Fiscal Multipliers in Brazil through the MIDAS Lens

Abstract

The objective of this study is to verify the macroeconomic effects of government spending shocks on activity in Brazil from 1999 to 2017. For this purpose, we calculate the spending multiplier using a methodology not yet applied in the literature, a Vector Autoregressive with Mixed Frequency, proposed by Ghysels (2016), more specifically, a mixed data sampling VAR - MIDAS-VAR. The mixed-frequency VAR models allow us to measure the impact of high-frequency data at low frequency and vice versa. To calculate the impact of the increase in spending on GDP (gross domestic product), different types of spending were considered, namely: primary expenditure, personnel, social benefits, subsidies, investment, and costing. The central government's primary revenue was used for the revenue variable. The expenditure and income series are the high-frequency variables (monthly observations), whereas GDP is a low-frequency series (quarterly). The fiscal multipliers of primary spending found here are less than one, which suggests that there is no so-called Keynesian effect on output. Among the spending components, the investment multiplier attracted the most attention because its estimate was close to zero.

Keywords: Fiscal multiplier, mixed frequency vector autoregression, mixed data sampling, Fiscal Policy

JEL Classification: C32, C53, E62

1 Introduction

The failure of conventional monetary policy to deal with the contraction in demand following the outbreak of the financial crisis of 2008/2009 meant that fiscal stimulus packages were introduced in several countries. The belief that these packages would be fundamental to help the economic recovery was amplified by the fact that several countries have reached the so-called zero lower bound, with no room for further reductions in interest rates by their central banks. This exceptional circumstance spurred a new wave of research on fiscal policy activism and the magnitude of fiscal multipliers. Furthermore, more recently, the Covid pandemic has led to new fiscal stimulus in both developed and emerging countries, which has renewed interest in fiscal multipliers [1]. From the perspective of economic policy, it is very important to know the magnitude of fiscal multipliers among different types of spending in order to guide the design of fiscal policy in Brazil. The debate on fiscal policy has intensified in the political scene, especially after the 2022 elections.

Even though fiscal policy is commonly employed to achieve stability, there is still considerable uncertainty about the effects of fiscal policy on macroeconomic performance. These effects can be evaluated through the analysis of fiscal multipliers, which quantify the influence of the government's tax and expenditure decisions on overall economic output [2].

The empirical literature on fiscal multipliers is typically composed of the estimation of vector autoregressive (VAR) models, although there are also some studies using DSGE (Dynamic stochastic general equilibrium) models. However, estimating the causal effects of fiscal policy on economic activity represents an immense challenge, since fiscal shocks and macroeconomic variables are actually correlated at the same time. The great difficulty is to identify fiscal events that are exogenous and unexpected. Three main approaches are taken to deal with this problem in VAR models. The first, initially adopted by Blanchard & Perotti (2002), assumes that government spending does not react simultaneously to the product and uses institutional information on the tax system, as well as information on tax elasticities and income transfers. The second, known as the narrative approach, uses fiscal episodes that can be considered exogenous to the state of the economy, such as the significant increases in military spending resulting from wars and threats of wars (for example, Ramey & Shapiro (1998). The third, proposed by Mountford & Uhlig (2009), imposes signal restrictions on income and expenditure variables, as well as orthogonality to a shock of business cycles and a shock of monetary policy, which are also identified with signal restrictions.

This paper contributes to the literature in several ways. Firstly, we will directly explore the existence of data with different frequencies to estimate the fiscal multiplier in Brazil, giving up

[1] According to Morelli & Seghezza (2021), just like the central banks in other developed nations, the European Central Bank - ECB - swiftly and efficiently responded to the COVID-19 pandemic.This fact is interesting because ECB is a monetary union, which historically responded to shocks in a more gradual manner.

[2] More recently, Gunasinghe et al. (2020) also examined the effect of fiscal policy shocks on income inequality, taking the case of Australia into consideration and the results were dependent on the type of fiscal shock considered.

any type of aggregation. In addition, we will also use disaggregated data for public spending and obtain the multiplier for each of these expenditures. This allows to compare fiscal impacts depending on how the government directs its spending, which will contribute to a better understanding of the effects of fiscal policy in Brazil.

Finally, we will use a methodology that has not yet been applied in Brazil to estimate the effects of government spending shocks on the economy, using a mixed frequency VAR, proposed by Ghysels (2016). More specifically, we will use data at two frequencies: government expenditure and revenue are observed monthly, while GDP is a quarterly series. The methodology or technology suggested by Ghysels (2016) of the mixed frequency VAR model is relatively simple. This is due to four factors, according to (Ghysels (2016)): (i) a specification that does not involve latent shocks; (ii) a specification for measuring the impact of high frequency data on low frequency data and vice versa; (iii) parsimonious; (iv) a specification that can be estimated and analyzed with standard VAR analysis tools - such as impulse response analysis, variance decomposition, etc.

The mixed-frequency VAR models allow you to measure the impact of high frequency data at low frequency and vice versa. This approach used here is not based on representations of latent processes or shocks. As a consequence, mixed data sampling VAR is an alternative to the commonly used state space models for mixed frequency data. State-space models are parameter-oriented, while mixed-frequency VAR models are observation-oriented models, as they are formulated exclusively in terms of observable data and do not involve latent processes, as well as shocks, thus avoiding the need to formulate measurement equations, filtration etc. [3]

2 Brief Literature Review

According to Matheson & Pereira (2016), an increasing number of studies highlights that the impact of government spending on economic activity in emerging economies is generally weaker compared to advanced economies. Ilzetzki (2011) employs a panel of Emerging Market Economies (EMEs) and reports that the short-term multipliers for spending and revenue lie within the range of 0.1 to 0.3 and 0.2 to 0.4, respectively. Furthermore, Ilzetzki et al. (2013) estimate that output responses to fiscal shocks in EMEs are not only lower but also considerably less persistent compared to AEs (advanced economies).

