ESSAYS ON FISCAL POLICY EFFECTS ON MACROECONOMICS OUTCOMES

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Ivan Enrique Davila Fadul

Dr. Joseph Haslag, Thesis Supervisor

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The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled:

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presented by Ivan Enrique Davila Fadul, a candidate for the degree of Doctor of Philosophy and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. Josehp Haslag

Dr. Christopher Otrok

Dr. David Kaplan

Dr. Christopher Wikle

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ESSAYS OF FISCAL POLICY EFFECTS ON MACROECONOMIC OUTCOMES

Ivan E. Davila Fadul

Dr. Joseph Haslag, Dissertation Supervisor

ABSTRACT

The dissertation consists in three chapters addressing the effects of fiscal policy on macroeconomic outcomes. In the first chapter, I take advantage of the scarcity of evidence on the effects of public spending on GDP growth in developing countries. Thus, the main focus is in the top five emerging economies, Brazil, Russia, India, China and South Africa, known as BRICS, that accounts for almost a quarter of world GDP have received little attention. Through an Auto-regressive Panel-Vector (P-VAR) model, using quarterly data from 1997Q1 to 2017Q4, I estimate that the government spending multiplier is 0.145% on impact ***(t=0)***, and a cumulative multiplier of -0.125% percent in 5 years. Also, I analyze how the results of the baseline model vary according to specification adjustments, different order of the variables, and the use of alternative trend removal mechanisms. The robustness analysis shows that the multiplier is sensitive to these changes, which provides evidence of the possible causes of the varied results.

In the second chapter, I estimate the local fiscal multiplier using the literature on incumbency status and local spending. The literature suggests that regional authorities seek to influence their voters through increases in government spending during the election years. Given this, I build an instrument based on term limits and electoral laws established in the Legislatures of the 50 US states and the District of Columbia, to estimate the local fiscal multiplier for the period of 2007-2016. My estimate of the fiscal multiplier in the baseline model is 1.274. Through a robustness check, my estimator fluctuates between 1.208 and 1.239. My results are consistent with the estimations in the geographic cross-sectional multipliers literature for the United States.

In the third and last chapter, I evaluated the fiscal policy effects in a dollarized Latin American economy such as Ecuador. Therefore, I estimate both the linear and state-dependent impact and cumulative multiplier for the period between 1991Q1 and 2019Q4. The main result shows that the linear impact multiplier is 0.79 and fades in the medium and long term. Furthermore, in expansions and recessions, the impact multiplier is 1.42 and 0.91, respectively. However, the effect disappears in the long run when dealing with expansions. On the other hand, in periods of recession, the cumulative multiplier is 0.64, significantly different from zero at a 90% confidence interval. The results suggest that the multipliers are distinct between states at a 5% level of significance.

Chapter 1

Government Spending Shocks: None or some impact in BRICS?

1.1 Introduction

The estimated effects of government spending on aggregate macroeconomic results vary from being negative to positive. Commonly, during times of crisis, there are more calls for the government to provide solutions. Following Keynes's (1936) prescription, some researchers have argued that the government must increase its spending or cut taxes to mitigate a recession. Bilbiie, Monacelli, and Perotti (2019) find that the fiscal policy effectively achieved its objective of stabilizing the economy, comparing it with a scenario without fiscal policy. In contrast, detractors argue that the state must stay out of the economy since its strategies will have zero impact on output. The main reason is the crowding-out effects on consumption and private investment, as suggested by the Ricardian Equivalence.[1]

[1] Seater (1993) performs an extensive analysis of the theory behind the Ricardian Equivalence. In his notes on Intermediate Macroeconomics at the University of Notre Dame, Eric Sims presents a practical illustration of the impact of Ricardian equivalence on fiscal policy, specifically on the government spending multiplier. Christiano, Eichenbaum, and Rebelo (2011) and Clemens and Miran (2012) formally analyze the repercussions of Ricardian equivalence on their estimated multipliers.

Despite the abundant evidence of the effects of government spending on output, this analysis is scarce in the case of developing countries. Scarcity originates from the lack of reliable data published, as emphasized by Ilzetzki, Mendoza, and Végh (2013). Thus, most studies focus on countries or groups of countries that have high-income or developed economies such as the United States (USA) and the United Kingdom (UK) or the European Union (EU) and the Organisation for Economic Co-operation and Development (OECD), respectively. A portion of the remaining studies includes developing countries in their samples to compare across types of economies. The main comparison covers differences in effect size between advanced and emerging economies as Ilzetzki, Mendoza, and Végh (2013), and Hory (2016) do. Consequently, a few essays use relatively large samples that focus their attention in developing countries such as Kraay (2012, 2014). The situation worsens in cases of samples with a reduced number of developing countries, as in the works of Yuan and Chen (2015) and Jawadi, Mallick, and Sousa (2016).

In this paper, I conduct a conditional assessment of whether government spending changes affect real GDP in Brazil, Russia, India, China, and South Africa, hereafter BRICS. Figure 1.1 illustrates the importance of BRICS in the world economy and compares it with groups of developed countries such as the EU, the G-10, and the OECD.[2] The BRICS experienced an average annual growth of 5.06% from 1990 to 2017. The difference between the growth rates of BRICS and the rest of the groups are statistically different at all significance levels traditionally used. This growth allowed BRICS to move from the 11% to the 22% share of the world economy, placing one-step ahead of the EU with a 20% share. The BRICS' public spending presents similar variations to the other groups of countries, even though it has the lowest

[2]The G-10 corresponds to the group of countries that agreed to contribute more money to the IMF to grant a more massive amount of credits to other countries. In the beginning, the group was made up of Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States. In 1964 Switzerland was added.

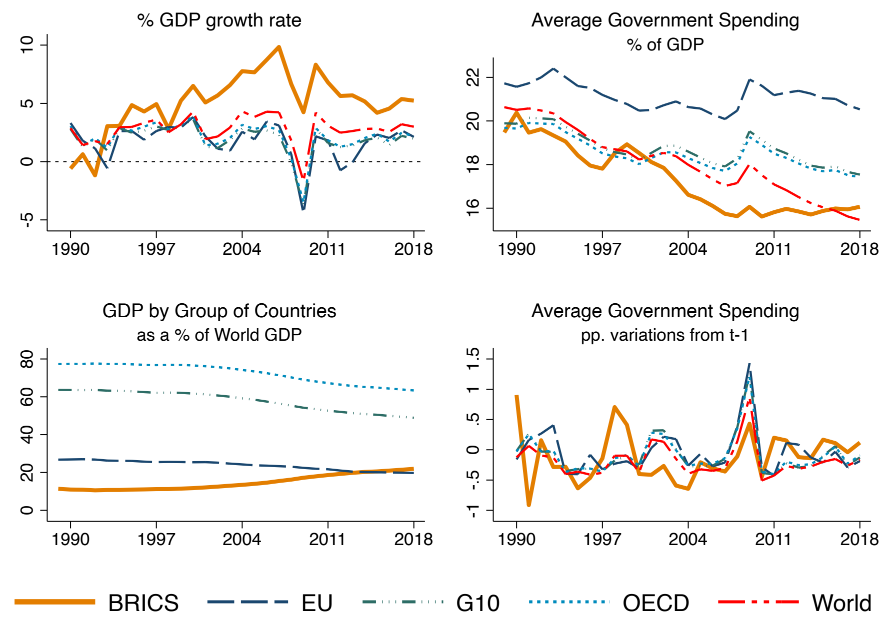

Figure 1.1: BRICS' GDP and government consumption annual performance compare to the EU (navy long-dashed line), G-10 (emerald three-dot dashed line), OECD (light blue very-short-dashed line), and the World (red short-and-long dashed line). The solid dark orange line represent BRICS data.

average participation in GDP among the countries' groups, with a 16%.[3]

To analyze if there is any implication of the government's actions and spending decisions on growth, I estimate the impact and cumulative government spending multiplier *(GSM)* using quarterly data over the period 1997Q1 - 2017Q4. Formally, Cogan, Cwik, Taylor, and Wieland (2010) define the (GSM) as the percentage change in real GDP in response to a one percent increment in government spending. To estimate the government spending multiplier, I use the post-estimation methods proposed by Blanchard and Perotti (2002), and further developed by Mountford and Uhlig (2009) for the impact and cumulative multiplier, respectively.

The empirical estimation starts with a Panel-Vector Auto-regressive (P-VAR) model, which includes country-fixed effects. To remove the country-fixed effects, I follow the so-called Helmert Procedure, which calculates the mean of all future val-

[3]The data comes from the World Bank Open Data database.

ues and deducts it from each observation. To achieve identification, I estimate the P-VAR following the Blanchard and Perotti (2002) scheme, which orders government consumption first followed by the rest of the variables, akin to a Cholesky's decomposition. The baseline specification follows Ravn et al. (2012) and includes final government consumption, output, private consumption, current account, and real effective exchange rate; all the variables are a deviation from the quadratic trend. Furthermore, to deal with seasonal patterns, all variables were seasonally adjusted using ARIMA X-13.

The impact multiplier in the baseline model is 0.145%, significantly different from zero in a 90% confidence band. Later the multiplier turns negative, but not significantly different from zero, and settles on -0.126% at the 20 quarters horizon. In short, the effects of an increase of 1% in government spending induces a 0.145% rise in GDP at impact, but it causes a negative cumulative response of -0.126% after 20 quarters. This multiplier interpretation is for each additional percentage that the government decides to consume in goods; the GDP will increase by 0.145 percent. The multiplier size means that each extra percentage of public consumption is unproductive since it does not stimulate the private sector productivity.

This paper's first contribution is on the literature on the effect of public spending in developing countries. Specifically, for BRICS, this document goes further compared to previous work by providing an empirical estimate of the government spending multiplier. In earlier works on BRICS, Yuan and Chen (2015) and Jawadi et al. (2016), they do not calculate the multiplier. The authors estimate the effects of the interaction of fiscal and monetary policy on the economies' growth. Their discussions focus on impulse response (IRF) functions that cannot be directly interpreted as multipliers since they are elasticities. Moreover, the authors do not follow the government spending multiplier literature's identification strategy to estimate the IRFs.

The second contribution is to characterize the determinants of the conflicting results between the previous works in BRICS. Modeling choices matter in this literature due to the presence of endogeneity. Variations in government spending may come from GDP changes, given that the fiscal authorities could adopt policies in response to alterations in the country's economic activity. In like manner, the change in GDP can also be promoted by the government through its spending. The endogeneity generates identification problems in applied macroeconomic studies, as highlighted by Nakamura and Steinsson (2018). To deal with the identification problems, authors look for natural experiments that are appropriate and relevant to the study's specific research question. In the absence of natural experiments, the most common resource is to specify a model under assumptions about the economy's behavior.

Different specifications are used in the literature to estimate *GSM*, which may explain the varied range of both positive and negative results. The specifications show a different combination of the variables included in the vector, and a different order of the used variables to achieve identification. For example, some studies order government spending first, but others order it in the third or fourth position. This mix of specifications leads to a wide range of multipliers that differ in magnitude and direction.

That said, I test if the baseline model results are robust related to five tweaks in my empirical approach. First, I propose three alternative specifications following Ilzetzki et al. (2013), Yuan and Chen (2015) and Jawadi et al. (2016) using a common dataset. Second, I assess the repercussions of ordering government consumption in a position different from first, contrary to the Cholesky's decomposition proposed by Blanchard and Perotti (2002). Third, I assess how the results vary when I include actual quarterly fiscal-balances in opposition to Yuan and Chen (2015). [4] Fourth, I explore the effects of including the US Federal Funds rate in the first position following Jawadi et al. (2016). Finally, the fifth adjustment considers the use of two alternative

[4] In Yuan and Chen (2015) since they did not have quarterly series for fiscal balances, the authors state that it was necessary to interpolate the annual series and thus obtain their quarterly series.

trend removal methods corresponding to the HP filter and the Hamilton's (2018) filter.

There are five main takeaways from the robustness check. First, modifying the specification by omitting or adding variables influences the results. Omitting consumption, as in Ilzetzki et al. (2013), magnifies the multipliers. On the other hand, the inclusion of monetary policy variables such as Yuan and Chen (2015) and Jawadi et al. (2016) contracts the impact multiplier while changing the direction of the cumulative multiplier. Second, the variable ordering matters. When the fiscal variables are not ordered first, contrary to Blanchard and Perotti's (2002) identification strategy, the impact multiplier is zero. Hence, the null impact multiplier agrees with Yuan and Chen's (2015) and Jawadi et al.'s (2016) results. Third, the inclusion of quarterly fiscal balances results in a negative impact and cumulative multiplier, contrary to what was found by Yuan and Chen (2015). Fourth, the inclusion of the US Federal Funds rate provides evidence that supports the baseline model results. However, they contradict the substantial effect found by Jawadi et al. (2016). Fifth and last, the use of different filters does not affect the impact multiplier, although it affects the cumulative multiplier. The HP filter makes it positive, while the Hamilton's (2018) filter makes it even more harmful by magnifying its negative value.

I have organized the rest of this paper in the following way. The following section presents the literature review covering the types of multipliers, the approaches used for their estimation, and the scenarios where it is asymmetric. Section 1.3 describes the data and methodology employed in this paper following the results from the baseline scenario. In contrast, Section 1.4 describes the econometric methodology used in the alternative scenarios and the alternative specifications that characterize the robustness check. Finally, Section 1.5 concludes this paper.

1.2 Literature Review

Researchers have devoted considerable effort to identify the impact of fiscal stimulus on economic aggregates. In particular, the effects of increases in public spending during a crisis. During the Great Recession, national governments disbursed large amounts of money to mitigate a sharp contraction in their economies. Some examples are the governments of advanced countries such as the United States, Spain or Greece, and emerging economies such as Brazil and China.

There is no consensus on the effects of increased public spending on boosting the economy or avoiding contraction. From the beginning, the literature addressed this topic distinguishing public spending characteristics. There is a distinction between temporary and permanent changes in government purchases.Barro (1981) argues that temporary purchases have more substantial effects on GDP compared to permanent purchases. In contrast, Baxter and King (1993) using a neoclassical model, states that permanent purchases had more significant results than those caused by temporary purchases.

The literature has made efforts to group multipliers in different ways. Farhi and Werning (2016) group fiscal multipliers into two types: local (summary) and national. Local multipliers use cross-sectional panel data, and econometric methods applied in cross-section microeconomics. OLS estimation is the primary method to obtain summary multipliers. The researchers look for a causal effect between public spending and the dependent variable. Such estimates suffer from possible biases. So it is necessary to use instrumental variables or a GMM system. Thus, identification comes from finding events that meet two conditions. The first condition is that the events are independent of local economic activity. In the second condition, there must be a correlation between the instrument and fiscal policy. For example, Acconcia, Corsetti, and Simonelli (2014) use the enactment of a new law. The law demands the municipal council dismissal for having relationships with the Mafia. So, the dismissal represents an abrupt stoppage in government spending.[5]

National multipliers come from the analysis of a time series of aggregated variables. There are three main approaches to estimate government consumption effects from aggregate evidence: i) the narrative approach using starting dates of wars, ii) use defense spending as an instrument of total government spending, and iii) estimate impulse-response functions based on a structural vector auto-regressive multivariate model (SVAR) or through the local projection method (LP).

Ramey and Shapiro's (1998) narrative approach uses dates where the United States starts its arming process begin for wars. The dates take into account the Korean War, the Vietnam War, and the Carter-Reagan buildup. The war dates are dummy variables and included in an autoregressive model with one variable. Later, Ramey (2011b) improved the approach by constructing a new variable called *defense news*. The *defense news* variable registers the estimates of the expected discounted value of changes in government spending in response to changes in the international political arena.[6] The primary source is the news published by *BusinessWeek* and newspapers. The news includes events that would cause the US's probable participation in wars and thus anticipated military expenses.

Barro and Redlick's (2011) instrumental approach requires the use of defense spending, not total expenditure. The authors argue that defense expenditures are exogenous to economic activity. Defense spending should not be related to other variables that may affect GDP to be exogenous. Nevertheless, there are two factors associated positively with the war period and defense spending. Those two factors are

[5]There is a standard extra strategy observed in studies such as Acconcia et al. (2014), Brückner and Tuladhar (2014), Nakamura and Steinsson (2014), and among other authors. The researchers use time fixed-effects and region, state, or geographical area fixed-effects. The addition of time fixed effects allows controlling the repercussions of aggregate shocks and the interaction of national fiscal and monetary policies. The inclusion of geographical area fixed-effects contributes to identifying regional trends that are present on the GDP and Government Spending. Moreover, the region's fixed-effects leave aside properties that do not vary in a particular area.

[6]The process implemented by Ramey (2011b) follows a similar approach as Romer and Romer (2010) use for construct a new variable based on tax policies.

patriotism and rationing, which could cause bias in the coefficient. Another downside is that many developing countries cannot apply this approach due to the lack of data related to military spending. Developing countries usually do not have this data or have not experienced massive wars.

The SVAR approach, applied by Blanchard and Perotti (2002), constructs a vector of variables corresponding to public expenditure, taxes, and output. The critical problem is that both the spending and taxes are dependent on the country's economic activity. This relation leads to immediate effects of the production on expenditure levels or taxes that the authors call automatic effects. Additionally, fiscal authorities adjust spending in reaction to a change in output. Blanchard and Perotti (2002) argue that researchers should use quarterly data to avoid immediate fiscal policy adjustment. Besides, the vector of variables includes its lags, so the variation in government spending only comes from exogenous sources. Finally, Blanchard and Perotti (2002) argue that the variables in the vector should follow a specific order. This order aims to end the relationship between tax and expenditure. This step is comparable to a Cholesky's decomposition. The variable of interest is first ordered, in this case, public spending.

There are criticisms for both Blanchard and Perotti's (2002) SVAR approach and the VAR method itself. One downside over the Blanchard and Perotti's (2002) SVAR scheme is the lack of foresight. Identified unexpected fiscal shocks could well be considered as anticipated events. As stated by Ramey (2011b), defense expenditures have waiting times between the decision and the execution of the spending. Hence, Ramey obtains the same results of the SVAR when she includes a delay in the wars' dates. Additionally, Auerbach and Gorodnichenko (2013a) propose the use of Jordà's (2005) local projection method. The method allows the inclusion of non-linearities in the estimation of impulse-response functions. Also, the local projection avoids the dynamic restrictions imposed by the VAR.

The literature on the effects of government spending and its wide variety of results can agree that the multiplier is not linear, but rather depends on the economic regime. In other words, the multiplier is state-contingent. The literature's main distinctions include economic characteristics as different phases of the economic cycle, monetary policy close to the lower zero bound, or their level of income or economic development.

The first important branch addresses state-dependent multipliers at the level of economic activity. The multiplier is larger during periods of recession or slacks compared with economic expansions. Auerbach and Gorodnichenko (2012, 2013a) find evidence that supports significant differences between the linear and state-dependent multipliers for the US and the OECD countries, respectively. In times of recession, the estimated multiplier reaches a positive and large magnitude. While in expansions, the multiplier is negative. Caggiano, Castelnuovo, Colombo, and Nodari (2015) show that fiscal multipliers are statistically higher than those during the economic depression.[7] In contrast, both Owyang, Ramey, and Zubairy (2013) and Ramey and Zubairy (2018), find no evidence to support such large multipliers in periods of high unemployment in the US.[8]

A second branch of the literature shows the implications of monetary policy in the spending multiplier. The multipliers in this branch tend to be larger than one. Woodford (2011) argues that the multiplier depends on the assumptions made about monetary policy. The author provides evidence consistent with multipliers smaller, equal, and greater than one. Cogan et al. (2010), considering rational expectations, show that the multipliers are sensitive to how long the interest rate is near the zero lower bound (ZLB). Subsequently, Drautzburg and Uhlig (2015) find evidence consistent with the notion that the multiplier depends on how many quarters the monetary

[7] Besides, Riera-Crichton, Vegh, and Vuletin (2015) add one more layer to the analysis by considering the direction of government spending at the start of the recession or expansion. The authors find evidence that the multiplier is sensitive to this extra layer.

[8] Biolsi (2017) argues that the results obtained by Ramey and Zubairy (2018) could be due to the threshold selected to determine which unemployment rate corresponds to a bad time in the economy.

policy maintains the zero lower bound.

Furthermore, Christiano, Eichenbaum, and Rebelo (2011) finds that when the monetary policy follows Taylor's rule, the multiplier is low. When the nominal interest rate is set equal to zero, the multiplier reaches values higher than one, increasing private consumption and inflation. Recently, Leeper, Traum, and Walker (2017) find results consistent with a larger multiplier during a passive monetary policy.

A third branch of the literature evaluates how a country's characteristics, such as level of debt or exchange rate type, influenced the magnitude of the government spending multiplier. First, Corsetti, Meier, and Müller (2012) analyze the role that the interaction of different exchange rates and states of both public finances and the financial sector play in the transmission of fiscal policy. The authors define a healthy scenario as an economy with low public debt, without a financial crisis, and a flexible exchange rate scenario. In that scenario, they cannot find evidence that an increase in government purchases is systematically related to output changes. In contrast, the multiplier reaches a magnitude of up to two during times of financial crisis. In the same way, Born, Juessen, and Müller (2013) confirm that the multiplier is higher under fixed exchange rates. Later, Ilzetzki et al. (2013) shows that the effect of spending is greater in countries with higher economic development, fixed exchange rates, or less-open economies. On the other hand, when faced with high debt, the multiplier is negative. It is worth mentioning that, in this case, the authors analyze the scenarios as independent without considering the interaction between the four characteristics. Only two of these characteristics, the high degree of development and low debt level, are confirmed by Chian Koh (2017). The author extends the sample to 120 countries and argues that the composition of their sample is driving the results obtained by Ilzetzki et al. (2013).[9]

[9]Miyamoto, Nguyen, and Sheremirov (2019) analyzes the effects of government consumption on the exchange rate and consumption differentiating between advanced economies and developing economies. In developing economies, an increase in government spending leads to an appreciation of the exchange rate and increased consumption.

Study	***Area***	***Main Result***
Ramey (2011a)	US	0.8 - 1.5
Beetsma and Giuliodori (2011)	14 EU Countries	1.5
Ravn et al. (2012)	USA, UK, CAN, AUS	0.52
Ilzetzki et al. (2013)	High Income Economies	0.66
Chian Koh (2017)	High Income Economies	0.97
Hory (2016)	Advanced Economies	1.33
Ramey (2019)	US	0.6 - 1
Atems (2019)	US	1.2

Table 1.1: Empirical results in Developed Economies

The literature suggests positive multipliers, and, in some cases, larger than unity, when it comes to advanced economies. Table 1.1 shows the empirical results obtained in a sample of studies that include advanced economies in their object of study. For example, in the United States, Ramey (2011a) argues that the multiplier is between 0.8 and 1.5 when it comes to a temporary increase in government purchases financed through a deficit. Then, Ramey (2019) adjusts this range to place it between 0.6 and 1 considering other aspects of the fiscal policy, such as fiscal consolidations. With this new narrow range, the author suggests that although there is a positive multiplier, it still does not reach a magnitude that stimulates the private activity. However, this range still leaves out other recent results, such as Atems (2019). Atems uses a P-VAR with quarterly data from the fifty US-States and find a cumulative multiplier of 1.2.

In groups of developed countries, there is also evidence that the multiplier is positive. For example, Ravn et al. (2012) find a 0.52 multiplier when they analyze data from a panel of four developed economies: the United States, the United Kingdom, Canada, and Australia. Also, Beetsma and Giuliodori (2011) evaluate the multiplier effect of government spending in 14 member countries of the European Union. Their main result is that a one percent increase in government purchases causes a 1.5%

Study	***Area***	***Main Result***
Ilzetzki and Vegh (2008)	Dev-Countries	0.67
Ilzetzki et al. (2013)	Dev-Countries	-0.03
Kraay (2012)	29 low-income	0.5
Kraay (2014)	102 dev-countries	0.4
Jha et al. (2014)	10 Asian Economies	0.30*
Chian Koh (2017)	Dev-Countries	0.63
Hory (2016)	Emerging Economies	0.41
Shen et al. (2018)	Dev-Countries	0.3
Yuan and Chen (2015)	BRICS	0
Jawadi et al. (2016)	BRICS	1.5**

[*] The estimate is for China, and at impact.
[**] After an increase in G by 2.7%

Table 1.2: Empirical results in Developing Economies

increase after one year. After five years, the effect is 0.66%.[10]

There is less evidence about the effect of public spending in developing economies. Table 1.2 shows a survey of the literature focusing on developing countries. The literature suggests that the multiplier effect is smaller than in developed economies or below zero. Ilzetzki and Vegh (2008) when looking for evidence that fiscal policy in developing countries is procyclical, find that the multiplier reaches a maximum of 0.67. This value is below the multiplier of 0.90 found for developed economies. Subsequently, Ilzetzki et al. (2013) evaluate in greater detail how the level of development affects the magnitude of the multiplier. The authors claim that the multiplier is negative in both impact and cumulative, with values of -0.029 and -0.63, respectively.

In the same way, Hory (2016) divides its sample between advanced economies (AEs) and emerging markets (EMEs). The author provides evidence that multipliers in EMEs are smaller compared to AEs. In this case, the impact multiplier is 0.41 for EMEs, a third of the multiplier found for AEs.

[10]Brinca, Holter, Krusell, and Malafry (2016), using a panel of 15 OECD countries, find that the spending multiplier is sensitive to differences in the level of inequality in the economy.

When the sample covers only developing or low-income countries, the multipliers are positive and relatively small. Kraay analyzes the effects of disbursements of World Bank loans on two samples. First, in 2012, Kraay builds a database of 29 low-income economies and find a multiplier of 0.5. Later, in 2014, the author expands the sample to cover 120 developing economies and finds the multiplier to be 0.4. Similar results are found by Shen, Yang, and Zanna (2018) when analyzing the effects of government consumption on output on low-income countries. The authors differentiate consumption financed through internal debt, external debt, or aid. When it comes to financing through domestic debt, the impact multiplier is 0.3, while the five-year cumulative multiplier is -0.5. In contrast, in the remaining two scenarios, the multipliers in impact and cumulative are 0.4 and 0.3, respectively.

In smaller panels of emerging countries, the impact effects of government spending are positive. Jha, Mallick, Park, and Quising (2014) claim that public spending generates a positive impact on the output of 10 Asian economies. However, it fades in the medium term. Shrinking the sample, focusing on the BRICS countries, Yuan and Chen (2015) contend that when there is an increase in fiscal balances, the output response is not statistically different from zero. Although this fiscal policy instrument is not similar to a rise in public spending, its purpose is to explain that there are no transmissions of fiscal policy to output. Instead, Jawadi et al. (2016) find that a change of 2,7% in government spending has a significant effect on GDP in the medium and long-term. The estimated response is greater than one (1.5%) on a horizon of 20 quarters.

Naturally, those conflicting results leave room for questions about BRICS' response to changes in government consumption. First, which of the previous results is the effect of public spending on economic growth? Second, since previous studies follow the same model with different variable ordering, are the results still valid if the public expenditure is ordered first in the Cholesky's decomposition as Blanchard and

Perotti (2002) suggest? Third, related to Yuan and Chen (2015), do the results differ if government consumption or actual quarterly fiscal balances are used instead of interpolated fiscal balance?. Lastly, in the case of Jawadi et al. (2016), is it important to declare the US Federal Funds interest rate as exogenous?

