Fiscal multiplier in Brazil: the role played by controls

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Abstract

There is no consensus on the size and significance of fiscal spending multipliers in Brazil, reflecting a broader debate in international literature. Different model specifications hinder comparisons across studies. We find that controlling for the Brazilian monetary policy interest rate and a measure of sovereign risk leads to insignificant linear and state-dependent multipliers. However, excluding these covariates results in significant multipliers, albeit with a substantially poorer goodness-of-fit. The inclusion of sovereign risk markedly changes the conclusions. Our findings are robust across various robustness checks, including different estimates for the probability of being in a recessionary state and specifications normally used in the literature. Given the strong evidence of sovereign risk's influence on the business cycle in emerging economies, particularly Brazil, its inclusion is essential for accurately studying fiscal multipliers.

Keywords: Fiscal Policy, Fiscal Multiplier, Local Projection, State-Dependency, Sovereign Risk

JEL Codes: E32, E62, H5, H62, H63

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1 Introduction

As noted by Ramey (2019), research on fiscal multipliers has experienced a resurgence since the global recession triggered by the 2007-2009 financial crises. During this period, governments worldwide implemented substantial fiscal packages to mitigate the economic shock. The importance of this topic grew further with the implementation of expansive fiscal policies to counteract the recessionary effects of COVID-19 in 2020. Disagreements about the magnitude of fiscal multipliers and the stabilizing role of fiscal policy continue to fuel academic debate. We contribute to this discussion by examining the case of Brazil, a major emerging economy that has extensively employed fiscal policies.

The literature on Brazil's fiscal multipliers presents diverse findings. Cavalcanti & Silva (2010) and Holland et al. (2020) found no significant linear multiplier, whereas Matheson & Pereira (2016) reported a peak linear multiplier of around 0.5. Alves et al. (2019) estimated significant one-year multipliers ranging from 0.7 to 1.2. In contrast, non-linear models yield mixed results: Orair et al. (2016) found a significant multiplier during recessions (2.2) but not during growth periods, while Alves et al. (2019) identified a higher multiplier during regular states (3.4) compared to recessions (2.7), though statistical tests could not reject the equality of these multipliers. Grudtner & Aragon (2017) and Holland et al. (2020) reported no significant estimates irrespective of the state of the economy. These disparities may be attributed to differences in the instruments for fiscal policy and the set of covariates considered.

Starting with the instrument, Orair et al. (2016) and Alves et al. (2019) expand the traditional measure of government expenditure in goods and services (the ”G” in the NIPA) by including other non-financial public sector spending. This broader measure incorporates direct transfers to families through pensions and social programs, public investment, and credit subsidies provided by state-owned banks, particularly the Brazilian National Development Bank (BNDES). We adopt this methodology, as it offers a broader perspective on different manners to conduct fiscal, and we update their fiscal spending and revenue time series up to the fourth quarter of 2019. In contrast, Grudtner and Aragon (2017) and Holland et al. (2020) use the standard NIPA ”G”, thus excluding public investment, transfers to families, and subsidies to firms and households from their analysis.

Another key distinction among these studies lies in the differences in regression controls. Orair et al. (2016) and Alves et al. (2019) utilize lags of government spending, government revenue, and GDP. This approach is a popular baseline in fiscal impulse studies, as established by Blanchard & Perotti (2002), to which Grudtner & Aragon (2017) include lags of public debt and exchange rate, while Holland et al. (2020) incorporate lags of the Brazilian monetary policy interest rate (SELIC) as a control. We consider the inclusion of SELIC critical to address potential interactions between monetary and fiscal policy, as highlighted by Auerbach & Gorodnichenko (2017). None of these studies, however, include a measure of sovereign risk, despite substantial evidence indicating its significant role in influencing business cycles in Brazil and other emerging economies.[1] Sovereign risk can endogenously impact fiscal policies, particularly in Brazil, where fiscal laws mandate minimum spending in various areas as a percentage of government revenue, which fluctuates with the business cycle. Including a measure of sovereign risk is vital for accurately identifying fiscal shocks, as it helps account for unobserved factors affecting GDP and public expenditure dynamics. Moreover, sovereign risk acts as a conduit for global shocks (Akıncı (2013), Fernández et al. (2017), Fernández et al. (2018), Ferreira & Valério (2022)). The SELIC rate similarly affects economic activity with delays and responds to both domestic and international shocks.[2]

This study evaluates the significance of both linear and state-dependent fiscal spending

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[1] Recent findings for Brazil include Ferreira & Valério (2022), Fernández et al. (2017), and Fernández et al. (2018). But the list of works showing the importance of sovereign risk shocks in the determination of the business cycle is extensive and includes Mendoza (1991), Calvo et al. (1993), Uribe & Yue (2006), Bocola (2016), Arellano et al. (2017), among others. Liu (2023) verifies that even for the USA the government finances influence the size of the spending multiplier, which is found to be positive in states of low debt/GDP and negative in states of high debt/GDP.

[2] Ferreira & Valério (2022) verify that the Brazilian GDP, its sovereign risk, and the domestic monetary policy interest rate respond to shocks in the world demand, world supply, and world uncertainty, which together account for about 32% of the 1-year forecasting error variance (FEV) of the country’s GDP, and 63% for 4-year forecasting. Direct shocks applied to a measure of sovereign risk are found to contribute about 20% of the 2- and 4-year FEV. Similar figures are reported by Fernández et al. (2018).

multipliers. Our primary contribution is demonstrating how results and conclusions are significantly influenced by the choice of covariates beyond the base set established by Blanchard & Perotti (2002). We find that excluding SELIC and the sovereign risk measure (Emerging Market Bonds Index for Brazil - EMBI Br+, or simply EMBI hereafter) ensures the significance of the multipliers in both linear and non-linear specifications. This holds true even after accounting for dummy variables that control for the recession caused by the 2008/2009 global financial crisis and the deep recession in Brazil from Q2 2014 to Q4 2016, the worst since 1900. Merely excluding the past dynamics of EMBI from the models is sufficient to yield significant linear and slackness multipliers, aligning with previous findings in the literature. Notably, the complete model that results in insignificant multipliers also delivers the best model fit according to R^2, adjusted-R^2, and AKaike Information Criterion (AIC).

A secondary contribution of this study is the observation that the recession from 2014Q2 to 2016Q4 appears to have imposed a lasting strain on Brazil's growth rate, at least through the end of our sample in 2019Q4. Official seasonally adjusted statistics indicate that GDP in 2016Q4 was 8.2% lower than in 2014Q1. The average quarter-over-quarter growth rate from 2000Q2 (the starting point for the dependent variables in our regression after adjusting for differences and lags) to 2014Q1 was 3.64%, which declined to -0.46% from 2014Q2 to 2019Q4. From 2017Q1 to 2019Q4, the average growth rate was 1.86%, with GDP in Q4 2019 only 0.1% higher than in 2014Q1. Across all models employed, we find a highly significant negative level dummy for the period 2014Q2 to 2019Q4.

We base our econometric analyses on local projection (LP) (Jordà (2005)). To our goals, one of the main advantages of the LP is the fact that it is more conducive for inference of state-dependent specifications compared to vector autoregression methods such as smooth transition VAR and threshold VAR.[3]

Different theoretical perspectives predict varying impacts of fiscal stimulus. Keynesian models view fiscal policy as an effective tool for stimulating the economy during periods

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[3] See Plagborg-Møller & Wolf (2021) for a very depth comparison between LP and VAR, including their asymptotic properties.

of slackness, with increased government expenditure boosting output, household income, and consumption, thereby creating a positive feedback loop known as the Keynesian fiscal spending multiplier. Conversely, another perspective suggests that fiscal expansion could contract output if public debt is perceived as unsustainable, leading to higher sovereign spreads, risk premia, and interest rates, as discussed by Bocola (2016). For instance, Liu (2023) report negative spending multipliers in high public debt/GDP states due to increased risk premiums. Auerbach & Gorodnichenko (2013) found average quarterly responses close to -0.2 for OECD countries outside of recessions, possibly due to concerns about public debt sustainability. The classical view emphasizes the crowding-out effect, typically not predicting positive impacts from fiscal impulses.

