 2 presents higher but negative responses.

A discretionary change of 1 ppt of GDP in transfers leads to a contemporaneous reaction of GDP of 3.5% for regime 1 and -7.12% for regime 2. For the following periods, regime 1's response presents a downward trend, reaching negative responses in the 4th quarter. By contrast,

regime 2's response function presents positive values of response between the 4th and the 9th quarters. With regards to inflation, the contemporaneous impact when faced with this shock is of -2.30 ppts and 3.23 ppts for regimes 1 and 2, respectively. Moreover, interest rate's on-impact response is of 0.34 ppts for regime 1 and -1.57 ppts for regime 2. Regime 2 registers negative values for responses during the first year, reaching -9 ppts in the 3rd quarter, whereas regime's 1 response presents a positive peak in the 6th quarter of 7.16 ppts.

Finally, a change worth 1 ppt of GDP in taxes, produces a contemporaneous reaction of GDP of 0.05% for regime 2 and of 0.11% for regime 1. Inflation's contemporaneous response to the same shock is of -0.02 ppts for regime 1 and 0.21 ppts for regime 2. In both regimes, the impulse response is very volatile switching from positive to negative responses throughout the period considered. Interest rates present a contemporaneous response of -0.09 and -0.15 ppts for regimes 1 and 2, respectively

Figure 3 – Impulse responses Non-linear Local Projections Model – Regime 1 (Expansion)

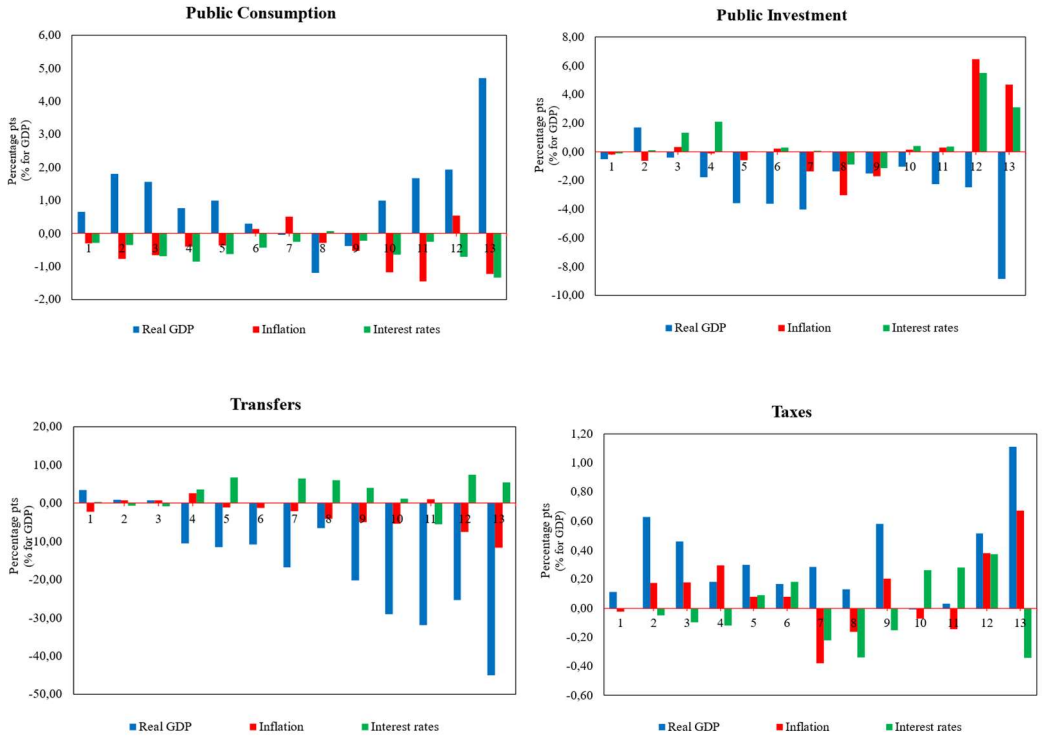
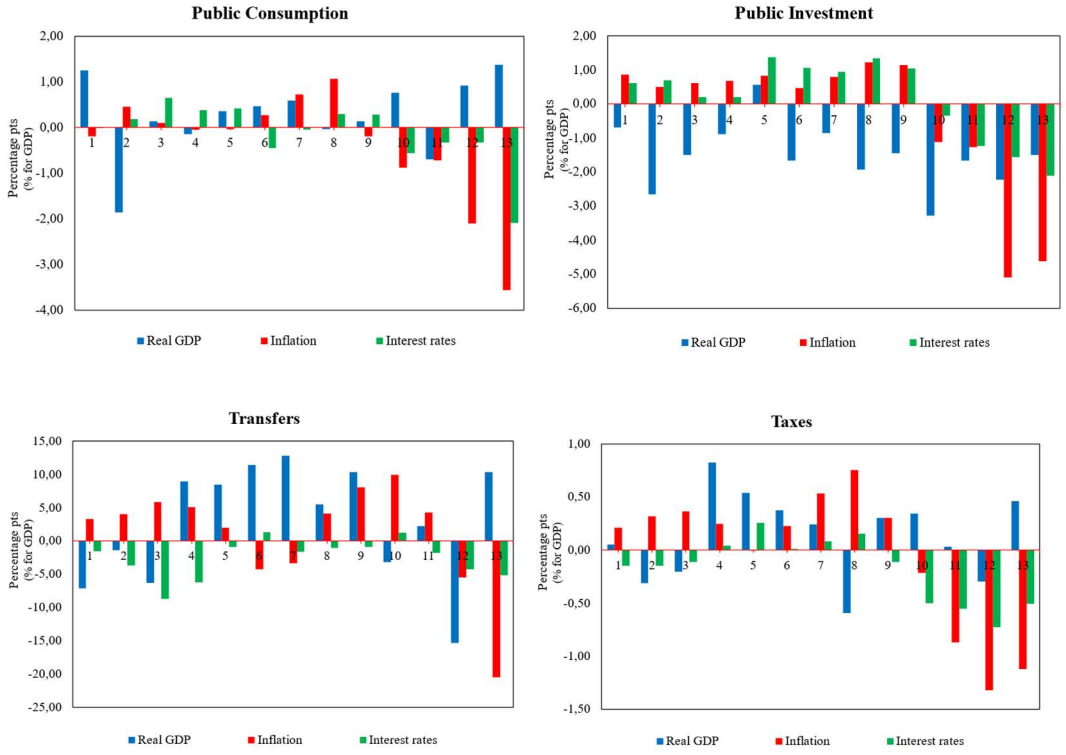


Figure 4 - Impulse responses Non-linear Local Projections Model – Regime 2 (Recession)



6. Discussion

In the previous section results for all response variables were presented, however this section focuses on the fiscal multipliers. Fiscal multipliers are the ratio of a change in output to a discretionary change in one of the fiscal variables. Multipliers can be greater than 1 if the change in output is of greater magnitude when compared to the fiscal shock's magnitude. In these situations, it is most likely that the fiscal shock is impacting output not only directly but also through other channels, for example, by boosting private consumption. Multipliers can also be lower than 1 due to a variety of reasons. First, if crowding-out effects of private sector activities are present, they contribute to a decline in the fiscal multiplier below 1. Second, if part of the increase in government spending is applied on imports, there is a lower percentage of the spending increase that contributes to the output increase, whereas the other part

contributes negatively. Finally, if agents are Ricardian, when there is with a fiscal stimulus, they save part to face the future increase in taxation, thus reducing the value of the multiplier. Furthermore, multipliers might also be contractionary (negative). This can be the case when crowding out effects are of high magnitude that the decline in private sector activity ends up being greater than the effect of the shock itself on output.

Table 1 shows the fiscal multipliers for the different shock variables along the three models considered. CM stands for contemporaneous multiplier while 1YM means 1-year multiplier.