To answer the first question, I will specify my baseline model in the next section. For the remaining concerns, I will perform a robustness check in Section 1.4. The robustness checks will include minor modifications to the initial specification, such as the inclusion or omission of variables, and changes in the identification strategy.

1.3 Baseline Scenario

This section aims to describe the data collected, the methodology used, and the estimated government spending multiplier in BRICS with these ingredients. The baseline specification is based on the specification developed from the literature review. Subsequently, this specification and, more importantly, the results will be subjected to a series of robustness checks using variations of the model addressed in the next section.

I present the selected variables in the model specification with their respective sources and descriptive statistics. Then, I briefly analyze the size of the group's economies and compare them to the average GDP of the BRICS countries. Besides, I highlight specific characteristics of the variables that provide essential information to estimate the government spending multiplier. The main feature is the average interest rate, used to calculate the cumulative multiplier. Subsequently, I describe the actions taken to isolate the effects of the increase in prices and seasonal behavior. Finally, I detail the transformations made to address the possible unit-roots that could affect the model's stability.

The next step is to specify the baseline model and the methods needed to estimate

Variable	Definition
$\boldsymbol{Y}$	Real GDP by Country
$\boldsymbol{G}$	Real Government Final Consumption Expenditure
$\boldsymbol{C}$	Real Private Final Consumption Expenditure
$\boldsymbol{CA}$	Current Account-to-GDP ratio
$\boldsymbol{REER}$	Real Broad Effective Exchange Rate
$\boldsymbol{def}$	GDP Deflator Index 2015Q3=100
$\boldsymbol{ir}$	Short-term interest rate
$\boldsymbol{xr}$	National currency to US Dollar

Country	Source
Brazil	OECD
Russia	CBR & Rosstat
India	OECD
China	*Chang et al. (2016)* & SAFE
South Africa	OECD

$\boldsymbol{Y}$, $\boldsymbol{G}$, $\boldsymbol{C}$ and $\boldsymbol{REER}$ are log difference from the quadratic trend.

$\boldsymbol{CA}$ is in levels.

Table 1.3: Data definition & sources.

the government spending multiplier. Lag-length selected is also presented. The particular order of the variables to achieve identification in the variations of government spending. After that, I discuss the various transformation procedures to estimate the multiplier of government spending and, finally, the selected method's motivation.

My results will focus on the orthogonalized impulse-response functions to observe the reactions of the remaining variables in the model to a change in public spending, normalized to an increase of one percent. I also analyze how these reactions relate to the literature, whether the results provide evidence of support or contrast to previous findings. Then, to better appreciate the multiplier, I present both the impact and the cumulative multiplier graphically.

1.3.1 Data

Table Table 1.3 shows in detail the variables used with their definition and source by country. There are five variables measured over 21 years in the baseline scenario, spanning the period 1997Q1 until 2017Q4. The variables are real GDP ($\boldsymbol{Y}$), real government final consumption expenditure ($\boldsymbol{G}$), real private final consumption expenditure ($\boldsymbol{C}$), the current account balance-to-GDP ratio ($\boldsymbol{CA}$) and the real broad effective exchange rate ($\boldsymbol{REER}$). When data are reported as nominal series, the GDP Deflator ($\boldsymbol{def}$) is used to convert the series to a real series. After that, I transform into natural logarithms, except for $\boldsymbol{CA}$, which is in levels. Current account balances are in terms of U.S. dollars and then converted to the respective national currency using the national currency's average daily rates to U.S. Dollar Exchange Rate ($\boldsymbol{xr}$).

For Brazil, India, and South Africa, the primary sources are two. First, the Main Economic Indicators complete database from the Organization for Economic Cooperation and Development (OECD). Second, the International Financial Statistics (IFS) by the International Monetary Fund (IMF). Both databases were accessed through the Federal Reserve Economic Data (FRED). As an additional validation process to ensure no inconsistencies in the data, I compare the collected data with published data by each country's official entities: the Central Bank of Brazil, the Ministry of Statistics and Programme Implementation of India, and the Reserve Bank of South Africa.

Concerning China, most of the compiled economic data come from Chang, Chen, Waggoner, and Zha (2016). However, the current account data come from the State Administration of Foreign Exchange (SAFE), spanning between 1998Q1 and 2018Q3. By using Chang et al. (2016) and SAFE data, there is an advantage owing to their frequency compared to data from international organizations or local agencies. The OECD only shows quarterly data for GDP, while the National Bureau of Statistics of China (NBS) shows annual private and public consumption data.

In Russia's case, the time series of the current account comes from the Central Bank of the Russian Federation, including information since 1994Q1. GDP, government, and private consumption come from the Federal Service of State Statistics, and the series begins in 1995Q1. These sources cover a more extended period than the FRED and OECD data, which show series that start in 2003Q1.

Further, all series were seasonally adjusted when appropriate to deal with seasonality in the quarterly data (climate or social factors). The seasonal approach is the X-11 algorithm through the X-13ARIMA-SEATS Seasonal Adjustment Program created and maintained by the U.S. Census Bureau.

Table 1.4 shows the descriptive statistics for BRICS. The sample consists of a maximum of 420 observations for each variable across countries for 20 years. Missing values occur, especially in the case of China. The descriptive statistics of the BRICS countries show that the panel's average GDP growth corresponds to 1.13%. The maximum and minimum growth rate of GDP during the sample period belongs to the Russian Federation. During 1998, Russia faced a currency crisis that led the country to default on public and private debt. On the other hand, the highest growth rate is related to the recovery period after the Great Recession of 2009, supported by the return of capital inflows and the increase in oil price. Additionally, during the Great Recession, Brazil and India also presented substantial variations in their GDP. While Brazil faced a 4% contraction of its GDP, India had an economic growth of almost 6% after the financial crisis.

Regarding government spending, on average, it represents 16.31% of GDP and shows relatively low volatility with a standard deviation of 3.49%; with the governments of South Africa and Brazil with the highest average spending (19%), while the government of India (11%) has the lowest average expenditure. Finally, the interest rate shows an average of 9.17% being highly volatile due to its standard deviation of

$\boldsymbol{Variable}$	$\boldsymbol{Obs.}$	$\boldsymbol{Mean}$	$\boldsymbol{SD}$	$\boldsymbol{Min}$	$\boldsymbol{Max}$
$\boldsymbol{\Delta Y}$	419	1.13	1.41	-7.59	8.37
$\boldsymbol{G/Y}$	420	16.31	3.49	8.63	21.55
$\boldsymbol{C/Y}$	420	54.76	8.80	35.42	68.21
$\boldsymbol{CA}$	416	0.72	4.55	-6.61	19.53
$\boldsymbol{REER}$	420	103.09	22.53	59.57	152.67
$\boldsymbol{def}$	419	7.28	8.55	-26.78	78.48
$\boldsymbol{ir}$	411	9.17	6.99	1.10	44.68

$\boldsymbol{\Delta Y}$ is the GDP growth rate in percentage terms.
The variables are expressed as to-GDP ratios.

Table 1.4: Descriptive Statistics - *BRICS*

6.99%, where Brazil and China present the sample period's maximum and minimum interest rate, respectively.

To analyze the economies' sizes, I compare the average GDP during the last two years of the sample (2016-2017).[11] The Chinese economy is 39 times larger than the South African economy, the latter being the smallest economy in the group with an average GDP of $77 billion. The second-largest economy corresponds to India, whose average GDP is $578 billion and accounts for about one-fifth of the Chinese economy. In third and fourth places, Brazil's ($408 billion) and Russia's ($328 billion) economies represent about an eighth and a tenth of the Chinese economy, respectively. Since China's average GDP is $1,573 billion, it is three times higher than the average, and it could be said that it is the country that leads upwards to average values generating some distortion. The average GDP of the group is higher than the maximum GDP of Brazil, Russia, and South Africa, and it is barely lower compared to India's maximum GDP.

[11]Nominal GDP in local currency were converted to constant U.S. dollar following the World Bank methodology.

1.3.2 Methodology

The Model

I consider a Panel-Vector Autoregression (P-VAR) model with fixed-effects. This approach has been used in the literature to estimate the effect of fiscal policy on macroeconomic variables, especially in output and private consumption.[12] The specification is given by:

$$Z_{i,t} = \gamma_0 + \Gamma(L)Z_{i,t} + \Gamma_i + \epsilon_{i,t} \tag{1.1}$$

Where $\boldsymbol{Z_{i,t}}$ is a vector of endogenous variables for country i and quarter t, $\boldsymbol{\gamma_0}$ is a vector of constants, $\boldsymbol{\Gamma(L)}$ is a polynomial matrix in the lag operator, $\boldsymbol{\Gamma_i}$ are country fixed effects and $\boldsymbol{\epsilon_{i,t}}$ is a vector of error terms. Among the advantages of using a P-VAR, which uses the generalized method of moments (GMM), can reveal some relationships across countries. Besides, the model benefits from a VAR model's characteristics describing the dynamic behavior of the economic series of each state over time. The main disadvantage of this dynamic panel is that there is no way to traditionally remove the fixed effects. The use of common methods to remove the fixed effects can cause huge gaps in the data. Abrigo and Love (2016) explain that the missing data tend to be magnified. For a solution to this drawback, Arellano and Bover (1995) propose the use of the forward orthogonal deviation or so-called Helmert transformation, which uses future values of the variables.

For the baseline scenario, the endogenous variables included in the P-VAR model

[12] Ravn et al. (2012) measure the effect of government spending on economic growth and private consumption in 4 industrialized countries (U.S., U.K., Australia, and Canada). Nickel and Tudyka (2014) determine the fiscal stimulus multiplier depending on the level of debt in 17 countries of the European Union. In emerging countries, specifically in BRICS, Yuan and Chen (2015) study the effect of a shock of the structural fiscal balances on output. Also, in BRICS, Jawadi et al. (2016) analyze how much the output varies following a shock in government consumption considering the U.S. federal funds rate. Finally, Atems (2019) addresses the multiplier effect of government spending by taking advantage of the publication of the quarterly GDP series of the 50 U.S. States.

are the log difference from the quadratic trend of the real government spending, $G_{i,t}$, the real GDP, $Y_{i,t}$, the real private consumption, $C_{i,t}$, the real effective exchange rate, $REER_{i,t}$, and the level difference from the trend of the current account balance-to-GDP ratio $CA_{i,t}$.[13]

Therefore, the representation of the vector $\boldsymbol{Z_{i,t}}$ would be:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, C_{i,t}, CA_{i,t}, REER_{i,t}]' \tag{1.2}$$

This ordering of the variables agrees with previous literature on the effect of government expenditure (Blanchard and Perotti (2002), Galí, López-Salido, and Vallés (2007), Ramey (2011b), and Ilzetzki et al. (2013)), and impose a lower-triangular Cholesky's decomposition to achieve identification. The variables are ordered from the most exogenous to the most endogenous. Therefore, by calling government spending first, the assumption is that G does not react to changes in GDP contemporaneously. Still, it does after one quarter while the other variables do respond to changes in GDP.

In contrast, Yuan and Chen (2015) and Jawadi et al. (2016) focus on government spending effect in BRICS, following a different ordering. Yuan and Chen (2015) state that they follow the order suggested by the literature on the transmission mechanisms of monetary and fiscal policies. That is, the variable used as a proxy for government spending (the ratio of fiscal balances to GDP) is ordered in the fourth position after the growth rates of GDP, the Consumer Price Index (CPI), and the monetary aggregate M3 (broad money).[14] In the case of Jawadi et al. (2016), despite follow-

[13]Time series exhibit a gradual growth over time, evidence of the presence of a trend. Additionally, the variables contain unit roots that, if no additional transformation were used, would generate spurious regressions. Transformations can be made through growth rates (noisier) or as suggested by the government spending multiplier literature including controls for the trend (Gordon and Krenn (2010), Beetsma and Giuliodori (2011), Ramey (2011b), Blanchard and Perotti (2002), Ramey (2016)) or detrending (Cogan et al. (2010), Auerbach and Gorodnichenko (2013a), Ravn et al. (2012), Ilzetzki et al. (2013), Nickel and Tudyka (2014)).

[14]M2 and marketable instruments issued by the monetary financial institution (MFI) sector, accordingly to OECD.

				Information Criterion		
Lag	***CD***	***J***	***J p-value***	$\boldsymbol{M-BIC}$	$\boldsymbol{M-AIC}$	$\boldsymbol{M-HQIC}$
1	.9766	108.4083	.0070	-339.2447*	-41.5916	-159.5712*
2	.9835	48.6896	.5260	-249.7457	-51.3103*	-129.9634
3	.9853	27.9014	.3124	-121.3162	-22.0985	-61.4250
4	.9969	.	.	.	.	.

* Preferred model under the respective Information Criterion.

Table 1.5: Model and Moment Selection Criteria (MMSC)

ing the triangular identification structure proposed by Blanchard and Perotti (2002), the government consumption variable is placed fourth after the U.S. Federal Funds rate (considered as exogenous according to the authors), GDP, and CPI. The authors ensure that the effects of government spending are captured through the interaction between GDP, CPI, G, and the interest rate.

In dynamic panel data models, to determine the lag order, I use the model and moment selection criteria (MMSC) developed by Andrews and Lu (2001). The basis of this approach is the *J(a, b)* statistic of Hansen (1982), using the parameters selected by a and the moments selected by b. To select the optimal lag number to be included in the model, MMSC minimizes the difference between the magnitude of the J statistic and a second term that rewards using more moment conditions or fewer parameters. The authors point out that this process is similar to the commonly used selection criteria of Akaike information criteria (AIC), the Bayesian information criteria (BIC), and the Hannan-Quinn information criteria (HQIC). The optimal number of lags (transformed through the forward orthogonal deviation) corresponds to the one that presents the lowest value in the information criteria, specifically in M-AIC for this baseline scenario.

To select this optimal number of lags with MMSC, one must specify how many lags in levels will be used to implement the MMSC chosen lags. By default, MMSC determines that the optimal lag will be instrumented by the same number of lags in levels (i.e., if MMSC selects two lags to included in the model, then two lags in levels will be used to implement the two transformed lags). When choosing the same number of lags, both transformed and in levels, the model will be just identified. In contrast, one can override the default option by assigning more lags in levels to achieve over-identification and obtain the J statistic.

In this paper, the P-VAR uses four lags in levels of the endogenous variables included in $\boldsymbol{Z_{i,t}}$ to instrument the transformed lags selected by MMSC. In the baseline model, I test the inclusion of up to four transformed lags by instrumenting them with four lags in levels.[15] Also, standard errors were considered robust to certain types of misspecification.

In Table 1.5, M-AIC selects two lags, while M-BIC and M-HQIC suggest that the preferred model corresponds to a first-order P-VAR. Given these results, I could choose either one or two lags to estimate the baseline model, but first, I must consider the J statistic. When the p-value is lower than any level of significance commonly used, the null hypothesis is rejected. This rejection implies possible misspecification, not satisfying the orthogonality conditions, or both. Here, the p-value of the J statistic of one lag is less than a five percent significance level. Considering this, and doing my work comparable to Yuan and Chen (2015) and Jawadi et al. (2016), I use a second-order P-VAR.[16]

Concerning the impulse-response functions, to estimate the 90% confidence interval, I use 1,000 Monte Carlo simulation draws; and later, they were normalized to

[15] Blanchard and Perotti (2002) includes four lags of the quarterly variables to remove endogeneity in government spending and identify its variations. Ramey (2019) also decides to include four lags in the specification to "model the dynamics." Likewise, Ilzetzki et al. (2013) argue that their results are robust to the inclusion between one and eight lags, using quarterly data.

[16] As a robustness check, I evaluate the inclusion of up to six transformed lags. MMSC suggests the inclusion of only one transformed lag in each case. The p-values of the J statistic are less than a ten percent significance level. Therefore, the null hypothesis is rejected.

show the response of a one-percent increase in government spending.

Government Spending Multipliers

The multiplier cannot be estimated directly from the impulse-response functions because the VAR variables are transformed into logarithms; therefore, their coefficients are interpreted as elasticities. As a method of post-estimation transformation, Blanchard and Perotti (2002) calculate the multiplier as the ratio of the GDP response at the horizon k to the initial variation of government expenditure at horizon *0* and dividing it by the average share of government spending in GDP. This multiplier can be represented as follows:

$$impact(k) = \frac{\Delta y_0}{\Delta g_0} \frac{1}{g/y} \tag{1.3}$$

Where equation (1.3) at k=*0*, denotes the impact multiplier. That is, for each one percent that increases government spending, the output will increase by the percentage calculated in (1.3).

Further, Mountford and Uhlig (2009) propose the cumulative multipliers for the U.S. introducing a new measure. The authors argue researchers should use the discounted present value of the variations in GDP and G. Moreover, they calculate the multiplier by modifying the first ratio on equation (1.3) into the ratio between the summation of the present value of the response in output and the summation of the present value of the variation in G, both for period t from *0* to T. Equation (1.4) not only applies to models with one country; instead, it can be used in a panel of countries as Ilzetzki et al. (2013) did.

$$cumulative(T) = \frac{\sum_{t=0}^{T} (1+i)^{-t} \Delta y_t}{\sum_{t=0}^{T} (1+i)^{-t} \Delta g_t} \frac{1}{g/y} \tag{1.4}$$

Two main criticisms exist against the multipliers obtained through equations (1.3) and (1.4). First, Gordon and Krenn (2010) suggest that both the numerator and the denominator should be calculated as the difference between the change in Y (or G) generated by innovations in G minus the change in Y (or G) estimated by the VAR in the absence of innovations G, that is, calculated as the marginal effect of G on Y relative to the marginal effect of G on itself. Second, both equations assume that public spending to GDP ratio (Y/G) is constant throughout the study period, which according to Ramey (2019), makes multipliers exhibit a counter-cyclical pattern compares to what they truly are. Besides that, keeping constant the Y/G ratio is a feature that can hardly be satisfied since governments tend to adjust their spending according to the economic level of the moment or due to external factors. For example, Ramey and Zubairy (2018) find that the average Y/G ratio when considering all the periods of their sample is 1.5 times greater and more volatile than only the post-WWII periods are included.

These criticisms led to the introduction of pre-estimation transformations to avoid using equations (1.3) and (1.4). Gordon and Krenn (2010) propose normalizing the original series by expressing them as ratios of potential output ($\frac{G}{Y^*}$), which is calculated as an exponential trend where GDP grows at a constant quarterly rate between the reference years selected by the authors; thus, changes in the share of government spending in GDP can be captured. More recently, Barro and Redlick (2011) propose that the change in government spending G can be normalized as a growth rate with respect to a lag of the GDP ($\frac{G_t - G_{t-1}}{Y_{t-1}}$) to ensure that all variables are expressed in the same units. Further, Ramey (2016) indicates that the potential output can also be estimated by adjusting the log real GDP to a quadratic or quartic trend.

Despite the criticisms and different methods to normalize the values before estimating the models, post-estimation transformation methods are commonly used in the literature to estimate the impact and cumulative multiplier. For instance, Ilzetzki et al. (2013) calculate the government spending multiplier for a set of developed and emerging countries, while Atems (2019) estimates the multiplier for the U.S. States. Also, in Yuan and Chen (2015) and Jawadi et al. (2016), their procedure suggests no previous transformation on the data to do any calculation, although they do not calculate the multiplier. Therefore, the baseline model will be following equations (1.3) and (1.4).

1.3.3 Results

Figure 1.2 shows the impulse response functions of 1% shock of government spending on Y, C, CA, $REER$ and on itself (solid thick black line), with their respective 90% confidence bands (black dashed line) obtained through the Monte Carlo simulation with 1,000 repetitions.

The top center panel of Figure 1.2 shows the GDP response. The results indicate that a shock in government spending increases GDP by 0.02%, being significantly different from zero. The response becomes insignificant in the first quarter, and turns negative in the second quarter but settling around 0% three and a half years later. These results differ from those of Ilzetzki et al. (2013), which finds that the impact response of output is negative and not significant in developing countries.

In contrast, Yuan and Chen (2015) report an increment in output, not significantly different from zero at any quarter, as a response to an increase in the fiscal balance ratio. This result is contrary to what is found in this paper. Meanwhile, Jawadi et al. (2016) show that the GDP presents a not significant impact response but grows steadily up to 1.5% due to a change in public spending of 2.7% at 20 quarters after the impact being significantly different from zero at all times.

This paper's impulse-response functions cannot be quantitatively compared face-to-face with those of the BRICS previous works. There are marked differences in both the handling of the data and the estimation of the P-VAR. Additionally, they present different processes for the estimation and graphing of impulse response functions.

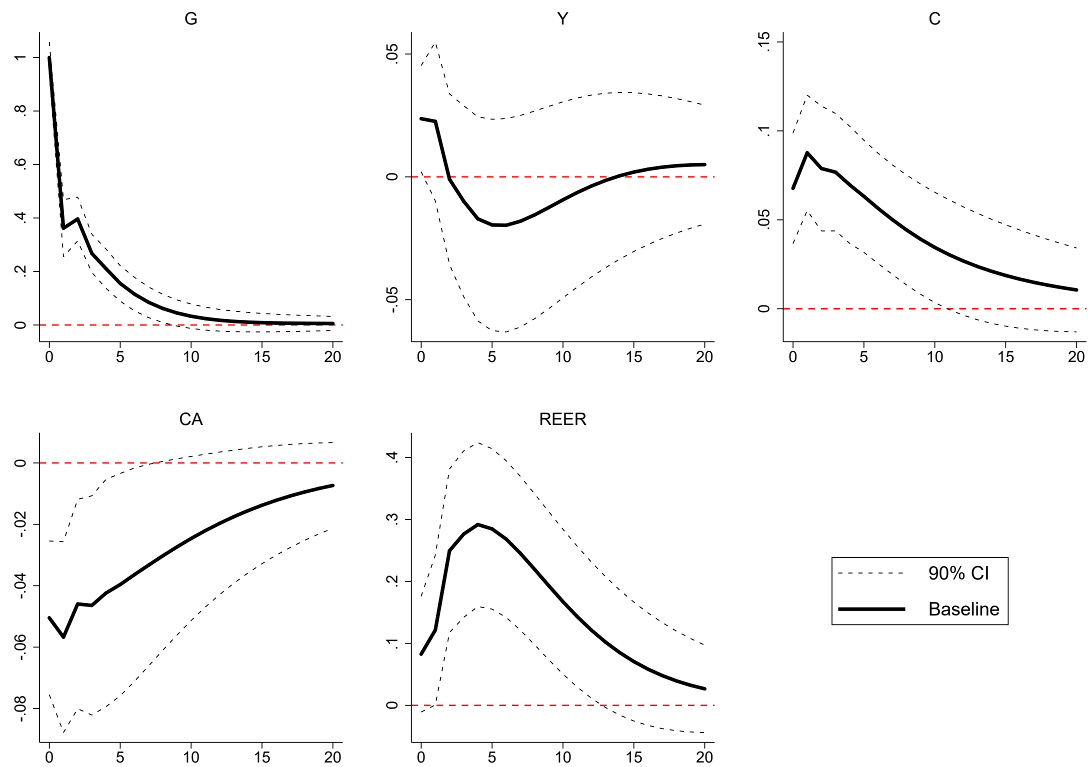

Figure 1.2: Impulse response functions to a 1% increase in government spending. Thick solid black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

Still, they can be compared qualitatively.

First, this document's data were transformed into logarithmic deviations from the quadratic trend, a process similar to Ilzetzki et al. (2013) and widely used in the literature. Instead, Yuan and Chen (2015) and Jawadi et al. (2016) both use the first difference of logarithms akin to the growth rates of the variables.

Second, the variable included in the P-VAR as a proxy for the fiscal policy varies from Yuan and Chen (2015). The baseline model has government consumption as a proxy for the fiscal policy, similar to Jawadi et al. (2016), while Yuan and Chen (2015) use the changes in the ratio of structural fiscal balances to GDP, which were interpolated from the annual series. Besides, the interpretation of a fiscal balance shock would correspond to a contractionary policy; and not to an expansionary policy, such as the increase in government spending. In other words, an improvement in the fiscal balances has its origins at the rise in government revenue via taxes or the decrease of government spending.

Third, the impulse response functions are transformed to show the variables' response to a shock of 1% in the variable specified as an impulse. There is no evidence that this transformation was implemented by either in Yuan and Chen (2015) or Jawadi et al. (2016). In those papers, the authors show the impulse-response functions in their original shape corresponding to a standard deviation shock.

The top left corner of Figure 1.2 exhibits the consumption response, which is also significantly different from zero, and being persistent until the tenth quarter. The impact response is 0.07% and reaches a peak of 0.09% in the next quarter. However, my result is not in line with what should be expected from Ricardian equivalence, a decrease in private consumption following an increase in government spending. Earlier contributions in the literature support this crowding-in effect on consumption, such as Blanchard and Perotti (2002); and Galí et al. (2007) for U.S. Also, Beetsma and Giuliodori (2011) find qualitatively similar results in the European Union countries and Miyamoto, Nguyen, and Sheremirov (2019) in developing countries.

Auerbach and Gorodnichenko (2013b), add a feature to the debate when they find that consumption is crowded out in expansions but stimulated when it comes to recessions. The authors comment that this could occur because the change in government spending contains news about possible variations in both output and productivity. In contrast, Linnemann (2006) explains that the effect leading to a higher level of consumption after a rise in government spending can be the product of the complementarity between employment and private consumption. Instead, Bouakez and Rebei (2007) advise that complementarity is between government expenditure and private consumption, leaving aside the employment.

Conversely, concerning the variables that capture variations in the international position, I observe that the exchange rate increases by 0.08% to reach 0.29% within the first year, then declines to around 0% as the horizon approaches the twentieth quarter; the current account presents a negative and significant response of negative 0.05% persisting until the ninth quarter. An increase in the exchange rate makes domestic goods more expensive for foreigners, while foreign goods are considered cheaper for local consumers. The exchange rate appreciation implies a reduction in exports and, in turn, an increase in imports leading to a deterioration in the current account, manifesting itself as a decrease in its ratio to output.

Concerning the literature, the results are consistent with Ravn et al. (2012)'s deep-habit model for data from Australia, Canada, the United Kingdom, and the United States; and also, with Yuan and Chen (2015) for the BRICS case. The Miyamoto et al.'s (2019) results further extend the countries' sample to 96 developing economies. However, the results differ from those obtained by Ilzetzki et al. (2013) who report that the exchange rate depreciates, and the current account improves in developing countries, before the first year in response to a 1% government spending shock.

In summary, a 1% increase in government spending causes a significant GDP increase immediately. Then the GDP shows a contraction is not significantly different from zero. This process occurs, while private consumption expands, the current account deteriorates together with an appreciation of the exchange rate.

The effects of increased public spending are only informative as they are elasticities and cannot be interpreted as the real multiplier. To estimate the impact and cumulative multiplier, I follow equations (1.3) and (1.4), respectively, which correspond to the post-estimation transformation process used in the literature.