To address these varying scenarios, the empirical literature has increasingly employed non-linear models that allow fiscal multipliers to change depending on the state of the economy, with notable contributions from Auerbach & Gorodnichenko (2012), Miyamoto et al. (2018), and Ramey & Zubairy (2018). Despite the use of such models, the international literature has not reached a consensus. Some studies find that government spending multipliers exceed 1 during recessions but are insignificant during normal periods (e.g., Auerbach & Gorodnichenko (2012); Auerbach & Gorodnichenko (2013); Fazzari et al. (2015); and Caggiano et al. (2015)). However, other studies report multipliers below 1 with no significant differences between economic states (e.g., Owyang et al. (2013); Alloza (2017); and Ramey & Zubairy (2018)). Recent theoretical models suggest counter-cyclical effects of government spending, often relying on significant labor market or financial frictions (e.g., Michaillat (2014); Canzoneri et al. (2016)), while standard New-Keynesian DSGE models generally predict multipliers around 1, regardless of the economic cycle (e.g., Sims & Wolff (2018); Zubairy (2014)).

The remainder of the paper proceeds as follows: Section 2 describes the data, with special attention to the adjustment of the government fiscal statistics, extending the approach of Orair et al. (2016) until 2019. Section 3 discusses the econometric methodology, explaining the identification strategy, the measurement of the multiplier and inference. Section 5 reports the estimates of government spending multipliers on GDP and its components, Section ?? contextualizes our results with others in the literature, while section 6 concludes.

2 Data

We utilize quarterly data spanning from 1999Q1 to 2019Q4. The time series for government expenditure and revenue are based on the methodology outlined by Orair et al. (2016), which we have extended to cover up to 2019Q4. This approach results in a more accurate representation of the various mechanisms employed in fiscal policies. A significant motivation for adopting this methodology was to address the improper accounting practices widely used by the Federal government from 2011 to 2014, aimed at artificially inflating the reported primary surplus. These practices, often referred to as creative accounting, were criticized by experts, journalists, politicians, and the general public.[4]

According to Orair et al. (2016), a more accurate measurement of Brazilian government expenditure necessitates adjusting the baseline statistic, which consists of the total spending by the central government and transfers from the Federal government to states and municipalities. The adjustments include: (i) subtracting deposits in the Brazilian sovereign wealth fund, the LC100/01 fund,[5] and the capital injections into Petrobras in 2010Q3; and (ii) adding transfers to the Brazilian Development Bank (BNDES) and the liabilities recorded on the central bank's balance sheet due to delayed transfers from the National Treasury to state banks and official funds, which were also responsible for executing the fiscal policy as mandated by the Federal government.[6] For revenue, the baseline is the total revenue

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[4] Mendes (2022) compiled a book with short articles by various specialists detailing, among other things, the misreporting practices in fiscal statistics. Unfortunately, the book is currently only available in Portuguese.

[5] The LC100/01 fund was established by local complementary law number 110/01 as an assistance fund for workers facing specific unemployment situations.

[6] This adjustment is necessary because these liabilities represent expenditures conducted by Federal banks (Banco do Brasil and Caixa Econômica Federal) and official federal funds (Finame and FGTS) to implement the proposed fiscal policy. According to Brazilian fiscal law, the National Treasury must reimburse these

of the Central Government, from which we exclude the tax relief account and losses from asset transactions. The monthly adjusted time series are then converted into quarterly data, deflated using the GDP deflator (2019Q2 = 100), and seasonally adjusted using the ARIMA X13 method, following this sequence. Appendix A provides further details on the data and adjustments.

We use the official quarterly GDP series published by the Brazilian Institute of Geography and Statistics (IBGE). To maintain consistency with the procedures applied to the government expenditure and revenue series, we use the current value GDP, deflate it with the GDP deflator, and seasonally adjust it using the ARIMA X13 method.

Our models also incorporate two additional variables: the SELIC rate and the Emerging Market Bonds Index (EMBI) for Brazil. Previous research has demonstrated the significant influence of sovereign risk on the business cycles of emerging economies, in addition to its role as a transmitter of global shocks (Ferreira & Valério (2022), Fernández et al. (2018), among others).

Two primary reasons justify the chosen sample range. First, the current methodology for the central government account, as computed by the Brazilian National Treasury, is available from 1997. Second, Brazil operated under a crawling peg exchange rate system until the first week of January 1999, when it transitioned to a free-floating exchange rate. Given that the fiscal multiplier's size tends to vary across different exchange rate regimes,[7] we opt to begin our analysis from the first quarter of 1999, a choice also made by Orair et al. (2016) and Grudtner & Aragon (2017). In contrast, Alves et al. (2019) and Holland et al. (2020) commence their analyses from 1997. Although we conduct robustness checks to compare results using different regressors, incorporating data from 1997 and 1998 is not our primary concern, as our objective is to evaluate responses under the current regime.

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expenditures to the banks and funds, which was not occurring, hence the registration of these amounts as liabilities on the Central Bank's balance sheet.

[7] For example, Ilzetzki et al. (2013) demonstrate that fiscal multipliers are generally larger in countries with a fixed exchange rate regime.

3 The Econometric Model

Our analysis employs the local projection (LP) method developed by Jordà (2005), which has been further advanced in studies such as Auerbach & Gorodnichenko (2013), Miyamoto et al. (2018), and Ramey & Zubairy (2018) to explore the dynamic effects of fiscal policies. The LP method is particularly useful in models that consider state-dependent multipliers, offering more straightforward inference compared to state-dependent vector autoregression methods like Smooth Transition VAR and Threshold VAR[8].

Our baseline LP model with state dependence is described by the following equations:

$$\begin{aligned} x_{t+h} = {} & f(k_{t-1})(\alpha_{A,h} + \Psi_{A,h}(L)z_{t-1} + \beta_{A,h}shock_t) \\ & + (1 - f(k_{t-1}))(\alpha_{B,h} + \Psi_{B,h}(L)z_{t-1} + \beta_{B,h}shock_t) + \epsilon_{t+h} \end{aligned} \tag{1}$$

and

$$f(k_t) = \frac{exp(-\gamma k_t)}{1 + exp(-\gamma k_t)}, \text{ with } \gamma > 0,\ E(k_t) = 0, \text{ and } E(k_t^2) = 1,$$

where x_{t+h} represents the response variable at horizon $t+h$ ($h = 0, 1, ..., H$), z_{t-1} is a vector of lagged control variables, $shock_t$ is the fiscal shock, $f(k_t)$ is a logistic function bounded between 0 and 1 that indicates the likelihood of being in the states A (recession) and B (not recession), and k_t is a business cycle index normalized to have a mean of zero and unit variance. The coefficients $\beta_{A,h}$ and $\beta_{B,h}$ capture the state-dependent response of x_{t+h} to $shock_t$, while ϵ_{t+h} is the error term.

Some authors utilize a dummy variable to differentiate between recessionary and normal states of the business cycle (see Ramey & Zubairy (2018), Bernardini & Peersman (2018), Miyamoto et al. (2018)). Although this is a straightforward and intuitive strategy, it is more suitable for extended time series with multiple recession periods. Given our relatively short dataset spanning 21 years, employing a logistic function, as in Auerbach & Gorodnichenko

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[8] For a comprehensive comparison between VAR and LP, see Plagborg-Møller & Wolf (2021).

(2012), enhances consistency by allowing the business cycle state to take any value between 0 and 1.

The traditional linear model for estimating fiscal multipliers is a special case of equation 1, where state dependence is not considered:

$$x_{t+h} = \alpha_h + \Psi_h(L)z_{t-1} + \beta_h shock_t + \epsilon_{t+h}. \tag{2}$$

In this model, the set of β_h for $h = 0, 1, ..., H$ forms the impulse response function.

A potential issue with impulse responses from local projection is the presence of serial correlation in the error terms, induced by leading the dependent variable, which may lead to a moving average structure and reduce estimator efficiency. To address this and enhance efficiency, we follow Jordà (2005), Auerbach & Gorodnichenko (2013), and Ramey & Zubairy (2018), using heteroskedasticity and autocorrelation-consistent (HAC) standard errors as proposed by Newey & West (1987).

The Fiscal Multiplier

There are various methods to calculate fiscal multipliers. Blanchard & Perotti (2002) use peak multipliers, representing the maximum output response following a government expenditure shock. Auerbach & Gorodnichenko (2013) consider the average quarterly output response to a government spending shock at $t = 0$. However, we adopt the cumulative (or integral) multiplier approach used by Mountford & Uhlig (2009), which accounts for the cumulative response from 0 to h in relation to the cumulative expenditure response over the same period, $\frac{\Delta gdp_{t,t+h}}{\Delta g_{t,t+h}}$. This method acknowledges that a fiscal stimulus initiated at $t = 0$ may persist beyond $t = 0$, thus requiring consideration of the entire sequence of additional spending to accurately measure the output response.