Table 1 – Contemporaneous and 1-year multipliers

Fiscal Multipliers								
	SVAR		LPL		LPNL_S1		LPNL_S2	
	CM	1YM	CM	1YM	CM	1YM	CM	1YM
Public Consumption	0.82	0.11	0.86	0.70	0.65	1.00	1.24	0.35
Public Investment	0.25	-0.28	0.06	-0.20	-0.52	-3.56	-0.69	0.56
Transfer	0.36	2.89	2.02	3.88	3.51	-11.56	-7.12	8.47
Tax	-0.04	-0.19	-0.04	-0.19	0.11	0.30	0.05	0.54

For the first two models several conclusions can be derived. First, the public consumption multiplier is high, close to 1, supporting the Keynesian economic theory. This result falls within the range of values for contemporaneous government consumption multipliers found in the most relevant literature. Bova and Klyviene (2019) finds a value of contemporaneous government consumption multiplier of 0.18, whereas Spilimbergo, Symansky and Schindler (2009) point to a value of 0.7 for the same multiplier and Castro et. Al. (2013) reports a value of 1.2. The fact that the multiplier found in this paper seems to fall in the uppermost fifty percentile of the range supported by literature, supports strong effects of public consumption on GDP over the 10-year period considered. This finding might suggest that a great percentage

of the periods considered constituted periods of high sensitiveness of GDP to public consumption shocks. In fact, the data considered encompasses 5 years of financial crisis (2010-2014), periods during which spending multipliers are likely to be higher. The non-linear multiplier estimated aligns with this theory and provides more insights on the magnitudes of multipliers in the different phases of the business cycle. The 1-year multiplier estimated by local projections is considerably larger than the one estimated by SVAR, in line with what is found in Bova and Klyviene (2019) and Hamer-Adams and Wong (2018). In this case, the local projections method suggests a more gradual dissipation of the shock's effect, while SVAR method implies a more rapid dissipation.

The public investment contemporaneous multiplier is positive but smaller when compared to the public consumption multiplier. Across literature, public investment multipliers have been found to be lower that other government spending multipliers. Bova and Klyviene (2019) finds no effects of public investment shocks on output (0 multiplier) attributing the justification to the prevalence of public-private partnerships in Portugal, which constitute the most multiplier-enhancing public investments but are typically not recorded as public investments in official records. Moreover, its 1-year multiplier presents negative values. Although puzzling, this result has been found before in international studies, such as in Hamer-Adams and Wong (2018). Again, it is possible that the public investment variable is mis-specified by not capturing the public-private partnerships. Another possible explanation is the possibility that public investments are associated with imported goods. In this scenario, economic theory predicts a decline in output.

Transfers multiplier's is positive for both local projections and SVAR methods but differ substantially in magnitude for the contemporaneous period. The overall high and greater than 1 transfers multiplier indicates the presence of constrained households that, once granted with additional disposable income, increase considerably their consumption, and boost the general

private sector activity.

Regarding the taxes contemporaneous multipliers, local projections and SVAR methods estimate the exact same parameters. The multipliers are negative, in line with the economic theory that an increase in taxation has an adverse impact on output. Although several authors in literature find counterintuitive positive tax multipliers, these two models seem to overcome that problem. The fact that the multiplier is considerably small in the cotemporaneous period and shock seems to be long-lasting, the result might suggest that agents attempt to smooth consumption.

Overall, local projections and SVAR methods estimate similar multipliers. Plagborg-Møller and Wolf (2021) argue that VAR models and local projection models estimate the same impulse response functions and should be thought as conceptually estimating the same results. The authors demonstrate that, in theory, a local projections model that incorporates p lags as controls yields impulse response coefficients that are consistent with those of a VAR model of order p. Nevertheless, for longer horizons, divergence between the two models' coefficients would be anticipated. Since this paper estimates a SVAR or lag-order 2 and local projections with 4 lags as controls, some differences between impulse response coefficients are expected.

Furthermore, the non-linear local projections model provides some additional insights. First, contemporaneous multipliers for periods of recession are considerably larger than multipliers for periods of expansion, in line with Keynesian theory. However, the 1-year multipliers are greater in scenarios of expansion. These two facts combined insinuate that, in recessions, the impacts, although higher at the moment of impact, fade very quickly, while in periods of expansion, responses seem to exhibit some delays.

For public consumption shocks, the contemporaneous multiplier is greater than 1 for recession periods and positive but lower than 1 for expansion periods. These results are aligned with overall literature, namely Auerbach and Gorodnichenko (2012) and Castro et. al (2013)

that estimates a 1-year recession public consumption multiplier of 2, contrasting with 1.2 for "normal times". This finding supports the idea that, under economic distress, private agents face credit constraints, thus benefit largely from the fiscal stimulus, and spur the private sector activities. The recession multiplier is significantly higher than those obtained through linear models, whereas the expansion multiplier is lower. This provides support for the theory presented early that the recessionary quarters in the analyzed period elevate the linear public consumption multipliers up to the fiftieth percentile.

Regarding the other shock's multipliers for recession and expansion, results are considered puzzling and inconsistent. Regime switching models require larger sample sizes to accurately estimate the parameters, as such, a small sample size might not provide enough information for an unbiased estimation. Furthermore, the possibility of existence of an unobserved variable may bring endogeneity issues when estimating the model separately for periods of recession and expansion.

The data availability and low sample size seems to be, in fact, the main limitation of this estimation, that also impacts the statistical significance of the estimated multipliers. Some of the coefficients are not significant, however, they align with economic theory and are consistent with findings from other empirical studies. Therefore, while the statistical significance of these estimates may be weak, their validity and reliability are supported by economic theory and empirical evidence. Future research with larger samples could provide more precise and robust estimates. However, for linear models, it is not expected that the estimated coefficients will vary significantly, since they are already in line with expectations. It's worth noting that contemporaneous public consumption multipliers, where discussion is focused, are significant at the 95% confidence level across the three models.

7. Conclusion

This study aimed to estimate fiscal multipliers in Portugal using different econometric methods. The SVAR methodology is a well-established and widely used approach in fiscal multipliers' literature to estimate impulse response functions. However, this study also sheds light on the local projections method which, while not as widely used, is also a reliable method to estimate impulse response functions. Conceptually, both methods estimate the same impulse response functions, however, while SVAR is based on a system of equations with multiple variables and its lags and thus, estimates all impulse responses at the same time for all variables, local projections adopts more dynamic approach by estimating the response of a variable over different horizons. In addition, this paper employs the non-linear local projections method to estimate the fiscal multipliers in Portugal separately for periods of recession and periods of expansion.

Overall, this paper finds that linear local projections and SVAR methods estimate similar impulse response coefficients and perform equally well.

One of the primary findings of this paper is the significant, positive, and large contemporaneous government consumption multipliers estimated by the linear models. (0.82 in SVAR and 0.86 in linear local projections). Moreover, when utilizing the non-linear local projections model to estimate multipliers separately for periods of expansion and recession, this study finds that contemporaneous government consumption multipliers are significantly higher in periods of economic downturn. These results support the Keynesian theory, indicating that when the economy is operating below full employment, an increase in government spending does not lead to a decline in private spending, hence crowding-out effects are low or non-existent. These findings have important implications for policymakers, highlighting the effectiveness of government consumption as a stimulus to overcome recessionary periods.

Furthermore, this study finds overall positive and large responses of GDP to transfer

shocks and negative responses to tax increases. With regards to non-linear models, this study finds larger contemporaneous shocks' effects on output for recession periods when compared to expansion periods. However, impacts in recessions dissipate quickly whereas in impacts during expansion period present some delays and appear to be more long-lasting.

Finally, some estimates are not significant, which may be due to the small sample size in this study. However, the estimated multipliers for linear models are in line with economic theory and previous empirical studies. Future research could with larger sample could provide more robustness to this estimation. Nevertheless, this study brings valuable contributions on the effectiveness of fiscal policy in Portugal and provides useful insights for policymakers and researchers.