Following equation (1.3), a 1% change in government spending (Δg_0) leads to an increase of 0.024% of the GDP (Δy_0), and the average share of government spending in GDP (g/y) is 16.30%; thus, the impact multiplier is 0.145%, significantly different from zero, meaning that for each one percent that increases public spending the

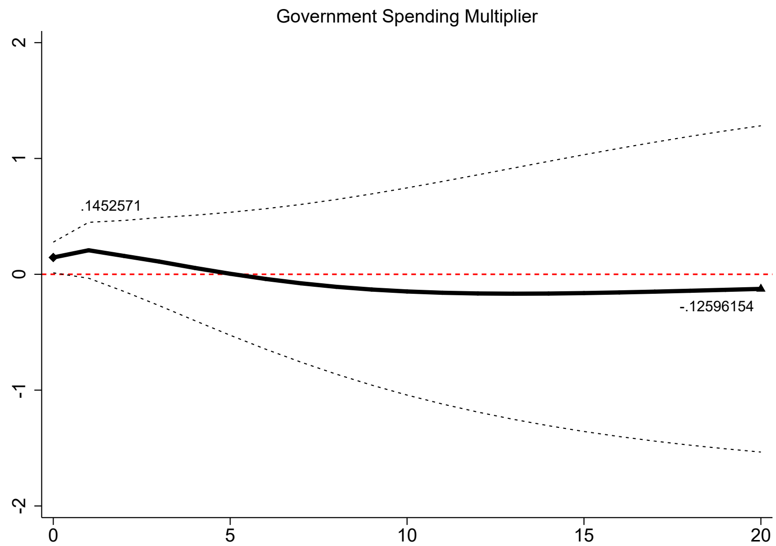

Figure 1.3: Impact and cumulative government spending multiplier following the baseline scenario specification. Thick solid black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

output will increase by 0.145% on impact.

In contrast, for estimating the cumulative multiplier following (1.4), it is necessary to include the median interest rate (7.55%) across all periods and countries in the sample. Thus, an increase of one percent in government spending generates an accumulated impulse with a present value of 2.709% ($\sum_{t=0}^{T}(1+i)^{-t}\Delta g_t$) leading to an output accumulated discounted response of -0.055% ($\sum_{t=0}^{T}(1+i)^{-t}\Delta y_t$), while the average share of government spending in GDP (g/Y) is 16.30%; therefore, the cumulative multiplier is -0.126%, that is not significantly different from zero.

The multipliers estimated in this baseline model are aligned with what the literature claims. The literature suggests that multipliers are smaller than those obtained in advanced economies, and generally less than one. Ilzetzki and Vegh (2008) argue that fiscal policy in developing countries is pro-cyclical with a multiplier that reaches a maximum of 0.63%, about 0.30 percentage points below the multiplier in developed countries. Moreover, Kraay (2012) ensures that the government spending multiplier gets a value of 0.48 in a year for low-income countries, and 0.40 for 102 developing economies. Likewise, Hory (2016) finds that the multiplier in developing economies is 0.41 at impact. Therefore, the results here add to evidence that multipliers in emerging economies are lower than those in developed economies.

Despite all the evidence in favor, the results still show discrepancies compared to previous works, specifically to Ilzetzki et al. (2013) and Chian Koh (2017). Although the cumulative multiplier is similar to the one obtained by Ilzetzki et al. (2013), the difference occurs when the impact multiplier is analyzed. In this paper, the results establish a positive and significant multiplier, whereas it is a negative value not significantly different from zero for them. In contrast, the baseline model's cumulative multiplier does not match the findings of Chian Koh (2017). The author finds significant multipliers in impact and cumulative, with magnitudes of 0.63 and 0.78, respectively.

The multipliers in advanced economies range from 0.8 to 1.5 for the United States' case as a reference. Ramey (2011a) assures this range in her compilation of several works on the subject. Leeper et al. (2017) supports this. The authors find that the average U.S. multiplier is 1.3 considering two scenarios, passive or active fiscal policy. Likewise, in Canada's case, Owyang et al. (2013) find a multiplier that reaches a maximum of 0.57 in its linear model and 0.65 in a high unemployment scenario. Also, Glocker, Sestieri, and Towbin (2019) in the United Kingdom's case claim that although the multiplier varies over time (greater than one in recessions), on average, this reaches a value of 0.48. Concerning sets of advanced economies, Ravn et al. (2012) using a deep habit model, find that the multiplier is around 0.52 at impact, for four advanced economies. Additionally, Corsetti et al. (2012) ensure that the multiplier at impact is about 2.3, while the accumulated reaches 2.6, under a financial crisis scenario.

Given the variety of multipliers in the literature, in the next section, I will evaluate how sensitive my baseline model results are to changes in the model's specification and the selection of alternative ways to remove the trend in the variables.

1.4 Robustness Checks

To assess how sensitive the baseline model results are, I construct five alternative scenarios based on the literature review. To perform sensitivity analyses relative to the baseline model results, four of the five scenarios correspond to specification modifications related to Ilzetzki et al. (2013), Yuan and Chen (2015), and Jawadi et al. (2016). The focus on these three variations of the specification is primarily based on the fact that these papers address the effects of government spending on emerging economies. The results obtained are somewhat different from those of the baseline-model.

The Ilzetzki et al.'s (2013), Yuan and Chen's (2015), and Jawadi et al.'s (2016) specifications need several modifications to obtain comparable results to the baseline model findings. The specification that requires the fewest steps is Ilzetzki et al.'s (2013), to omit private consumption. Instead, the Yuan and Chen's (2015) and Jawadi et al.'s (2016) specifications require at least three steps. First, the inclusion of monetary policy variables and the omission of private consumption. Second, take into account that the instrument of fiscal policy is fiscal balances in Yuan and Chen (2015). Likewise, consider the inclusion of the US Federal Fund rates in the first position in vector Z, for the case of Jawadi et al. (2016). Third and last, both works' identification approach places the variable of fiscal policy in a different position from the first place.

The remaining situation corresponds to the use of two different detrending methods. There are several options to remove the trend, different from those I used in the baseline scenario. Among the main options, and by far the most used, corresponds to the Hodrick-Prescott (HP) filter, although it has received several criticisms over the years. The most recent criticism corresponds to Hamilton (2018), who assures that this filter creates relationships that do not exist and therefore leads to spurious dynamics; given this, he proposes a new filter as a solution.

1.4.1 Omitting or Adding Control Variables

In this part, I evaluate three different specifications proposed by three previous works. Table 1.6 summarizes the representation of the Z vector under each of the alternative specifications discussed in this subsection. The motivation is the conflicting results between each of the studies' results and the baseline model results.

The results of the baseline-model show a positive impact multiplier and a negative non-significant cumulative multiplier. Ilzetzki et al. (2013) estimate the multiplier in a panel of 44 economies, dividing them into two groups, high-income and developing. The authors' specification does not include private consumption C as a variable. They find that developing economies show a negative multiplier at both impact and cumulative. Specifically, these results differ from those obtained in this paper, where the multiplier is positive at impact, and the cumulative is smaller, about 25%.

Also, a compelling case arises from the analysis of the BRICS countries. Yuan and Chen (2015) and Jawadi et al. (2016) show conflicting results compared to each other, and both contradicting the baseline-model results. In Yuan and Chen (2015) the authors argue that there is no significant impact on output following a shock in their fiscal policy instrument, structural fiscal balances. On the other hand, Jawadi et al. (2016) find that the effect of spending on output is greater than one and significant in the medium and long term.

Comparable to	$Z_{i,t}$
AS-I: *Ilzetzki et al. (2013)*	$[G_{i,t}, Y_{i,t}, CA_{i,t}, REER_{i,t}]'$
AS-II: *Yuan and Chen (2015)*	$[G_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]'$
AS-III: *Jawadi et al. (2016)*	$[G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]'$

Table 1.6: Vector $Z_{i,t}$ under different specifications

Alternative Specification I (AS-I)

In this subsection, hereafter referred to as *AS-I*, I will follow Ilzetzki et al.'s (2013) model specification. The authors estimate a system of equations through a panel OLS with fixed effects considering four variables: $\boldsymbol{G}$, $\boldsymbol{Y}$, $\boldsymbol{CA}$, and $\boldsymbol{REER}$. Therefore, I should keep these four variables and omit the private consumption variable in representation (1.2). The authors also enforced a lower-triangular Cholesky's decomposition akin to the one imposed in the baseline scenario.

There are two other modifications compared to the baseline-model, the specification remains different from Ilzetzki et al.'s (2013) in two aspects. First, to remove the fixed effects they use the first difference, while I use forward orthogonal deviation in the baseline-model specification. Second, I use the log difference from the quadratic of $REER_{i,t}$, they use the growth rate ($\Delta REER_{i,t}$). Hence, the vector $\boldsymbol{Z_{i,t}}$ for the AS-I specification here is represented as:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, CA_{i,t}, REER_{i,t}]' \tag{1.5}$$

Although in Ilzetzki et al. (2013), the authors do not use any formal criterion for the selection of the lag order, they decided to use four lags regardless of any group of countries to be evaluated. Likewise, they assure that their specification and results are robust to select any number of lags between 1 and 8. In this paper, as there is only one group of countries (emerging), the MMSC suggests two lags as its optimal value, according to M-AIC. In this case, similar to the baseline scenario, there are

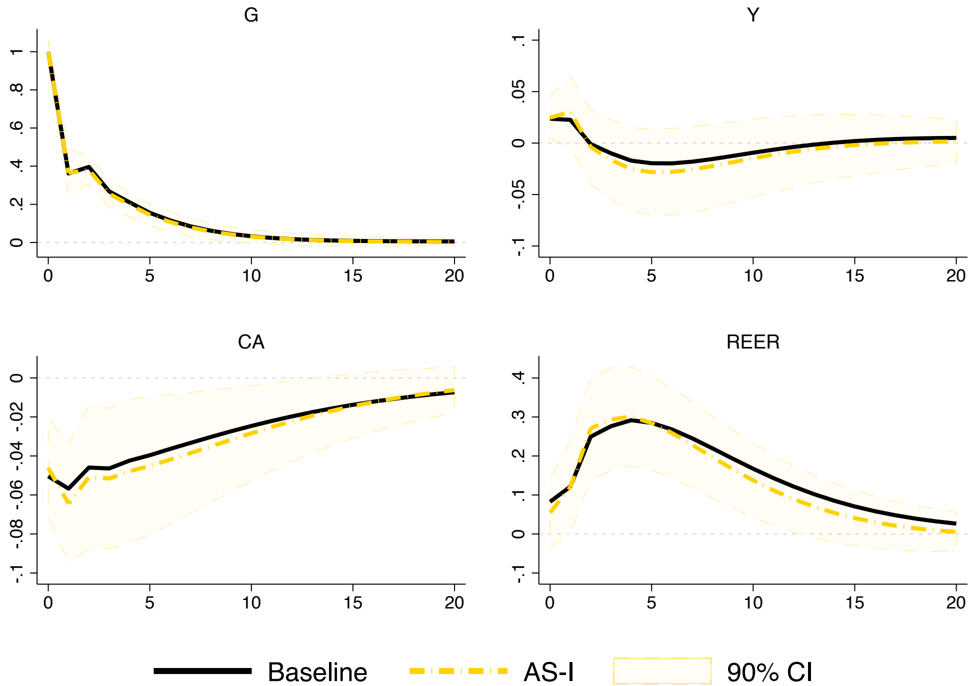

Figure 1.4: Impulse response functions to a 1% increase in government spending. Gold dashed line represents point estimates following Ilzetzki et al.'s (2013) specification. The thick solid black line represents point estimates of the baseline scenario, and the gold-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

discrepancies when choosing the optimal order between the M-BIC/M-HQIC and the M-AIC criteria. While AIC determines two lags, the other two criteria suggest that the optimal value corresponds to one lag. However, according to Hansen's J statistic, the null hypothesis that the instruments are valid is rejected at any level of significance traditionally used.

Figure 1.4 show the impulse-response function following Ilzetzki et al.'s (2013) specification (gold dashed line) compared to the baseline scenario (thick solid black line) along with 90% confidence bands (gold-colored area). In Figure 1.4, the panels show no significant difference between the estimates obtained under each of the specifications represented in vector $Z_{i,t}$. Qualitatively, the impulse-response functions behave similarly, maintaining the forms and directions of the baseline scenario. As an illustration, the response of $\boldsymbol{CA}$ is still negative after a shock of 1% in $\boldsymbol{G}$ (the same for $\boldsymbol{REER}$; the response is still positive). On the other hand, quantitatively, the estimates under the AS-I tend to be larger; that is, they are more negative or more positive than the base scenario. For example, in the upper right panel, $\boldsymbol{Y}$ has a response of 0.030 in horizon 1, which is higher by 0.007 percentage points than the $\boldsymbol{Y}$'s response in the baseline scenario. Likewise, the lowest point of the baseline scenario reaches only -0.0197, while in the AS-I, it is around -0.0282.

Alternative Specification II (AS-II)

Since baseline scenario results are in contrast to those obtained by Yuan and Chen (2015), doubts arise whether this contradiction is due to modifications in the specification. The changes go from the inclusion of other variables in vector $Z_{i,t}$, the use of a different variable as a proxy for fiscal policy, the lag order selection, or the ordering of the variables. In this part, I address the inclusion of the monetary policy variables, the use of government spending ($\boldsymbol{G}$) variable as the primary fiscal policy variable in the model, and formalize the lag-length selection through the Model and Moment Selection Criteria (MMSC).

According to Yuan and Chen (2015), the vector $Z_{i,t}$ includes the log first difference of the $\boldsymbol{CPI}$ and the growth rate of money, the short-term interest rate in levels, and fiscal balance ratios instead of government consumption. The inclusion of these variables could provide relevant information for the estimation of the model, and thereby significantly vary the results obtained in the baseline scenario to the point of yielding similar calculations to those presented by Yuan and Chen (2015). However, during this subsection, the main fiscal policy instrument is $\boldsymbol{G}$. In subsequent robustness analyzes, I address fiscal balances instead of government spending and later ordering the variables. Therefore, here the variables considered are government consumption ($\boldsymbol{G}$), inflation ($\boldsymbol{\pi}$), the short-term interest rate ($\boldsymbol{ir}$), and the growth rate of narrow money ($\boldsymbol{M1}$).[17]

The vector $Z_{i,t}$ could be represented as follows:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]' \tag{1.6}$$

Following these vector representations, and subsequently applying equations (1.3) and (1.4); then, this can be interpreted as the estimation of the government spending multiplier considering the interaction of fiscal and monetary policy in an open economy.

Concerning the lag order selection, Yuan and Chen (2015) point out that they established two lags to estimate the P-VAR since the Akaike criteria information (AIC) suggests this, using the ratios of fiscal balances as a proxy for fiscal policy. Here, when the fiscal policy's proxy is $\boldsymbol{G}$, MMSC also chooses two lags as optimal. It is worth mentioning that Hansen's J statistic rejects the null hypothesis at all significance levels commonly used. Consequently, this alternative model could present problems in the orthogonality conditions, a necessary property in the instruments used for estimation.

Figure 1.5 shows the impulse-response functions of a 1% government spending shock on the rest of the variables, using $\boldsymbol{G}$ as the proxy variable for fiscal policy. The dashed red line represents point estimates following Yuan and Chen's (2015) specification and Blanchard and Perotti's (2002) ordering. Additionally, a 90% red-colored confidence region is shown after 1,000 Monte Carlo draws. Besides, a thick solid black line represents point estimates of the baseline scenario.

In Figure 1.5, when government consumption $\boldsymbol{G}$ is the fiscal variable, the behavior of the impulse-response functions maintains relatively the same form and direction compared to the baseline model results. The upper left panel shows the response of $\boldsymbol{G}$ to a shock in itself. The two specifications show an increase, in a similar magnitude,

[17]Inflation is calculated in annual terms as the log first difference of the deflator times four.

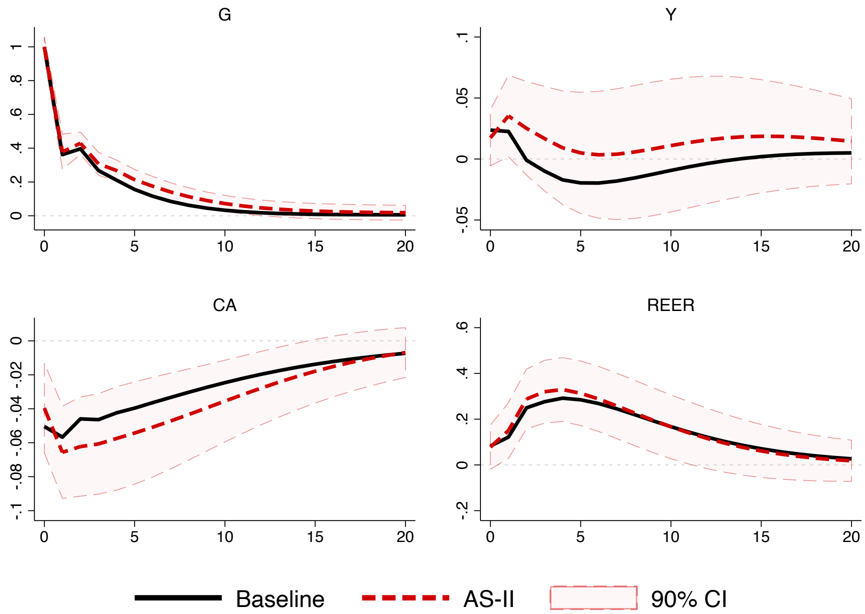

Figure 1.5: Impulse response functions to a 1% increase in government spending $\boldsymbol{G}$ ordered 1st. Thick solid black line represents point estimates of the baseline scenario. Dashed red line represents point estimates following following Yuan and Chen's (2015) specification, and the red-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

in government spending in the second quarter after impact. The upper right panel shows the big difference in $\boldsymbol{Y}$'s response among specifications. The change in the specification, including monetary policy variables, induces a positive reaction of $\boldsymbol{Y}$ to an increase in $\boldsymbol{G}$. Likewise, the $\boldsymbol{CA}$ and $\boldsymbol{REER}$ panels show little variation compared to the baseline model. Both specifications estimate a deterioration of the current account in impact until the first trimester, where it begins its recovery until it is around 0% after 20 quarters. This current account pattern is synchronized with the $\boldsymbol{REER}$ reaction and behavior. The lower right panel shows an appreciation of the $\boldsymbol{REER}$ until the third quarter and then fades as it approaches 20 quarters. Finally, the upper right panel representing $\boldsymbol{Y}$ exposes substantial differences in magnitudes both in impact and at the horizon of 20 quarters. The estimated IRF-s identify an impact of lesser magnitude, although still close to the baseline scenario's impact.

Alternative Specification III (AS-III)

The third change of specification corresponds to consider different aspects proposed by Jawadi et al. (2016). The motivation lies in the contrast of the results between the baseline model and Jawadi et al.'s (2016) findings. In this paper, the output reacts to a shock in government consumption but does not reach 1.5% on the 20-quarters horizon. This contradiction generates specific questions about the reasons why the results are on opposite sides. Specifically, this subsection analyzes how a change in the specification concerning the inclusion or omission of variables impacts the results. Especially whether there is any substantial implication if a variable is declared as exogenous in the P-VAR.

Jawadi et al. (2016) have a specification comparable to Yuan and Chen's (2015), in the sense that they are studying the interaction between fiscal and monetary policy. Besides, Jawadi et al. (2016) analyze whether there is any mechanism of transmission or influence of the US monetary policy, including the US Federal Fund Rate ($\boldsymbol{FFR}$) as an exogenous variable. The authors decide to omit variables that can measure the BRICS countries' performance in international markets such as the current account and the real effective exchange rate. This modification is especially striking, considering that the US is one of the largest trading partners of each of the BRICS countries. The multiplier will correspond to an interpretation similar to AS-II, nevertheless, for a closed economy.

In this way, the vector $Z_{i,t}$ has a different representation than the baseline model. Here, the vector $Z_{i,t}$ declares $\boldsymbol{FFR}$ as an exogenous variable making the transition from a P-VAR to a P-VARX.

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]' \tag{1.7}$$

Despite including the change in the specification and the declaration of $\boldsymbol{FFR}$ as

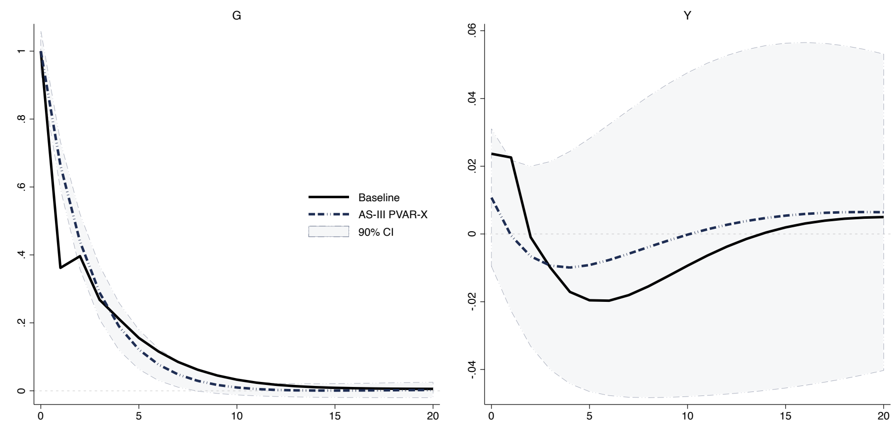

Figure 1.6: Impulse response functions to a 1 unit shock in government spending $\boldsymbol{G}$ ordered 1st and $\boldsymbol{FFR}$ is declared exogenous. Thick solid black line represents point estimates of the baseline scenario. Dark navy dotted-dashed line represents point estimates following Jawadi et al.'s (2016) specification, and dark navy-colored area is the 90% confidence area after 1,000 Monte Carlo draws

exogenous; both models, Jawadi et al. (2016) and specification (1.7), maintain substantial differences. The differences could also be grounds for not having a consensus on the results. There are three different issues to deal with: sample size, fixed time-country effects, and the method of addressing unit-roots. Here, the periods within the sample cover almost 22 years of quarterly data from 1997Q1 to 2017Q4. This sample omits several previous years that are included by Jawadi et al. (2016), but in turn, it adds approximately five years. Therefore, the AS-III sample is similar in length but covers different years. The inclusion of fixed time-country effects is not optimal since the model's estimation power would be sacrificed; thus, in this work, the inclusion of this type of fixed effect is not considered. Finally, AS-III uses logarithmic deviations from each series' quadratic trend to treat processes with unit-roots. Instead, Jawadi et al. (2016) argue that they use the first differences of the variables.

Figure 1.6 shows the impulse response functions to a 1 unit shock in government spending $\boldsymbol{G}$ following Jawadi et al.'s (2016) specification. The dark navy dotted-dashed line represents point estimates when $\boldsymbol{FFR}$ is declared exogenous, modifying the *P-VAR* into a *P-VARX*. The thick solid black line represents point estimates of the baseline scenario, and the dark navy-colored area is the 90% confidence area after 1,000 Monte Carlo draws for specification (1.7).

In the left panel of Figure 1.6, the government consumption response does not show an increase in the second quarter; thus, there is a decreasing response throughout the horizon. Meanwhile, the right panel's output responses show differences between the specification (1.7) and the baseline scenario. When $\boldsymbol{FFR}$ is declared as exogenous, and $\boldsymbol{G}$ is ordered first, the behavior of the IRFs closely resembles those found in the baseline model. Here, the difference is that the response is flatter, minimizing the effect of $\boldsymbol{G}$ in $\boldsymbol{Y}$. That is, the estimated magnitudes are modulated. In impact and after 20 quarters, the magnitudes are similar to the baseline model results, but the impact and cumulative effects are not significantly different from zero.

The findings in this subsection gather evidence against the results mentioned by Jawadi et al. (2016). Here, government consumption does have a positive effect on the impact on $\boldsymbol{Y}$. After the second quarter, the responses exhibit a contraction until it becomes negative. However, later the reaction turns positive near the 20 horizon quarters. The maximum and minimum response of $\boldsymbol{Y}$, over the 20 quarters, are 0.01% and -0.01%, respectively. Those estimated values are far away from the Jawadi et al.'s (2016) findings. The data cannot replicate the initial zero effect of fiscal policy in the BRICS countries' economic growth with a growing medium-term trend. The model developed by Jawadi et al. (2016) established this trend.

Estimated Government Spending Multipliers

Figure 1.7 shows the estimates of government spending multiplier under the different specifications considered in this section. The multiplier analysis focuses on the differences between the baseline model and the three alternative specifications. However, the comparison between the estimates of the alternative specifications and previous findings is only possible in the case of Ilzetzki et al. (2013). This limita-

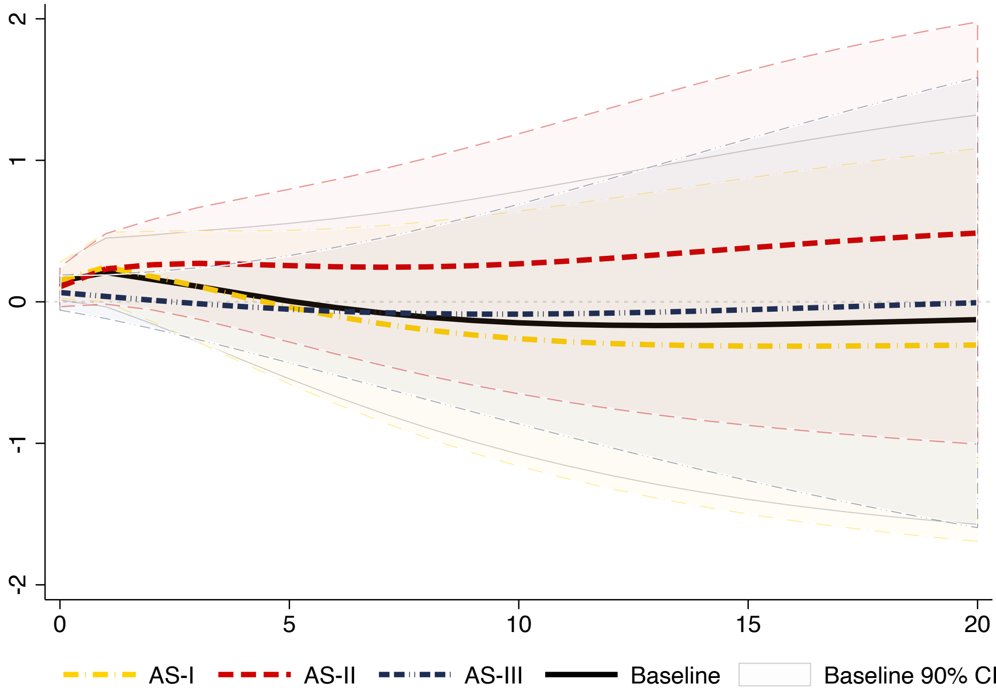

Figure 1.7: Government Spending Multipliers for the Alternative Specifications. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-I (gold), AS-II (red), and AS-III (navy) alternative specification with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

tion is because earlier studies on BRICS do not calculate the government spending multiplier.