To facilitate inference, we estimate models 1 and 2 by regressing the cumulative response on a set of covariates z_{t-l} and on $shock_t$, with $shock_t$ now representing the cumulative expenditure shock from 0 to h. These cumulative variables are defined as:

$$w_{t+h} = \frac{W_{t+h} - W_{t-1}}{GDP_{t-1}}, \tag{3}$$

where W denotes the level of any target variable. For GDP, we have $x_{t+h} = \frac{GDP_{t+h} - GDP_{t-1}}{GDP_{t-1}}$, and the shock is $shock_{t+h} = \frac{G_{t+h} - G_{t-1}}{GDP_{t-1}}$.[9] Figure **??** illustrates these two transformed variables for $h = 4$. As discussed by Hall (2009) and Barro & Redlick (2011), normalizing all variables by $GDPt - 1$ simplifies the interpretation of the coefficients $\beta_{A,h}$, $\beta_{B,h}$, and β_h, which, following Ramey & Zubairy (2018), can be directly interpreted as multipliers without additional transformations.[10]

Identification

The government spending shock is identified using the standard Blanchard & Perotti (2002) institutional approach, which assumes that discretionary fiscal policy does not contemporaneously respond to output. This assumption is particularly reasonable when using quarterly data[11].

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[9] An alternative approach involves a two-stage estimation, where forecast errors of government spending from a prediction model are used as the expenditure shock ($shock_t$) in the second-stage regressions of models 1 and 2. For instance, using the linear model 2, the cumulative multiplier would be computed as $m_h = \frac{\beta^y h}{\beta^g h}$, where $\beta^y h$ is the impulse response coefficient of GDP to $shockt + h$. However, inference on m_h is complex and often requires simulation methods. Thus, we opt for single-stage estimation. Importantly, the Frisch-Waugh-Lovell theorem ensures the equivalence of coefficients estimated via one-stage or two-stage methods.

[10] A common practice is to log-transform variables, which results in elasticity coefficients requiring ex post transformation to derive the multiplier. For example, consider the model $ln(Y) = B_0 + B_1 ln(G) + U$, where U is an iid innovation. The partial derivative $\frac{\partial Y}{\partial G}\frac{1}{Y} = B_1\frac{1}{G}$ is not the multiplier, which is instead $\frac{\partial Y}{\partial G} = B_1\frac{Y}{G}$. The use of averages for Y and G for conversion can lead to bias, as shown by Ramey & Zubairy (2018). This bias can be avoided by pre-transforming the variables as in equation 3. For example, let $y_{t+h} = \frac{Y_{t+h} - Y_{t-1}}{Y_{t-1}}$ and $shock_{t+h} = \frac{G_{t+h} - G_{t-1}}{Y_{t-1}}$, and consider the model $y_{t+h} = C_0 + C_1 shock_{t+h} + error_{t+h}$. The partial derivative $\frac{\partial y_{t+h}}{\partial shock_{t+h}} = C_1$ directly provides the multiplier, accounting for the cumulative output response relative to the initial fiscal shock and the consequent series of accumulated expenditures.

[11] Ramey (2016) discusses the limitations of the standard Blanchard & Perotti (2002) identification scheme. In the U.S. context, Ramey (2011) identifies fiscal shocks using a narrative strategy based on U.S. military news time series. Auerbach & Gorodnichenko (2012) and Miyamoto et al. (2018) use deviations between private forecasts of government spending and actual spending to measure fiscal shocks. However, we are

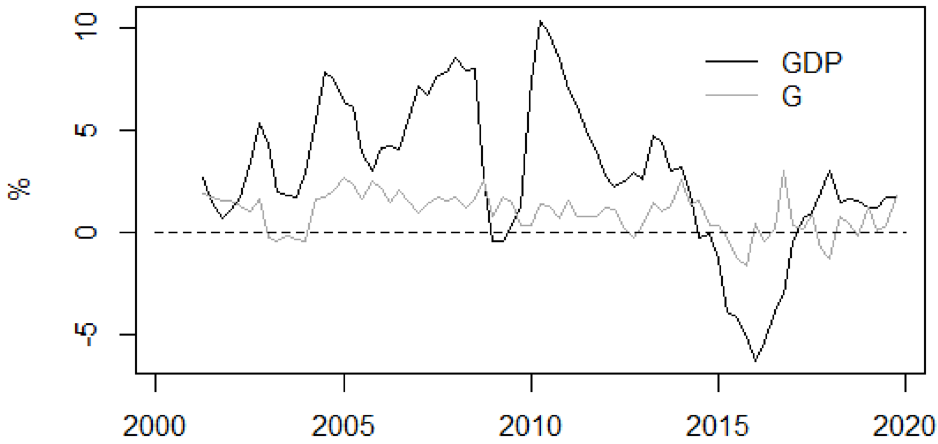

Figure 1: 4 quarters cumulative growth rate of GDP and normalized G

Notes: GDP and G correspond, respectively, to the normalized 4 quarters cumulative growth rate of GDP ($\frac{GDP_{t+4} - GDP_{t-1}}{GDP_{t-1}}$) and government spending ($\frac{G_{t+4} - G_{t-1}}{GDP_{t-1}}$).

In addition to not responding to fluctuations in current economic activity, a shock is by definition an unpredictable event. Our challenge is to filter out any predictable components of government spending to ensure that the remaining component likely represents a genuine spending shock. We approach this by including four lags of the control vector z_{t-l} ($l = 1, 2, 3, 4$), which comprises quarter-over-quarter growth rates of GDP, government spending, tax revenue, EMBI, and the first difference of the SELIC rate. The inclusion of the last two variables differentiates our econometric specification from those used by Orair et al. (2016), Grudtner & Aragon (2017), and Alves et al. (2019), with the inclusion of EMBI further expanding on the covariate set utilized by Holland et al. (2020).

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unaware of long time series forecasts for Brazilian government spending, and Brazil's lack of significant military engagements makes the narrative strategy more challenging.

4 Computing the Transition State $f(k_t)$

To construct the time series for $f(k_t)$, we require two inputs: a variable k_t that encapsulates business cycle information, and an estimate of γ. For k_t, we consider 2-, 5-, and 7-quarter moving averages (MAs) of GDP growth rates. We implement a grid search to identify values of γ that ensure 22% of the quarters in our sample are classified as in a slack state, aligning with the percentage of recessionary quarters in Brazil according to CODACE's business cycle dating[12]. Specifically, we select γ so that $Pr(f(k_t) > 0.78) = 0.22$. All three measures of k_t yield intervals for γ that meet this criterion, and we use the mean value within each interval. For MA(2), we find $\gamma \in [2.50, 2.61]$, and we use $\gamma = 2.55$; for MA(5), γ ranges from [2.08, 2.32], and we use $\gamma = 2.20$; for MA(7), γ lies between [2.73, 2.77], leading us to adopt $\gamma = 2.75$.

Figures 2, 5, and 6 (the latter two in the Appendix) compare the evolution of $f(k_t)$ for MA(5), MA(2), and MA(7) against quarters shaded in grey to indicate recessions. All three measures show a higher probability of slackness during recessions and a lower probability during non-recessionary quarters. However, differences arise upon closer examination. The excessive smoothing of MA(7) yields a relatively low probability (around 45%) of slackness during the recession of 2003Q1-2003Q2. Similarly, lower values of $f(MA(7))$ are observed during the recessionary periods of 2001Q2-2001Q4 and 2008Q4-2009Q1. While MA(7) reduces $f(k_t)$ in non-recessionary quarters, which is a drawback of MA(2), the latter offers high probability estimates of slackness during recessions at the cost of also indicating high slackness probability in non-recessionary periods. Despite no measure being perfect, we find that $f(MA(5))$ provides a more balanced view, making it our benchmark measure for $f(k_t)$ throughout the paper. Importantly, our robustness checks - discussed later - show that our conclusions remain consistent whether using MA(2) or MA(7), although $f(MA(5))$ offers the best fit. Additionally, using MA(5) facilitates comparisons with Alves et al. (2019) and Grudtner & Aragon (2017), who also use this measure to compute $f(k_t)$. Furthermore,

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[12] CODACE is a committee that dates recessionary periods in Brazil.