For the Brazilian case, there are some recent empirical studies estimating the size of the fiscal multiplier, but none of them exploring the different frequencies of the data and, therefore, using the mixed frequency approach. Pires (2014) employs a VAR model with regime switching to assess fiscal multipliers in the period 1996-2012 and finds no differences between multipliers

[3] An incompatibility between the time scale of a structural vector autoregressive model and the time series data used for its estimation can have serious consequences for identifying, estimating and interpreting impulse response functions. However, the use of mixed frequency data, combined with an appropriate estimation approach, can alleviate temporal aggregation bias, mitigate identification problems and generate more reliable responses to shocks.

during periods of recession and expansion. The government consumption multiplier is not significant in both regimes, and the investment multiplier, which is greater than 1, is significant only during periods of low volatility.

Castelo-Branco & Lima (2015), found results similar to those of Pires (2014) for the period 1999-2012, using a Bayesian structural model with Markov switching (MS-SBVAR)). In addition to confirming the evidence that multipliers do not vary with changes in the state of the economy, they also found that the multiplier for gross fixed capital formation is greater than one.

Orair et al. (2016) estimate a smooth transition VAR (STVAR) for the period 2002-2016 and bring a novel approach by estimating fiscal multipliers for different types of government spending. In times of recession, product responses are more intense (greater than one) for spending on acquisitions of fixed assets, social and personal benefits, but in expansions the shocks of these same expenses are not significant. On the other hand, the product's responses to subsidy and other expenditure shocks are not significant or have low persistence, both in the recessive and in the expansive regime.

Grüdtner & Aragon (2017) also use a smooth transition VAR (STVAR) for the period 1999.I-2015.IV and find that the spending multipliers (consumption plus government investments) do not differ between the recession and expansion regimes. In economic contraction, after a government spending shock, output and spending increase, while in expansion, the spending shock has no effect on the product and on government spending itself.

Finally, Holland et al. (2019) use different methodologies and obtain government spending multiplier estimates close to zero for the period 1997-2018. By estimating a threshold autoregressive vector (TVAR), they find a greater multiplier in the high growth regime, although the results are not robust.

Therefore, the purpose of this article is to fill a gap in the literature and directly explore the different frequencies in the available data for Brazil in order to calculate the fiscal multiplier. Moreover, we will follow Orair et al. (2016) which utilizes disaggregated data. Thus, the model was also estimated for each type of expenditure - personal, social benefits, subsidies, investment, and costing. The objective is to compare fiscal impacts depending on how the government directs its spending, which will contribute to a better understanding of the effects of fiscal policy in Brazil.

3 Econometric Methodology

The approach used in the study was developed by Ghysels (2016), which introduces a representation of a vector autoregressive (VAR) with mixed frequency. Ghysels & Marcellino (2018) calls this approach MIDAS-VAR (*mixed-data sampling VAR*). This type of VAR is an alternative to the state-space models commonly used for mixed-frequency data. This approach does not rely on representations of latent processes/shocks. Essentially, there are two approaches to handling mixed-frequency data. The parameter-focused approach, which is based on the state-space model and the Kalman filter. It involves treating the low-frequency series as a high-frequency series, with latent components. The observation-focused approach, on the other hand, consists in stacking the variables with the same frequency into a vector. This latter approach is the one used by Ghysels et al. (2016).

The methodology decomposes each high frequency variable into a set of low frequency variables (for example, a monthly variable is decomposed into three quarterly variables) and jointly models the resulting variables with those originally available at low frequency . The advantage of this configuration is that the structural VAR tools ($SVAR$) - i.e. estimation via least squares, Cholesky factorization, impulse response analysis and decomposition of variance - can be applied for a mixed frequency configuration.

Consider the following example, GDP is observed quarterly (low frequency) and government expenditure and revenues are observed monthly (high frequency). We could analyze the dynamics of the three series at quarterly frequency, ignoring the fact that we have monthly data for expenses and revenues. Thus, could you ask how a shock in spending and its future impact on GDP produced by analyzing a standard VAR model are related to the monthly surprises in the series? The quarterly shocks of the VAR model will be a mix of innovations in the underlying series. What kind of mixture would that be? What would be the costs in terms of impulse response analysis when we misalign the data while ignoring the high frequency data.

Let's assume a VAR involving three series x_t^H, z_t^H, for the high frequency series and y_t^L for the low frequency series. For the monthly / quarterly series, we will have x_t^H, $x_{t-1/3}^H$ and $x_{t-2/3}^H$, like the last ones, penultimate and first months of the quarter t. Let w_t^H be a vector containing the high frequency series x_t^H and z_t^H. Ignoring intercept, we can write:

$$\begin{bmatrix} w_{t+1-2/3}^H \\ w_{t+1-1/3}^H \\ w_{t+1}^H \\ y_{t+1}^L \end{bmatrix} = \begin{bmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} \\ \phi_{21} & \phi_{22} & \phi_{23} & \phi_{24} \\ \phi_{31} & \phi_{32} & \phi_{33} & \phi_{34} \\ \phi_{41} & \phi_{42} & \phi_{43} & \phi_{44} \end{bmatrix} \begin{bmatrix} w_{t-2/3}^H \\ w_{t-1/3}^H \\ w_t^H \\ y_t^L \end{bmatrix} + \varepsilon_{t+1} \tag{1}$$

This approach does not involve shocks / latent states or latent factors. This means that there is no need to use any type of filter (i.e. Kalman). Note that there are no latent high frequency shocks in the low frequency series. One implication is that we can apply standard VAR model techniques, such as impulse response and variance decomposition functions.