In the $\boldsymbol{AS-I}$ case, following equation (1.3), a 1% change in government spending leads to an immediate increase equal to 0.151% in the GDP and is significantly different from zero. Likewise, the cumulative multiplier following (1.4) is -0.305%. That is to say, a 1% increase in G generates GDP growth of 0.151% immediately, but in the long term, it would represent a not significantly different from zero (-0.305%).

Here, I compare $\boldsymbol{AS-I}$ multipliers against two different situations. The first corresponds to the baseline scenario and then compared in a second instance with Ilzetzki et al.'s (2013) results. When comparing the estimates under the two scenarios, baseline and AS-I, the calculations under the Ilzetzki et al.'s (2013) specification tend to be magnified compared to the baseline scenario. This effect is also observable when estimating the impact multiplier. The impact multiplier under the specification proposed by Ilzetzki et al. (2013) is larger by 0.006 percentage points. However, the cumulative multiplier is still not significantly different from zero.

On the other hand, when comparing the results of both baseline and AS-I scenarios against Ilzetzki et al.'s (2013) results, the differences in the impact and cumulative multiplier remain. Regarding the impact multiplier, both scenarios in this document show a positive multiplier significantly different from zero, while Ilzetzki et al.'s (2013) findings show a negative multiplier. Additionally, the cumulative multiplier under the two scenarios remains below the Ilzetzki et al.'s (2013) estimates. Cumulative multipliers in the baseline scenario and AS-I are about a quarter and a half compared to the multiplier estimated by Ilzetzki et al. (2013) for emerging countries.

Despite maintaining several similarities qualitatively, especially when dealing with directions, the impact multiplier remains significantly different from zero, even making the specification change. These results are consistent with the baseline scenario findings and serve as evidence against the results presented in Ilzetzki et al. (2013).

For $\boldsymbol{AS-II}$, the impact and cumulative multipliers are 0.106% and 0.486%, respectively. Only the impact multiplier is in any way similar to the baseline model estimate. Despite this, the cumulative multiplier presents quantitative differences. This cumulative multiplier would be interpreted as a shock of a one percent increase in $\boldsymbol{G}$, leading to a rise in output by 0.48% in five years. However, the multipliers are not significantly different from zero. Further, I cannot carry out a comparative analysis concerning Yuan and Chen's (2015) study.

Similarly, the $\boldsymbol{AS-III}$ scenario following Jawadi et al.'s (2016) specification finds a positive impact multiplier with a magnitude of 0.065%, that is about a half of the impact on the baseline scenario. Besides, the cumulative multiplier is -0.006% being roughly one-twelfth of the corresponding multiplier of the base model. However, the impact and cumulative multiplier values are relatively close to the baseline model estimates in magnitude. The multiplier behavior differs quantitatively between the two estimates having a flatter $\boldsymbol{AS-III}$'s multiplier curve during the 20-quarters horizon.

1.4.2 Alternative Policy Variables Aspects

Besides the inclusion of variables in the specification, one additional layer is added to the analysis to address the different approaches used in previous work on BRICS. In the case of the Yuan and Chen's (2015) specification, this extra variable addresses the use of quarterly fiscal balances as a proxy for government spending. Similarly, in the Jawadi et al.'s (2016), the second analysis incorporates the US Federal Funds rate ($\boldsymbol{FFR}$) ranked in the first position in the vector $\boldsymbol{Z_{i,t}}$, instead of declared it as exogenous as the *P-VARX* in Section 1.4.1.

In Yuan and Chen (2015) the authors state that they use ratios of structural fiscal balances to GDP as a fiscal policy variable, obtained from interpolations of annual series. Structural balances isolate effects related to the economic cycle or temporary situations of a single occurrence (e.g., an increase in the primary export commodity price). With this, only the trend of the fiscal policy is left to determine whether it is considered expansive or contractionary.

As an alternative, I use the proxy variable $\boldsymbol{fiscal}$, which measures the deviations in levels from the quadratic trend of the ratios of fiscal balances to GDP. The fiscal-balances are the difference between the nominal fiscal budget's revenues and expenses, obtained from the respective government agencies. Specifically from the Controller General of Accounts of India, Ministry of Finance of the Russian Federation, the Central Bank of Brazil, the National Bureau of Statistics of China (NBS), and the South African Reserve Bank. Subsequently, I converted them to fiscal-balances-to-GDP ratios using nominal GDP. It is worth mentioning that when using fiscal balances, a

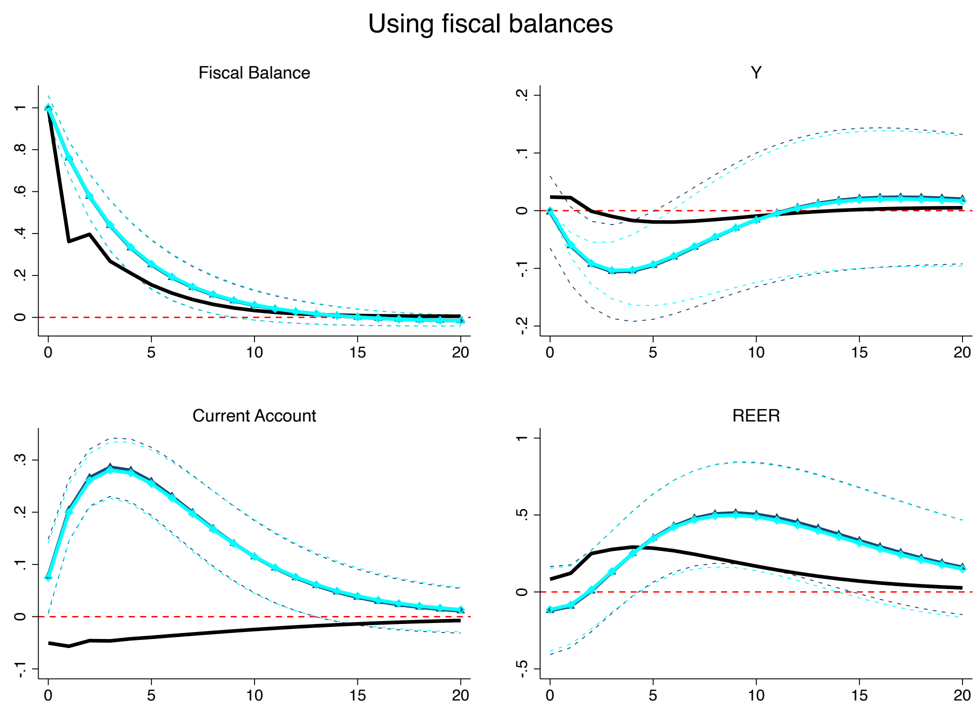

Figure 1.8: Impulse Response Functions to a 1% increase in $\boldsymbol{fiscal}$ ordered 1st. Thick solid black line represents point estimates of the baseline scenario. Dashed dark orange line represents point estimates following AS-II specification, and the dark orange-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

positive shock in the impulse response functions could be considered as an increase in revenues or as a decrease in government spending, so the effects of the latter could not be identified. Moreover, these results should be interpreted as a contractionary shock and not as expansive as when using $\boldsymbol{G}$.

The vector $\boldsymbol{Z_{i,t}}$ is represented in the following way:

$$Z_{i,t} = [fiscal_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]' \tag{1.8}$$

Figure 1.8 shows the behavior of the impulse response functions when $\boldsymbol{fiscal}$ is the fiscal policy instrument. All the results of this work contrast with the findings of Yuan and Chen (2015). Here, the upper right panel shows that $\boldsymbol{Y}$ does not react to a shock of 1% in $\boldsymbol{G}$. Subsequently, the output continues decreasing until the fourth

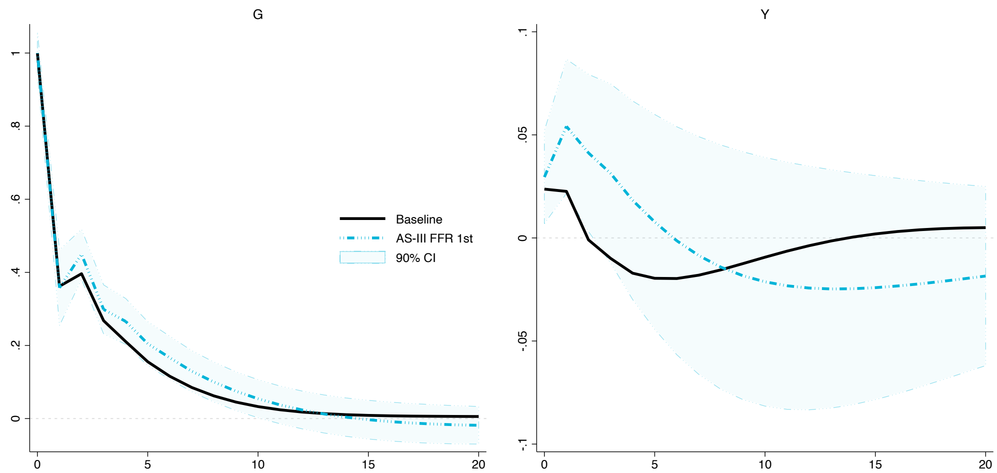

Figure 1.9: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$, when $\boldsymbol{FFR}$ ordered 1st. Thick solid black line represents point estimates of the baseline scenario. Light blue line represents point estimates following following AS-III specification, and the light blue-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

quarter to stabilize around zero after the eleventh quarter. Finally, it turns positive at the end of the horizon. Yuan and Chen's (2015) findings show that despite not being significant, there is an impact of 0.002% on $\boldsymbol{Y}$, after a fiscal shock. A related case occurs with the $\boldsymbol{CA}$ and $\boldsymbol{REER}$, while here, the results confirm an increase in $\boldsymbol{CA}$ and a depreciation of $\boldsymbol{REER}$; Yuan and Chen (2015) find that the current account deteriorates while the exchange rate appreciates at impact and then becomes null and depreciates, respectively.

The contractionary behavior in the output is expected, given the nature of the shock. Through the reduction of fiscal balances, a fiscal shock is related to a greater collection of taxes or lower government participation through its purchases. Whatever the government's strategy to reduce fiscal balances, it implies less consumption in the private sector.

Jawadi et al. (2016) decide to include the $\boldsymbol{FFR}$ following the recommendation of Kim and Roubini (2000) and Grilli and Roubini (1996). Grilli and Roubini (1996) argue that $\boldsymbol{FFR}$ should be considered in small open economies models to control the repercussions of US monetary policy changes in the domestic monetary policy. Jawadi et al. (2016) ordered $\boldsymbol{FFR}$ in the first place under the assumption that it does not react contemporaneously to the changes of the rest of the variables, thus becoming the exogenous variable.

The vector $\boldsymbol{Z_{i,t}}$ has the following representation:

$$Z_{i,t} = [FFR_t, G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]' \tag{1.9}$$

Figure 1.9 shows how one innovation in fiscal policy, $\boldsymbol{G}$, affects the development of $\boldsymbol{Y}$ when $\boldsymbol{FFR}$ is ordered first. The light blue dotted-dashed line represents point estimates following specification (1.9). The response of $\boldsymbol{G}$ on itself shows an increase in government spending during the second quarter, similar to the baseline model increase. The effect of $\boldsymbol{G}$ decreases until it becomes negative when it reaches 20 quarters.

Moreover, when dealing with $\boldsymbol{Y}$, the impulse-response functions have different characteristics and behaviors at the end of the 20 quarters' horizons, compared with the baseline model. When $\boldsymbol{G}$ is ordered second, following $\boldsymbol{FFR}$, the impact effect magnitude is higher by 0.006 percentage points than in the baseline model. Subsequently, the curve reaches its maximum (0.054%) during the second quarter to later decrease until -0.018% in the twentieth quarter.

The critical finding in this section is that under this modification of the specification, it is still impossible to replicate the effect found in the panels of impulse-response functions presented by Jawadi et al. (2016). Here, output responses decrease during almost all of the horizon periods, except for the first two quarters. On the other hand, Jawadi et al. (2016) show that the output response is zero at impact, never negative, and show an increasing response over the forecast horizon significantly different from zero. Jawadi et al.'s (2016) findings would imply a null impact multiplier, but a positive cumulative multiplier significantly different from zero. Therefore, an expansive

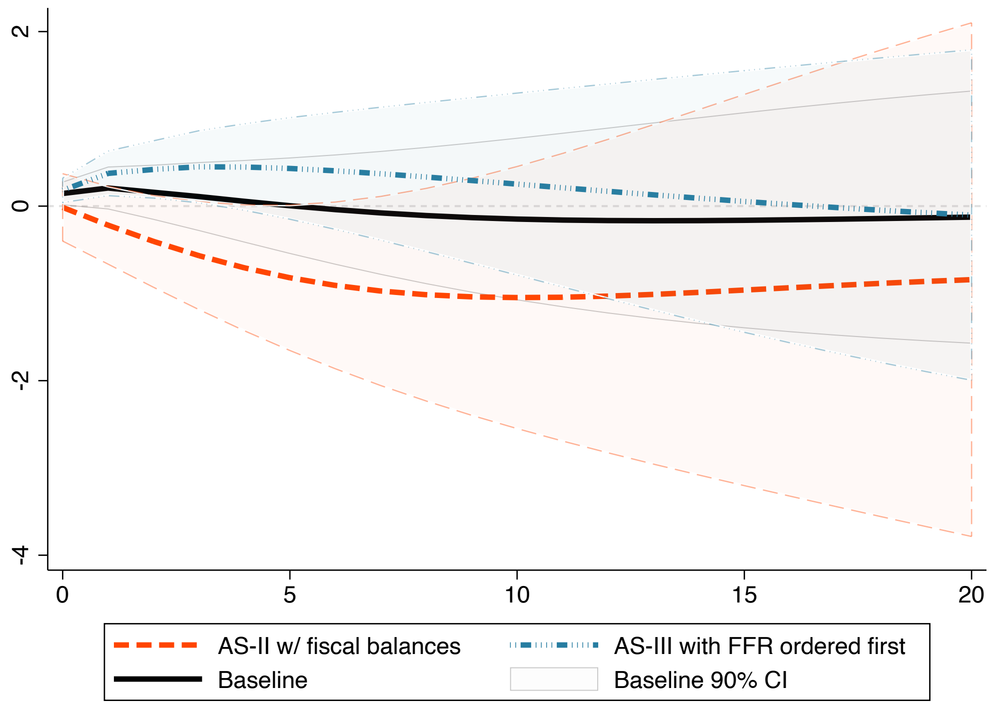

Figure 1.10: Government Spending Multipliers for the Alternative Fiscal and Monetary Policy Variables Aspects. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-II (dark orange) with $\boldsymbol{fiscal}$ ordered 1st, and AS-III (light blue) with $\boldsymbol{fiscal}$ ordered 1st alternative specifications with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

effect on the economy in the long-run.

Figure 1.10 shows the estimates of government spending multipliers under the specifications (1.8) and (1.9) following the identification approach proposed by Blanchard and Perotti (2002). The estimated multipliers across the specifications show conflicting evidence one more time. However, certain essential aspects worth mentioning. These subsection results are different compared to Yuan and Chen's (2015) findings because of the use of the contractionary fiscal policy instrument. When $\boldsymbol{fiscal}$ is ordered first, following the Yuan and Chen's (2015) specification, the impact, and cumulative multipliers turn negative to -0.014% and -0.842% respectively. Neither of the multipliers is statistically significantly different from zero. This result differs from the baseline-model in both magnitude and direction. However, this result agrees with Yuan and Chen's (2015) findings that there is no significant response.

In Jawadi et al.'s (2016) specification, the model finds a statistically significant impact multiplier of 0.181%, higher than the base scenario by 0.04 percentage points. Likewise, the cumulative multiplier reaches a non-statistically significant value of -0.102%, being less than the base scenario in 0.02 percentage points. Although the impact and cumulative multiplier values are similar in magnitude, the multiplier behavior differs significantly between the two estimates. The difference is that the multiplier, under the scenario of $\boldsymbol{FFR}$ enters the model ordered first, remains significant until the 3$^{\text{rd}}$ and positive until the 16$^{\text{th}}$ quarter. This behavior is not present in the baseline scenario where the multiplier becomes negative near the sixth semester. Thus, these subsection results are in line with the baseline-model in direction. Hence, the multipliers estimated in Section 1.3.3 are robust to the inclusion of the $\boldsymbol{FFR}$ ordered first.

1.4.3 Alternative Variable Ordering

The last big difference between this study and the two previous works, Yuan and Chen (2015) and Jawadi et al. (2016), is the order of the variables in the vector $\boldsymbol{Z_{i,t}}$. In the literature on public spending, Blanchard and Perotti (2002) suggest ordering the variables in a specific way to identify government spending shock. Precisely, the fiscal variable must be placed first in the vector to impose a lower triangular Cholesky's decomposition. Putting $\boldsymbol{G}$ in any position other than the first would not identify the model's fiscal impact. The central assumption to achieve identification is that the variable placed first does not react contemporaneously to the other variables.

Instead, Yuan and Chen (2015) ordered the fiscal-balance ratios variable in the fourth position following the literature corresponding to monetary/fiscal transmission. This order of the variables comes from the combination of the approaches used

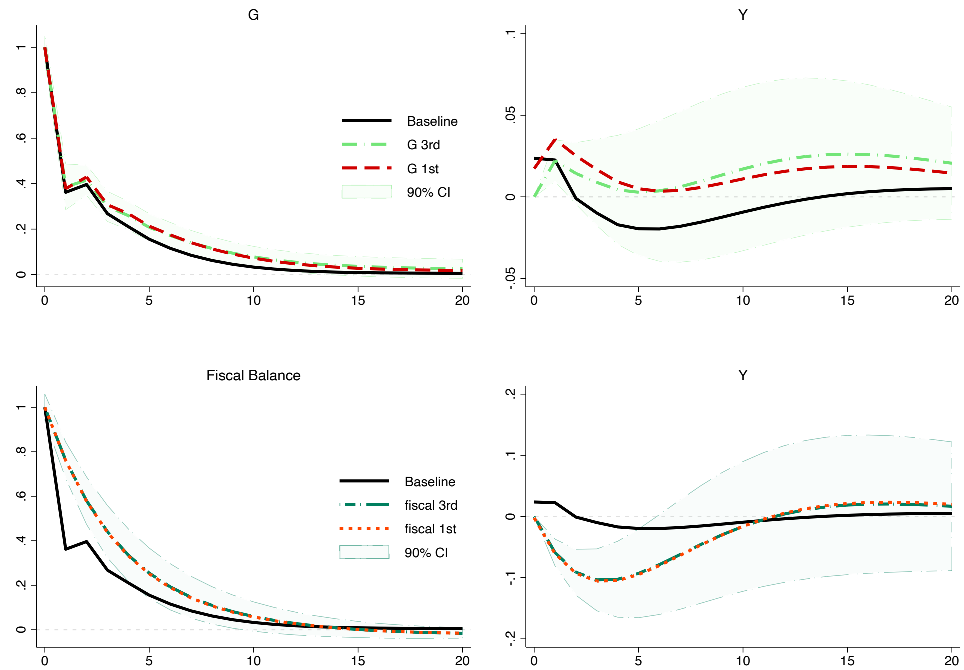

Figure 1.11: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$ or $\boldsymbol{fiscal}$ ordered in 3rd position. Thick solid black line represents point estimates of the baseline scenario. Light green and green lines represent point estimates when $\boldsymbol{G}$ or $\boldsymbol{fiscal}$ as fiscal policy instrument, respectively. Colored areas are the 90% confidence region after 1,000 Monte Carlo draws.

by Peersman and Smets (2001) and Kim and Roubini (2008). Peersman and Smets (2001) explain that changes in the interest rate do not affect the level of economic activity, prices, or the amount of money in the economy at any time. Additionally, Kim and Roubini (2008) argue that budget deficits are affected by economic performance within a quarter. However, the government spending literature suggests that if government spending is ranked fourth, it will imply that it reacts to GDP changes.

Moreover, it would not be possible to capture any effect of fiscal policy on economic growth. Therefore, this could explain why the authors find that fiscal policy innovations have no significant impact on output. The authors also assure that there are no substantial changes in their results when ranking the fiscal policy variable first, following Blanchard and Perotti's (2002) ordering.

The top right panel of Figure 1.11 shows a positive and persistent reaction of output until the last quarter within the horizon when government consumption is ordered third. The reaction's shape and direction are similar to that observed in AS-II, except that the response is null at impact after a government spending shock. When $\boldsymbol{fiscal}$ is ordered third, the estimated response is almost identical to the estimates when the variable is ranked first. In magnitude, the quantitative differences between each of the estimated IRF points are not higher than 0.003 percentage points. Moreover, the IRFs share similar characteristics in direction and shape either at impact or in the horizon of 20 quarters. However, those IRFs show marked differences with the results found in the baseline model. On the other hand, the estimates under this model serve as supporting evidence for the AS-II findings, but they contradict the baseline model results.

Jawadi et al.'s (2016) specification, and the specific order of the variables, has two aspects are worth mentioning. First, the authors determine the variables' order according to the literature on monetary policy shocks effects. Specifically, the authors establish the vector $\boldsymbol{Z_{i,t}}$-order following the approach proposed by Christiano et al. (2005). Under this approach, the macroeconomic variables and the price level are ordered first in the vector $\boldsymbol{Z_{i,t}}$. The primary assumption is that GDP and the deflator do not react instantly to monetary policy innovations, specifically the US federal funds rate shocks. Also, Christiano et al. rank the growth rate of the money supply after the federal funds rate accordingly to Friedman (1968).

The second aspect to consider is the fiscal policy variable's inclusion in the vector $\boldsymbol{Z_{i,t}}$. Jawadi et al. argue that government spending reacts contemporaneously to GDP but at a slower speed than the interest rate. Therefore, $\boldsymbol{G}$ is located after the GDP and the price level, but before $\boldsymbol{ir}$. This assumption is against what is stipulated by Blanchard and Perotti (2002) who maintain a delay in the preparation, proclamation, and execution of laws that allow changes in government spending. Therefore, $\boldsymbol{G}$ must

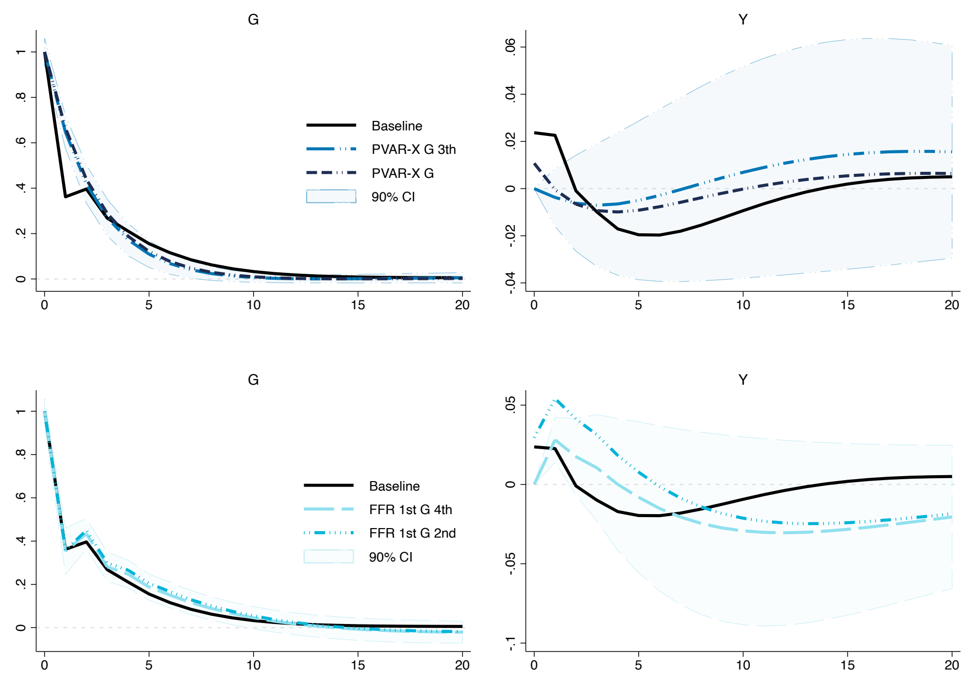

Figure 1.12: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$ ordered in a position different from 1st. The thick solid black line represents point estimates of the baseline scenario. Light Navy and light blue lines represent point estimates when $\boldsymbol{FFR}$ is declared as exogenous or ordered 1st, respectively. Colored areas are the 90% confidence region after 1,000 Monte Carlo draws.

be ordered first in the vector $\boldsymbol{Z_{i,t}}$. [18]

Figure 1.12 is divided horizontally into two sub-panels. First, in the upper panels, the model considers $\boldsymbol{FFR}$ as an exogenous variable. There is no increase during the second quarter for the government consumption response. Meanwhile, the output's behavior in the upper right panel shows differences between the specifications (1.7), (1.9), and the baseline scenario. The light navy lines at the top right panel showed the output reaction to a fiscal shock when $\boldsymbol{G}$ is in the third position after GDP and price level, as proposed by Jawadi et al. (2016). At first glance, the fiscal shock is not identified since there is no reaction on the output, showing a null effect on impact.

[18] Dungey and Fry (2009) analyzes the interaction of fiscal and monetary policy in New Zealand and provides a new approach to identify each shock separately. In their identification approach, they use an SVAR ordering G and then Y, inflation, and finally, the interest rate.

Consequently, as expected, the response becomes negative until the seventh quarter to continue with its growing process reaching a magnitude of 0.016% in the twentieth quarter, 0.01 percentage points more than the baseline scenario.

Second, the bottom panels of Figure 1.12 show how one innovation in fiscal policy, $\boldsymbol{G}$, affects the development of $\boldsymbol{Y}$ when $\boldsymbol{FFR}$ is not declared as exogenous. Instead, $\boldsymbol{FFR}$ is ordered first under the assumption that the other variables included in the vector $\boldsymbol{Z}$ would not affect it. By focusing attention on the response of $\boldsymbol{G}$ itself, the increase in $\boldsymbol{G}$ estimated during the second quarter is similar to the increase found in the baseline model and Figure 1.9. The effect of $\boldsymbol{G}$ becomes negative at the 20 quarters horizon. Moreover, when dealing with $\boldsymbol{Y}$, the impulse-response functions have similar characteristics. Though, compared with the baseline model, they present different behaviors at the end of the 20 quarters' horizons. The long-dashed and dashed lines have the same shape with an expected variant corresponding to the zero impact of $\boldsymbol{G}$ ordered fourth. Moreover, both curves reach their maximum during the second quarter and then decrease to -0.02% in the twentieth quarter.

The left panel in Figure 1.13 shows the estimates and behavior of the government spending multiplier under AS-II when $\boldsymbol{G}$ or $\boldsymbol{fiscal}$ are ordered in the fourth position. The panel shows that the fiscal policy shock is not identified regardless of the fiscal instrument used. Thus, the impact responses and, therefore, the multipliers are zero. However, the multipliers in this section behave as expected in both scenarios. The multiplier is positive after an expansionary shock, such as an increase in public spending. Meanwhile, it turns negative when a contractionary shock occurs as an improvement in the fiscal balance. In both cases, the multipliers are significantly different from zero in the short-run.