Auerbach & Gorodnichenko (2013) suggest that a moving average of more than four quarters of GDP growth is sufficient to capture the output gap and thus the degree of economic slackness.

Regarding the choice of using the average value for γ Figure 4 in the Appendix illustrates the evolution of $f(MA(5)_t)$ for the minimum and maximum grid values of γ: 2.08 and 2.32, respectively. The differences between them are negligible, supporting $\gamma = 2.20$ as a reasonable choice.

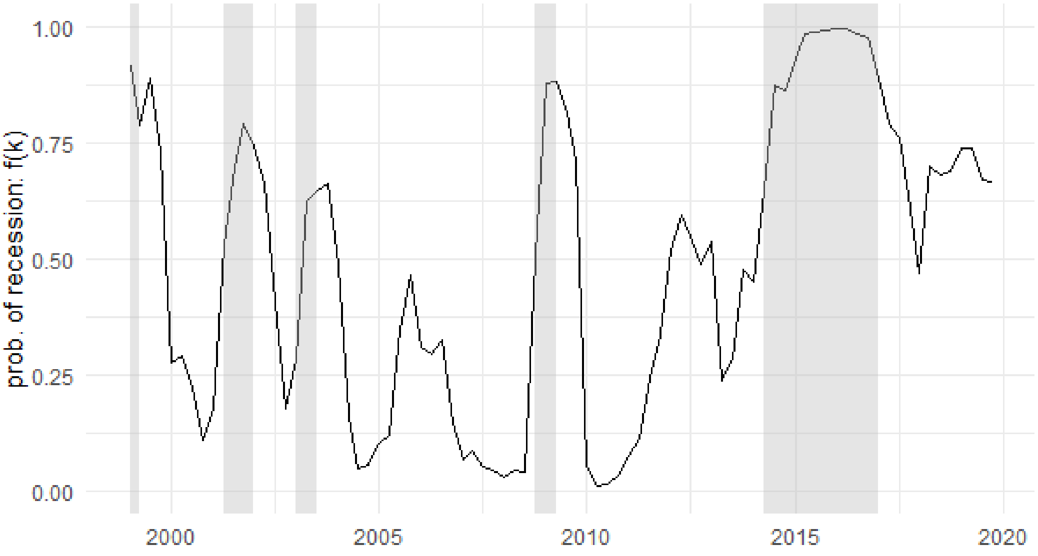

Figure 2: Probability of being in a recessionary state according to the logistic function $f(k)$ where k is a 5-quarter moving average of the GDP growth rate.

Notes: The shaded areas correspond to recessionary quarters according to CODACE. The solid black line represents the probability of being in a recessionary regime, calculated using the logistic function $f(k) = \frac{\exp(-\gamma k_t)}{1+\exp(-\gamma k_t)}$ with $\gamma = 2.20$ and k as the normalized 5-quarter moving average of GDP growth rate.

5 Results for the Linear Model

We begin by presenting the results for the linear model described in Equation 2. A key concern is the potential bias due to the omission of important control variables not considered in previous studies. To address this, we test several specifications. Our hypothesis is that the exclusion of the monetary policy interest rate and a measure of sovereign risk premium may undermine the argument that $\frac{G_{t+h}-G_{t-1}}{GDP_{t-1}}$ captures exogenous fiscal shocks, as these variables have well-known lagged effects on GDP growth. This concern is heightened by the potential endogenous reaction of government spending to shocks transmitted through these variables.

Table 1: Base estimates according to the linear local projection model

	$h=0$	$h=1$	$h=2$	$h=3$	$h=4$
Box A: linear model					
multiplier	-0.1810	-0.0251	0.3868	0.7618	1.3547
	(0.3309)	(0.4430)	(0.4423)	(0.5396)	(0.6752)
	[0.5867]	[0.9549]	[0.3857]	[0.1638]	[0.0499]
R^2	0.4553	0.4382	0.4690	0.4541	0.4410
adj-R^2	0.2394	0.2156	0.2586	0.2378	0.2195
Box B: linear + $D.2008Q4$					
multiplier	0.1224	0.2955	0.6927	0.9820	1.4726
	(0.2134)	(0.3209)	(0.3686)	(0.4938)	(0.6674)
	[0.5687]	[0.3614]	[0.0658]	[0.0520]	[0.0318]
$D.2008Q4$	-0.0526***	-0.0616***	-0.0583***	-0.0547***	-0.0476***
	(0.0052)	(0.0076)	(0.0107)	(0.0127)	(0.0133)
R^2	0.6586	0.6343	0.6074	0.5668	0.5221
adj-R^2	0.5142	0.4795	0.4413	0.3836	0.3199
Box C: linear + $D.2008Q4$ + $D.brecession$					
multiplier	0.0298	0.0360	0.1733	0.3032	0.6238
	(0.1986)	(0.2742)	(0.3763)	(0.4381)	(0.5430)
	[0.8815]	[0.8960]	[0.6470]	[0.4921]	[0.2560]
$D.2008Q4$	-0.0495***	-0.0546***	-0.0488***	-0.0443***	-0.0380***
	(0.0050)	(0.0065)	(0.0103)	(0.0116)	(0.0112)
$D.brecession$	-0.0073***	-0.0189***	-0.0282***	-0.0371***	-0.0453***
	(0.0027)	(0.0038)	(0.0055)	(0.0073)	(0.0108)
R^2	0.6923	0.7188	0.7165	0.6991	0.6714
adj-R^2	0.5536	0.5920	0.5886	0.5634	0.5232

Notes: Estimates based on equation 2, with h representing quarters following the shock. $D.2008Q4$ is a *dummy* variable to filter the impact of the 2008/2009 global financial crisis, while $D.brecession$ is a dummy variable to capture the lasting impact of the 2014Q2-2016Q4 Brazilian recession until the end of our sample in 2019Q4. *multiplier* is the cumulative (integral) spending multiplier for the GDP (β_h of equation 2). HAC standard errors are in parentheses and *p-value* in brackets. *** means significance at 1% confidence level.

Box A in Table 1 presents the estimates for the linear model 2. The column for $h = 0$ shows the impact multiplier, while the remaining columns display the cumulative multipliers for $h = 1$ to $h = 4$. We also report robust HAC standard errors for $\hat{\beta}_h$ in parentheses, the *t-statistic* and *p-value* in brackets, along with R^2, and *adjusted-*R^2.

The results indicate significance at standard confidence levels only for $h = 4$, with $\hat{\beta}_4 = 1.3547$. The other estimates are close to zero, with the highest being 0.7618 (*p-value* $= 0.1638$) for $h = 3$. The R^2 values are around 0.45 across all cases, suggesting a reasonable explanatory power for the model. Despite this, visual inspection of the residuals in Figure 3 reveals a large negative error associated with the 2008 financial crisis, potentially biasing the estimates. To address this, we introduce a dummy variable for the period.

The dummy variable, $D.2008Q4_t$, is defined such that $D.2008Q4_t = 1$ for any quarter in which 2008Q4 falls within the interval $[t, t + h]$, and 0 otherwise. For example, when estimating the 1-quarter cumulative growth multiplier, $D.2008Q4_t$ for both 2008Q3 and 2008Q4.

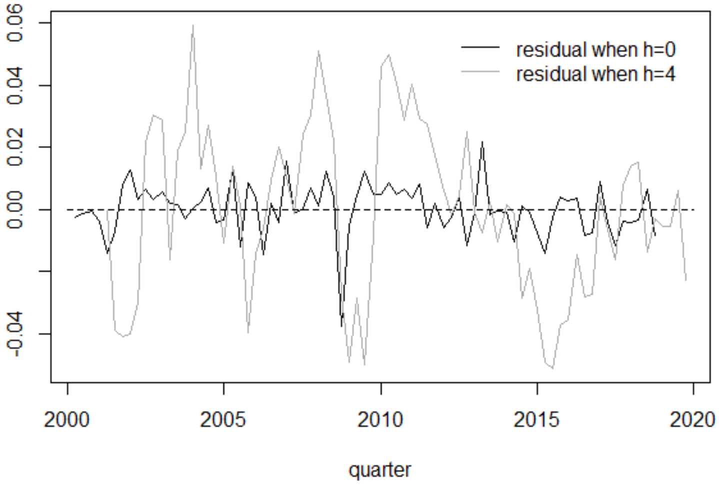

Figure 3: Residuals of the linear model for 0- and 4-quarter ahead forecasting equation.
Notes: The residuals are obtained from the linear local projection model 2 without the inclusion of any *dummy* variable.