The last equation of the system (1) is:

$$y_{t+1}^L = \phi_{41} w_{t-2/3}^H + \phi_{42} w_{t-1/3}^H + \phi_{43} w_t^H + \phi_{44} y_t^L + \varepsilon_{4,1t+1} \tag{2}$$

In contrast to the first (as well as the second and third) it measures the impact of low frequency in series, namely:

$$w_{t+1-2/3}^H = \phi_{11} w_{t-2/3}^H + \phi_{12} w_{t-1/3}^H + \phi_{13} w_t^H + \phi_{14} y_t^L + \varepsilon_{1,1t+1} \tag{3}$$

We need to make an extension for the structural VAR (SVAR) to be able to perform impulse response prediction and calculation. With a lower triangular matrix and we obtain the following system:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} w^H_{t+1-2/3} \\ w^H_{t+1-1/3} \\ w^H_{t+1} \\ y^L_{t+1} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} \\ \phi_{21} & \phi_{22} & \phi_{23} & \phi_{24} \\ \phi_{31} & \phi_{32} & \phi_{33} & \phi_{34} \\ \phi_{41} & \phi_{42} & \phi_{43} & \phi_{44} \end{bmatrix} \begin{bmatrix} w^H_{t-2/3} \\ w^H_{t-1/3} \\ w^H_{t} \\ y^L_{t} \end{bmatrix} + \varepsilon_{t+1} \quad (4)$$

Reading the system above for the second equation, we have:

$$w^H_{t+1-1/3} = -a_{21} w^H_{t+1-2/3} + \tilde{\phi}_{21} w^H_{t-2/3} + \tilde{\phi}_{12} w^H_{t-1/3} + \tilde{\phi}_{13} w^H_{t} + \tilde{\phi}_{14} y^L_{t} + \tilde{\varepsilon}_{2,1t+1}$$

(5)

And for the last equation:

$$y^L_{t+1} = -\sum_{j=1}^{3} a_{4j} w^H_{t+1-(3-j)/3} + \tilde{\phi}_{41} w^H_{t-2/3} + \tilde{\phi}_{42} w^H_{t-1/3} + \tilde{\phi}_{44} y^L_{t} + \tilde{\varepsilon}_{4,1t+1} \quad (6)$$

The latter is a MIDAS with lead equation that we found in discussions about *nowcasting*, while the former is a regression that predicts high frequency data in real time.

4 Data

We employ the MIDAS-VAR approach described in the previous section in order to estimate the effects of government spending shocks in Brazil over the period 1999 to 2017. To estimate the multipliers, monthly data from the Brazilian central government will be used and quarterly data on gross domestic product (GDP). In summary, the expenditure and revenue series are the high frequency variables (monthly observations), while GDP is the low frequency series (quarterly observations). The fiscal data used in the estimates were calculated by Orair & Gobetti (2017) and kindly provided by the authors.

The expenditure variable is given by the primary expenditure of the central government, formed by personnel expenses, social benefits (Social Security, LOAS/RMV, Allowance and Unemployment Insurance and "Bolsa Família"), subsidies, costing and investment. This series is the result of numerous adjustments made to the original data from the National Treasury for primary expenditures, according to the methodology explained by Orair & Gobetti (2017), aiming to correct “creative accounting” and “fiscal pedaling”.

In addition, the implicit spending of the Treasury with loans to BNDES, which are outside the primary result and diluted in the nominal net interest account of fiscal statistics, are incorporated into the subsidies account. The expenses of the My House and My Life program (*"Minha Casa Minha Vida"*), officially included in the investment account, and the expenses of CDE (Energy Development Account - "*Conta de Desenvolvimento Energético*") are also added to the subsidies account. Finally, for the revenue variable, the central government's primary revenue was used, also calculated by Orair & Gobetti (2017).

The choice to use data from the central government is only due to the fact that there are no statistics above the line (detailed by income and expenditure) for regional governments for the period before 2002. The product series is obtained from national accounts (IBGE). All series were deflated by the IPCA (Extended National Consumer Price Index) and then seasonally adjusted by the X-12 ARIMA13 method. Furthermore, all variables are in logarithmic form.

5 Results and Policy Implications

In this section we will present the results of our estimates. We have considered the base model, which consists of the variables of primary expenditure, primary revenue, and GDP, and we have calculated the fiscal multiplier following the expenditure shock (fiscal policy shock). [4] The identification strategy follows closely what has been proposed by Cavalcanti & Silva (2010) and also used by Holland et al. (2019), which is through the Cholesky decomposition, with the following ordering: Spending, Revenue, and GDP. It is noteworthy that in this strategy, high-frequency variables are ordered first in the VAR, i.e., before the low-frequency variable (GDP). It is also important to highlight that in this exercise, the outcome variables of interest are observed at a lower frequency than the shock. For our analysis, we adopt the same strategy as Bacchiocchi et al. (2020).