In the short-run, the multiplier is positive 0.122% and statistically significant within the first half after a government spending shock. Likewise, after one innovation in the fiscal balances, the multiplier is negative and statistically significant until the

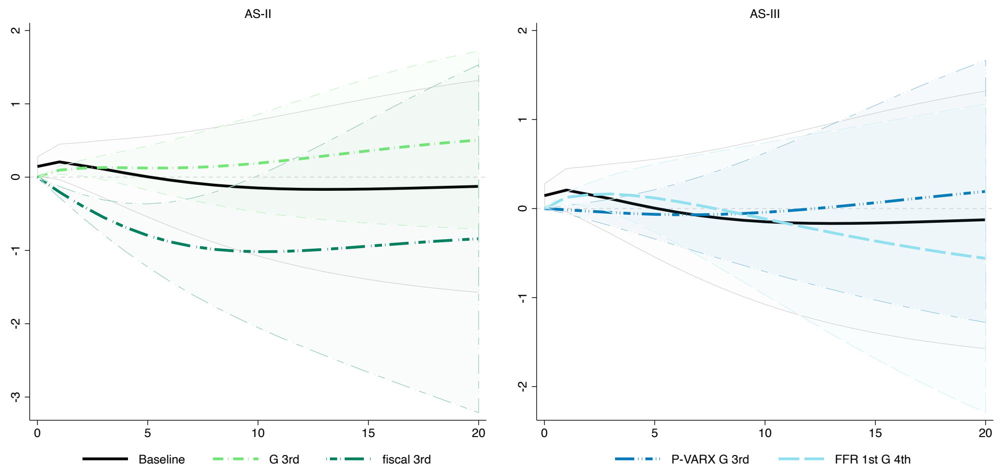

Figure 1.13: Government Spending Multipliers for the Alternative Ordering. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-II (green), and AS-III (navy) alternative ordering with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

ninth semester, where it reaches an estimate of -1.008%. Finally, the point estimates of the multipliers are almost identical regardless of the fiscal policy variable's order. The difference lies in the breadth of the confidence region. The negative multiplier in the short-term, statistically significantly different from zero, provides evidence against Yuan and Chen's (2015) findings.

Similarly, the right panel in Figure 1.13 shows the estimates and behavior of the government spending multiplier under AS-III. The light-navy and light-blue lines are the points estimates when $\boldsymbol{FFR}$ is declared as exogenous or ordered first, respectively, and $\boldsymbol{G}$ is in a position different from first. In both cases, the fiscal shock has a null response on GDP. Hence, the impact response and impact multiplier both are zero.

Two circumstances stand out at first glance. First, when $\boldsymbol{G}$ is ranked third on the P-VARX, the results resemble Jawadi et al.'s (2016) findings. That is a null impact and, subsequently, an increasing multiplier at the 20-quarter horizon. Second, when $\boldsymbol{G}$ is ordered fourth, there is a positive (0.155%) and statistically significant impact different from zero during the first semester.

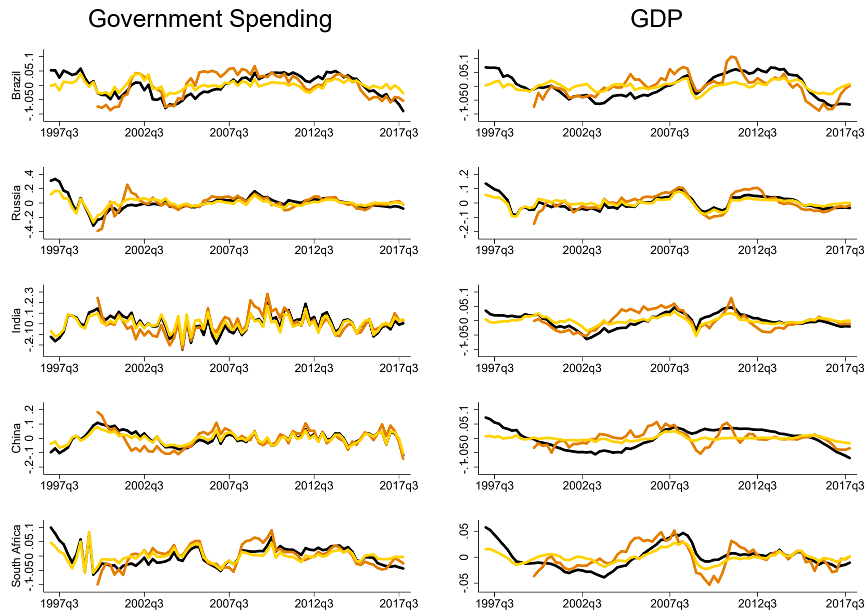

Figure 1.14: Cyclical component of $\boldsymbol{G}$ and $\boldsymbol{Y}$. Gold line represents point estimates using HP Filter, dark orange lines represent point estimates using Hamilton's (2018) filter, thick black line represents point estimates detrended from a quadratic trend.

1.4.4 Alternative Filters

The fourth and fifth scenario proposed in this section corresponds to alternative methods for removing the trend. The Hodrick-Prescott (HP) filter is the most popular and, in turn, the most used filter. The HP filter consists of breaking down a time series into two parts, the trend, and the cycle. Within the literature of the government spending multiplier, Atems (2019) used this filter as the prime method to detrend all the series included in the initial specification. Additionally, this approach also serves as an alternative for trend removal when authors make sensitivity analysis of the results as in Ravn et al. (2012).

Despite being widely used, Hamilton (2018) emphasizes that the HP filter causes some problems when removing the trend of the series. The main problem corresponds to the fact that this filter introduces non-existent relationships in the data. Those relationships may be caused by the marked differences between the adjusted values at the end of the sample and the values in the middle of the sample. Therefore, the author proposes each variable's regression, considering the four most recent previous periods as an alternative filter.

Figure 1.14 shows the cyclical component of the series of both government consumption and GDP of each of the BRICS countries. Each of the panels includes the component obtained by removing the quadratic trend (solid black line), using the HP filter (golden solid line), and finally, the filter proposed by Hamilton (solid orange line). It is worth mentioning that the Hamilton cyclic component begins after four quarters compared to the start of the components of the other two methods because it includes four lags in its process.

Depending on the method used and the filtered variable, these components behave similarly or show discrepancies. First, focusing on government consumption, the components have a similar behavior when the quadratic trend is removed, or the HP filter is used. However, this component after the Hamilton filter presents more pronounced variations, such as China's case in 2002. Specifically, the cyclical component becomes negative, while the two remaining methods show it as positive. For the Hamilton filter, there is an exogenous increase in public spending, while for the other two filters, this constitutes a decrease in the same variable after removing the trend.

The right panel represents the cyclic component of Y, which shows a smoother behavior in general. At first sight, there are not many variations between each method compared to G's behavior, especially in the HP filter case. Although there are no significant variations in each of the trend removal processes' cyclic components, specific vital facts call the attention at first sight. In China's case, only the Hamilton filter can identify the global financial crisis of the years 2009-2010, while the HP Filter shows a minimal reduction in GDP. Similarly, the Hamilton filter shows more considerable variation in the cyclic component of GDP than the other two methods. In Brazil and South Africa during the time between 2002Q3 and 2012Q3, Hamilton's (2018) cyclic

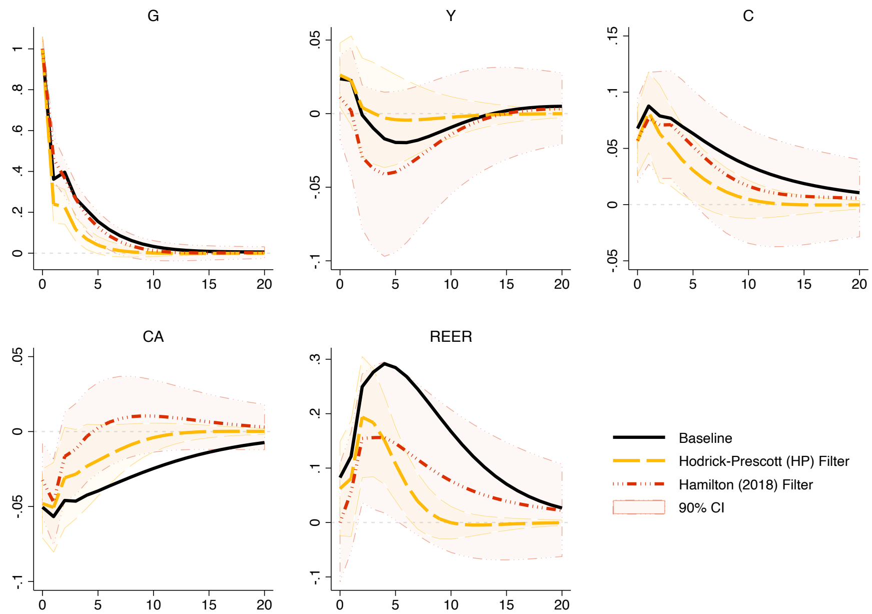

Figure 1.15: Impulse response functions to a 1 unit shock in government spending $\boldsymbol{G}$. Gold line represents point estimates using HP Filter, dark orange lines represent point estimates using Hamilton's (2018) filter, thick black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

component is above (or below when negative) of the other two methods.

Considering that both filters yield different cyclic components, it is expected that their impulse response functions will vary. Figure 1.15 shows the IRFs of the three methods. The golden lines correspond to the estimates made after removing the trend using the HP filter. In the same way, the orange lines represent the estimates when using the Hamilton filter. The black lines correspond to the estimates of the baseline scenario. This graphic also includes the 90% confidence band after 1,000 Monte Carlo draws for both the HP and Hamilton filter, represented as golden and orange dashed lines, respectively.

In Figure 1.15, it is observed that the IRFs vary among themselves in magnitude but not in form or direction. The curves maintain the same behavior and remain positive or negative, but the reactions are higher or lesser than the baseline scenario.

At the upper left panel, G's response to a shock in itself shows that both the baseline scenario and the Hamilton filter estimate a similar reaction. Meanwhile, the HP filter considers that the shock of government spending is blurred in a lower number of quarters.

Concerning output response, it remains significantly different from zero when considering the HP filter, but not when the Hamilton filter is used. With the Hamilton filter, the estimates are not significantly different from zero and indicate a smaller impact shock compare than the baseline scenario and the HP Filter. Although the IRFs represent variations at impact, this does not occur when the 20 quarters of the horizon have elapsed. The three methods converge to the same point with minimum variance in magnitude.

In the remaining panels of C, CA, and REER, it is observed that IRFs are similar in their behavior, serving as evidence in support of the baseline scenario findings. An increase in government spending generates a deterioration in the current account and an appreciation of the real effective exchange rate on impact. So that for longer forecast horizons, the current account shows signs of recovery to be around 0% after 20 quarters. The recovery happens all together with a depreciation of the real effective exchange rate until the twentieth quarter when the government spending effect fades out. Likewise, consumption still shows an increase in impact. The baseline scenario results provide evidence against the influence of consumption displacement when the government decides to increase its spending.

Figure 1.16 shows the impact and cumulative multipliers of each of the filters used, HP (gold line) and Hamilton (orange line), compared to the baseline scenario (black line) along with their respective 90% confidence bands. In HP filter case, the impact multiplier is similar to the one found in the baseline scenario, but this is not the truth when it comes to the cumulative multiplier. The cumulative multiplier shows differences in magnitude and direction since it has a positive cumulative effect

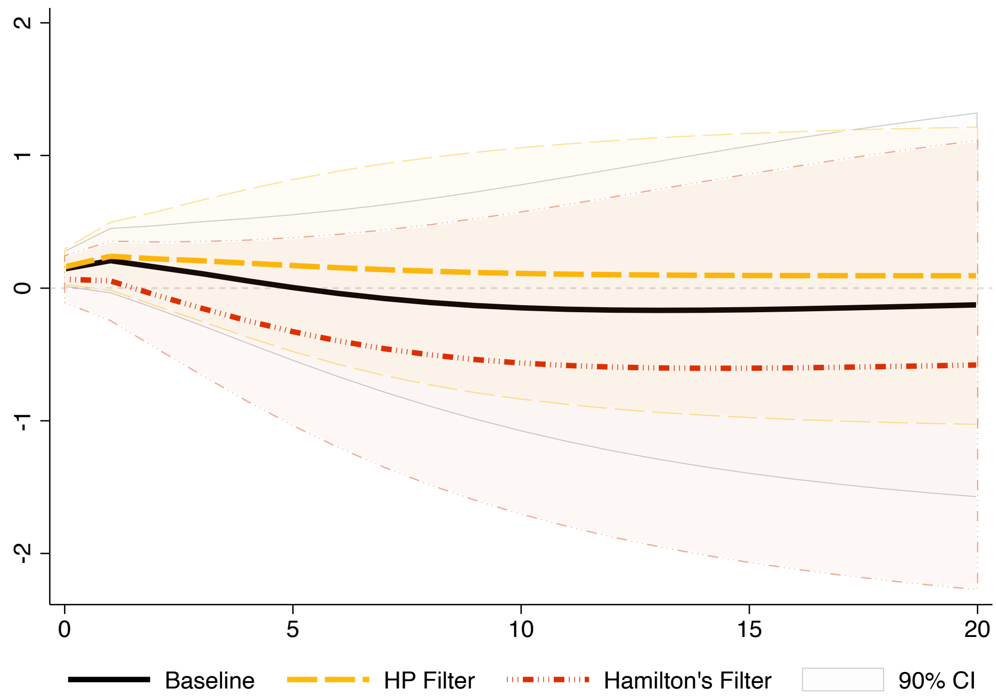

Figure 1.16: Impact and cumulative government spending multiplier. Gold line represents point estimates using HP Filter, dark orange line represents point estimates using Hamilton's (2018) filter, thick black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

of 0.09%. On the other hand, the Hamilton filter estimates a lower impact multiplier than the one found in the baseline model. The multiplier has a magnitude of 0.068% that represents about half of the baseline scenario's impact. On the other hand, unlike what happened with the HP filter, the cumulative multiplier does maintain the address. However, it magnifies the effect given that an effect is obtained at 20 quarters of -0.58%, an effect that is 4.5 times greater than that estimated in the base model. This multiplier is in line with Ilzetzki et al.'s (2013) findings. Although the differences are quantitatively different, the results are not statistically different.

The collected evidence adds details that support the baseline scenario estimates. That is, there is indeed a positive effect on impact after an increase in government spending. Later, this effect decreases until it becomes negative as the quarters pass.

During the horizon of 20 quarters, this negative aspect may have its origins in a higher tax burden or more significant public debt to pay the expenses and state investment of previous periods.

1.5 Conclusion

In this paper, I investigated whether government spending has any influence on BRICS countries' GDP. To maximize the amount of data available, I considered data from both international and national agencies to build a quarterly database covering more than 20 years in the BRICS. Moreover, taking a step beyond previous work, I used identification strategies and post-estimation methods consistent with the previous literature to calculate impulse response functions and the respective multipliers. Furthermore, I considered different adaptions to the specification, ordering of variables, and detrending method providing numerous estimates of the multiplier under alternative scenarios.

The estimates using BRICS' updated quarterly data and following the identification strategy proposed by Blanchard and Perotti (2002) suggest that the impact is below unity, while the cumulative multiplier is negative. Those two multipliers agree with previous literature about the effect of public spending on developing economies. The impact multiplier of 0.14 could mean that a one percent increase in public expenditure will increase GDP by 0.14% in impact. Instead, at a five-year horizon, the cumulative multiplier of 0.125 suggests that the GDP will decrease by 0.125%.

Furthermore, I compared the baseline model, the specifications where private consumption is omitted, or variables included to control the interaction with monetary policy. First, when the consumption variable is omitted, the baseline-model results tend to be magnified. The impact multiplier remains positive, reaffirming the baseline scenario findings, but serves as evidence against the results presented in Ilzetzki

			Peak	
	Impact	*Cumulative*	*Horizon*	*Peak*
Baseline Scenario	0.145⋆	-0.126	1	0.208
Alternative Specifications				
Comparable to Ilzetzki et al. (2013)	0.151⋆	-0.305	1	0.246⋆
Comparable to Yuan and Chen (2015)	0.106	0.486	20	0.486
Comparable to Jawadi et al. (2016)	0.066	-0.006	0	0.066
Alternative Policy Variables				
$\boldsymbol{fiscal}$ 1st	-0.014	-0.842	0	-0.014
$\boldsymbol{FFR}$ 1st & $\boldsymbol{G}$ 2nd	0.181⋆	-0.102	3	0.451⋆
Alternative Ordering				
AS-II $\boldsymbol{G}$ 3rd	0.000	0.506	20	0.506
AS-II $\boldsymbol{fiscal}$ 3rd	0.000	-0.840.	0	0.000
$\boldsymbol{FFR}$ exog & $\boldsymbol{G}$ 3rd	0.000	0.193	20	0.193
$\boldsymbol{FFR}$ 1st & $\boldsymbol{G}$ 4th	0.000	-0.559	3	0.164
Alternative Filters				
HP Filter	0.161⋆	0.094	1	0.240
Hamilton's (2018) Filter	0.068	-0.579	0	0.068

⋆ Significantly different from zero in a 90% confidence band.

Table 1.7: Multipliers - Summary

et al. (2013). Second, by introducing variables to control monetary policy, impact multipliers remain positive and similar to the results of this paper's original specification. Instead, there is distortion in the cumulative multipliers. The multipliers become positive in the case of Yuan and Chen (2015) and minimally below zero when it comes to Jawadi et al. (2016). These results contradict both papers' findings.

To make my paper comparable with Yuan and Chen (2015), I replaced my government spending variable with quarterly fiscal balances. Here a shock of fiscal balances negatively affects GDP both in impact and cumulative. The negative effect on GDP is expected, considering that an increase in the fiscal balance can be translated as an increase in tax collection, a decrease in public spending, or both. Therefore, these results serve as evidence contradicting the Yuan and Chen's (2015) results. The authors show an increase in output as a response to a rise in the fiscal balance ratio.

Similarly, I included the variable of the interest rate of the United States' federal funds in the first place as Jawadi et al.'s (2016) specification. This change in the specification gives multipliers identical to the base model with a shock that contracts GDP at 20 quarters horizon. They are evidence against Jawadi et al.'s (2016) results where a government spending shock leads to a massive increase in output.

Lastly, the ordering of the variables and the detrending method are examined. If the fiscal variables are ordered in a position other than the first one, the shocks will not be identified and will show in the IRFs a null impact. Besides, the HP filter estimates an impact multiplier similar to the baseline-model but remains positive for the 20-quarter horizon. In contrast, Hamilton's (2018) filter maintains the direction of the multipliers. Although, in the case of the cumulative, this is about four times that of the base scenario.

For future work, I must consider the criticisms that exist against the post-estimation transformation method and the use of VARs. Concerning post-estimation transformations, Gordon and Krenn (2010) suggest that both the numerator and the denominator should be calculated as the marginal effect of G on Y relative to the marginal effect of G on itself. Also, this type of transformation imposes a strong assumption that the government spending to GDP ratio (Y/G) is constant throughout the study period as Ramey and Zubairy (2018) suggest. Also, Jordà (2005) argues VARs could not be a reliable specification of the data generating process, that is why he proposes his local projection method as a natural alternative for the calculation of the IRFs and estimation of the multipliers.

Chapter 2

Re-election and Spending: The Fiscal Multiplier in the US States

2.1 Introduction

There are links between fiscal policy and politics in general. One of those links is the political business cycle *(PBC)* hypothesis. The hypothesis suggests that government officials incur in expansionary fiscal policies to increase their re-election probability in the next elections, as Frankel (2010) states. Frey and Schneider (1978), Rogoff and Sibert (1988), and Davidson et al. (1990) highlight how incumbency plays a preponderant role in the modification of fiscal policies and instruments in the United States *(US)*. The strategies' goal is to increases the chances of a re-election. These modifications include increases and changes in the composition of government spending. Moreover, Bee and Moulton (2015) suggest increases in government employment as one more strategy.

A couple of concerns jump over the implications of the presence of the *PBC* in the United States. First, does the hypothesis allows one to identify the modifications, specifically increases in public spending in the US States? Second, if it exists, what is the effect of changes in government spending on GDP growth or personal income? This effect is define by Cogan, Cwik, Taylor, and Wieland (2010) as the government spending multiplier *(GSM)*.

To estimate the multiplier, I propose the eligibility status of the current governors to seek re-election to estimate the causal effect of public spending at the state level. The eligibility is a political instrumental variable that considers the existence of the PBC and legal aspects proper of the US Government organization. Under the US Constitution, the national federal government coexists with the state and local governments. Therefore, each US State writes its constitution, determine the government organization, and manage their elections. Thus, the instrument complies with the requirements that Nakamura and Steinsson (2018) considers necessary to deal with the endogeneity between government spending and economic growth variables.

As a first step, I document the different aspects of the election process, and terms limit in the fifty US states and the District of Columbia during the period 2007-2016. In this period, 149 elections were held every four years and on different years, depending on the US State's legislature. Within the 149 elections, 116 incumbent governors hold the status of being eligible for re-election based on the term limits. Nevertheless, only 94 governors run seeking a re-election.

Subsequently, following Acconcia et al. (2014), I made a comparison of means between two samples (election year vs. non-election years) looking for evidence of public spending increases. One issue is the definition of electoral years. General elections happen in November, but political campaigns begin several months ahead, commonly in March. The problem is that March and November belong to two different Fiscal Years (FY). Therefore, it is necessary to collect quarterly data and then transformed it into annual fiscal data.

The empirical estimation begins with two-stages least square (2SLS) instrumental variable (IV) model with time and region fixed-effects. The model specification follows

Barro and Redlick (2011) transformation, which consists of calculated year-on-year changes in the variable with respect to one lag of the personal income or GDP. Thus, the variables included in the model are percentage variation from the previous period. The instrument is positively related to government spending, and it is statistically different from zero at all levels of significance commonly used.

The estimated effect of the change in state government spending suggests a local fiscal multiplier of 1.274 when the model specification includes one lag of the personal income. The multiplier is statistically significant at the 5% level. Besides, the multiplier is also economically significant since its interpretation is that for each dollar that the government decides to spend, the personal income in the average US State will exhibit an increment of 1.274 dollars in the personal income.

Moreover, following Olea and Pflueger (2013), I carried out the post-estimation weak IV test to assess the instrument's power. The test rejects the hypothesis of the presence of a weak instrument at the 5% level. Besides, as a robustness check, I evaluate the sensitivity of the baseline specification multiplier by dropping different geographical areas and changing the population variable. The first case consider excludes the State of Virginia and the District of Columbia due to legal limitations. As a second case, the model excludes the state of North Dakota considered as outlier due to the prevalent participation of the mining and energy component of their Gross State Product (GSP). The multiplier fluctuates between 1.208 and 1.239, being statistically different from zero at the 5% significance level. Third, when changing the population variable for the civil population or the labor force, the multiplier reaches a value of 1,222 and 1,288, respectively. Additionally, in the present work, I estimate the multiplier over two years is between 1.48 and 1.59. These results are consistent and related to other papers that use local-level data. The most common approach consists of a mix of instrumental variables, and fixed effects on cross-sectional panel data stand out.

The rest of the paper has the following organization. The next section, Section 2.2, discusses the current state of the literature on government spending increases effects on growth outcomes. Section 2.3 describes the data, methodology, and the specification followed to estimate the multiplier. Section 2.4 discuss the literature related to the political business cycle at national and local level. Later, I explain the instrument proposed from its construction until the specification of the 1st stage regression equation. Section 2.5 provide the results and robustness check for the government spending multiplier estimations. Finally, Section 2.6 addresses the final comments of this paper.

2.2 Literature Review

Two types of multipliers can be calculated, national or local, depending on the available data and the identification approach. National multipliers require time series of aggregate variables to implement one of the three main methods to identify exogenous shocks in public spending. Ramey and Shapiro (1998)proposed the first identification strategy, known as the narrative approach. The narrative approach included a dichotomous variable to reference the dates of wars in which the United States was involved. Later, this variable became the defense news variable proposed by Ramey (2011b).

The second identification approach requires the estimation of the impulse response functions (IRFs). To estimate the IRFs Blanchard and Perotti (2002) use an SVAR model where the vector of variables includes public expenditure, taxes and output. The key ingredient of this approach is set the variable of interest in the first position of the vector, comparable to a Cholesky's decomposition. In this case, public expenditure should be ordered first, to achieve identification. However, the unexpected fiscal shocks that are identified under the SVAR scheme, could well be considered as anticipated events. As stated by Ramey (2011b), defense expenditures have waiting times between the decision and the execution of the expenditure. Later, Jordà (2005) proposed the new local projection method as an alternative for the estimation of the impulse response functions.

Finally, the third approach developed by Barro and Redlick (2011) is more in line with local multipliers identification strategy. They appeal to US defense spending considered an exogenous expense to the country's economic situation. They use variations of government spending (federal) in defense, to determine the magnitude and direction of the multiplier effect of defense spending on GDP. The use of the growth rate of defense spending and not of total spending is mainly since the (federal) defense spending is exogenous to economic activity. They rule out the likelihood that participating in a war is due to economic expansion or recession. Contrary, changes in non-defense spending (education, social service, etc.) are related to variations in government income and are therefore endogenous to GDP

Ramey (2011a) argues that in the United States, between the 1940s and 2000s, the the national multiplier estimates are in a range between 0.8 and 1.5. Furthermore, she argues that the range of values is obtained independently of the method used. However, Ramey (2019) provides evidence that the estimates fall into a smaller range of 0.6 and 1. Furthermore, Caggiano et al. (2015) argue that the magnitude of these multipliers depends in essence on the state of the economy. Its main result shows that fiscal multipliers are statistically greater than one during periods of economic depression. In the same way, Ilzetzki et al. (2013) find spending multipliers under different scenarios of economic activity. The results indicate that the effect of spending is greater in each of the following situations: greater economic development, fixed exchange rate or closed economies. Instead, when faced with situations of high debt, the multiplier is negative.

About local multipliers, the estimation of the causal effect of public expenses in the dependent variable is made through the Ordinary Least Squares (***OLS***) method, which often presents bias. To avoid bias, it is necessary to use instrumental variables or system-GMM. The identification in this type of multipliers, mainly, comes from finding events that are independent of local economic activity and, in turn, are correlated with government spending or fiscal policy. Chodorow-Reich (2019) shows that local multipliers in the US are in a range of 1 to 2.5, where most of the studies have focused on the measurement of the fiscal stimulus provided during the financial crisis thru the American Recovery and Reinvestment Act of 2009 (***ARRA***).