Another critical period that could bias the estimates is the recession from 2014Q2 to 2016Q4. This recession was notably severe and prolonged, with GDP in 2016Q4 being 8.2% lower than in 2014Q1 (seasonally adjusted). The average quarter-over-quarter growth rate from 2000Q2 to 2014Q1 was 3.64%, compared to -0.46% from 2014Q2 to 2019Q4. Even after the recession, growth remained sluggish, averaging 1.86% annually from 2017Q1 to

2019Q4. In 2019Q4, real GDP was only 0.1% higher than in 2014Q1. The residuals for the 4-quarter forecasting equation in Figure 3 show negative residuals persisting from 2014Q2 to 2016Q4, further justifying the inclusion of the $D.brecession_t$ dummy, which is set to 1 for all $t \geq 2014Q2$, and 0 otherwise. This dummy captures the structural shift evident from the data starting in 2014Q2, at least until the end of our sample.

Boxes B and C in Table 1 display the results after incorporating $D.2008Q4$ and $D.2008Q4$ + $D.brecession$ into the linear model 2. In both cases, the dummies are highly significant, with *p-values* below 1%. The inclusion of these dummies increases both R^2 and $adjusted{-}R^2$. The most substantial improvement is observed with the inclusion of $D.brecession$. For instance, for $h = 4$, the model with both dummies achieves an R^2 of 0.6714, compared to 0.5221 with only $D.2008Q4$ and 0.4410 without dummies. The improvement is even more pronounced in *adjusted-*R^2, which is 0.5232 in the full model, 0.3199 with $D.2008Q4$, and 0.2195 in the base specification. Similar patterns are observed for $h = 0, 1, 2, 3$, strongly indicating that the specification including both dummies is the most appropriate for assessing the spending multiplier's size and significance. These findings also suggest a structural break after 2014Q2.

Now, evaluating the estimated multipliers from the most complete specification (Box C), we find them to be highly insignificant at standard confidence levels, with the highest *p-value* (0.2560) for the 4-quarter multiplier ($\hat{\beta}_4 = 0.6238$). Figures change when only adding $D.2008Q4$ (Box B), with $\hat{\beta}_4 = 1.4726$ and *p-value* of 0.0318, close to the estimates of the full restricted specification: 1.3547 and *p-value*=0.0499, respectively. The overall pattern, extended for others h, is that the substantial improvement in the goodness-of-fit after including both *dummies* results in non-significant multipliers.

Analyzing the estimated multipliers from the most comprehensive model (Box C), we find them to be generally insignificant at standard confidence levels, with the highest *p-value* (0.2560) observed for the 4-quarter multiplier ($\hat{\beta}_4 = 0.6238$). However, when only $D.2008Q4$ is included (Box B), $\hat{\beta}_4 = 1.4726$ with a *p-value* of 0.0318, close to the estimates of the unrestricted specification: 1.3547 and *p-value* $= 0.0499$. The general pattern across h is that the substantial improvement in the model fit after including both *dummies* results in non-significant multipliers.

Our conclusion about the insignificance of the linear spending multiplier aligns with previous findings for Brazil by Cavalcanti & Silva (2010) and Holland et al. (2020), but contrasts with Alves et al. (2019), who report significant 1-year multipliers ranging from 0.7 to 1.2, and Matheson & Pereira (2016), who find a significant peak linear multiplier around 0.5. The values reported by Alves et al. (2019) are similar to those obtained from our more restrictive specifications regarding the use of dummy variables.

Our findings are also consistent with key studies in the literature: Auerbach & Gorodnichenko (2013) estimate an insignificant mean quarterly response of around 0.14 over a 1-year horizon for OECD countries, while Ramey & Zubairy (2018), whose methodology we closely follow, estimate a non-significant 2-year integral linear multiplier of 0.38 for the USA. Additionally, Auclert et al. (2018) report cumulative multipliers of 0.4 under balanced budget fiscal policy and 1.3 under debt-financed policy, in a model with heterogeneous agents. These values are within the range of our estimates.

Controls for the Linear Model

Comparing results across studies can be challenging due to differences in covariates. In the Introduction, we noted that while some studies on Brazil include controls for the monetary policy interest rate, none account for a measure of sovereign risk. This omission is significant, given substantial evidence that the Brazilian business cycle is strongly influenced by sovereign risk shocks, or that sovereign risk acts as a conduit for global shocks (e.g., Ferreira & Valério (2022) and Fernández et al. (2018)).

To assess the importance of $SELIC$ and $EMBI$, we examined the impact of omitting these controls. For brevity, we focus on the 2- and 4-quarter ahead forecasting equations of our preferred specification, which includes $D.2008Q4 + D.brecession$, as well as a model without dummies, since none of the cited studies include them. The results are presented in Table 2, with the restricted specification in Box A and the full dummy model in Box B.

The last two columns of Box B show the results when $SELIC$ and $EMBI$ are excluded. Under these conditions, R^2 and *adjusted*-R^2 are notably lower than in the full model presented in Box C of Table 2. For $h = 2$, the R^2 and *adjusted*-R^2 decrease to 0.5716 and 0.4626, respectively, compared to 0.7165 and 0.5886 when both $SELIC$ and $EMBI$ are included. For $h = 4$, the values drop to 0.5796 and 0.4727, respectively, compared to 0.6714 and 0.5232 in the unrestricted model. Notably, the absence of these controls results in significant 2- and 4-quarter integral multipliers at the 5% level, with point estimates of 0.5590 and 0.8948[13], which are higher than the insignificant estimates from the full model (0.1733 and 0.6238, respectively). Similar trends are observed when $SELIC$ and $EMBI$ are omitted individually. For instance, excluding $EMBI$ results in an *adjusted*- of 0.5554 and 0.4868 for $h = 2$ and $h = 4$, respectively, while the multipliers increase to 0.3049 and 0.7032, with the latter reaching 10% significance. When only $SELIC$ is excluded, the *adjusted*-R^2 drops to 0.4895 and 0.4696 for $h = 2$ and $h = 4$, respectively, with multipliers rising to 0.3188 and 0.7591, the latter being significant at 5%.

Overall, the results in Table 2 demonstrate that both $EMBI$ and $SELIC$ significantly impact the future dynamics of GDP. Omitting these variables degrades the model's fit and increases the estimated multipliers, which may even become significant at standard confidence levels. The results in Box A, where no dummies are included, exhibit similar patterns.

6 State Dependent Multiplier

Table 3 presents the estimates of state-dependent multipliers for 0 to 4-quarter cumulative growth of GDP. Box A shows the estimates without any dummy variables, while Box B includes the effects of the dummies $D.2004Q4$ and $D.recession$, which is our preferred

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[13] These significant estimates are similar to those reported by Alves et al. (2019), who do not include $SELIC$ and $EMBI$ among their covariates.

Table 2: The influence of covariates in the linear local projection model

	No EMBI		No SELIC		No EMBI, no SELIC	
	$h = 2$	$h = 4$	$h = 2$	$h = 4$	$h = 2$	$h = 4$
	Box A: no *dummies*					
multiplier	0.5899	1.6109	0.7055	1.6801	0.9237	1.8491
	(0.5370)	(0.6775)	(0.6015)	(0.7700)	(0.6153)	(0.7570)
	[0.2766]	[0.0208]	[0.2457]	[0.0333]	[0.1385]	[0.0175]
R^2	0.3754	0.3375	0.3342	0.3340	0.2090	0.2725
adj-R^2	0.1892	0.1399	0.1356	0.1353	0.0404	0.1174
	Box B - dummies: $D.2008Q4$ and $D.brecession$					
multiplier	0.3049	0.7032	0.3188	0.7591	0.5590	0.8948
	(0.3827)	(0.4107)	(0.2669)	(0.3710)	(0.2570)	(0.2129)
	[0.4291]	[0.0925]	[0.2374]	[0.0456]	[0.0336]	[0.0001]
R^2	0.6695	0.6186	0.6206	0.6058	0.5716	0.5796
adj-R^2	0.5554	0.4868	0.4895	0.4696	0.4626	0.4727

Notes: Estimates of the government spending multiplier of the GDP based on the linear local projection equation 2, with h representing quarters following the shock. The complete set of covariates includes lags on the growth rate of GDP, government expenses, tax collection, EMBI and lags on the first difference of SELIC. The results we present are obtained after relaxing the covariates mentioned in the top of columns. Box A reports results when no *dummy* variable is included, being comparable to Box A in table 1. Box B reports results when dummy variables $D.2008Q4$ and $D.brecession$ are included, being comparable to Box C in table 1. HAC standard errors are in parentheses and *p-value* in brackets.

specification due to the substantial improvement in R^2 and *adjusted*-R^2. Specifically, the *adjusted*-R^2 increases from 0.2801 to 0.6384 for $h = 0$ and from 0.3379 to 0.5823 for $h = 4$. Additionally, Box B indicates that both dummies are significant at conventional significance levels from $h = 0$ to $h = 3$, with only $D.brecession$ remaining significant when $h = 4$. This result suggests a structural break in the data beginning around 2014Q2.