We will also perform the same exercise by considering the other components of expenditure, including personnel expenses, social benefits, subsidies, investments, and costings. [5] To determine the number of lags, we shall employ the Akaike and Schwarz information criteria (AIC e BIC, respectively). Our choice of the maximum number of lags was equal to 3, thus reducing the number of lags. The parameters to be estimated grow exponentially, as more lags are added, and therefore, following the two information criteria, the most parsimonious model with only one lag was chosen as shown in Table 1 and Table 2. [6] This for all models estimated in this analysis.

We will follow the definition of Ramey & Zurairy (2018) and calculate the fiscal multipliers

[4]Ramey & Zurairy (2018) explains that when the expenditure shock is identified as being the *a la* Blanchard-Perotti shock, part of current expenditure not explained by the other lags in the control variables. So your performance is better in the short term.

[5]In this case, we substitute the primary expense variable for each of the components of expenses, always maintaining the VAR formed by three variables.

[6]Considering 3 lags, 154 coefficients are estimated, with two lags 105 and with a lag 56 coefficients.

Table 1: Information Criteria - AIC

Spending Components	**1 Lag**	**2 Lags**	**3 lags**
Primary Spending	**-22,3665**	-21,2732	-20,5185
Personnel Spending	**-20,3865**	-19,9574	-19,0227
Social Benefits	**-22,5316**	-21,3560	-20,4419
Investments	**-12,2260**	-11,1448	-10,2438
Subsidies	**-8,6961**	-7,7345	-6,8391
Costing	**-16,7558**	-15,9760	-15,3001

Source: Elaborated by the authors

Table 2: Information Criteria - SBC

Spending Components	**1 lag**	**2 lags**	**3 lags**
Primary Spending	**-20,7110**	-18,1468	-15,8996
Personnel Expenses	**-18,7311**	-16,8310	-14,4037
Social Benefits	**-20,8762**	-18,2296	-15,8230
Investments	**-10,8706**	-8,0184	-5,6249
Subsidies	**-7,0407**	-4,6081	-2,2202
Costing	**-15,1003**	-12,8496	-10,6812

Source: Elaborated by the authors

as the ratio of the integral of the response of the variable of interest to the integral of the fiscal variable. The proposed approach for calculating the multiplier, referred to as the integral multiplier, is particularly relevant as it addresses a key policy question by measuring the cumulative gain in GDP in relation to the cumulative government spending over a given period (Ramey & Zuraiy (2018) [7]. In other words, the integral multiplier for an h-period horizon (M_h) will be given by the cumulative response of GDP over the cumulative response of public spending, according to the following equation:

$$M_h = \frac{\sum_{j=0}^{h}(\beta_{t+j}^{Y})}{\sum_{j=0}^{h}(\beta_{t+j}^{G})} \tag{7}$$

where β_{t+j}^{Y} is the product's response to the fiscal shock j horizons ahead and β_{t+j}^{G} is the spending response to the government shock [8].

Tables 3 and 4 present the results of fiscal multipliers at 4 and 8 quarters following the fiscal shock (i.e., 1 and 2 years, respectively). Due to the high-frequency nature of fiscal variables, the fiscal shock may take place in the first, second, or third month of a given quarter. Therefore, tables 3 and 4 present the fiscal multiplier value for each expense component, for the month m, of the quarter t. For example, in Table 3, the fiscal multiplier of social benefit spending, referring to the second month of the quarter, after 1 year, was equal to 0.0392.

[7] Ramey and Zubairy (2018) argue that the cumulative multiplier may provide a more accurate representation of the effects of fiscal policy when these effects accumulate over time.

[8] We used a 20-quarter horizon, equivalent to 60 months.

Table 3: Fiscal Multipliers - 4 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,1736	-0,0014	0,1702
Personnel	0,0229	-0,0895	0,0504
Social Benefits	0,0671	0,0392	0,2153
Investments	0,0006	-0,0340	0,0494
Subsidies	0,0118	-0,0317	0,0030
Costing	0,0014	-0,0114	0,1105

Source: Elaborated by the authors

Table 4: Fiscal Multipliers - 8 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,3086	-0,2194	0,2721
Personnel	0,1023	-0,0680	0,1114
Social Benefits	0,1791	0,1083	0,3449
Investments	-0,0033	-0,0486	0,0746
Subsidies	0,0146	-0,0525	0,0049
Costing	-0,0464	-0,2619	0,1733

Source: Elaborated by the authors

In general, the results indicate that in all cases, the fiscal multiplier is less than one. The estimates show that primary spending has little effect on output in the first and second year (four and eight quarters, respectively) following the fiscal shock. This suggests that there is no Keynesian effect. According to macroeconomic theory, if the fiscal multiplier is greater than one, after a fiscal expansion through an increase in public spending, for example, the final effect on the product would be greater than the initial expansion. However, according to the results obtained, this would not be valid for the Brazilian economy. This result is in line with most of the literature on the fiscal multiplier in Brazil.

More specifically, in the case of total primary expenditure, the values found here are close to other estimates for Brazil. Peres (2007) using a VAR model for the period 1994-2005, finds multipliers between 0.3 and 0.4. Cavalcanti & Silva (2010) and Matheson & Pereira (2016) estimate SVAR models, although for different periods, and find fiscal multipliers close to zero, in the range 0.7-1 and around 0.5, respectively. Finally, Holland et al. (2019) claim that the best estimate they can obtain for the spending multiplier, using different methodologies, is close to zero. Although we have found negative values for the primary expenditure multiplier, for the second month of the quarter, for four and eight months after the fiscal shock, for the remaining periods, the maximum found does not reach 0.7. Thus, our results support the non-existence of the Keynesian effect for the Brazilian economy.