Previous studies focus on the estimation the number of jobs generated by changes in public spending due to *ARRA*. In other words, previous works focus on the impact of the fiscal stimulus on employment. Additionally, as this change in public expenditure is endogenous, it is necessary to resort to instrumental variables. For example, Chodorow-Reich et al. (2012) use changes in state Medicaid outlays to instrument the relief provided by the Recovery Act. The authors argue that for every million dollars in funds spent on Medicaid, there is an increase of 38 jobs. In contrast, Wilson (2012) uses the number of federal highway miles or youth participation in the population as an instrumental variable. The author finds evidence that every million dollars spent by *ARRA* created eight jobs from this approach. Similarly, Conley and Dupor (2013) uses the cross-sectional variations in the fall in the revenues of local and state governments together with the variations in the financing of federal highways. In this way, the authors estimate that every million dollars spent by the Recovery Act generated five jobs. Likewise, Dupor and McCrory (2018) uses US-counties level data to instrument exogenous changes in the Recovery Act to estimate it effects in local labor markets. The spending affects the sub-region where it happens directly, and it spillovers in the rest of the region. The authors estimate that the local result is ten jobs for every million dollars. In addition, in the rest of the area, the *ARRA* spending creates eight jobs per million dollars. Compared with previous jobs, these results show a decrease in the cost of each job from $125,000 to approximately $100,000. [1]

On the other hand, Shoag (2010, 2013), Clemens and Miran (2012), Nakamura and Steinsson (2014), Serrato and Wingender (2016) and Auerbach, Gorodnichenko, and Murphy (2020) move away from *ARRA* analysis. The authors use a different event to instrument exogenous changes in government spending to estimate the local income multiplier for the United States. Shoag (2010) and Shoag (2013) takes advantage of the return of the state public pension plans that serve as a exogenous source of financing for public expenditure. He finds an income multiplier between 1.43 and 2.12. Similarly, Clemens and Miran (2012) focus on the differences in the balanced-budget requirements among states' fiscal institutions. The authors argue that deficit-financed expenditures will vary depending on the level of stringency. In other words, in times of crisis, the stricter the rules, the greater the budget cut will be to avoid possible future deficits. In that way, the main result is an impact multiplier of 0.4. Later, Nakamura and Steinsson (2014) define the US economy as a monetary and fiscal union of states with the objective of determining the open economy relative multiplier (OERM). *OERM* measures the effect of public spending on the output and employment of one region relative to another region. Its main variable corresponds to the variations in acquisitions by state within the process of military buildup and national drawdowns. The results for their base instruments show that the multiplier of defense spending is 1.43 in the case of the US states, and 1.85 in the case of regions. Serrato and Wingender (2016) estimates an income multiplier between 1.7 and 2 using population differences between censuses. The authors main argument is Federal Spending (transfers to States) depends on population estimates. In addition, they suggest State and Local government spending could respond in a similar way. Lastly, Auerbach et al. (2020) takes advantage of the US Department of Defense (DOD) contracts database to estimate the city-level multiplier considering

[1] Dupor and Mehkari (2016), Dupor, Kudlyak, Karabarbounis, and Saif Mehkari (2021)

spillovers in neighboring cities. The authors argue that there is a positive one-to-one relationship between DOD spending and city-level GDP. In addition, this same dollar spent by DOD through contracts increases the GDP of neighboring cities by 58 cents. Hence, their leading state-level multiplier is $1.63.

Additionally, there are other papers that use a similar approach in other countries. Acconcia et al. (2014) use the approval of the law No. 164 of 1991 issued by the Italian government to determine the multiplier effect of a cut in public expenditure on investments of the municipalities belonging to different provinces of Italy. This generate an estimated coefficient of the public expenditure multiplier of 1.55 that is interpreted as the impact on the reduction of one percent of public investment. Brückner and Gradstein (2014) seek to measure the effectiveness of fiscal stimulus in output during the crisis from 1990 to 2000 in Japan. The magnitude of the fiscal stimulus package during this period is approximately one quarter of Japan's GDP. They find a public investment multiplier of 0.93.

2.3 Empirical Approach

2.3.1 Data

The goal of this paper is to estimate the effect of public spending on personal income growth at the state level in the US. For which, I have built a database that contains information about political characteristics, personal income and public expenditure of state and local government for each of the 50 states and the District of Columbia during the period 2007-2016. Hence, the model have 510 observations during the determined period.

There are two special cases that worth to mention, the state of Virginia and the District of Columbia. The State of Virginia is considered even though the governor

Variable	Definition	Source
$\boldsymbol{y}$	Real per capita Personal Income	BEA
$\boldsymbol{g}$	Real per capita State and Local Gov. Direct Expenditure	US Census
$\boldsymbol{ft}$	Real per capita State and Local Gov. Federal Transfers	US Census
$\boldsymbol{or}$	Real per capita State and Local Gov. Own Revenues	US Census
$\boldsymbol{d}$	Real per capita State and Local Gov. Debt	US Census
$\boldsymbol{POP}$	Population by State	US Census
$\boldsymbol{CPI}$	CPI by Region Index 2015=100	BLS
$\boldsymbol{pol}$	Political Strength	NCSL/Congress
$\boldsymbol{ur}$	Unemployment Rate	BLS
$\boldsymbol{cl}$	Unemployment Claims	FRED
$\boldsymbol{fs}$	Fall Enrolment	NCES
$\boldsymbol{epg}$	Number of Establishments in Private Goods- & Service-producing	BLS

Table 2.1: Data source and definition

must wait one period to be considered eligible for a candidacy, that is, s/he cannot seek re-election. The District of Columbia shows a government organization similar to the states where the highest authority is the Mayor of the city. Later, as a robustness check, I consider dropping Virginia, the District the Columbia, and both.

There are specific political data at state level that depend on each State Legislature. For example, electoral years, term limits, results of the general elections, and the period comprised within the fiscal years. These data come from the National Governors Association (NGA), except in the case of fiscal years. The fiscal year time frame is available at the National Conference of State Legislatures (NCSL).

An additional feature to consider is the strength of the political party during a specific period. To estimate political strength ($\boldsymbol{pol}$), I considered the State & Legislative Partisan Composition Tables from NCSL and the list of members of the Senate and House of Representatives available in the US Congress.[2] With this information, I constructed an indicator that takes values between 0 and 1, where one represents that the chosen authority is registered as Republican.[3] Subsequently, I calculate the

[2]This calculation includes Nebraska, whose laws determine that, theoretically, the legislative branch is composed of a single non-partisan chamber. Currently, in practice one can check the members' political party affiliation.

[3]Official offices vary from state to state, and not all states have the same number of offices.

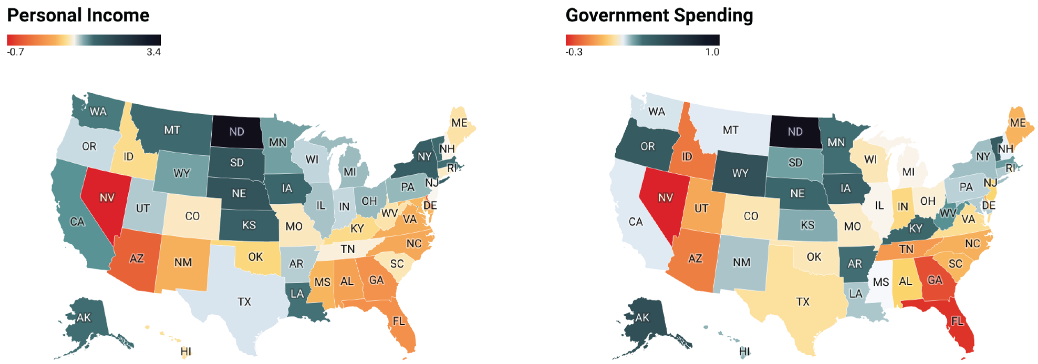

Figure 2.1: Average percentage growth rate of the real per capita personal income, and the real per capita government spending with respect to $y_{s,t-1}$ by US State.

average between the offices. For example, the state of Idaho in the 2003 fiscal year reaches a value of 0.93. This value close to one represents that the Republican party held the majority of the offices. Although the Republican party has a majority in both the Senate and the House of State representatives, there are still members of other political affiliations. Therefore, the value is less than one.[4]

The economic data were collected quarterly and subsequently transformed to annual fiscal data. I made this change since the annual data published by the local and/or national institutions follow the Gregorian calendar.[5] Instead, annual fiscal data considers each state's fiscal calendar. Almost all US States Fiscal Year (FY_{t+1}) runs from July 1 of year $\boldsymbol{t}$ to June 30 of the next year $\boldsymbol{t+1}$. Only four states start their fiscal year on a different date: New York (3/31), Texas (8/31), Alabama, and Michigan (9/30).

Table 2.1 shows the data source for each of the economic variable used in this paper. The personal income data comes from the Bureau of Economic Analysis

The offices considered are: Presidency, US Senate, US House of Representatives, Governor, Lt. Governor, Secretary of State, Attorney General, Auditor, Treasurer, State Senate, State House of Representative.

[4]The indicator should be interpreted as the political strength of the republican party since it is the only political party that was codified. Therefore, a value close to 0 does not necessarily represent the Democratic party.

[5]Gregorian calendar runs from January to December of the same year.

(BEA).[6] The State and Local income, expenditure and debt data comes from the US Census Bureau.[7]. On the income side, the variables are federal transfers and own revenues. Federal transfers are financial allocations from the federal government to keep running the federal programs. Own revenues are the sum of the collection of state taxes, charges, and miscellaneous. Debt encompasses both short and long-term debt issuance. Gathering these three variables together, they represent the financing sources for government spending. Public spending, revenue and debt data was collected in thousands of dollars, but later adjusted to millions of dollars. All nominal data was deflated using the CPI-All Urban Consumers by Region from Bureau of Labor Statistics (BLS). Then, the data were transformed into per capita terms using the population estimated by state from the US Census Bureau.

Figure 2.1, on the left side, shows the average growth rate of the real personal income per capita by US states. Red-colored states, such as Nevada (-0.69%) and Arizona (-0.20%), have the lowest growth rates among the 50 states and the District of Columbia. In contrast, with a 3.43 and 1.92 percent growth rate, the blue-colored states of North Dakota and Nebraska, exhibit the highest rates. In a like manner, the right side of Figure 2.1 shows the growth rates of government spending at the state and local levels (g_s) in terms of the lag of personal income. Here the blue-colored states of North Dakota (0.95%) and Alaska (0.0.50%) show the highest growth rate of g_s. Meanwhile, Florida and Nevada's red-colored states have the lowest growth rates of g_s at -0.25 and -0.27 percent, respectively.

Moreover, this work includes variables related to the activity level of the economy and the demographic aspects of the United States. Two variables capture the business or productivity level. The first variable is the number of unemployment claims from the Federal Reserve Economic Data (FRED). The remaining variable is the number

[6] SQINC1 Personal Income: SA1 Personal Income Summary: Personal Income, Population, Per Capita Personal Income.

[7] Government Finance: State and Local Summary Tables by Level of Government database

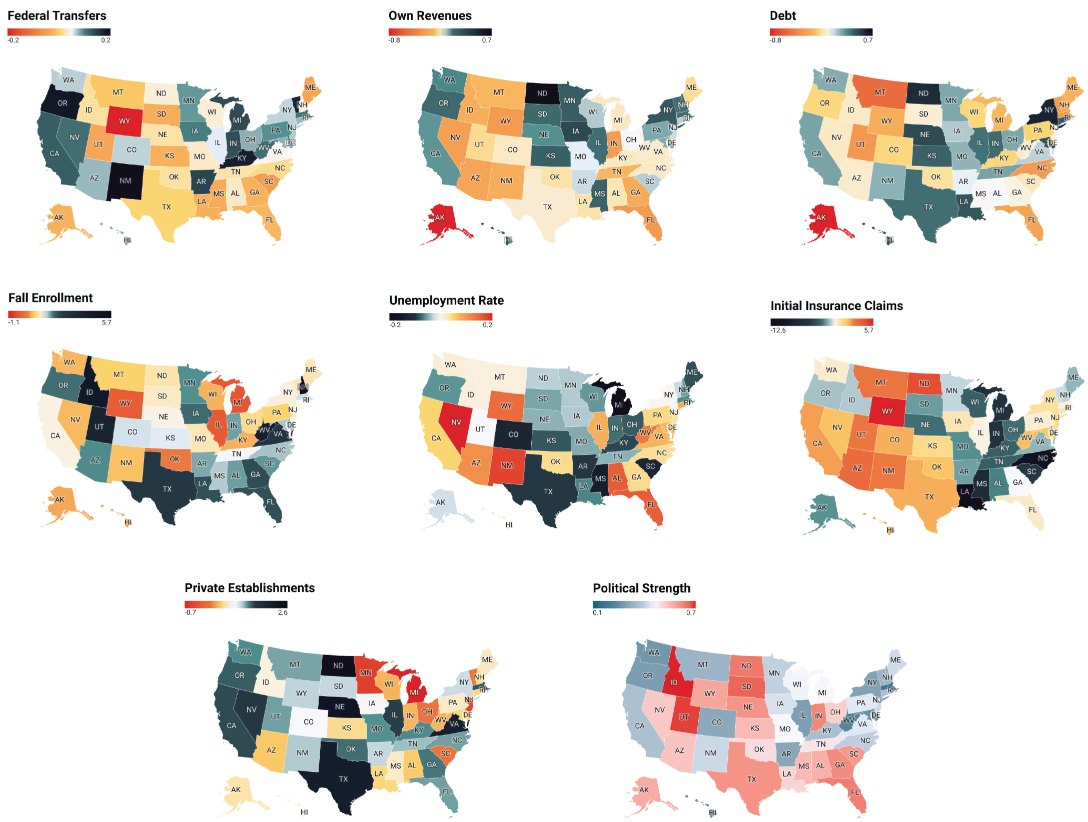

Figure 2.2: Average growth rates for the control variables, by US State.

of private establishments in goods and service producers, were extracted from BLS. Likewise, I use the changes in the number of students enrolled in the fall for the start of a new academic year as a proxy of changes in the population with high level of education. The enrollment data comes from the National Center for Education Statistics (NCES).

Figure 2.2 continues with the analysis of the average growth rates of each of the remaining economic variables. The federal transfers, own revenues, and debt graphics consider the growth of the variable with respect to the lagged value of personal income. The unemployment rate is expressed as the first difference in the unemployment rates. The rates of the remaining variables are calculated as the first difference of the logarithms of the values. The color scale is maintained; therefore, red states have the lowest growth rates (or the highest decline rates as in the case of debt).

Figure 2.2 shows that New Mexico has experienced the highest average growth in terms of federal transfers (0.24%). In contrast, the state of North Dakota has the highest growth rate in terms of its own revenues (0.75%), and the number of private establishments (2.59%). The District of Columbia ranks first in the debt growth rates (0.65%). Regarding unemployment and initial insurance claims, Nevada (0.22 pp) and Wyoming (5.66%) are the states that lead the most substantial increases in each category. Finally, New Hampshire holds the first place as a destination for students with an average growth in enrollment of 5.19%. With respect to political strength, Idaho (0.72) is the state where the Republican party has more official offices under their control, compared to the District of Columbia where the most favored political party is Democrat (0.10). Taken together, Figure 2.1 and Figure 2.2 show the heterogeneity across the US States and the District of Columbia.

2.3.2 Methodology

Following Barro and Redlick (2011), I define $Y_{s,t}$ and $G_{s,t}$ for each of the fifty one territories. $Y_{s,t}$ represents the personal income growth rate calculated as $Y_{s,t} = (y_{s,t} - y_{s,t-1})/y_{s,t-1}$. Likewise, $G_{s,t}$ is the growth rate of the State and Local Government direct expenditure in terms of the personal income from the previous period, namely $G_{s,t} = (g_{s,t} - g_{s,t-1})/y_{s,t-1}$. In both definition, $y_{s,t}$ and $g_{s,t}$ correspond to real personal income and real public expenditure in per capita terms. Both Nakamura and Steinsson (2014) and Acconcia et al. (2014) use an empirical specification that adjusts to the needs of this study for estimating the spending multiplier. The empirical model is:

$$\boldsymbol{Y}_{s,t} = \theta_s + \delta_t + \beta \boldsymbol{G}_{s,t} + \rho \boldsymbol{X}_{s,t} + \epsilon_{s,t} \tag{2.1}$$

US Regions divisions			
Far West	***Great Lakes***	***Mideast***	***New England***
Alaska	Illinois	Delaware	Connecticut
California	Indiana	District of Columbia	Maine
Hawaii	Michigan	Maryland	Massachusetts
Nevada	Ohio	New Jersey	New Hampshire
Oregon	Wisconsin	New York	Rhode Island
Washington		Pennsylvania	Vermont
Plains	***Rocky Mountain***	***Southeast***	***Southwest***
Iowa	Colorado	Alabama	Arizona
Kansas	Idaho	Arkansas	New Mexico
Minnesota	Montana	Florida	Oklahoma
Missouri	Utah	Georgia	Texas
Nebraska	Wyoming	Kentucky	
North Dakota		Louisiana	
South Dakota		Mississippi	
		North Carolina	
		South Carolina	
		Tennessee	
		Virginia	
		West Virginia	

Table 2.2: US Regions defined by the Bureau of Economic Analysis (BEA).

In this model, θ_s and δ_t are the state and time fixed effects. Then, β represent the spending multiplier in the short-run, while $\boldsymbol{X}_{s,t}$ denotes a vector of control variables. The model is estimated with a error term $\epsilon_{s,t}$.

The addition of time fixed effects contributes to control the repercussions of aggregate shocks, and national monetary policies, such as changes in the interest rates. As a reference, both for the United States (Woodford (2011), Christiano, Eichenbaum, and Rebelo (2011), Leeper, Traum, and Walker (2017) and Ramey and Zubairy (2018)), and for Japan (Miyamoto, Nguyen, and Sergeyev (2018)) there is evidence that multipliers reach magnitudes higher than one when the interest rate is close to zero lower bound (ZLB). Additionally, Cogan et al. (2010) and Drautzburg and Uhlig (2015) add that the multiplier is sensitive to the length of the period when the interest rate is close to the ZLB. Therefore, the omission of the time fixed effects could lead to blended effects from both fiscal and monetary policy.

The inclusion of state fixed-effects helps with three critical aspects related to state-specific characteristics. First, it identifies the State's trends of both government spending and personal income. Second, it isolates the features that do not change over time. Finally, it controls the potential endogeneity problem due to the correlation between the state-specific characteristics, government spending, and their sources of financing. For example, Serrato and Wingender (2016) show how several federal funds transferred to the state and local offices depend on each State population estimates. This example is similar to the situation raised by Acconcia et al. (2014) who claim that this relation would brings spurious OLS estimates.

Precisely the population aspect represents a challenge for the model. Mather and Ravikumar (2020) noted two striking facts. First, nearly half of the US population resides in less than five percent of the US counties. Second, only Los Angeles County could be the 10^{th} largest state in terms of population. These aspects of population disparity and the link between population and federal allocations lead to two adjustments in the model. One adjustment is the inclusion of up to two lagged variables for federal transfers' growth rate as a control variable. Then, my regressions are weighted by the state-level population.

Figure 2.3 shows the relationship between the average growth rates of each of the model's two main variables. The growth rates of government spending and personal income are on the x- and y-axes, respectively. The upper-right corner highlights the substantial average growth in personal income in North Dakota. This growth is positively correlated with the more considerable average change in government spending. North Dakota belongs to the Plains region and its primary industry contributing to the real Gross State Product (GSP) is mining, quarrying, and oil and gas extraction. In the case of North Dakota, the high spending is fueled by the increases in rev-

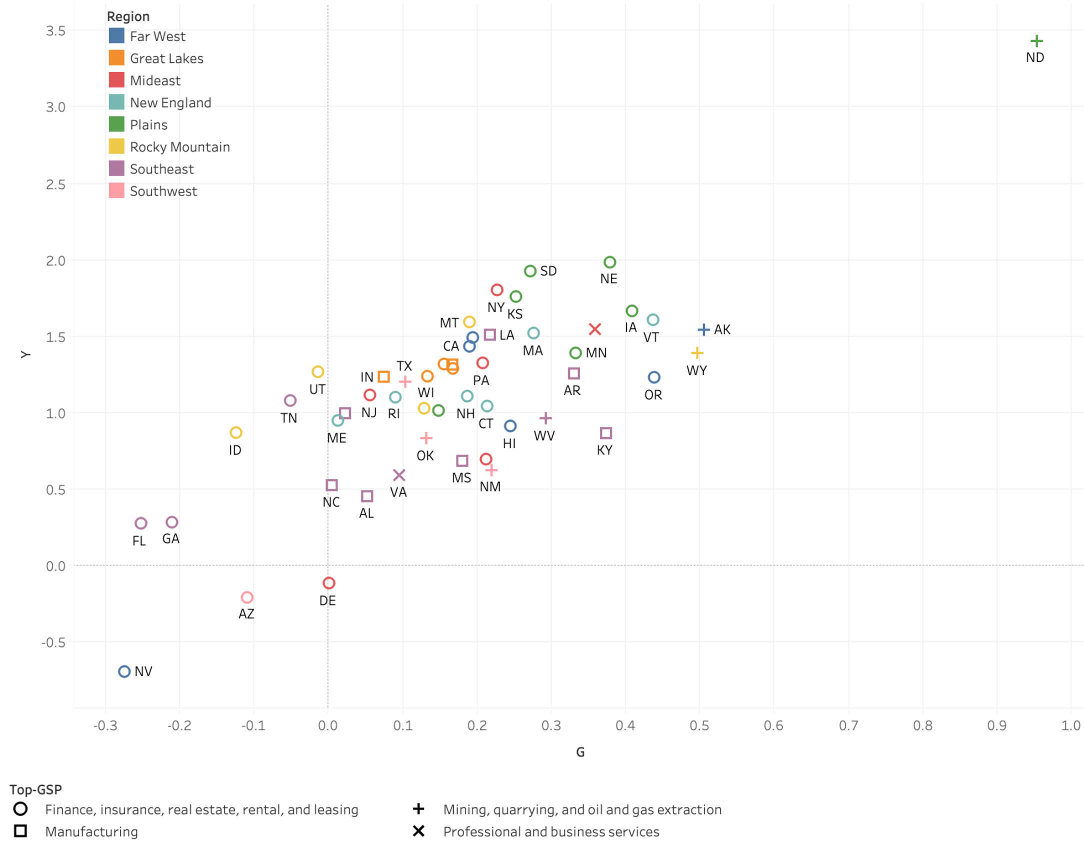

Figure 2.3: Relationship between personal income ($y_{s,t}$) and the state and local government spending ($g_{s,t}$) by US State. The color is determined by the Region, while the shape is an indicator of the top Gross State Product (GSP) component. The data was calculated as the percentage growth rate of the variable with respect to $y_{s,t-1}$, following Barro and Redlick (2011).

enues and debt. Instead, Nevada, whose primary industry is finance, insurance, real estate, and leasing, lives a different story in the lower-left corner of the figure with the second-lowest personal income growth rate. This almost zero growth in personal income is also related to the considerable average decrease in public spending. The contraction in government spending could be explained by the reduction of debt and the reduction of its own revenues. Thus, to control the dynamics in the relationship between personal income and government spending, I include one lag in both variables' growth rate.

In a similar way, own revenues and debt play a major role in state budgets and in the model. These two variables are included by the three different requirements or limitations to which the period's state budgets are subject. First, 46 US States must be governed, constitutionally or statutory, under the balanced budget requirement that prevents authorities from spending more than they collect in revenue. However, only 40 of these states require that the final budget approved and signed by the Governor be balanced. Second, the US States have policies to set the limit on authorized debt or debt service. In the first case, 40 US States maintain the debt limit tied to a specific value or a proportion of personal income or state revenue. In the same way, 28 US states set limits on their debt services as a percentage of the state's income levels. Third, 28 US States established limitations on the growth rates of revenue or expenses. For example, the Missouri legislature cannot increase taxes by more than one percent of total state revenue. [8] For these reasons, the model includes two lags ($t-1$ and $t-2$) of own revenues, and the current debt level together with one lag (t and $t-1$).

The vector X serves to control the influence of two possible factors that modify economic activity regardless of the eligibility status to seek re-election of an incumbent. The first factor corresponds to intense political campaigns before and during the fiscal year of the general elections. Political campaigns require goods and services, both locally manufactured and imported, to promote the candidates. The variable included is the growth rates of private establishments that produce goods or services. Private establishments variable enter the model as contemporary value and a lagged value. Also, to account for the cyclical conditions, the model considers up to two lagged variables related to the activity level. The first one is the percentage point change in the unemployment rate, and the second variable is the growth rate in the unemployment insurance claims.

The second factor is linked to political aspects: the political strength of a party in

[8] The budget process, with its limitations and requirements, is analyzed in depth by the National Association of State Budget Officers through the Budget Processes in the States.

the state, and growth rate in fall college enrollment. Political strength is a proxy for the ability of a governor to reorganize the budget to establish re-election strategies. A governor who shares the same political party with the majority in the Legislatures and other official offices could face less opposition to modify the composition of budget expenditures. This variable enters the model as contemporary and one lagging value since it influences the preparation and execution of the state budget. Likewise, the growth in the inflow of college students enrolled in a state serves as a proxy of the possible political alignment in the state population. Pew Research Center (2018) suggests that college graduates align with the Democratic party. The enrollment variable enters the model as contemporary growth rate and a lagged value.

2.4 The Instrument: Eligibility to Run

A saying that is part of the popular wisdom is politicians that are seeking re-election implement strategies that encourage voters to reward them with their vote. Mainly, these strategies are related to increases in public spending or decreases in the tax burden during the election year. This strategy is not distinctive of a particular political party or ideology. However, is there a change in public spending due to the elections?

At the national level, there is evidence that changes in government spending depend on the characteristics of the countries. Brender and Drazen (2005) says there may be fiscal manipulation in the new democracies. However, in already consolidated democracies, this strategy can be identified. Then, this strategy makes the voter refrain from voting for the incumbent. This effect of not granting the vote to the authority seeking re-election is supported by Brender and Drazen (2008). Also, Enkelmann and Leibrecht (2013) finds no evidence of an electoral cycle in spending concerning Western countries considered as old democracies. In contrast, Shi and

Svensson (2006) argues that during the election year, there is a significant increase in the fiscal deficit, which is higher in less developed countries. However, Vergne (2009) ensures that what varies during the electoral years is the composition of public spending but not the fiscal deficit. The author argues that the resources are reallocated and destined to more visible and, consequently, more valuable elements for the voter.

At the local or regional level, there is evidence that there is an increase in public spending during elections. Also, this incumbent's strategy improves the chances of re-election. Balaguer-Coll et al. (2015), Chamon et al. (2019), and Repetto (2018) provide evidence, consistent with this fact, for the cases of Spain, Brazil, and Italy respectively. Additionally, public spending depends on whether the local government and the central government are aligned. Kukołowicza and Góreckib (2018), Chortareas et al. (2016), and Corvalan et al. (2018) point out that in Poland, Greece, and Chile, the changes in public spending are more pronounced when the local government is from the same political party, or an ally, of the Presidency.

Nevertheless, there is also evidence that government spending declines. Garmann (2017) finds an inverse relationship between the change in public expenditure and how conservative the voter is in fiscal terms. The more advisory the voting group is the less public expenditure before electoral processes. Additionally, Pierskalla and Sacks (2018) believes that investment plans suffer during election campaigns. If the incumbent seeks re-election but is not competent enough, the investment plans during the election campaign are not adequately managed. Therefore, a reduction in capital expenditure.