Focusing on the results in Box B, the *p-values* in brackets indicate that the estimated multipliers are insignificant at standard confidence levels, regardless of the forecasting horizon or the state of the business cycle. For example, the lowest *p-values* are 0.2980 for the slackness multiplier at $h = 0$ (($\hat{\beta}_A = -0.4740$) and 0.3014 for the no-slackness multiplier at $h = 4$

($\hat{\beta}_B = 0.9789$). This pattern of non-significant estimates persists even in the *no-dummies* model, as evidenced by the *p-values* in Box A. Consistent with these findings, the *p-values* for testing $H_0 : \beta_A = \beta_B$ against $H_1 : \beta_A \neq \beta_B$, reported in the last row of each box, are also quite high.

Our findings align with those of Grudtner & Aragon (2017) and Holland et al. (2020), who also found no evidence of significant state-dependent fiscal multipliers. However, their analysis used a narrow measure of government spending, which does not fully capture fiscal policies implemented through public investment, loans, subsidies to firms, or direct transfers to households. In contrast, our findings diverge from those of Orair et al. (2016) and Alves et al. (2019), who used a similar measure of G but did not employ the same controls as our study. Orair et al. (2016) reported a significant 4-year slackness multiplier of approximately 2.2, while Alves et al. (2019) estimated a significant 2-year cumulative slackness multiplier of 2.7 and a non-slackness multiplier of around 3.4.

Controls for the State-Dependent Model

Given that our results conflict with most findings from the literature focused on Brazil, we estimate several specifications relaxing the presence of $SELIC$, $EMBI$ and the *dummies* from the base model, formed by the shock variable $\frac{G_{t+h} - G_{t-1}}{GDP_{t-1}}$ and lags on the growth rate of GDP, G, and tax revenues. The results for five different specifications are displayed in Table 4. We only conduct this exercise for $h = 4$, which is the horizon we previously observed higher multipliers and smaller *p-values.* Each column, from *model* 0 to *model* 4, consider different specifications whose characteristic can be assessed by the *yes* or *no* in the line associated *dummies*, $SELIC$, and $EMBI$. To facilitate comparisons, the column *model* 0 displays results of our preferred model, being identical to the last column of Box B in Table 3.

Given that our results differ from much of the literature focused on Brazil, we explore various specifications by removing the $SELIC$ rate, $EMBI$, and the dummy variables from

Table 3: State-Dependent Spending Multipliers - $f(k)$ with k as a MA(5) of GDP Growth

	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
Box A: no *dummies*					
β_A (slackness)	-0.6051	-0.6067	0.2270	1.1007	1.4030
	(0.7696)	(0.9128)	(0.8563)	(0.9191)	(1.3839)
	[0.4375]	[0.5111]	[0.7926]	[0.2398]	[0.3183]
β_B (no slackness)	0.0758	0.6052	0.1627	-0.2863	0.7706
	(0.8570)	(0.9752)	(0.7480)	(0.9793)	(1.3354)
	[0.9301]	[0.5393]	[0.8292]	[0.7719]	[0.5679]
R^2	0.6887	0.7303	0.7853	0.7506	0.7137
$adj - R^2$	0.2801	0.3762	0.5035	0.4232	0.3379
p-value when $H_1 : \beta_A \neq \beta_B$	0.6195	0.4286	0.9597	0.3936	0.7985
Box B - dummies: $D.2008Q4$ and $D.brecession$					
β_A (slackness)	-0.4740	-0.5012	-0.3619	0.3494	0.1050
	(0.4475)	(0.7015)	(0.6089)	(0.7879)	(1.1631)
	[0.2980]	[0.4805]	[0.5568]	[0.6606]	[0.9287]
β_B (no slackness)	0.1551	0.4816	0.3659	0.0508	0.9789
	(0.6518)	(0.8507)	(0.5873)	(0.8392)	(0.9309)
	[0.8135]	[0.5755]	[0.5380]	[0.9521]	[0.3014]
$D.2008Q4$	-0.0390***	-0.0472***	-0.0304***	-0.0227*	-0.0145
	(0.0060)	(0.0063)	(0.0076)	(0.0132)	(0.0119)
$D.brecession$	-0.0103**	-0.0175***	-0.0226***	-0.0311***	-0.0431***
	(0.0038)	(0.0048)	(0.0044)	(0.0053)	(0.0080)
R^2	0.8534	0.8647	0.8649	0.8448	0.8307
$adj - R^2$	0.6384	0.6663	0.6668	0.6171	0.5823
p-value when $H_1 : \beta_A \neq \beta_B$	0.5079	0.4506	0.3814	0.8335	0.6605

Notes: Estimates of the government spending multiplier for the GDP based on equation 1 with a transition function $f(k)$ where k is a 5-quarter moving average of the GDP growth. h represents quarters following the shock. The complete set of covariates includes lags on the growth rate of GDP, government expenses, tax collection, embi and lags on the first difference of Selic (monetary policy interest rate). Box A reports results when no *dummy* variable is included, while Box B reports results when the dummy variables $D.2008Q4$ and $D.brecession$ are included. HAC standard errors are in parentheses and *p-value* in brackets. *, **, and *** represent, respectively, significance at 10%, 5%, and 1% confidence level.

the base model, which includes the shock variable $\frac{G_{t+h} - G_{t-1}}{GDP_{t-1}}$ and lags of GDP growth, G, and tax revenues. The results for five different specifications are displayed in Table 4. We limit this analysis to $h = 4$, the horizon where we previously observed higher multipliers and smaller *p-values*. Each column, from *model* 0 to *model* 4, represents different specifications, characterized by the presence or absence of dummies, $SELIC$, and $EMBI$. For comparison, *model* 0 replicates our preferred model, matching the last column of Box B in Table 3.

In *model* 1, where none of the three controls are present, we estimate a high slackness multiplier of 3.8743, which is significant at conventional levels (*p-value* $= 0.0292$). The no-slackness multiplier is 1.2445 with a *p-value* of 0.2107. The R^2 and *adjusted*-R^2 are 0.4611 and 0.1692, respectively, much lower than the benchmarks of 0.8307 and 0.5823, indicating poorer model fit and suggesting that the large difference between estimated multipliers may be due to omitted variable bias. Notably, Orair et al. (2016) and Alves et al. (2019), which use similar measures of G and T as our study, also report high (and significant) slackness multipliers, 2.2 and 2.7, respectively. However, Orair et al. (2016) finds the no-slackness multiplier insignificant, while Alves et al. (2019) reports a significant multiplier around 3.4.

$Model$ 2, which only incorporates $SELIC$, is a traditional specification according to our literature review. Our estimates using this model also indicate a high and significant slackness multiplier, $\hat{\beta}_A = 3.2499$ and *p-value* $= 0.0062$. The no-slackness multiplier presents smaller (0.5242) and not significant at standard levels (p-value = 0.5737). Worth observing that adding lags of differences of $SELIC$ substantially improves the fitting with respect to *model* 1, since R^2 increases to 0.5871 and $adjusted - R^2$ to 0.2361, but the goodness-of-fit remains much worse than the benchmark *model* 0, which also suggests omitted variable bias in the estimates of *model* 2.

In *model* 2, which only includes $SELIC$, our estimates indicate a high and significant slackness multiplier ($\hat{\beta}_A = 3.2499$, *p-value* $= 0.0062$). The no-slackness multiplier is smaller (0.5242) and not significant (*p-value* $= 0.5737$). Adding lags of differences of $SELIC$ substantially improves the model fit compared to *model* 1, with R^2 increasing to 0.5871 and *adjusted*-R^2 to 0.2361. However, the goodness-of-fit remains poorer than that of *model* 0, again suggesting omitted variable bias in *model* 2.