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APPENDIX

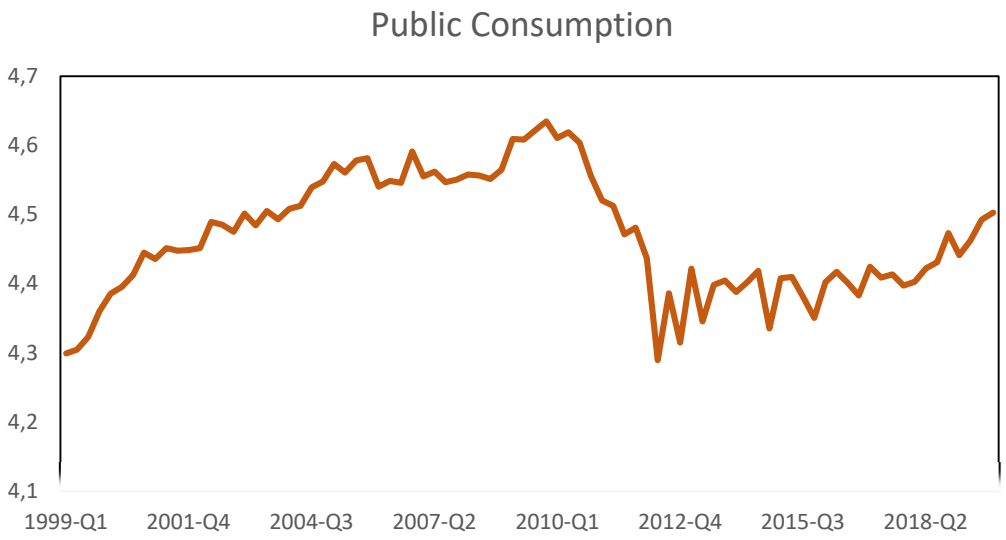
A – Table of Construction of elasticities

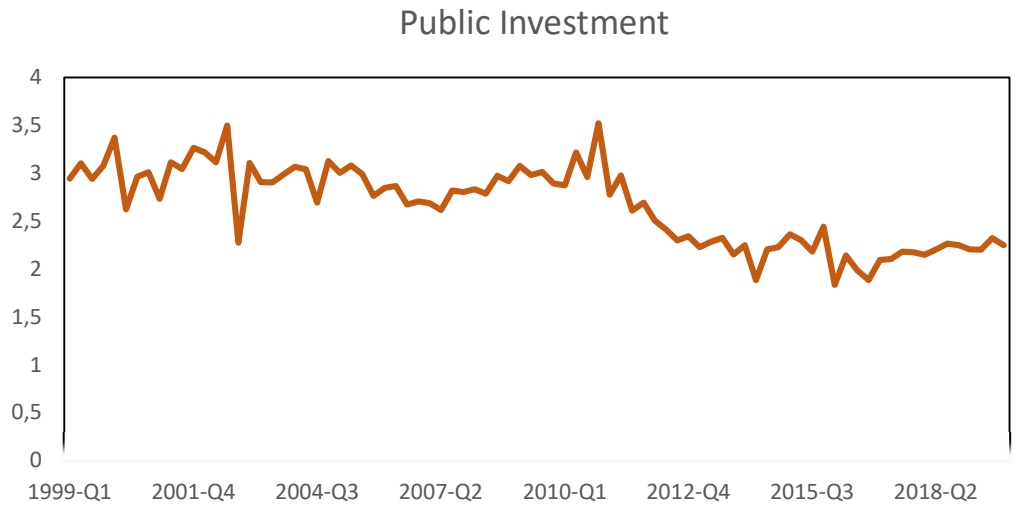
All elasticities were chosen according to Bova and Klyviene (2019).

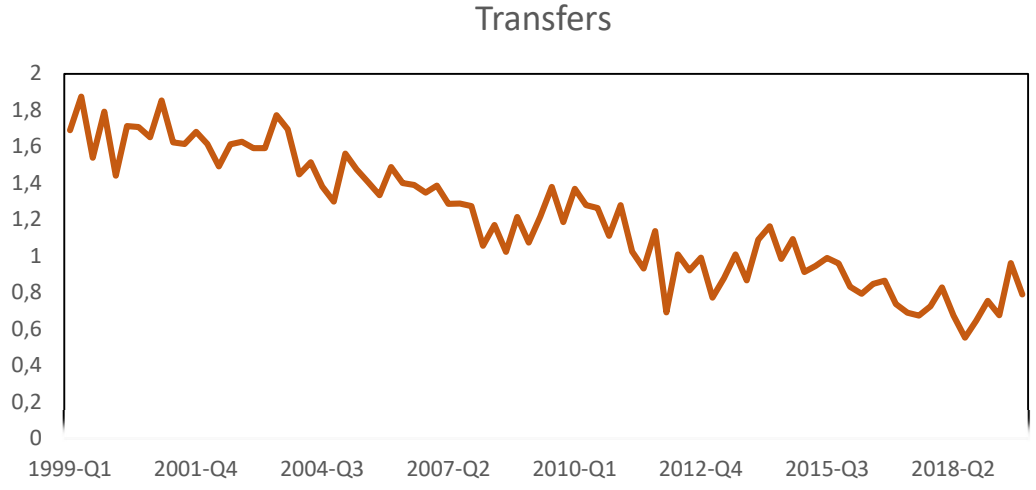
Elasticities of fiscal variables with respect to interest rate	All set to 0, following Bova and Klyviene (2019)
Elasticity of Government Consumption with respect to Output	Set to 0 since the variable is assumed to be rigid and not to easily change with output
Elasticity of Government Investment with respect to Output	Set to 0 since the variable is assumed to be rigid and not to easily change with output
Elasticity of Transfers with respect to Output	Set to -0.4 since only unemployment benefits respond to output automatically, and constitute a small part
Elasticity of Taxes with respect to Output	Bova and Klyviene (2019) estimates an elasticity of 0.6 for direct taxes and an elasticity of 1 for indirect taxes. Since this paper uses the aggregate of both indirect and direct taxes, a weighted average was performed. Since throughout the years, each type of taxes constituted roughly 50% of total tax revenue, this elasticity was set to 0.8
Elasticity of Government Consumption with respect to Inflation	Set to -0.5 according to the theory that most items include are not indexed
Elasticity of Government Investment with respect to Inflation	Set to -1 according to the argument that indexation occurs with several lags
Elasticity of Transfers with respect to Inflation	Set to -1 according to the argument that indexation occurs with several lags
Elasticity of Taxes with respect to Inflation	The same reasoning applied to the Elasticity of Taxes with respect to Output was applied here. With an estimation of 0.3 for direct taxes and of 0 for indirect taxes from Bova and Klyviene (2019), this paper sets this elasticity to 0.15