Two different aspects of the election process should be considered for the gubernatorial elections, an election year, and terms limit. First, the elections are held every four years and carried out on different calendar year depending on the State, as shown in the left side of Figure 2.4. Thus, states can be classified into four different election groups. Group 1 is made up of 36 states and the District of Columbia, including

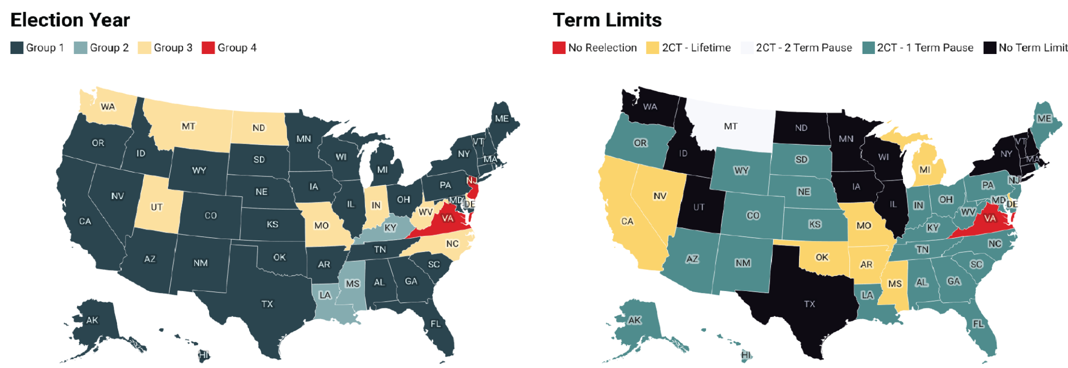

Figure 2.4: States grouped by election-year and term limits

the relatively large states of California, Florida, Illinois, New York, Pennsylvania, and Texas. Particular cases are the states of New Hampshire and Vermont. Their elections take place every two years instead of every four years. However, these states also hold elections in the years of group 1. Hence; they are included in Group 1. The polls for group 1 have been in the years 2006-2010-2014. Group 2 consists of the states of Kentucky, Louisiana, and Mississippi, that held elections in the years 2007-2011-2015. Group 3 consists of 11 states (Delaware, Indiana, Missouri, Montana, New Hampshire, North Carolina, North Dakota, Utah, Vermont, Washington, West Virginia) with elections in the years 2008-2012. Finally, the states of New Jersey and Virginia had elections in the years 2009-2013, and they form the group 4.

Second, there are different term limits in each State, as shown in the right side of Figure 2.4. Besley and Case (1995) argues that the limits of periods are significant when the person in charge is seeking re-election since one of their objectives is to maintain or create a good reputation. The terms limit varies from not being able to be re-elected consecutively at any time, as in the case of Virginia, until being able to be re-elected indefinitely as in the State of New York or Texas. There are other intermediate limits, such as in Arkansas or California, where governors can be re-elected for a single occasion in their political life, or as in Florida or Georgia, where they can be re-elected only once consecutively, but without limit during the political life.

During the period 2007-2016, 149 elections were held across the fifty states plus the District of Columbia. Then, 116 current governors held the status of being eligible for re-election based on the terms limit established by state laws. However, a lesser amount of governors run seeking re-election, they were 94. David Patterson, Governor of New York in 2009, becomes a particular case. In September 2009, the Governor announced that he would seek reelection to the office. Then, in February 2010, he gave up participating in any electoral contest. The decision was made due to low levels of popularity and at the request of the White House.

Additionally, it is considered that during an election year, there are two different times where the incumbent participates actively in politics. In March, the political party organizes the primary elections whose objective is to choose a single candidate to run in the general elections. Then, in November, each political party nominates its candidate in search of being the next elected authority. Therefore, the incumbent would modify public spending on both occasions. These two moments can generate problems for the study since March and November of the same electoral year correspond to two different fiscal years. That is, for the 2020 election year, March corresponds to the final stage of the fiscal year 2020, while November is included in the initial phase of the fiscal year 2021. To address this lag of the fiscal year with the election year, I adjusted the quarterly series by converting them to the annual fiscal series.

A necessary step is to determine if there is a difference in public spending during the voting periods. Thus, following Acconcia et al. (2014), I make a one-sided comparison of means between two samples. The treatment group is all states that are in elections in a given year, while the control group is composed of the remaining states that do not have a vote in a given year.

Table 2.3: Change on Public Spending Change as:

	Elections		***Eligible to Run***		***Running***	
	(t-1,t)	(t)	(t-1,t)	(t)	(t-1,t)	(t)
% of PI	0.129	0.118	0.245***	0.219**	0.225**	0.242**
	[1.81]	[1.57]	[3.49]	[2.66]	[3.17]	[2.78]
% of Spending	0.685*	0.628	1.193***	1.067**	1.108***	1.171**
	[2.22]	[1.87]	[3.85]	[2.88]	[3.54]	[3.01]
Observations	272	149	207	116	164	94

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 2.3 shows the results for the comparison of means. I consider the election years, the eligibility of re-election and running for re-election as the three possible scenarios where public spending can vary. Besides, the table considers the changes in public expenditure in two different time frames. The first frame is where differences in the expense are found in both the primary and general elections, i.e., at time t-1 and t. The second frame corresponds to variations during only the general elections, i.e., at time t. The results show that there is no statistically significant difference when it comes to the election year. In the cases of being eligible for re-election or running for re-election, the difference in public spending in terms of percentage of income as public expenditure is it becomes statistically significant.

Given these results, the election years alone do not represent a valid instrument for public spending, leaving only the other two scenarios remaining. Being eligible to seek re-election does not imply that the current governor is running. There are several reasons to decline to run. First, compete for another office as the Governor of Massachusetts, Mitt Romney, in 2006. Second, decide to retire as the Governor of New Jersey, Richard Codey, in 2005. Finally, third, be defeated in the primaries as the Governor of Alaska, Frank Murkowski, in 2006. In the same way, these reasons explain why the country's economic activity could influence the decision to run for re-election. A governor during a recession could not deliver many goods and services, and therefore, desist in his candidacy, generating bias in the results. With this, the only valid instrument is the eligibility to seek re-election considering changes in spending at t and $t-1$ periods. Thus, the 1^{st} stage of my baseline model is:

$$\boldsymbol{G}_{s,t} = \theta_s + \delta_t + \phi \boldsymbol{Rule}_{s,t} + \rho \boldsymbol{X}_{s,t} + \eta_{s,t} \tag{2.2}$$

2.5 Results

2.5.1 Baseline Model

Table 2.4 shows the results of my baseline specification for two versions of the model, including and excluding the lagged value of the endogenous variable $\boldsymbol{Y}$. The first two columns show the estimate by *OLS*. The contemporary spending and a lagged value are statistically and economically significant at the 1% level in the model independently if the lagged value of the personal income is included. The local spending multiplier under this model is between 0.448 and 0.489. As Acconcia et al. (2014) expose, these results can present upward or downward bias depending on the type , counter- or pro-cyclical, of fiscal policy that the government implements. For Bashar et al. (2017) the GDP and government spending move in the opposite direction for the US; that is, the US fiscal policy is countercyclical, and therefore the results of the *OLS* estimation may show downward bias.

The results of changing the specification from *OLS* to *IV 2SLS* are shown in the remaining four columns. The coefficient varies to 1.123 and 1.274 depending on whether the lagged value of $\boldsymbol{Y}$ is included or not in the specification. This result

Table 2.4: Public Spending Multplier

	OLS	OLS	1st Stage	2nd Stage	1st Stage	2nd Stage
G(t)	0.489****	0.448***		1.123*		1.274**
	[0.140]	[0.146]		[0.662]		[0.625]
G(t-1)	-0.184	-0.250	-0.215****	-0.069	-0.226****	-0.094
	[0.185]	[0.190]	[0.055]	[0.222]	[0.056]	[0.225]
Y(t-1)		0.203**			0.034	0.180*
		[0.102]			[0.023]	[0.101]
Allowed to Run			0.256****		0.263****	
			[0.051]		[0.053]	
F-test Instruments				25.590		24.807

**** Significant at the 0.1% level
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

can be interpreted as the effect on personal income caused by the increase in 1% of State & Local government spending. Thus, a 1 percent increase in government spending lead to an increase in personal income of 1.274%. The same analysis and interpretation could be done in terms of dollars, so that an additional $1 of public spending generates an increase of $1.274 in real personal income per capita in the average State. These results are statistically and economically significant at a 5% significance level. Comparing the *IV 2SLS* estimates to their respective *OLS* estimates, the multipliers under the IV estimation are three times higher. Hence, the *OLS* results present downward bias.

One aspect to notice is that the first lag of $\boldsymbol{Y}$ is positive and different from zero at the five percent significance level in the last column of Table 2.4. Then, the dynamic effects of public spending can be calculated as the ratio between the impact multiplier and one minus the $\boldsymbol{Y_{t-1}}$ coefficient. As a result, the baseline model estimates a multiplier of 1.553% over two years.

Moreover, Table 2.4 shows the coefficient and significance of the instrument for

Table 2.5: Olea and Pflueger's (2013) robust weak instrument test.

	α		
Critical Values	**10%**	**5%**	**1%**
τ = 5%	33.105	37.418	46.219
τ = 10%	19.748	23.109	30.125
τ = 20%	12.374	15.062	20.816
τ = 30%	9.650	12.039	17.232
Effective F-statistic = 24.807			N = 510

both versions of the model. The coefficient is positive and statistically significant at the 0.1% level in both cases. Additionally, the lower part of Table 2.4 shows the value of the F-statistic tests when the model includes or excludes the lagged value of $\boldsymbol{Y}$. The F-statistic measuring the power of the instrument is 25.59 and 24.90, respectively.[9]

To assess the power of the instrument, I implement the robust test for weak instruments proposed by Olea and Pflueger (2013). Table 2.5 shows critical values for four different tau levels and three different significance levels after IV 2SLS estimate. The authors recommend, and they use it as a reference, the critical value from the combination of $\tau = 10\%$ and level of significance $\alpha = 5\%$ as a threshold to reject the null hypotheses of the weak-instrument. Therefore, with an effective F-statistic of 24.807, higher than the critical value of 23.109, the test rejects the null hypothesis.

	VA	DC	ND	VA&DC
G(t)	1.213**	1.301**	1.208*	1.239**
	[0.618]	[0.630]	[0.619]	[0.623]
G(t-1)	-0.073	-0.149	-0.085	-0.213
	[0.229]	[0.219]	[0.224]	[0.225]
Y(t-1)	0.183*	0.180*	0.167*	0.184*
	[0.102]	[0.102]	[0.102]	[0.102]
Observations	500	500	500	490
F-test Instruments	24.440	24.237	25.487	23.865

**** Significant at the 0.1% level
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 2.6: Multiplier after dropping geographical areas

2.5.2 Robustness Checks

The first robustness check evaluates that both the estimates of the line specification base vary by reducing the number of geographical areas. Specific geographical locations do not comply strictly with the requirements of the model. For example, the State of Virginia does not allow the re-election of its governor, so it goes against the characteristics of the built instrument. In Article V Section 1, the Virginia Constitution states that the Governor-elect may serve only a four-year term without being permitted to seek reelection. Likewise, the District of Columbia , despite having a state organization, it does not have statehood within the United States' federal government. The last attempt to achieve statehood was in 2016 through a referendum. In June 2020, the US House of Representatives approves the statehood proposal. However, the media claims that the US Senate and the White House will veto this

[9]Empirically, there is a rule of thumb method to asses if an instrument is weak. The threshold is ten. If the F-Stat is less than ten, then instrument is weak.

bill.

On the other hand, as shown in Figure 2.3, the State of North Dakota could be considered as an outlier by presenting an average per capita personal income growth rate twice the size of the rest of the states. It is worth emphasizing that the income of this state has as the primary source the extraction of oil. Therefore, in this first part of the section, the multiplier is estimated considering the exclusion of North Dakota, Virginia, and the District of Columbia individually. In addition, the model considers dropping the State of Virginia and the District of Columbia as a whole.

Table 2.6 shows the estimates of the base model considering the exclusions of the states and the District of Columbia. The restored obtained do not vary significantly compared to the previous results. The impact multiplier fluctuates between 1,208 and 1.301 and remains different from zero at the 5% of the significance level. In the same way, the coefficient for $\boldsymbol{Y_{t-1}}$ does not present considerable volatility. The estimates remain close to the baseline model result, ranging from 0.180 and 0.184 in three of the four cases. The only case in which the coefficient decreases to 0.167 is when North Dakota is excluded. In the same way, considering the coefficients of $\boldsymbol{G_t}$ and $\boldsymbol{Y_{t-1}}$, the model estimates a two-year multiplier between 1.48 and 1.58. Finally, the bottom part Table 2.6 shows the F-test instrument varies between a minimum of 23.865 to a maximum of 25.487. These values of the statistics-F also exceed the critical value of Table 2.5. Therefore, the null hypothesis of a weak instrument is rejected.

Another critical factor in analyzing is how the coefficient varies when controlling for a different demographic measure. Thus, the second robustness check analyzes the variation of the estimates of the base specification by changes in the population proxy variable. For restrictions on available data, the base model considers the annual population estimated in July by the US Census Bureau as a reference of the population of the fiscal period of the subsequent year. That is, the July 2015 population is considered the population of the fiscal year 2016. However, this would not be reliable

	Civ. Pop.		Labor Force	
	1st Stage	2nd Stage	1st Stage	2nd Stage
G(t)		1.222**		1.288**
		[0.634]		[0.621]
G(t-1)	-0.230****	-0.042	-0.225****	-0.027
	[0.054]	[0.202]	[0.054]	[0.206]
Y(t-1)	0.022	0.186**	0.027	0.189**
	[0.020]	[0.093]	[0.021]	[0.088]
Allowed to Run	0.257****		0.259****	
	[0.049]		[0.053]	
F-test Instruments		27.452		23.730

**** Significant at the 0.1% level
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 2.7: *GSM* using Civilian Population and Labor Force Quarterly Data

since the rest of the variables are quarterly and then transformed into annual fiscal data. Therefore, I collect the Bureau of Labor Statistics variables with quarterly series of civilian population and labor force. By definition, each of these variables is a subgroup of the population. The civilian population variable considers all persons aged 16 and over who are not part of the armed forces neither reside in institutions as nursery homes or prisons. However, it does include all non-citizens living in the United States who do not reside in an embassy. Similarly, the labor force is a subgroup of the civilian population that counts only employed and unemployed persons. Hence, the variable with the most similarities to the state population corresponds to the civilian population.

Table 2.7 is divided into two parts. First, the second and third columns correspond to the specification where the proxy variable for the population is the civilian population. Here, the impact multiplier decreases to 1.222, which is economically and statistically different from zero at a significance level of 5%. The interpretation of this coefficient indicates that for every dollar spent by state and local governments, personal income increases by $1.22. The magnitude of the multiplier is in line with the results of the base model.

Furthermore, the coefficient for $\boldsymbol{Y_{t-1}}$ also remains significant, positive, and close to the initial result with a magnitude of 0.186. Likewise, measuring the instrument's power, the F-statistic reaches a value of 27.452, being greater than both the critical value and the F-statistic of the baseline model. Hence, the null hypothesis of the existence of a weak instrument is once again rejected.

Instead, the second part of Table 2.7, in columns four and five, considers the Labor Force as a population proxy variable. The coefficients of both $\boldsymbol{G}$ and $\boldsymbol{Y_{t-1}}$ are economically and statistically significant at the five percent significance level and provide evidence of the robustness of the initial model results. The magnitudes do not present substantial variations when compared with the results of the base model. In the case of $\boldsymbol{G}$, the multiplier in impact increases to 1.288 while the coefficient of $\boldsymbol{Y_{t-1}}$ increases to 0.189. In this case, the F-statistic shows a decrease compared to the base model, however not enough to be greater than the critical value. In this way, the null hypothesis of the presence of a weak instrument is again rejected.

The two-year multiplier that captures the dynamic aspects of the model reaches a magnitude of 1.50 and 1.59 depending on the population variable used. An exogenous change in public spending due to the governor being allowed to seek a release represents an increase in personal income between 1.50 and 1.59 dollars in two years. However, these results should only be interpreted as cross-sectional multipliers and do not consider the interaction between the national fiscal and monetary policy.

In summary, the robustness check provides evidence indicating that the baseline model results of the equation (2.1) are not volatile under two specific changes. First, the multiplier is not sensitive to the exclusion of geographic areas that do not fully comply with the requirements stipulated for constructing the instrumental variable. Second, the change in the population proxy variable does not generate disproportionate changes in the multiplier estimate.

2.6 Conclusion

In this study I provide evidence that support the existence of a multiplicative effect of public spending on per capita personal income at the regional level for the United States. The model take advantage of the identification of a political business cycle in public spending. Incumbent governors who are allowed to seek re-election modify the State's spending strategy upwards during the election years. The literature suggest that governors adopt this strategy in order to build a good image or point out that they are competent governors who must continue in office, and consequently capture more votes from their electorate in the governors' elections. Thus, I use the eligibility of the governor as an exogenous instrument to identify the effects of increases of government spending on the increase of personal income.

I estimate that the local multiplier is 1.274 in the baseline specification including the political strength feature and all fifty US States and the District of Columbia. The political strength is a measure of the political party power and control in each State. The results obtained are related to the literature of multipliers that use econometric methods not commonly used in macroeconomics. As a robustness check, I drop the State of Virginia, the District of Columbia, individually and jointly, and the State of North Dakota. The multipliers' magnitude fluctuates from 1.213 to 1.301. In addition, all of the multipliers are statistically different from zero at the 5% level of significance, except in the case of dropping the District the Columbia where the coefficient meet the 10% level of significance. Similarly, the change in the population variable provides evidence that the baseline model estimates are not sensitive to using the civil population and labor force variables as a proxy. In addition, the impact multiplier is in the range of 1.22 and 1.29, maintaining the 5% significance level. Finally, the dynamic multiplier of years fluctuates between 1.48 and 1.59, similar to the 1.553 obtained in the baseline model.

It is worth emphasizing that these multipliers should be interpreted as the effect of government spending on personal income for the average state. Likewise, the multiplier estimated in this work serves as the upper limit of the national multipliers. These multipliers do not consider the spillover effects of other states. Therefore, for future work, the relationship between US states could be included, and a quantile IV regression could also be used.

Chapter 3

Fiscal Policy Effects in Latin America: The case of Ecuador

3.1 Introduction

The current pandemic era has caused countries to turn their full attention to government involvement in the national economy once again. Mainly, the countries considered Keynes's (1936) prescription regarding the call to governments' active participation to stimulate economies in times of crisis. The current COVID-19 crisis forced economies to temporarily close to protect human lives.[1] Consequently, governments enacted economic relief laws based on the injection of money into the economy as fiscal policy.[2] However, some developing countries did not have the resources or scientific studies to address this crisis.

In Ecuador's case, the effects of fiscal policy on economic outcomes can be considered an unexplored topic. Therefore, the debate on what measures should be taken by the national government during this time of health and economic crisis was based

[1]On March 11, 2020, the World Health Organization declared the virus COVID-19 as a global pandemic.

[2]United States enacted the CARES Act which stipulates a $150 billion relief fund

more on rhetoric than empirical evidence. Among the few studies, Carrillo Maldonado (2017) shows evidence that the economy reacts positively to changes in public spending. In addition, the author makes a distinction of the GDP reaction between recessions and expansions where the evidence suggests that the effects are greater during the former. García-Albán, González-Astudillo, and Vera-Avellán (2021) add to the discussion the distinction the government spending type, which in the case of an increase in government consumption spending has a positive effect on GDP. However, the authors find evidence that public investment spending effect is lesser compared to the effect after a change in public consumption spending.

In this paper, I analyze the repercussions of fiscal policy, in specific shocks in government spending, on Ecuador's economic growth. Therefore, I estimate the impact and cumulative government spending multiplier, both linear and state-dependent, for Ecuador. The data comes from the quarterly national accounts published by the Central Bank of Ecuador (BCE) and covers almost 30 years, from 1991Q1 to 2019Q4. All variables were seasonally adjusted through the US Census Bureau's ARIMA X-13 program and transformed into real per capita terms.

One key feature of this work is the use of pre-estimation transformation methods where the variables of interest are divided for potential GDP as suggested by Gordon and Krenn (2010). With this step, I avoid the bias of keeping constant the G/Y ratio used in the post-estimation transformation methods proposed by Blanchard and Perotti (2002) and Mountford and Uhlig (2009). To obtain the trend of GDP to be used as potential GDP, I follow Erráez (2014) who uses the HP filter to determine the economic cycles that Ecuador has gone through since 1993.

Moreover, I use Jordà's (2005) local projection method to estimate impulse response functions (IRFs). This method was introduced in the government spending multiplier literature by Auerbach and Gorodnichenko (2012) as an alternative to the SVAR method proposed by Blanchard and Perotti (2002). Also, following Auerbach and Gorodnichenko (2013a) I construct the $\boldsymbol{\kappa}$ index from seven-quarters moving average of GDP growth rate to distinguish periods of expansion and recession. The final step to estimate the government spending multiplier is the use of the one-step equation proposed by Ramey and Zubairy (2018) for both the linear and state-dependent models.

The linear baseline model estimates an impact multiplier of 0.79, significantly different from zero in the 90% confidence interval. The multiplier remains positive throughout the horizon, although it is not different from zero during the second and third years. At the fourth and fifth years of the horizon, the cumulative multiplier becomes economically and statistically significant despite the decrease in its magnitude to 0.38 and 0.27, respectively.

In periods of low economic growth (recessions), the impact and cumulative multipliers are 0.91 and 0.64, respectively. It is worth noting that the multiplier is different from zero throughout the horizon, except in the seventh quarter. When dealing with periods of high economic growth (expansions), the impact multiplier is positive, different from zero at a significance level of 10% and magnitude 1.42. Nevertheless, the effect rapidly moved to negative and non-zero around -0.66 in the 20th quarter. Finally, the p-value based on heteroscedastic- and autocorrelation-consistent (HAC) standard errors indicates that the multipliers are different across economic states as of the twelfth quarter.

The robustness check provides evidence in favor of the baseline model estimates for the linear and state-dependent cases. Here, I use the international price of a West Texas Intermediate (WTI) oil barrel. The global price serves as a proxy variable for the national oil production, considered a Leading Indicator to determine the business economic cycle of Ecuador accordingly to Erráez (2014).

The contributions of this paper in the literature of the multiplier of government spending in Ecuador cover three aspects. First, this document uses pre-estimation transformation methods proposed by Gordon and Krenn (2010) and Ramey (2016). In other words, this work avoids the use of the public spending-to-GDP ratio necessary for estimating multipliers under traditional approaches. Second, the main model of this study uses Jordà's (2005) local projection method to estimate the IRFs and multipliers. Previous studies, Pacheco (2006) and Carrillo-Maldonado (2015); Carrillo Maldonado (2017), obtain their IRFs through the structural vector auto-regressive SVAR model proposed by Blanchard and Perotti's (2002). Finally, this study includes the estimation of state-dependent multipliers estimated in dollars. For example, Carrillo Maldonado (2017) argues that his MSVAR model, which investigates the effects of public spending in recessions and expansions, focuses on the reaction of the economic activity index and not on GDP. Thus, the author claims that the results cannot be translated into dollar amounts.

The organization of the paper is as follows. In the next section, Section 3.2, I detail the relevant literature to this work, ranging from the procyclicality of fiscal policy in developing countries to selected papers that discuss the implications of higher public spending in Ecuador. Then, the Section 3.3 explains the data collection and transformation process as well as the methodology used to estimate the impact and cumulative multipliers. Further, Section 3.4 analyzes the results obtained from the linear and state-dependent multipliers and evaluates the robustness of the results. Finally, the Section 3.5 presents the conclusions of this paper.

3.2 Related Literature

The scarcity of fiscal policy studies and its relationship with macroeconomic aggregates is not something particular to Ecuador, it also affects Latin America. There are few studies on the region's fiscal policy, mainly due to the lack of quality data, as Gavin and Perotti (1997) argue. Most of these studies are focused on determining procyclicality in the fiscal policy of the countries. For example, Gavin and Perotti (1997) shows the differences between industrialized countries and Latin America concerning fiscal policy behavior. The authors assert that in Latin America, fiscal policy is pro-cyclical, and public spending is even more pro-cyclical in recessions due to revenue volatility. Subsequently, Vegh and Vuletin (2014) ensure significant differences between the countries of the region. The authors' findings provide evidence that only some countries have modified their fiscal policy. In specific, Brazil, Chile, and Mexico had moved away from procyclical to countercyclical policy. In the same sense, Céspedes and Velasco (2014) show evidence that commodity-exporting countries such as Argentina, Chile, Ecuador, and Peru have decreased the government spending cyclicality in the period between 1985-2009.

On the other hand, the effects of public spending on GDP have been measured by estimating the government spending multiplier. The main distinction in the multipliers is the type of data collected and the approach selected for its estimation. Farhi and Werning (2016) classifies them into local and national multipliers.[3] The national multipliers are obtained through three different approaches. The most popular approach is the SVAR model proposed by Blanchard and Perotti (2002) to estimate IRFs. This approach uses a vector of quarterly frequency variables in which the government spending variable is ranked first, and then GDP. This ordering, similar to a Cholesky's decomposition, allows the identification of exogenous shocks in public spending that does not react simultaneously to GDP due to lags in its implementation. Second, the narrative approach proposed in Ramey and Shapiro (1998), and later extended in Ramey (2011a), uses the war dates on which the United States begins its process to participate in wars. These dates serve as a reference for calculating the federal government's discounted present value of defense expenditures. Finally,

[3] Local multipliers focus on panels of geographic regions that are part of a monetary union, such as the US States (Nakamura and Steinsson (2014)) or the European Union (Coelho (2019). Chodorow-Reich (2019) explains the estimation method and shows in detail the different results obtained for the United States.

Barro and Redlick (2011) proposes the use of federal defense spending as an instrument of government spending. For the authors, defense spending is the exogenous part of government spending that includes endogenous components such as education.

Nevertheless, Auerbach and Gorodnichenko (2012) propose Jordà's (2005) local projection method as an alternative to estimate the IRFs needed to estimate both linear and state-dependent multipliers. Furthermore, Ramey (2011b) criticizes the VAR model assuring that shocks can be considered as anticipated events rather than exogenous. Therefore, Ramey and Zubairy (2018) proposes the estimation of the government spending multiplier through a one-step regression based on Jordà's (2005) equation. This proposal is opposite to the traditional approach proposed by Blanchard and Perotti (2002) and Mountford and Uhlig (2009).

The low participation of Ecuador and Latin America in fiscal policy studies means that the best strategy was to focus on the differentiated effects between developed and developing countries. Evidence suggests that the effects are smaller when it comes to emerging economies. In Ilzetzki and Vegh (2008), the government spending multiplier obtained through a VAR model is 0.63 for the panel of developing countries, being less than the multiplier for developing countries (0.91). Then, Ilzetzki et al. (2013) using an OLS Panel for 44 countries, obtain negative impact and cumulative multiplier in the case of developing countries with magnitudes of -0.03 and -0.63, respectively. On the other hand, the multipliers are positive for developed countries, 0.39 in impact and 0.66 cumulative, and statistically different from zero.