To our knowledge, the literature on Brazil has not considered using dummies. In *model* 3, which includes only the dummies without $SELIC$ and $EMBI$, the slackness multiplier is significant at the 10% level (1.9606), roughly half the estimate in *model* 1 without dummies. The no-slackness multiplier (1.1951) remains close to that in *model* 1, but with a *p-value* of 0.1010, which could be considered significant given the small degrees of freedom, a common argument for using a 68% confidence interval. These significant estimates are obtained even with improved model fit over *model* 1 by adding the dummies, as R^2 increases to 0.6842 and *adjusted*-R^2 to 0.4920. However, the fit is still worse than *model* 0, indicating that $SELIC$ and $EMBI$ play crucial roles in altering the results.

Lastly, in *model* 4, which includes $SELIC$ and the dummies, the model fit improves further, with $R^2 = 0.7812$ and *adjusted*-R^2=0.5739, closer to but still lower than the values in *model* 0, which also has a lower AIC. Despite these modest differences in fit statistics, the improvements in *model* 0 significantly affect the estimated multipliers, especially $\hat{\beta}_A$, which is 0.1050 in our benchmark but 1.2472 (*p-value* = 0.1374) without $EMBI$ in *model* 4. The estimated β_B becomes 0.7991 (*p-value* = 0.1883), compared to $\hat{\beta}_B = 0.9789$ (*p-value* = 0.3014) in *model* 4.

In summary, the inclusion of various controls significantly impacts the estimated fiscal spending multipliers. Incorporating the monetary policy interest rate improves the model fit while maintaining the significance of the slackness multiplier. However, adding a measure of sovereign risk further enhances the fit, resulting in insignificant multipliers regardless of the business cycle state.

Robustness - alternative measures of $f(k)$

To assess the robustness of our conclusions, we examine how the results change when using $f(MA(2)_t)$ and $f(MA(7)_t)$ to estimate the probability of being in a non-slackness state of the business cycle. Consistent with our earlier analysis of the importance of each covariate, we focus only on the 4-quarter cumulative multiplier. This robustness check is conducted on our benchmark specification, which includes both dummies, $SELIC$, and $EMBI$. The results, presented in Table 5, show that although the point estimate multipliers differ slightly, they remain insignificant, with *p-values* exceeding 0.30. The table also indicates that our benchmark choice, $f(MA(2)_t)$, yields the highest R^2 and the lowest Akaike Information Criterion (AIC), suggesting it provides the best fit among the alternatives considered.

Table 4: 4-quarter cumulative state-dependent spending multipliers of different specifications

	model 0	*model* 1	*model* 2	*model* 3	*model* 4
dummies	yes	no	no	yes	yes
SELIC	yes	no	yes	no	yes
EMBI	yes	no	no	no	no
β_A (slackness)	0.1050	3.8743	3.2499	1.9606	1.2472
	(1.1631)	(1.7236)	(1.1245)	(1.1322)	(0.8219)
	[0.9287]	[0.0292]	[0.0062]	[0.0900]	[0.1374]
β_B (no slackness)	0.9789	1.2445	0.5242	1.1951	0.7991
	(0.9309)	(0.9811)	(0.9241)	(0.7142)	(0.5964)
	[0.3014]	[0.2107]	[0.5737]	[0.1010]	[0.1883]
R^2	0.8307	0.4611	0.5871	0.6842	0.7812
$adj - R^2$	0.5823	0.1692	0.2361	0.4920	0.5739
AIC	-328.15	-277.32	-281.30	-313.41	-324.93
p-value when $H_1 : \beta_A \neq \beta_B$	0.6605	0.2510	0.1237	0.6512	0.7197

Notes: Estimates of the 4-quarter cumulative government spending multiplier for the GDP based on equation 1 with a transition function $f(k)$ where k is a 5-quarter moving average of the GDP growth. Every specification includes 4 lags on the growth rate of GDP, government spending and revenue. The line *dummies* indicates if $D.2008Q4$ and $D.brecession$ are included or not. Lines *dselic* and *dembi* indicate, respectively, whether 4 lags of the first difference of $SELIC$ and 4 lags of the growth rate of $EMBI$ are among the covariates. *model*0 is our base (complete) model, and the results are identical to those reported in the last column of Box B of Table 3. HAC standard errors are in parentheses and *p-value* in brackets.

Table 5: 4-quarter cumulative state-dependent spending multipliers for different $f(z)$

	$MA(5)$	$MA(2)$	$MA(7)$
β_A (slackness)	0.1050	0.4102	0.9194
	(1.1631)	(0.9823)	(1.1239)
	[0.9287]	[0.6793]	[0.4198]
β_B (no slackness)	0.9789	0.4026	1.0523
	(0.9309)	(0.9013)	(1.0475)
	[0.3014]	[0.6583]	[0.3231]
$D2008Q4$	-0.0145	-0.0148	-0.0054
	(0.0119)	(0.0153)	(0.0206)
$D.brecession$	-0.0431***	-0.0376**	-0.0488***
	(0.0080)	(0.0137)	(0.0120)
R^2	0.8307	0.7929	0.8024
$adj.R^2$	0.5823	0.4893	0.5125
AIC	-328.15	-313.06	-316.56
p-value when $H_1 : \beta_A \neq \beta_B$	0.6605	0.9965	0.9402

Notes: Estimates of the 4-quarter cumulative government spending multiplier for the GDP based on equation 1 with transition function $f(k)$ with k being 2-, 5-, and 7-quarter moving average of the GDP growth. HAC standard errors are in parentheses and *p-value* in brackets.

7 Concluding Remarks

As in the international literature, there is no consensus on the size and significance of fiscal multipliers in Brazil. The variations in controls used in statistical analyses complicate comparisons across studies, prompting us to investigate how key variables might influence results and the resulting conclusions. In the context of the Brazilian economy, significant differences in fiscal policy instruments also distinguish various works.

Our findings demonstrate that including $SELIC$ and $EMBI$ among the covariates leads to notably different results compared to previous studies where these variables were absent. While $SELIC$ has been used in some studies, those works often employ a very restricted measure of fiscal policy. Conversely, $EMBI$ has not been considered in studies about fiscal multiplier in Brazil, despite substantial evidence of sovereign risk's impact on the business cycle in emerging economies, particularly Brazil.

We closely replicate previous findings of significant linear and state-dependent fiscal multipliers when $SELIC$ and $EMBI$ are excluded from the controls. We also find significant linear and slackness fiscal multipliers when only $SELIC$ is included. However, when both $SELIC$ and $EMBI$ are accounted for, no significant fiscal multiplier is observed, even after controlling for significant events such as the 2008/2009 global and domestic recession and the 2014/2016 deep and prolonged recession in Brazil. Additionally, incorporating $SELIC$ and $EMBI$ significantly improves model fitting.

Our analysis uses a fiscal spending time series from 1999Q1 to 2019Q4, incorporating public sector spending on goods and services as well as other traditional forms of fiscal policy, such as transfers to households, subsidies to firms, and loans provided by state-owned banks. These forms of fiscal policy have been extensively employed by the Brazilian Federal government.

There is ample opportunity and need for further analyses incorporating the set of controls we propose. One crucial area for policy purposes is to evaluate the significance and size of specific forms of public spending. Orair et al. (2016) have conducted such analyses for Brazil but used a limited set of econometric controls that we have shown to bias estimates, inflating the multipliers and making them appear significant.

Another promising avenue is to examine the response of macroeconomic aggregates, comparing the findings with the predictions of different theories regarding the channels through which fiscal policy operates, particularly in relation to the state of the business cycle. This direction has been previously considered for Brazil, but using a restricted set of covariates.

Finally, it would be particularly valuable to evaluate the heterogeneous effects of fiscal policy. Specifically, examining the impact on salaries and employment across different household groups, such as informal versus formal sector labor, educated versus non-educated individuals, and low-income versus high-income households, is crucial for policy decisions.

Appendix

A Data

We utilize quarterly balanced data from 1999Q1-2019Q4. Table A1 lists the data used in the empirical analysis. For each variable, we reported the ID in the original database, the scale, the source, and relevant remarks (e.g., variable transformation and aggregation method etc.). All monetary variables are deflated by GDP deflator and deseasonalized using the standard ARIMA X13.