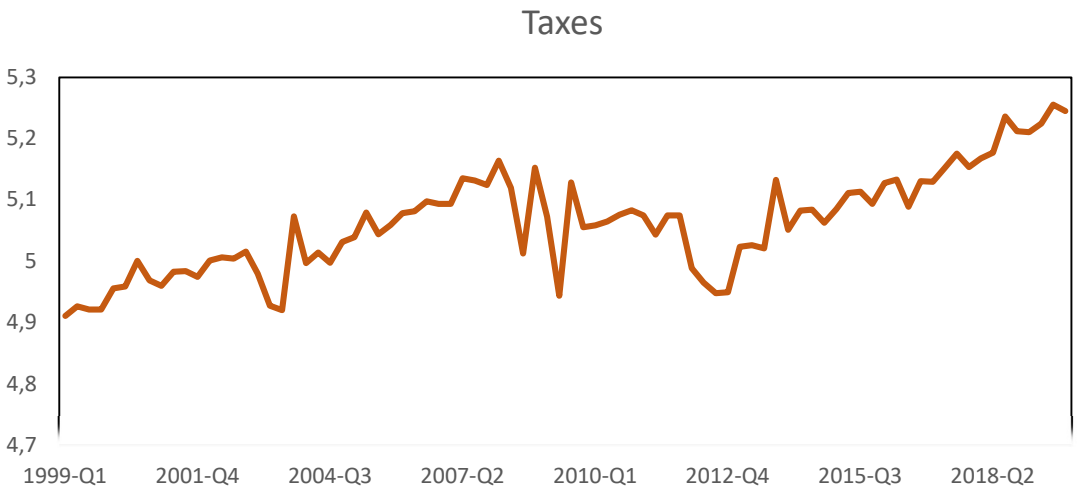
B – Descriptive Statistics of Data

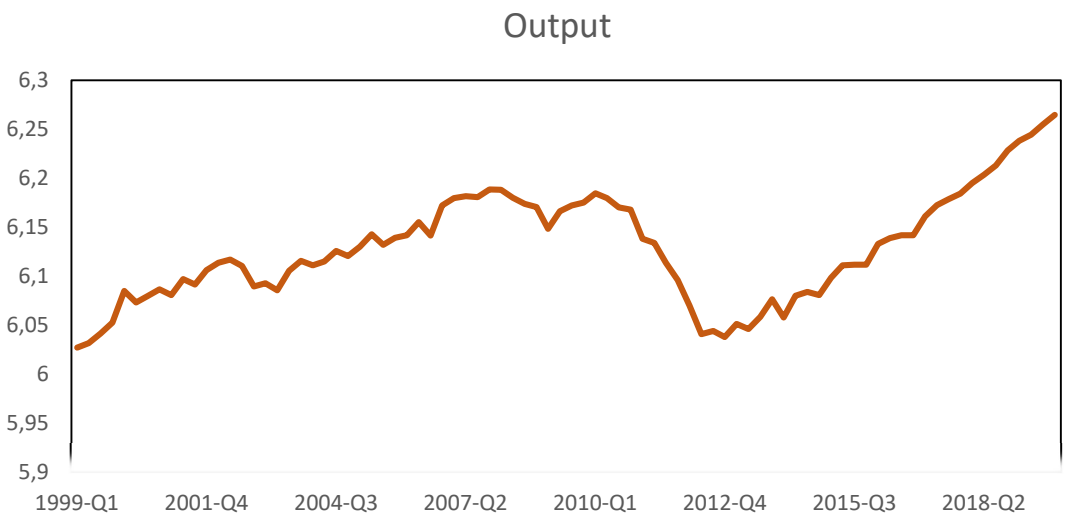
	Public consumption	Public investment	Public transfers	Taxes	Output	Inflation	Interest Rate
Mean	4.470	2.663	1.208	5.062	6.129	0.019	0.046
Maximum	4.635	3.522	1.875	5.256	6.265	0.049	0.134
Minimum	4.289	1.836	0.552	4.911	6.027	-0.015	0.003
Standard Deviation	0.086	0.409	0.344	0.083	0.055	0.015	0.024

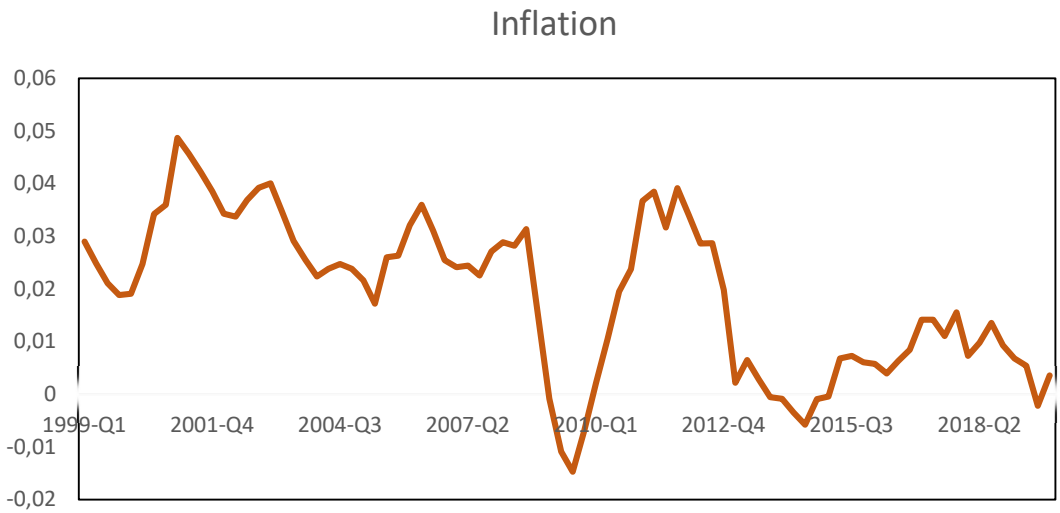

Public Consumption
4,7
4,6
4,5
4,4
4,3
4,2
4,1
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2

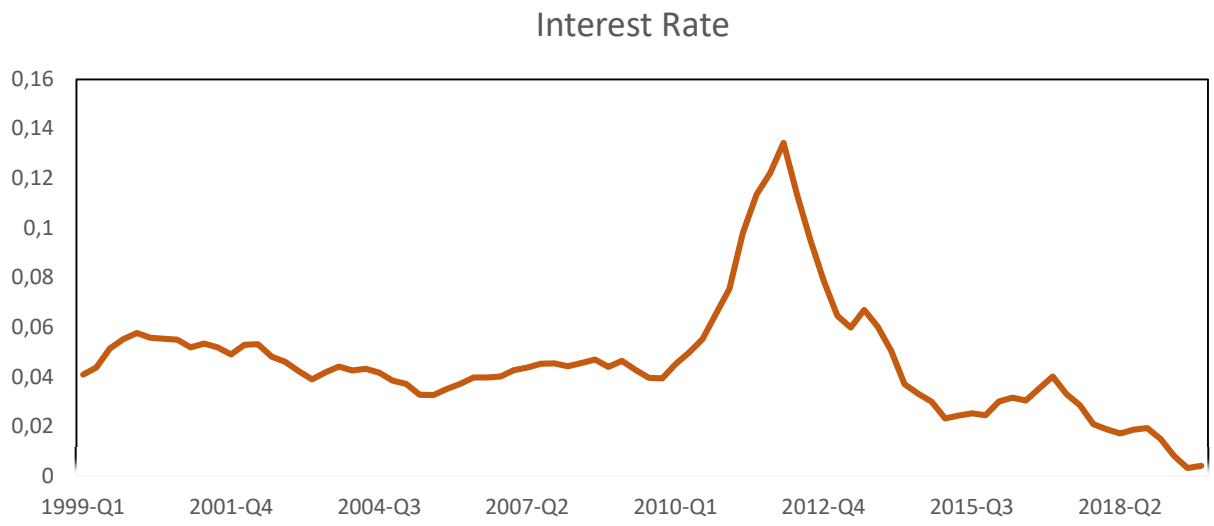

Public Investment
4
3,5
3
2,5
2
1,5
1
0,5
0
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2


Transfers
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2


Taxes
5,3
5,2
5,1
5
4,9
4,8
4,7
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2


Output
6,3
6,25
6,2
6,15
6,1
6,05
6
5,95
5,9
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2


Inflation
0,06
0,05
0,04
0,03
0,02
0,01
0
-0,01
-0,02
1999-Q1
2001-Q4
2004-Q3
2007-Q2
2010-Q1
2012-Q4
2015-Q3
2018-Q2