Multipliers for personnel spending did not exceed 0.12 and in two cases presented negative values, -0.0895 and -0.0680. The results found here are much lower than the $3,811$ found by Orair et al. (2016). Spending on social benefits is also much lower than that found by Orair et al. (2016) (8.6768). We found values less than 1 in all of the six multipliers that we calculated for this component of expenditure.

Subsidy expenses exhibited fiscal multipliers close to zero or even negative, which are values significantly different from the estimates of Orair et al. (2016) who found the value of 5.9617. This result highlights that misguided policy choices aimed at supporting certain sectors of the economy can lead to minimal impact on output. A similar result was found for multipliers of costing spending, close to zero and even negative. According to Ramey & Zurairy (2018) " *If multipliers are indeed this low, they suggest that increases in government purchases are unlikely to stimulate private activity and that fiscal consolidations that involve spending decreases are unlikely to do much harm to the private sector*"

The most controversial result found here was in relation to the fiscal multipliers of investments. We found values close to zero or even negative. The academic literature on the subject has found multipliers greater than one for this component of spending.

In general, the results obtained in the present study are consistent with the literature on the subject. It is worth noting that Holland et al. (2019) used a wide range of models and found estimates for the (integral) fiscal multiplier ranging from 0.01 to 0.26.

As robustness exercises of our results, we performed various alternative estimations, the results of which are presented in the appendix. For instance, we considered a more restricted sample period following de Abreu & Lima (2022). The sample reduction (starting in 2003 Q1) aimed to obtain a more homogeneous period by considering the post-inflation targeting and post-2002 crisis period. Furthermore, we also employed a Bayesian approach for model estimation, generalized impulse response function analysis, and the inclusion of control variables in the baseline model. Importantly, none of these exercises resulted in significant alterations to the findings presented here. The multipliers for all spending, including investment, are found to be less than one.

The response functions of GDP to shocks in each of the components of government spending are presented in the appendix. As the model utilized in this study is a mixed frequency VAR, we will provide the impulse responses for a spending shock in the first, second, and third months of the quarter t, respectively.

We can see how GDP evolves over the 20 quarters, after a shock from a standard deviation in primary spending. The product grows when the shock in primary expenditure occurs in the first and third months of the quarter, while in the second month, the effect is negative, during all quarters. The effect, albeit rather small, appears to be persistent.

Regarding personnel spending, we can observe that GDP increases when considering the third month of each quarter. However, for the second month of the quarter, GDP contracts and becomes positive again after six quarters. Considering a shock of spending on social benefits, we can see that after the shock in the first month of the quarter, GDP growth is greater than when there is a shock in the entire primary spending. In all months of a given quarter, there is a positive effect on the product and it appears to be persistent, albeit small.

The next component is investment spending. The findings are considerably contentious. GDP hardly responds to the shock of a standard deviation in investment spending. Considering the third month of the quarter, the effect appears to persist despite its small magnitude. The literature on fiscal multipliers has demonstrated that investment spending exerts the greatest impact on output. However, owing to the time lag in realizing returns from investment, the effects on GDP are considerably lower than expected.

Regarding costing spending, it can be observed that they have a negative effect on output, except for the shock incurred in the third month of the quarter. Finally, for subsidy spending, we observe that their effect is practically negligible for the first and third month of the quarter, and negative for the second. This result suggests that the subsidy policies had no effect on output.

6 Conclusion

The 2008/2009 financial crisis and the Covid-19 pandemic have reinforced the interest of policymakers and academics in the stabilizing role of fiscal policy, that is, its ability to act as a tool to promote economic growth and prevent an increase in unemployment. For many emerging countries, this issue has been a central part of the economic policy debate. Specifically, in the Brazilian case, this issue gained particular prominence after the 2022 presidential elections. In this context, knowing the likely effects of fiscal policy on economic activity and having good estimates of fiscal multipliers is important both for economists and policymakers.

The proposal of this study is to contribute to this debate by analyzing the impacts of spending shocks on the Brazilian product and evaluating if the multipliers of government spending vary according to the type of expenditure. We initially estimated the effect of total primary expenditure and subsequently, the effect of shocks from other components of expenditure (spending on personnel, social benefits, subsidies, investments, and costing).

For this, we fill a gap in the literature on the subject and explore the different frequencies available between fiscal data and GDP data. That is, we will not make any type of aggregation and will use all the information available from the monthly data (which are the fiscal data). We estimate a vector autoregressive with mixed frequency (MIDAS-VAR), using monthly data from the Brazilian central government, from the first quarter of 1999 (1999T1) to the second quarter of 2017 (2017T2), and quarterly data of the gross domestic product (GDP) in the same period. The mixed frequency approach proposed by Ghysels - MIDAS-VAR approach - has many advantages. One of them, which is especially interesting for this problem, is the possibility of using all the standard tools of the VAR for analysis in the context of mixed frequencies.

Estimates indicated that primary expenditure has little effect on output in the first and second years after the fiscal shock. The multipliers found were smaller than one, suggesting that there is no so-called Keynesian effect on the product.

Among the expenditure components, the highlight was investment spending, which had a fiscal multiplier of less than 1 in all horizons. In general, it was not found that fiscal policy has a Keynesian effect, that is, a tax multiplier greater than one.