Table A1: Data

Variable	*ID*	*Scale*	*Source*	*Remarks*
Real GDP	Y	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Real Government Spending	G	Level (million BRL)	TN/RTN Central Government Primary Balance Database(2)	Measurement error adjustment extending the Orair et al. (2016) contribution. Quarterly aggregated by the sum of the monthly data.
Real Government Revenue	T	Level (million BRL)	TN/RTN Central Government Primary Balance Database(2)	Measurement error adjustment extending the Orair et al. (2016) contribution. Quarterly aggregated by the sum of the monthly data.
Real Consumption	C	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Real Investment	I	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Real Exports	X	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Real Imports	N	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Agriculture, forestry, livestock and fishing (Real value added)	O1	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Industry (Real value added)	O2	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Manufacturing (Real value added)	O21	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Construction (Real value added)	O22	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
Services (Real value added)	O3	Level (million BRL)	IBGE/SCNT Quarterly National Accounts(1)	
GDP Growth	GR	Rate	Author's estimate	
2-quarter Moving Average Growth Rate	MA2	Rate	Author's estimate	
5-quarter Moving Average Growth Rate	MA5	Rate	Author's estimate	Right-aligned Moving Average.
7-quarter Moving Average Growth Rate	MA7	Rate	Author's estimate	Right-aligned Moving Average.
Potential GDP 1	YHP	Level (million BRL)	Author's estimate	Trend component of the HP Filter on Real GDP with $\lambda = 1600$.
Potential GDP 2	YHF	Level (million BRL)	Author's estimate	Trend component of the Hamilton Filter on Real GDP with $h = 8$ and $p = 4$.
Cyclical Output 1	CHP	Level (million BRL)	Author's estimate	Cyclical component of the HP Filter on Real GDP with $\lambda = 1600$.
Cyclical Output 2	CHF	Level (million BRL)	Author's estimate	Cyclical component of the Hamilton Filter on Real GDP with $h = 8$ and $p = 4$.
Capacity Utilization (Industry)	NUCI	Level (Index)	CNI-National Confederation of Industry(3)	Quarterly aggregated by the geometric mean of the monthly data.
EMBI	EGB	Level (Index)	JPMorgan	Quarterly aggregated by the geometric mean of daily data
EMBI+ Brazil	EBR	Level (Index)	JPMorgan	Quarterly aggregated by the geometric mean of daily data

(1) `https://www.ibge.gov.br/en/statistics/economic/industry-and-construction/17262-quarterly-national-accounts.html?=&t=o-que-e` (2) `https://www.tesourotransparente.gov.br/temas/estatisticas-fiscais-e-planejamento/estatisticas-fiscais-do-governo-geral` (3) `http://www.portaldaindustria.com.br/statistics/industrial-indicators/`

B Evolution of $f(z)$ under different γ

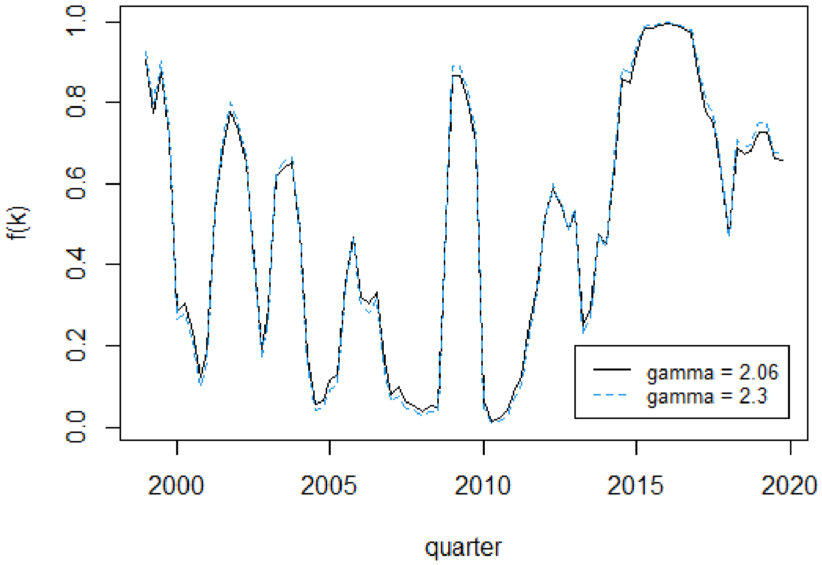

Figure 4: Evolution of $f(k)$ for $\gamma = 2.06$ and $\gamma = 2.30$ when k is the 5 quarters moving average for GDP growth.

Notes: These correspond to the minimum and maximum value for γ that guarantees guarantees $Pr(f(k_t) > 0.78) = 0.22$. Given their similarity, we decided to use the mean value: $\gamma = 2.18$

C Evolution of $f(z)$ using different 2 and 7 moving average for GDP growth

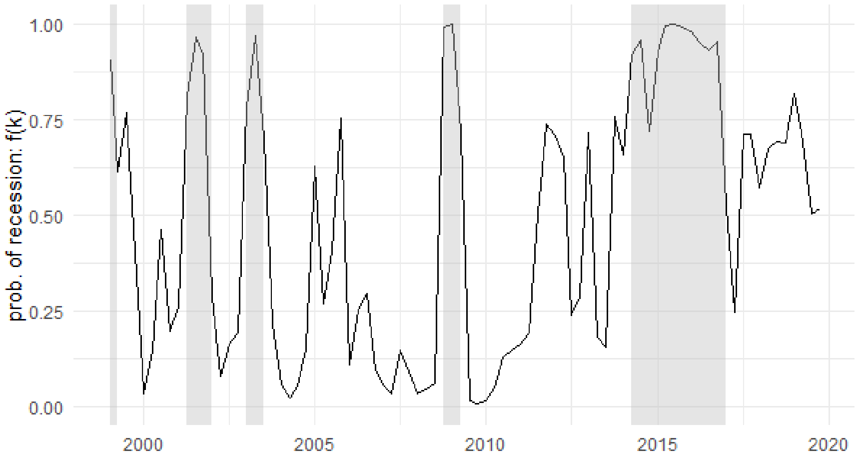

Figure 5: Probability of being in recession according to the logistic function $f(k)$ where k is a 2-quarter moving average for GDP growth.

Notes: The shaded areas correspond to quarters of recession according to CODACE. The solid black line represents the probability of being in recession according to the logistic function $f(k) = \frac{exp(-\gamma k_t)}{1 + exp(-\gamma k_t)}$ with $\gamma = 2.5550$ and k as the normalized 2-quarter moving average for GDP growth.

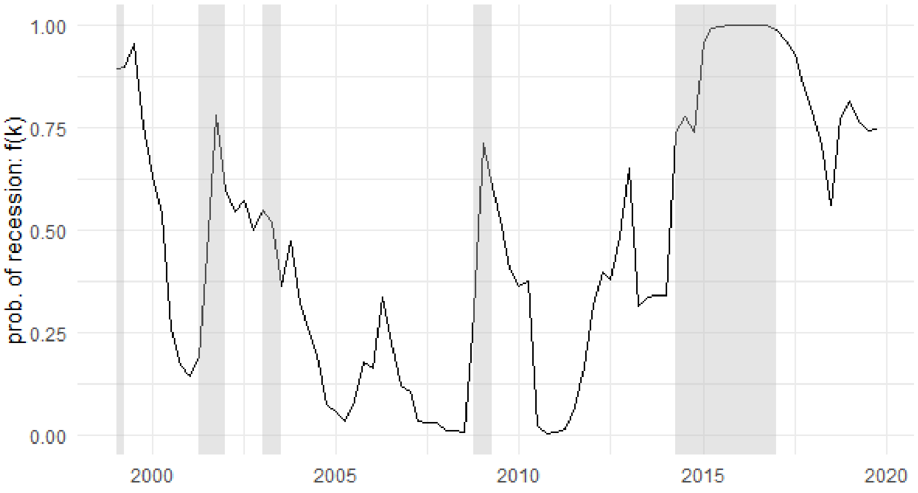

Figure 6: Probability of being in recessionary according to the logistic function $f(k)$ where k is a 7-quarter moving average for GDP growth.

Notes: The shaded areas correspond to quarters of recession according to CODACE. The solid black line represents the probability of being in recession according to the logistic function $f(k) = \frac{exp(-\gamma k_t)}{1 + exp(-\gamma k_t)}$ with $\gamma = 2.75$ and k as the normalized 7-quarter moving average for GDP growth.

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