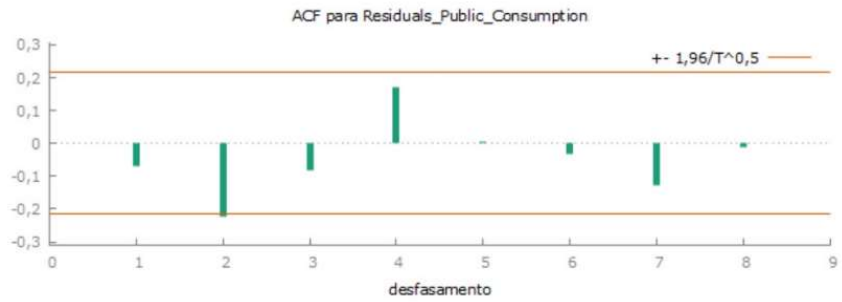


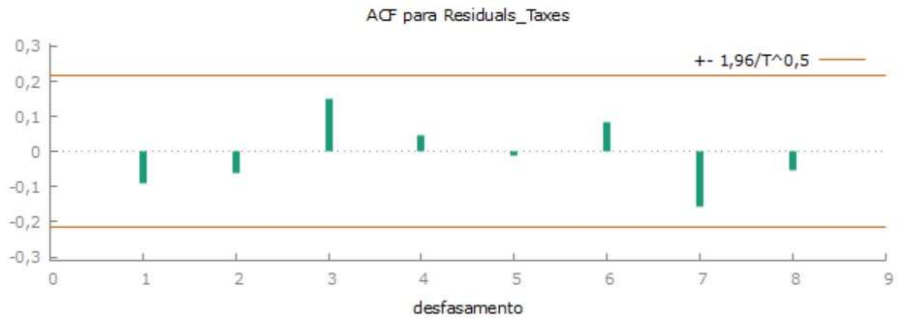
C – ADF and Johansen's Tests

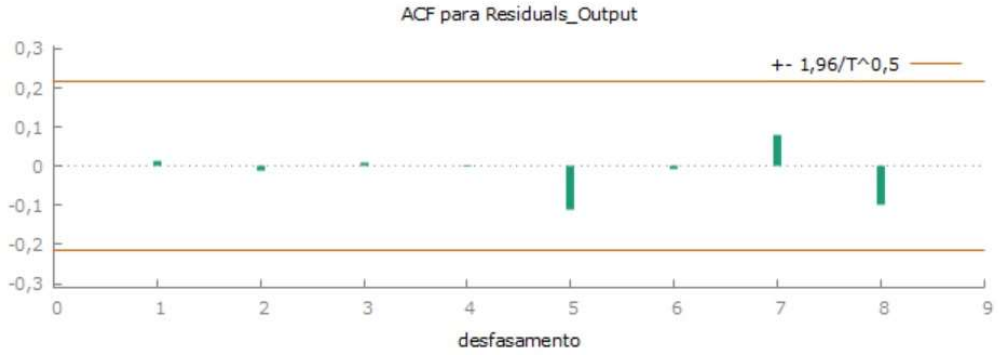
ADF tests		
variable	P-value	Conclusion
log - pc	0.2588	Fail to reject null hypothesis of unit root
log - I	0.7139	
log - tr	0.7207	
log - tx	0.8312	
log - y	0.7875	
inflation	0.05449	
intancle	0.1558	
Δ log - pc	1.837E-31	Null hypothesis is rejected, variables are I(o)
Δ log - I	2.849E-20	
Δ log - tr	1.609E-19	
Δ log - tx	4.253E-24	
Δ log - y	0.03152	
inflation	4.975E-9	
intancle	0.0002137	

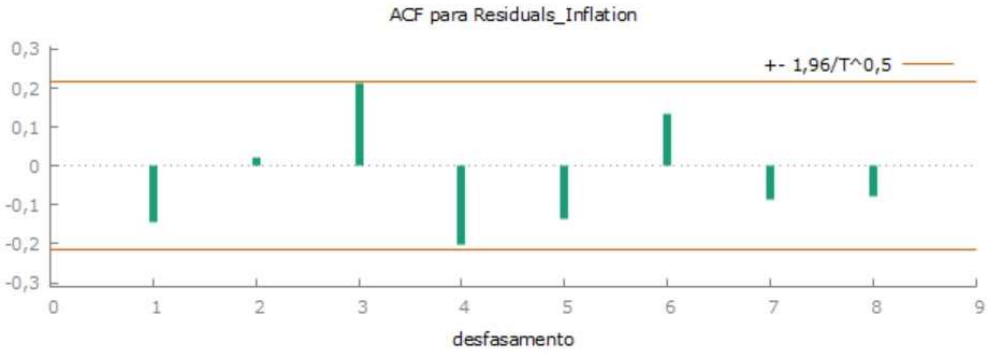
Johansen's CointegrationTest			
H0	Trace p-value	λmax p-value	Conclusion
r = 0	0.0001	0.0244	Variables are cointegrated
r ≤ 1	0.0023	0.0485	
r ≤ 2	0.0361	0.0967	
r ≤ 3	0.2256	0.2797	
r ≤ 4	0.5126	0.5904	
r ≤ 5	0.5621	0.5347	
r ≤ 6	0.4786	0.4786	

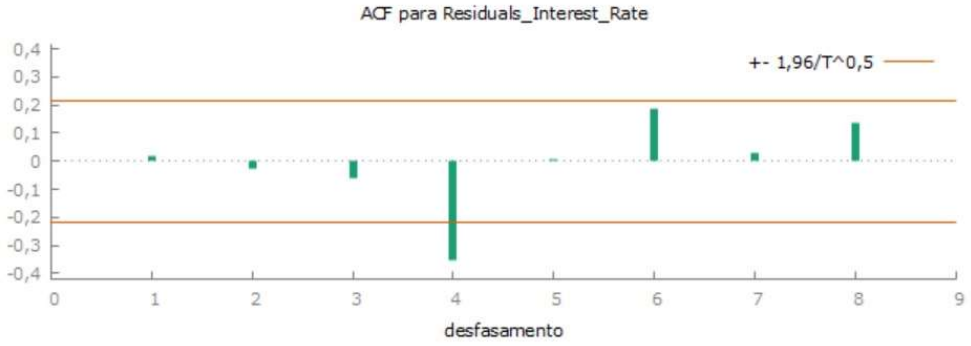
D – Autocorrelation plots of VAR residuals



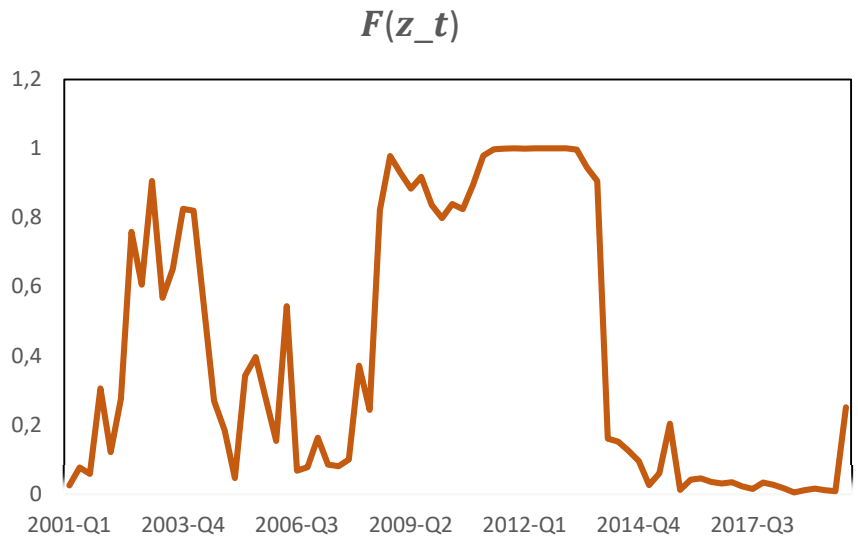



ACF para Residuals_Output
+- 1,96/T^0,5
0,3
0,2
0,1
0
-0,1
-0,2
-0,3
0
1
2
3
4
5
6
7
8
9
desfasamento


ACF para Residuals_Inflation
+- 1,96/T^0,5
0,3
0,2
0,1
0
-0,1
-0,2
-0,3
0
1
2
3
4
5
6
7
8
9
desfasamento

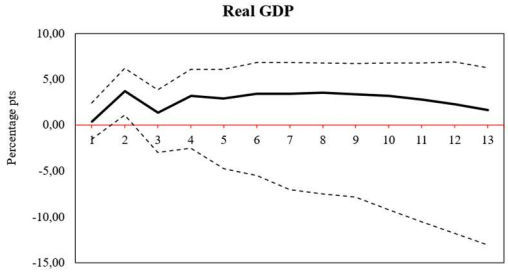

ACF para Residuals_Interest_Rate
+- 1,96/T^0,5
0,4
0,3
0,2
0,1
0
-0,1
-0,2
-0,3
-0,4
0
1
2
3
4
5
6
7
8
9
desfasamento

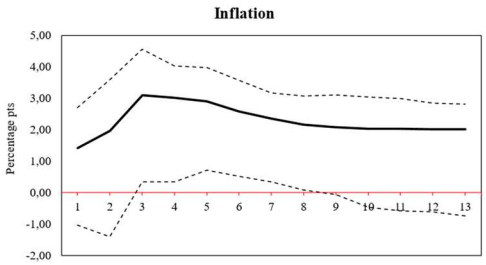
E – Plot of Regime 2 Probability, $F(z_t)$