In recent years, empirical research on the effects of government spending has been intensified, with non-linear responses, particularly with respect to the economic cycle, becoming the main concern. Unfortunately, exogenous limitations prevent progress in the calculation of fiscal multipliers in Brazil. One of the main obstacles, as pointed out by Orair et al. (2016), is the lack of considerably long fiscal statistical series. In addition, a number of issues arising from this study can be used in future research. One of the interesting issues to be addressed by future research is the use of alternative strategies for identifying fiscal policy shocks and estimating a version of the current model that takes into account the state of the economy.

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Appendix A Robustness analysis

In this section, we provide a series of alternative estimations to evaluate the robustness of our results. More specifically, we will perform the following exercises:

1. Bayesian estimation of the model;
2. Generalized Impulse Response function;
3. Alternative period: 2003Q1 to 2017Q2
4. Inclusion of control variables: exchange rate and interest rate (high-frequency variables);

A.1 Robustness: Bayesian Estimation of the model

In this exercise, the model was estimated using Bayesian methods, closely following the approach taken by Ghysels (2016). However, the impulse response functions were obtained through the empirical residual covariance matrix.

Table 5: Fiscal Multipliers - 4 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,1917	0,0001	0,1821
Personnel	0,0425	0,1769	0,0403
Social Benefits	0,0818	0,0838	0,1832
Investments	0,0155	-0,0134	0,0088
Subsidies	0,0118	-0,0317	0,0030
Costing	0,1057	0,0626	0,1455

Source: Elaborated by the authors

Table 6: Fiscal Multipliers - 8 quarters

Spending Components	Spending$_{t,1}$	Spending$_{t,2}$	Spending$_{t,3}$
Primary Spending	0,3866	0,0940	0,3070
Personnel	0,1814	0,2801	0,1744
Social Benefits	0,2286	0,1683	0,2947
Investments	0,0146	-0,0492	0,0984
Subsidies	0,0295	-0,0102	0,0049
Costing	0,0222	0,0354	0,2178

Source: Elaborated by the authors

A.2 Robustness: Generalized Impulse Response

In this exercise, we present the results considering the generalized impulse response function. Following Pesaran & Shin (1998), an orthogonal set of innovations is constructed that does not depend on the VAR ordering.

Table 7: Fiscal Multipliers - 4 quarters

Spending Components	Spending$_{t,1}$	Spending$_{t,2}$	Spending$_{t,3}$
Primary Spending	0,1631	-0,1618	0,1240
Personnel	0,0215	-0,0855	0,0727
Social Benefits	0,0585	0,0681	0,1219
Investments	0,0199	-0,0186	0,0006
Subsidies	0,0118	-0,0288	0,0050
Costing	0,0138	-0,1108	0,0916

Source: Elaborated by the authors

Table 8: Fiscal Multipliers - 8 quarters

Spending Components	Spending$_{t,1}$	Spending$_{t,2}$	Spending$_{t,3}$
Primary Spending	0,3086	-0,2278	0,2071
Personnel	0,1023	-0,0501	0,1339
Social Benefits	0,1791	0,1387	0,2253
Investments	0,0284	-0,0280	-0,0033
Subsidies	0,0142	-0,0483	-0,0106
Costing	-0,0467	-0,2588	0,1454

Source: Elaborated by the authors

A.3 Robustness: Alternative period: 2003Q1 to 2017Q2

In this exercise, we have opted to adopt a more restricted sample period, following de Abreu & Lima (2022). The purpose of limiting the sample period, starting from the first quarter of 2003, was to achieve a greater level of homogeneity by focusing on the post-inflation targeting and post-2002 crisis period.

Table 9: Fiscal Multipliers - 4 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,2510	-0,0004	0,1213
Personnel	-0,0207	0,0098	0,0292
Social Benefits	0,0175	-0,0878	0,1193
Investments	0,0178	0,0403	0,0942
Subsidies	0,0175	-0,0282	0,0015
Costing	0,0592	-0,0765	0,0392

Source: Elaborated by the authors

Table 10: Fiscal Multipliers - 8 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,3983	0,0095	0,2417
Personnel	0,0012	0,0665	0,0994
Social Benefits	0,050 8	-0,1086	0,2424
Investments	0,0430	0,0616	0,1525
Subsidies	0,0356	-0,0457	0,0038
Costing	0,1070	-0,1197	0,0829

Source: Elaborated by the authors

A.4 Robustness: Control Variables

In this exercise, we included two high-frequency control variables (i.e., monthly series): the exchange rate (external sector variable) and Selic rate (policy monetary variable). Notably, the same approach was also adopted by de Abreu & Lima (2022).

Table 11: Fiscal Multipliers - 4 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,1694	-0,0520	0,1274
Personnel	0,0114	-0,0090	0,0686
Social Benefits	0,1557	0,0675	0,0346
Investments	-0,0229	-0,0624	0,0373
Subsidies	0,0227	-0,0229	-0,0041
Costing	-0,0148	-0,1313	0,1047

Source: Elaborated by the authors

Table 12: Fiscal Multipliers - 8 quarters

Spending Components	$\text{Spending}_{t,1}$	$\text{Spending}_{t,2}$	$\text{Spending}_{t,3}$
Primary Spending	0,2801	0,0108	0,2550
Personnel	0,1281	0,0928	0,1501
Social Benefits	0,3348	0,1373	0,0854
Investments	-0,0826	-0,2282	0,0548
Subsidies	0,0317	-0,0349	-0,0035
Costing	-0,1619	-0,2777	0,2092