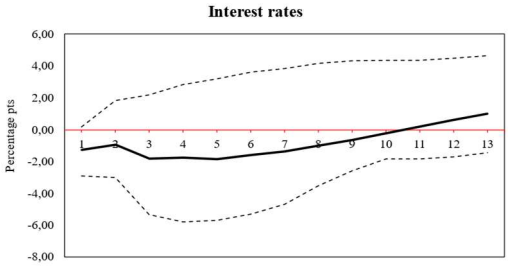


F – Impulse response Functions

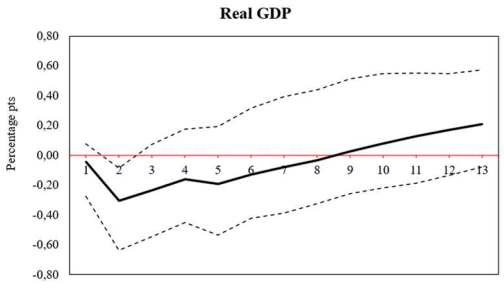
SVAR MODEL – Public Consumption Shock

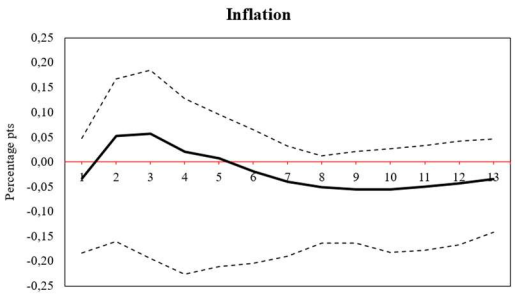


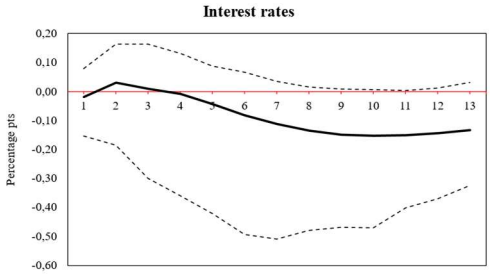




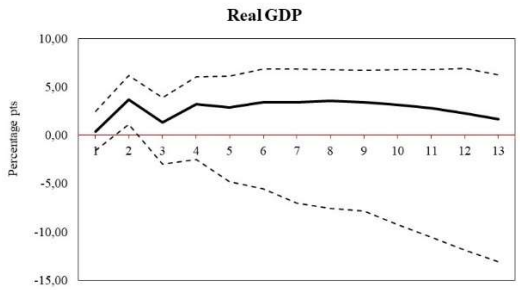
SVAR MODEL – Public Investment Shock

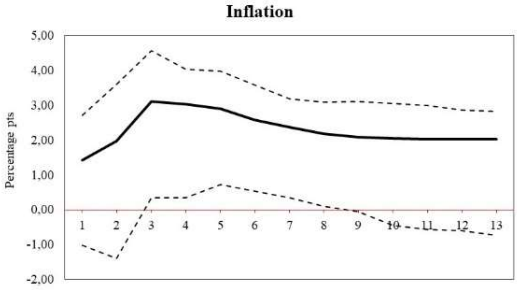


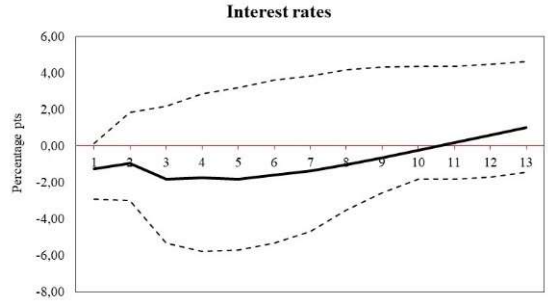




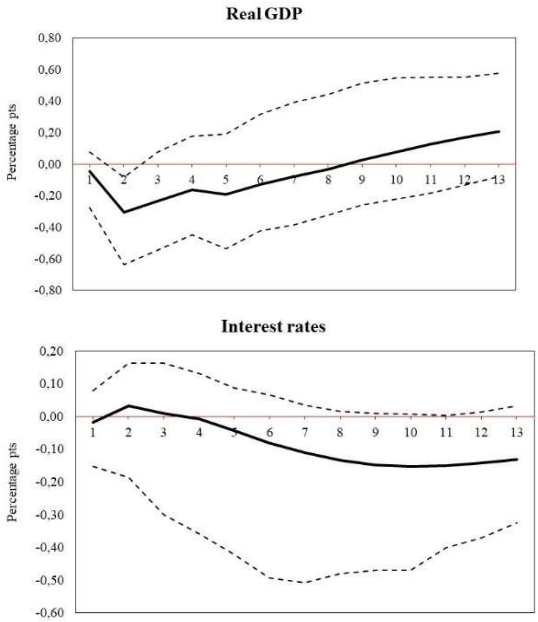
SVAR MODEL – Transfers Shock

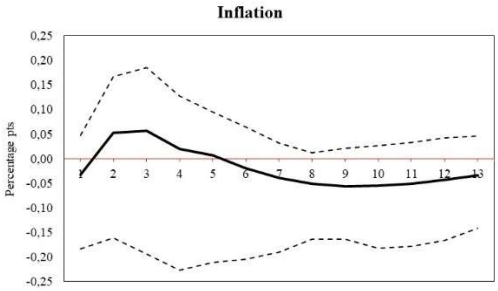




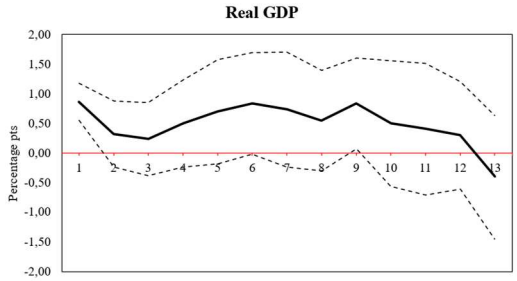


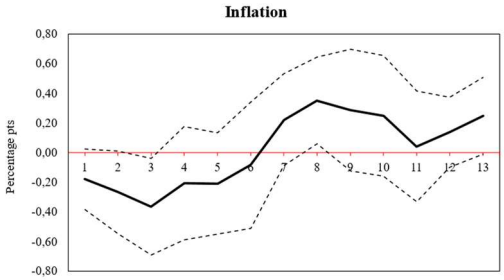
SVAR MODEL – Taxes Shock

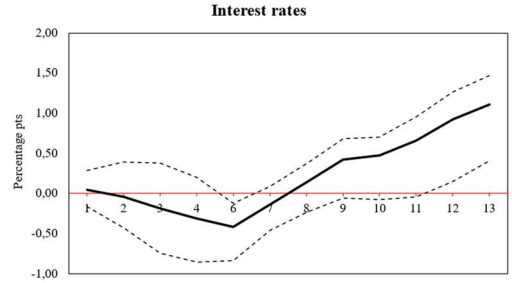




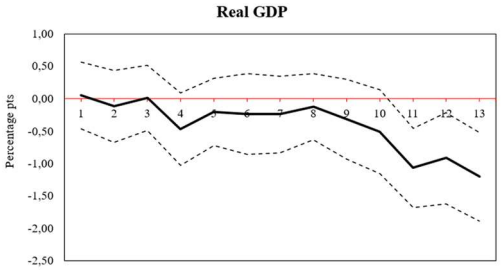
Linear Local Projections – Public Consumption

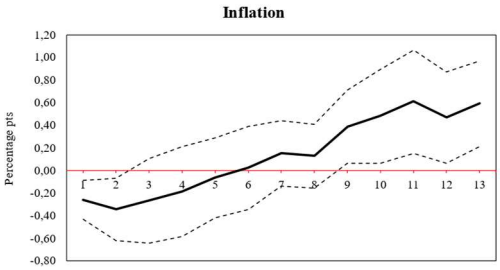


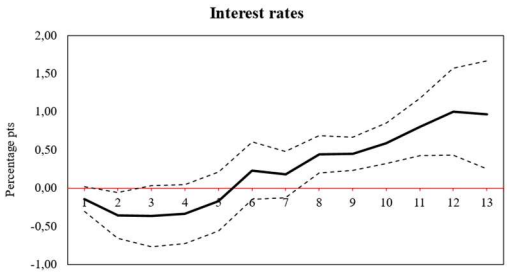




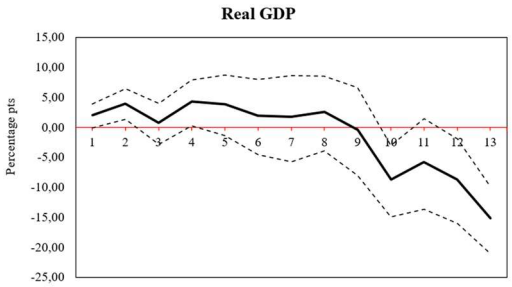
Linear Local Projections – Public Investment

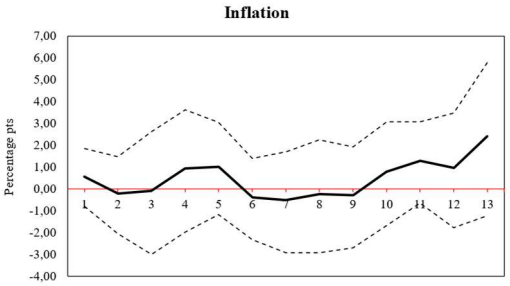


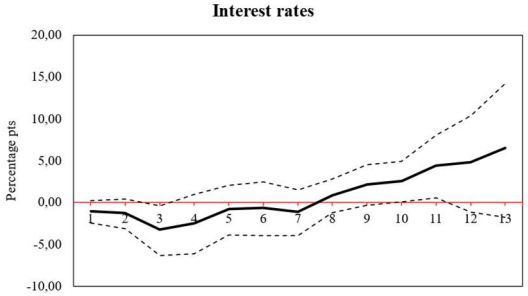




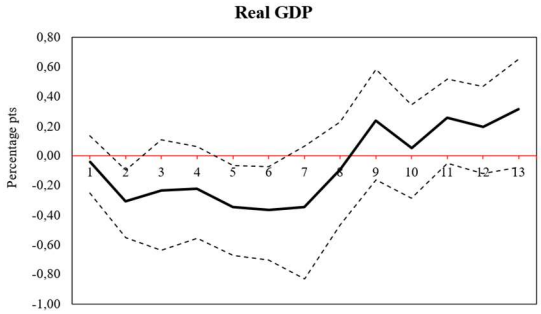
Linear Local Projections – Transfers Shock

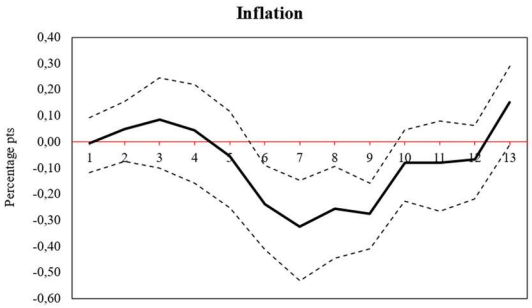


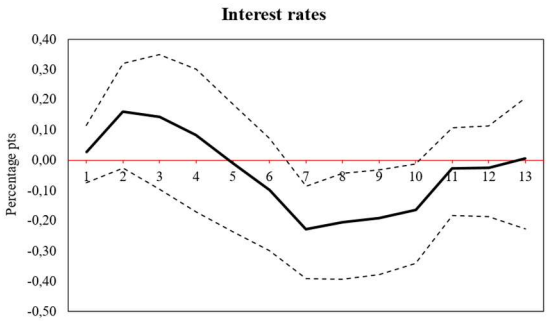




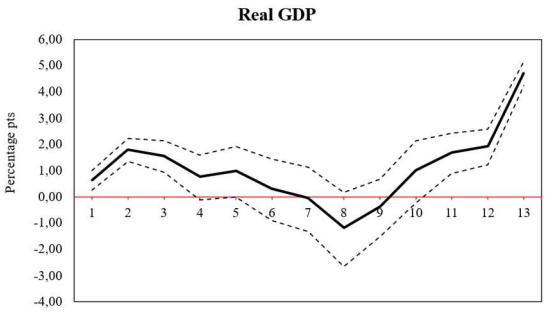
Linear Local Projections – Taxes Shock

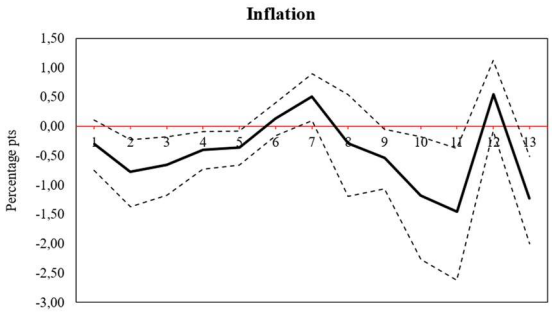


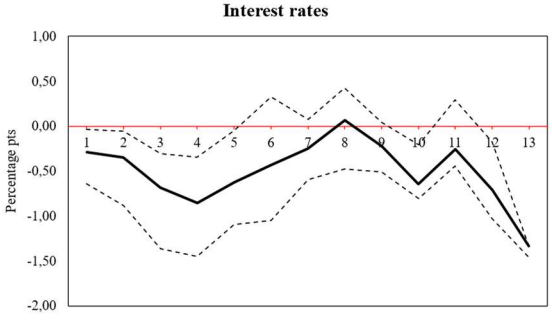




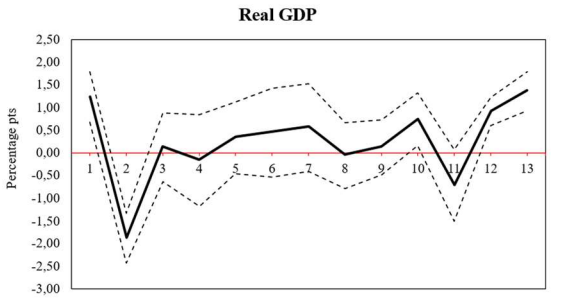
Non-Linear Local Projections – Public Consumption Shock, Expansion

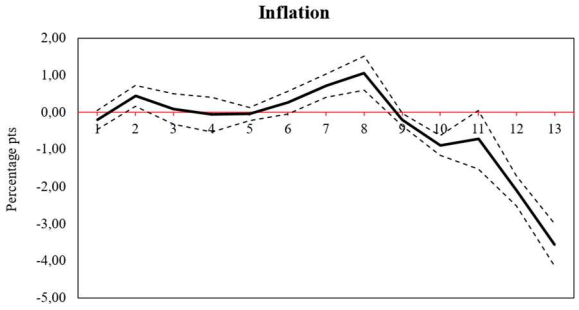


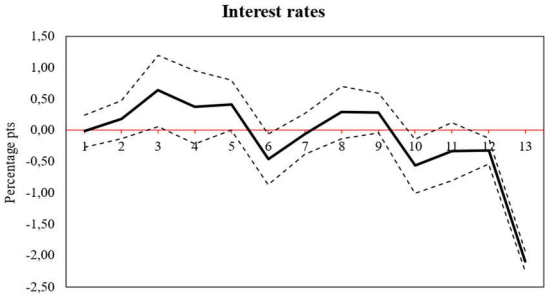




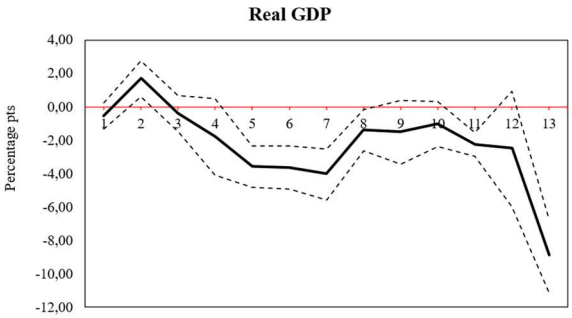
Non-Linear Local Projections – Public Consumption Shock, Recession