Source: Elaborated by the authors

Appendix B Impulse Response Function from the Base Model

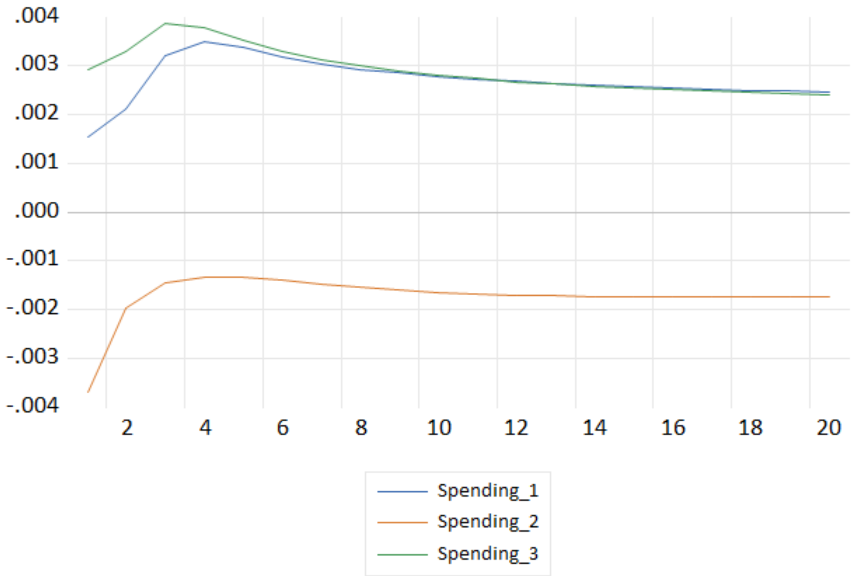

Figure 1: Response of GDP to fiscal policy shocks (Primary Spending): MIDAS-SVAR model.

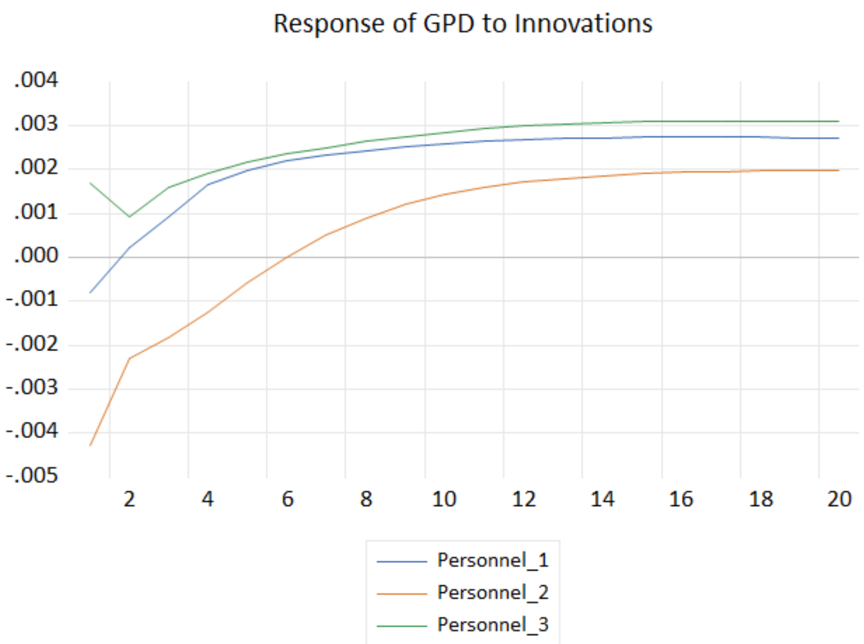

Figure 2: Response of GDP to fiscal policy shocks (Personnel Spending): MIDAS-SVAR model.

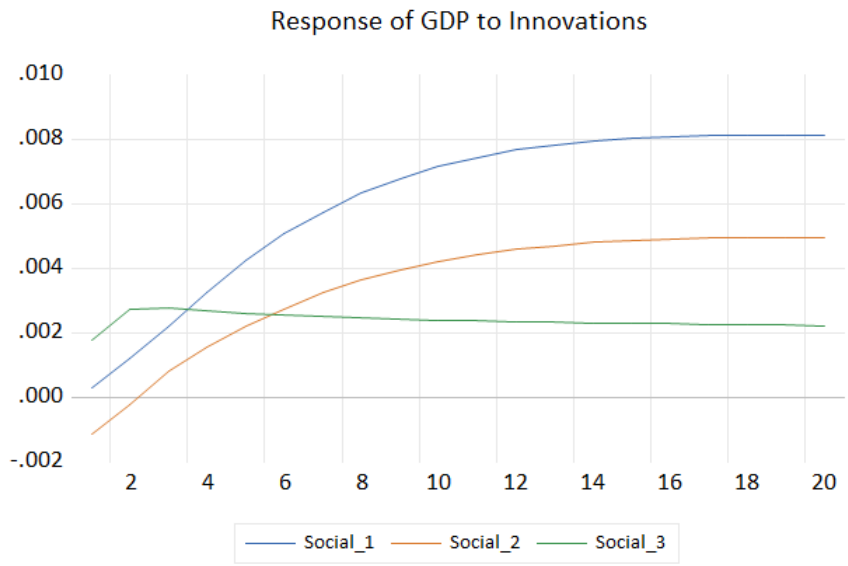

Figure 3: Response of GDP to fiscal policy shocks (Social Benefits): MIDAS-SVAR model.