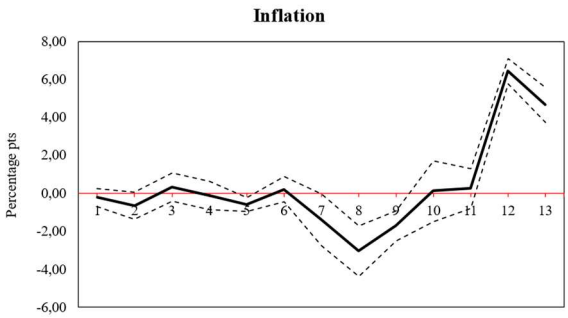


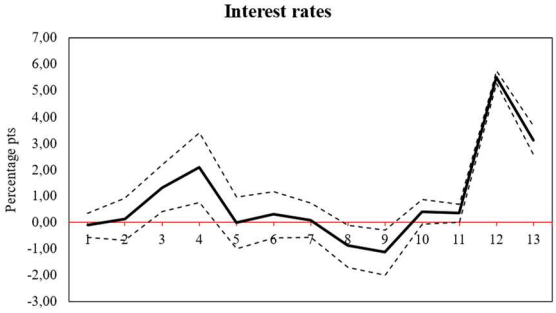




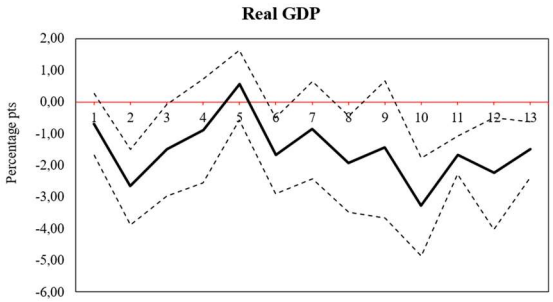
Non-Linear Local Projections – Public Investment Shock, Expansion

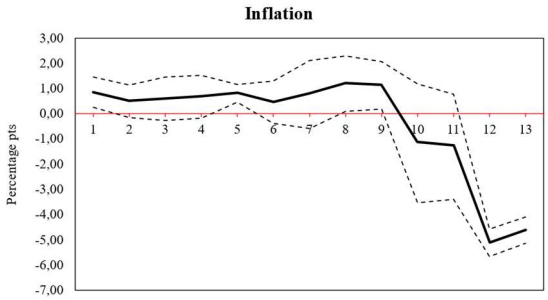


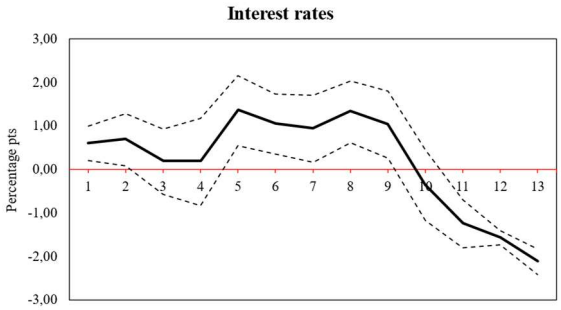




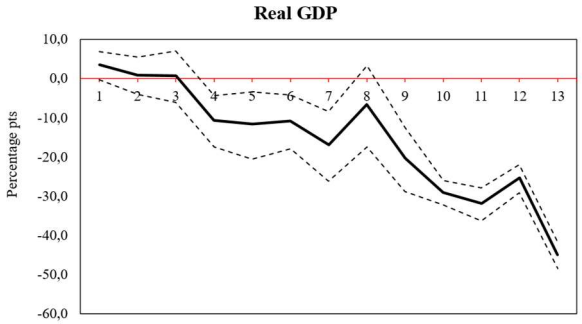
Non-Linear Local Projections – Public Investment Shock, Recession

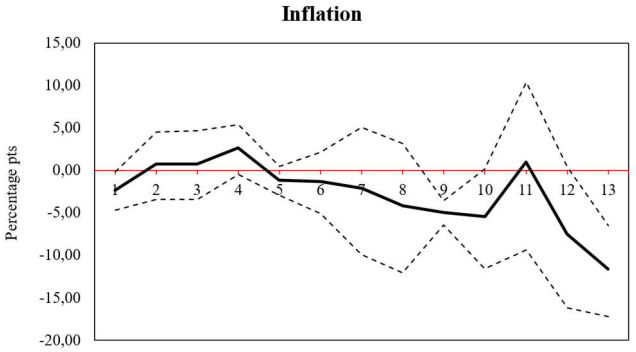


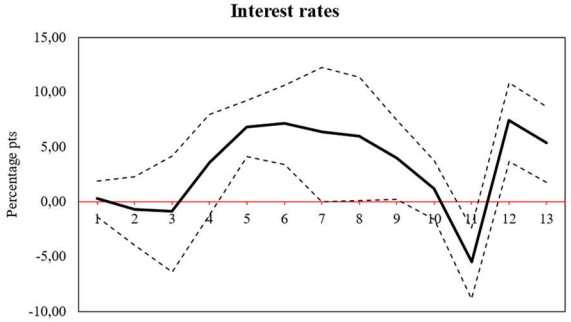




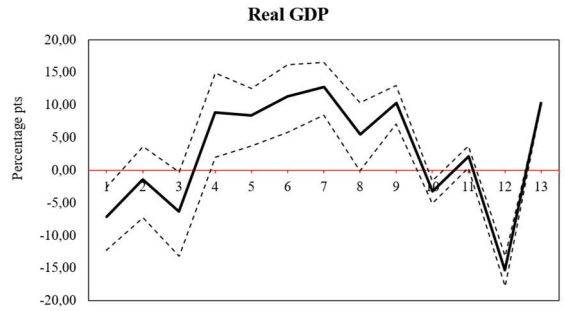
Non-Linear Local Projections – Transfers Shock, Expansion

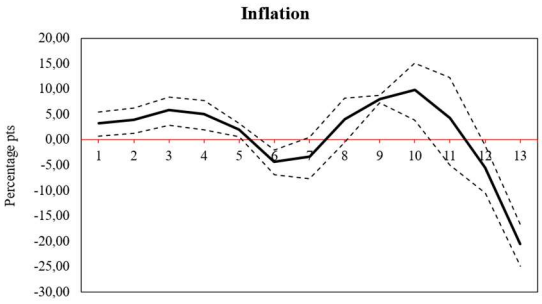


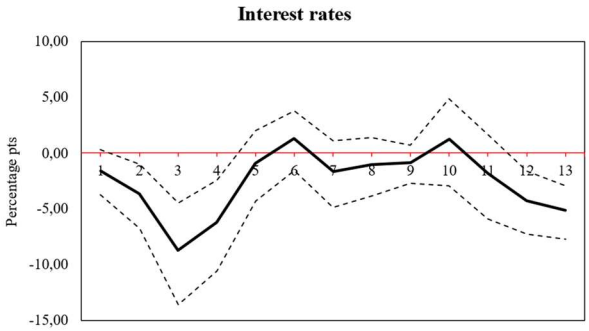




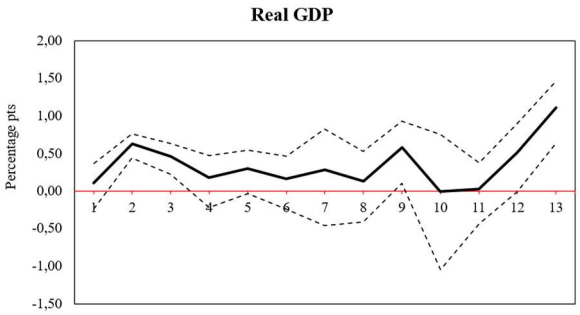
Non-Linear Local Projections – Transfers Shock, Recession

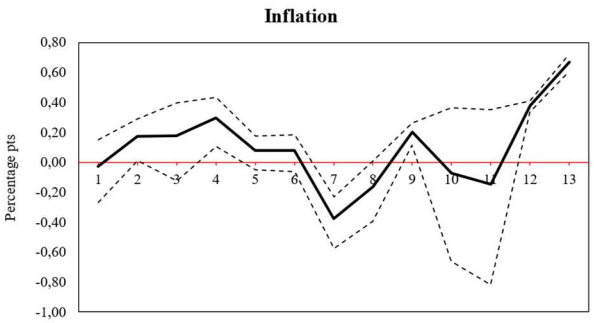


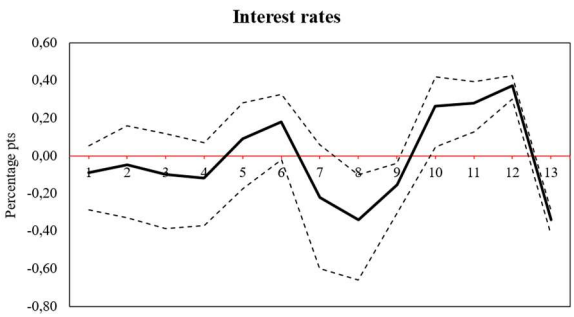




Non-Linear Local Projections – Taxes Shock, Expansion







Non-Linear Local Projections – Taxes Shock, Recession