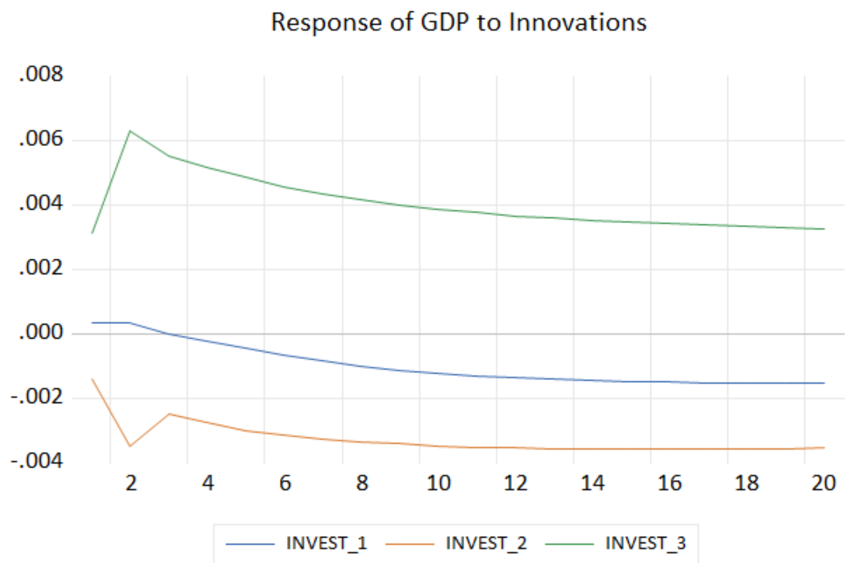

Figure 4: Response of GDP to fiscal policy shocks (Investments): MIDAS-SVAR model.

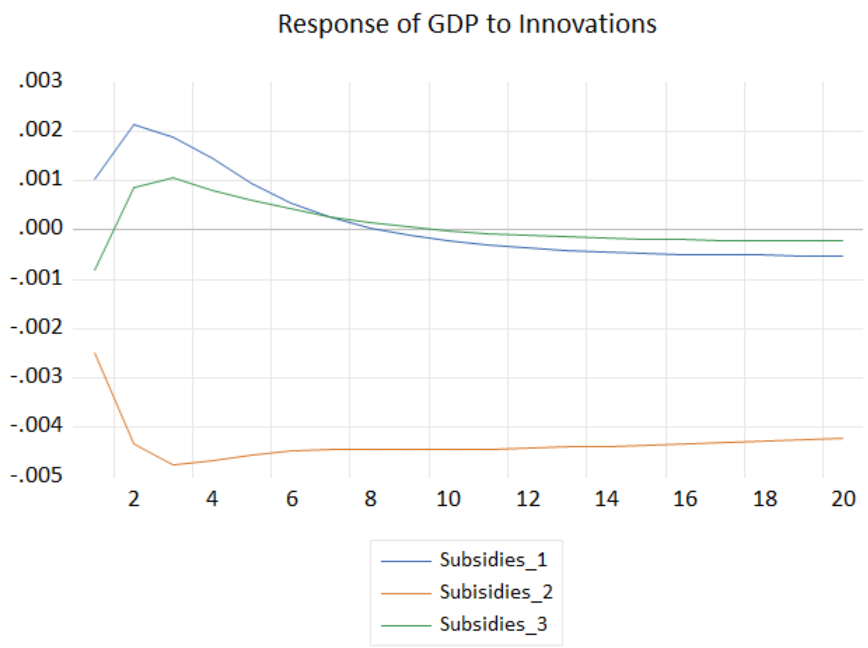

Figure 5: Response of GDP to fiscal policy shocks (Subsidies): MIDAS-SVAR model.

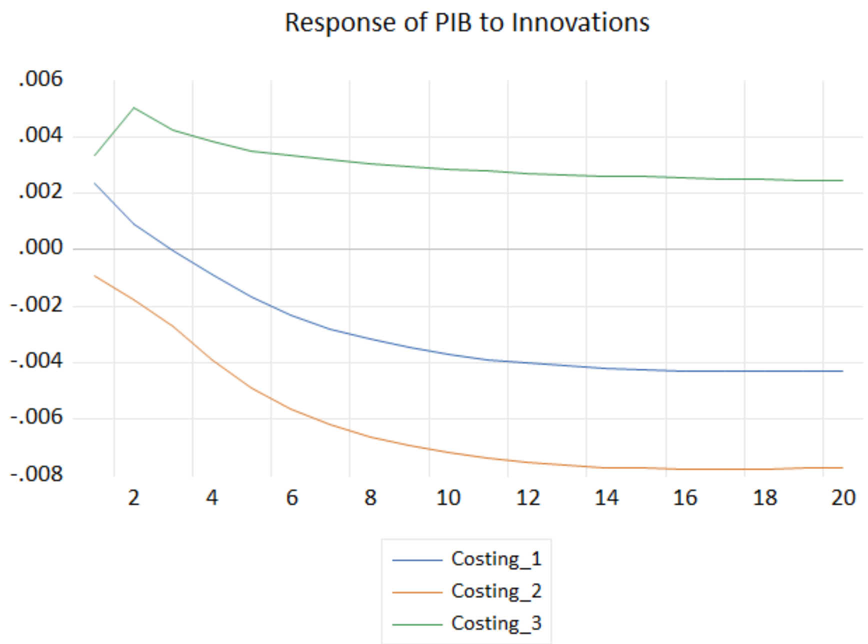

Figure 6: Response of GDP to fiscal policy shocks (Costing): MIDAS-SVAR model.