In the same way, Chian Koh (2017) uses an SVAR for a panel of 120 countries, finding impact multipliers of 0.63 that increase to 0.78 in the long term in the case of developing countries. Regarding the multipliers in developed countries, the magnitudes increase to 0.97 and 1.28 in impact and cumulative, respectively. Finally, Hory (2016) estimates an impact multiplier of 0.41 in emerging economies, while when dealing with advanced economies, the magnitude climbs to 1.33.[4]

Among the few studies on fiscal policy in Ecuador, most of them have a different approach to that of this work. For example, Pacheco (2006) uses a VAR model covering the period 1989 - 2005 to determine the reaction of GDP to innovations in government spending and tax collection. The author shows through IRFs that fiscal policy has a null impact on GDP growth and an effect that is not different from zero throughout the study horizon.[5]

Similarly, Carrillo-Maldonado (2015) uses an SVAR for the period 1993-2009 for the analysis of IRFs. The author shows that a shock in public spending has a negative effect close to zero, although this effect is not statistically different from zero at a significance level of 10%. Subsequently, Carrillo Maldonado (2017) continues its analysis, including the distinction between the periods of recession and expansion for the periods between 2003-2013. The main result is the positive effect of GDP in the face of a shock in public spending for the three scenarios: linear, recession, and expansion. However, these results fade in the long term and are not statistically significant throughout the entire study period. It is worth emphasizing that neither of the two previous studies estimated multipliers according to the literature.

Finally, in a recent study, García-Albán et al. (2021) used a Bayesian VAR (BVAR) to estimate the effects of public spending on consumption and investment considering two sources of net government revenue: taxes and oil revenues. The authors obtain impact multipliers of 0.07 and 0.02 after increasing consumption and capital government spending, respectively. Afterward, the cumulative multiplier of government consumption and investment reach values of 1.95 and 0.39 in the five-year horizon

[4]For the United States, Ramey (2019) claims the multiplier range is 0.6-1 when the authors include aspects such as fiscal consolidation. In the case of the European Union, Beetsma and Giuliodori (2011) finds multipliers with magnitude 1.5. Ravn et al. (2012) find a multiplier of 0.52 for the panel of 4 advanced economies: Australia, Canada, UK, and US

[5]Cristo and Gómez-Puig (2016) ensures that fiscal policy is sustainable in Ecuador due to the low level of debt in its study period. However, the authors emphasize that public spending and inflation can jeopardize this equilibrium path.

in each case. However, these results are not different from zero at a 68% confidence level throughout the period.

Previous results suggest a null effect of fiscal policy when dealing with increases in government spending when using Blanchard and Perotti's (2002) VAR models and Mountford and Uhlig's (2009) approach to estimate the cumulative multiplier. Therefore, the main question that arises is whether these results would change when using Jordà's (2005) local projection and Ramey and Zubairy's (2018) one-step regression for estimating multipliers. In the following sections, I specify the baseline model and the robustness check.

3.3 Empirical Approach

3.3.1 Data

This paper seeks to estimate the multiplier of government spending for Ecuador, a Latin American country whose economy was dollarized in 2000. The main motivations for the crisis and subsequent dollarization lie in the crisis caused by the fragility of its financial system and then magnified due to the weak institutional framework of the country as mentioned by Jácome (2004). Therefore, it is necessary to collect GDP, government spending, deflators, and population data from official government sources and not from international entities.

Table 3.1 shows the data source and definition of the variables used in this work. The main source is the Central Bank of Ecuador (BCE) since it is the institution in charge of quantifying and measuring the country's macroeconomic variables. The periods available are around 30 years and cover from the first quarter of 1991 to the last quarter of 2019. However, this compilation has some challenging aspects. First, starting in 2000, the Central Bank modified the quarterly and annual national

Variable	Definition	Source
$\boldsymbol{y}$	Quarterly GDP	BCE
$\boldsymbol{y^*}$	Potential GDP	Author
$\boldsymbol{g}$	Quarterly Government Consumption	BCE
$\boldsymbol{def}$	GDP Deflator (2007=100)	BCE
$\boldsymbol{pop}$	Population	BCE
$\boldsymbol{wti}$	West Texas Intermediate Oil Price	US EIA

Table 3.1: Data source and definition

accounts methodology. Then, in 2007 a new base year is established for the measurement of GDP. To minimize the risks of spurious data, I obtained the data from the BCE's real sector quarterly releases. From this source, I gathered the data for nominal GDP, nominal GDP components, and deflator. Subsequently, the nominal variables were deflated using the GDP deflator for 2007 (2007 = 100).

On the other hand, the entity in charge of the measurement of labor statistics is the Ecuadorian Institute of Statistics and Censuses (INEC). The INEC does not have a complete quarterly series to measure the population or employment rates. The problem lies in the lack of measurement of the formal and constant labor market due to the variability in the methodology for measuring employment rates. These methodologies were subject to the assumptions and restrictions imposed by the agency in charge. For this reason, I constructed an interpolated quarterly series of the Ecuadorian population based on population estimates from the Central Bank, which it uses to estimate the annual GDP per capita. The population interpolated series was used to convert the real series into real per-capita series. As the last step to treat the data and remove seasonality in the series, all variables were seasonally adjusted using ARIMA X-13 from the US Census Bureau.

It is worth mentioning that Ecuador does not have an official estimate of potential GDP. In other words, there is no official quarterly or annual series available. However, the economic cycle report is available that details the existence of six complete cycles until 2020. To determine the trend and to obtain the cycles, Erráez (2014) argues that the primary tool used was the HP filter. Therefore, I estimate potential GDP as the trend obtained from the HP filter.

Figure 3.1 shows the behaviour of logarithm of government spending and GDP in per capita terms together with the cycles established by the Central Bank of Ecuador. There are two parts to the Figure 3.1 story, before and after dollarization. Before dollarization, in the 90s, there was no economic stability, and the country was experiencing high inflation. This scenario led to a fall in GDP and a drastic contraction in government spending during 1998 and 1999, as Cristo and Gómez-Puig (2016) explain. Then, since 2000, both variables exhibit sustained growth. García-Albán et al. (2021) assure that the fluctuations in GDP from the year 2000 are caused by changes in the country's petroleum income that were sponsored by the high prices of a barrel of oil.

Finally, Erráez (2014) claims that the level of national oil production is considered as one of the variables for the construction of the Leading Indicator of the GDP Cycle and has an lead of at least one quarter. However, national production can be endogenous and depend on international oil prices. For this reason, I collect information on the prices of a barrel of West Texas Intermediate (WTI) oil from the US Energy Information Administration to construct a second variable that determines the change in the states of economic activity in the country. I will explain this variable in more detail in section Section 3.4.2.

3.3.2 Methodology

In this paper, the methodology used to estimate the impulse response functions is the local projections method developed by Jordà (2005). Auerbach and Gorodnichenko (2013a) initially used this method to estimate the IRFs in their work corre-

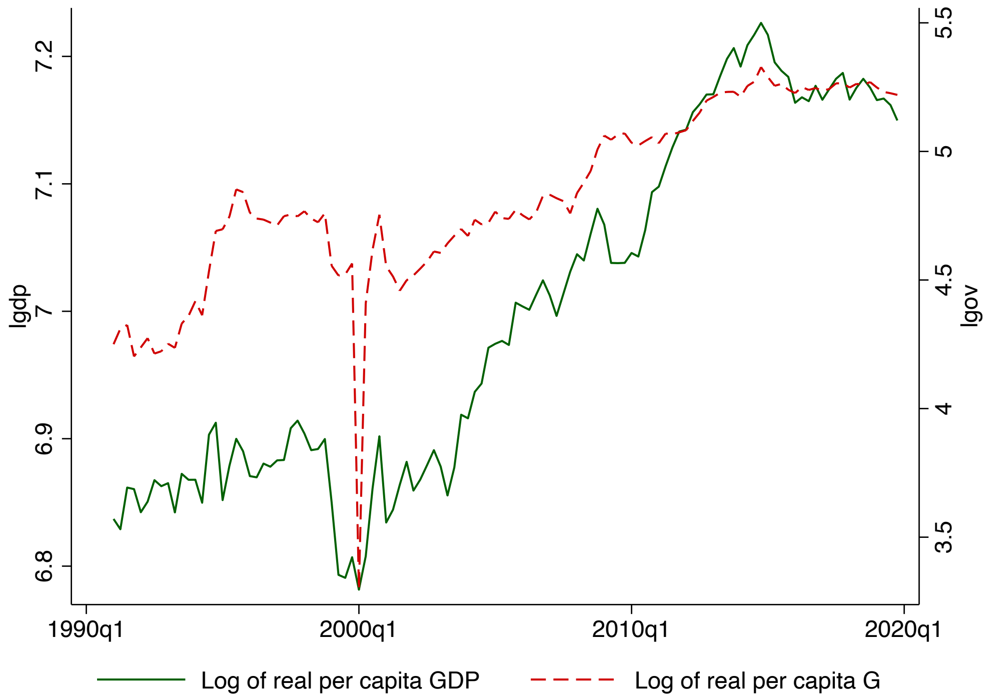

Figure 3.1: Government spending and GDP in real per capita terms.

sponding to the estimation of the government spending multiplier in a large number of Organization for Economic Cooperation and Development (OECD) countries. The authors extend their previous work (Auerbach and Gorodnichenko (2012)) and modified their country sample and methodology, moving from the SVAR approach, proposed by Blanchard and Perotti (2002) to the Jordà's (2005) method. The Blanchard and Perotti's (2002) SVAR approach requires that the vector of variables must have a particular ordering to achieve identification. Specifically, the first variable within the vector must be government spending, which must have a quarterly frequency. However, Ramey (2011a) argues the identified unexpected shocks can be considered as anticipated events.

The main advantage of using Jordà's (2005) local projection method is its simplicity. This method linearly estimates regressions for each of the variables in the study for every horizon h. The baseline model function to estimate is the following:

$$x_{t+h} = \delta_h + \Phi_h(L)z_{t-1} + \beta_h shock_t + \epsilon_{t+h} \tag{3.1}$$

Where $\boldsymbol{x_{t,h}}$ is the variable of interest, specifically $\boldsymbol{y}$ or $\boldsymbol{g}$ following Ramey and Zubairy (2018) base specification. Additionally, $\boldsymbol{\alpha_h}$ is a constant, $\boldsymbol{\Phi_h(L)}$ is the lag operator, $\boldsymbol{z}$ is the vector of control variables and finally $\boldsymbol{shock_t}$ follows the identification strategy proposed by Blanchard and Perotti (2002). The lag operator is a polynomial of order four, which combined with the vector $\boldsymbol{z}$ generates up to four lags of $\boldsymbol{g}$ and $\boldsymbol{y}$. Both variables of interest are part of the vector $\boldsymbol{z}$.

Similarly, the equation (3.1) can be adjusted to allow non-linearities to estimate impulse response functions that depend on the state of economic activity. For this, it is necessary to add the proxy variable $\boldsymbol{I}$ that takes the values from the transition equation (3.3) where a value near 1 reflects an extreme economic recession state, while $\boldsymbol{(1 - I)}$ indicates periods of economic expansion. Ramey and Zubairy (2018) suggest the use of Newey-West correction to make the standard errors robust to serial correlation. Therefore, the equation allowing for state-dependent impulse response functions looks like this:

$$\begin{aligned} x_{t+h} = I_{t-1}[\delta_{R,h} + \Phi_{R,h}(L)z_{t-1} + \beta_{R,h} shock_t] + \\ (1 - I_{t-1})[\delta_{E,h} + \Phi_{E,h}(L)z_{t-1} + \beta_{E,h} shock_t] + \epsilon_{t+h} \end{aligned} \tag{3.2}$$

To determine the low-growth (recession) and high-growth (expansion) economic states, I followed the approach proposed by Auerbach and Gorodnichenko (2012, 2013a) where they construct the index κ which is equal to the seven-quarter moving average of the growth rate of GDP. Later, κ is normalized through the following function with a γ equal to 1.5:

$$F(\kappa_t) = \frac{exp(-\gamma\kappa_t)}{1 + exp(-\gamma\kappa_t)} \tag{3.3}$$

The literature on government spending multipliers has discussions about the best approach for their estimation. On the one hand, Blanchard and Perotti (2002) uses logarithms of the variables, so the impulse response functions are elasticities rather than multipliers. Therefore, it is necessary to transform the estimates using the inverse of G's share of GDP. With this transformation, Blanchard and Perotti (2002) estimates the multiplier as the ratio between the variations of Y and the variations G.

Moreover, Mountford and Uhlig (2009) extends the approach and estimates the cumulative multiplier up to the period h through the discounted values at time zero of the variations of Y and G, multiplied by the inverse of the partition of G in Y. The G/Y ratio is the one that receives criticism. Ramey and Zubairy (2018) shows evidence that the average G/Y for the United States varies across periods. Specifically, she shows that the G/Y ratio for the post-WWII periods is almost twice as volatile compared to the pre-war periods.

In Ecuador's case, the G/Y ratio has a minimum of 3% during the 1998-1999 crisis and a maximum of 14% during the years 2017-2018. On average, in the pre-dollarization era, the G/Y ratio is 10% while for the periods after dollarization, it is 12 %. In other words, the G/Y ratio fluctuates during the time covered by this study.

On the other hand, the post-estimation transformation methods proposed by Gordon and Krenn (2010) claim that the economic variables should be redeemed to the same units by dividing them for the potential GDP $(\boldsymbol{Y^*})$. In this study, since there is no formal estimate of potential GDP in Ecuador, I use the HP filter to decompose GDP into two components: trend and cycle. The trend series is the proxy variable for $\boldsymbol{Y^*}$. Therefore, all of my macroeconomics variables are divided by the potential

GDP.

As an alternative method for the direct estimation of the cumulative multipliers, Ramey and Zubairy (2018) proposes to estimate the regression of the following equation:

$$\sum_{j=0}^{h} y_{t+j} = \psi_h + \gamma_h(L)z_{t-1} + m_h \sum_{j=0}^{h} g_{t+j} + \zeta_{t+h} \tag{3.4}$$

Where $\sum_{j=0}^{h} y_{t+j}$ is the sum of GDP from periods 0 to h, $\gamma_h(L)$ maintains its definition as the lag operator of order four, and $\sum_{j=0}^{h} g_{t+j}$ is the sum of government spending from periods zero to h.

In the same way as the equation (3.1), (3.4) can be adjusted to estimate the cumulative multiplier by including the dummy variable $\boldsymbol{I}$ that takes the values of transition equation (3.3) around 1 when it comes to times of extreme economic downturn. The equation for the estimation of the state-dependent multipliers is the following:

$$\begin{aligned}\sum_{j=0}^{h} y_{t+j} = I_{t-1}[\psi_{R,h} + \gamma_{R,h}(L)z_{t-1} + m_{R,h} \sum_{j=0}^{h} g_{t+j}] + \\ (1 - I_{t-1})[\psi_{E,h} + \gamma_{E,h}(L)z_{t-1} + m_{E,h} \sum_{j=0}^{h} g_{t+j}] + \zeta_{t+h}\end{aligned} \tag{3.5}$$

It is worth noting that the multipliers for the recession and expansion economic regimes correspond to $\boldsymbol{m_{R,h}}$ and $\boldsymbol{m_{E,h}}$, respectively. As Ramey and Zubairy (2018) mentions, the main advantage of this approach is that one can add more instrumental variables for an accurate estimation of the cumulative multipliers. Here, the instrumental variable used corresponds to the exogenous shock identified through the Blanchard and Perotti (2002) strategy. This shock is the residual value of the regression of government spending on up to four lags of Y and G.

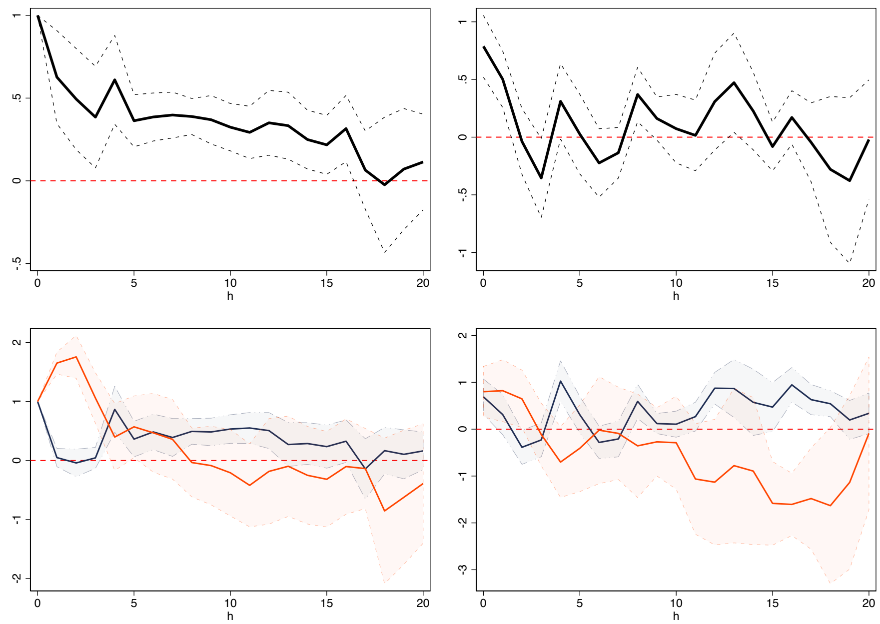

Figure 3.2: Government Spending and GDP responses to a government spending shock. Upper panels shows the linear responses, and the lower panels exhibits the state-dependent responses.

3.4 Results

3.4.1 Baseline Model

Figure 3.2 is divided into two panels. The upper panel shows the impulse response functions estimated for the linear model with the equation (3.1). G's response to self-shock is shown on the left side. The shock remains non-zero until the sixteenth period. Furthermore, the upper right graph shows Y's reaction to a G shock. On impact, GDP changes 0.78 % in response to a one percent change in government spending.

Similarly, the lower panel shows the impulse response functions for the two states of economic activity, recession, and expansion, through the equation (3.2). The orange lines represent periods of expansion, while the dark-navy lines correspond to the state of recession. The lower left graph shows that G, after a one percent shock on itself,

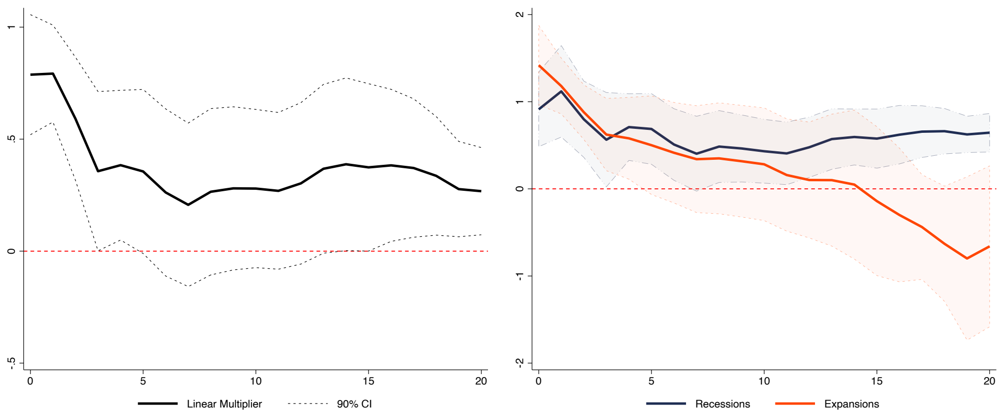

Figure 3.3: Government Spending Multiplier linear and state-dependent. Black lines depict the linear multiplier, dark navy lines correspond to the recession state, and orange lines show the multiplier in the expansion state. The colored-areas represent the 90% confidence interval

shares differently depending on the economic activity state. In the expansion state, it decreases from the second period and turns negative around the second year. On the other hand, in recession, the reaction is zero during the first periods to remain positive until horizon 20. The lower-left panel shows the response of GDP. In recessive periods, Y has an increase close to one on impact. In contrast, it has a lesser impact in expansive periods that turns negative as the periods go until the final horizon.

Figure 3.3 shows the linear and state-dependent cumulative multiplier visually. In the upper part of Figure 3.3, it exhibits an impact government spending multiplier of 0.78 and a 5-year cumulative multiplier of 0.27. In both cases, the multipliers are different from zero at the 90% confidence level. The interpretation of this multiplier is that for every dollar spent by the government, it represents an increase of \$0.78 in GDP at impact. However, its cumulative effect decreases to \$0.27 after five years.

The bottom part of Figure 3.3 shows the multipliers for periods of economic recession and expansion. In recessions (blue line), the impact and the cumulative multiplier are 0.91 and 0.64, respectively. On the other hand, in times of economic expansion, the impact multiplier takes a value of 1.41 to decreases until -0.66 after

Table 3.2: Cumulative *GSM* across Economic Activity states

	Linear Model	Recession	Expansion	HAC p-value
2-year	0.27	0.49	0.35	0.543
	[0.226]	[0.250]	[0.387]	
4-year	0.38	0.62	-0.30	0.000
	[0.206]	[0.203]	[0.466]	

five years. All multipliers are economically and statistically different from zero at the 10% significance level, except for the cumulative multiplier in expansions. The interpretation of these multipliers is similar to the previous one. For an additional dollar of government spending, Y will increase by $0.91 at impact to later fade until it reaches $0.64 in recessions. A similar analysis occurs for expansions.

Table 3.2 shows a summary of the linear and state-dependent multipliers at two and four years after impact. The last column of the table shows the test proposed by Ramey and Zubairy (2018), where it is evaluated if the multipliers differ across the states through the p-value based on heteroscedastic- and autocorrelation-consistent (HAC) standard errors. There is not enough evidence that the multipliers are different across states at two years, although they differ in the fourth year after the initial shock. After four years, the effect of a one percent increase in government spending reaches a 0.64% effect in recessions, while this effect is -0.30% in expansions.

3.4.2 Robustness Check

In the technical notes of the Central Bank of Ecuador, Erráez (2014) mentions that one of the variables that serve as a Leading Indicator to determine the economic cycle of Ecuador is the national production of barrels of oil. However, the choice of production levels may depend on the level of oil prices. Villafuerte and Lopez-Murphy (2010) shows evidence that oil-producing countries maintain a pro-cyclical

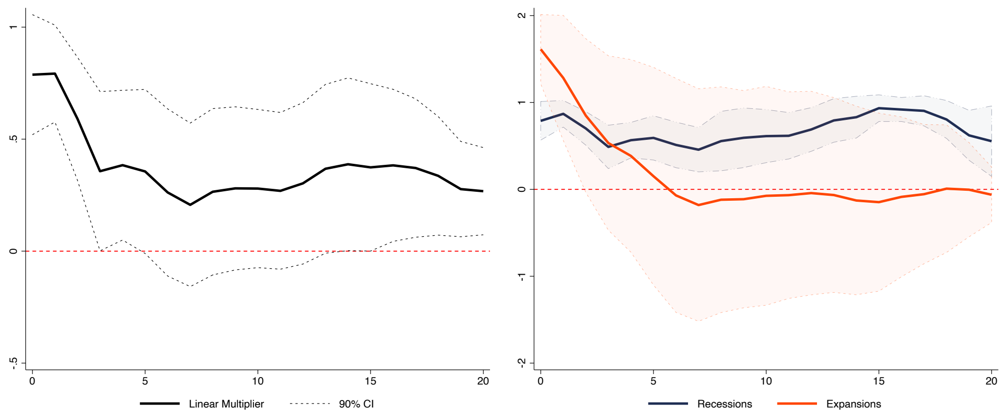

Figure 3.4: Government Spending Multiplier in a linear and state-dependent setting. Black lines depict the linear multiplier, dark navy lines correspond to the recession state, and orange lines show the multiplier in the expansion state. The colored-areas represent the 90% confidence interval

fiscal policy. In the case of Ecuador, Guerrero Quezada et al. (2009) using an SVAR show that an increase in the price of oil generates an increase in GDP. For this reason, I use international West Texas Intermediate oil prices as the standardized variable to determine when it is a period of expansion or recession.

Following equation (3.5), the linear and state-dependent multipliers are now estimated for the case when $\boldsymbol{I_t}$ takes values equal to one when dealing with periods of recession. The recession periods correspond to the quarters where the variations in the oil price are greater than the average of the variations in the standardized oil price variable. In this way, I avoided that the recession was determined only because oil prices were lower before the year 2000.

Figure 3.4 shows government spending multiplier in a linear and state-dependent setting. Black lines depict the linear multiplier, dark navy lines correspond to the recession state, and orange lines show the multiplier in the expansion state. The colored-areas represent the 90% confidence interval band. The right panel shows the linear multiplier of the section Section 1.3.3, while the left panel shows the multiplier under the new scheme for determining periods of recession or expansion.

	Linear Model	Recession	Expansion	HAC p-value
2-year	0.27	0.56	-0.12	0.425
	[0.226]	[0.208]	[0.790]	
4-year	0.38	0.92	-0.09	0.080
	[0.206]	[0.084]	[0.559]	

Table 3.3: *GSM* considering international oil prices variations

On the one hand, in recessions, the multiplier is positive and different from zero in a 90% confidence interval throughout the 20-quarter horizon. At impact, the \$1 increase in government spending produces a \$0.79 increase in the GDP. The multiplier in recessions reaches its lowest point during the seventh period (\$0.46), while its highest point corresponds to the fifteenth period with an estimated value of \$0.93. Furthermore, in the last period of the horizon, the cumulative multiplier remains positive at five years, although it decreases to \$0.55. The interpretation of the cumulative multiplier suggests that every dollar spent by the government generates an increase of 55 cents after five years. Although the multiplier remains positive, it is still less than 1, so public spending would be considered unproductive.

On the other hand, in expansions, the multiplier is positive and different from zero at a significance level of 10% until the first quarter of the horizon. The impact multiplier suggests that for every public dollar spent, GDP increases by \$1.61. However, this positive effect fades quickly and turns negative after a year and a half, where it reaches a value of -0.07. Then, in the next quarter, the multiplier comes to a minimum of -0.18. Subsequently, the cumulative multiplier fluctuates around zero until the end of the horizon, being statistically not different from zero. Therefore, in expansions, the positive impact of an increase in public spending is short-term, while this effect is nil in the long term.

Table 3.3 shows the summary of the cumulative multipliers after two and four years together with the HAC p-value. The HAC p-value serves as a reference to assess whether multipliers differ across economic regimes. The first row of the Table 3.3 indicates that the multiplier reaches a value of 0.56 and -0.12 in the case of recessions and expansions, respectively. In addition, the HAC p-value indicates that there is not enough evidence to show that these multipliers are different from each other. On the other hand, when analyzing the second row of Table 3.3, the cumulative multiplier at the 4-year horizon increases to 0.92 in the case of recessions. In contrast, in the case of expansions, it presents a slight variation to -0.09. In this case and horizon, the multipliers differ between states of economic activity, given that the HAC p-value is significant at a confidence level of 10%.

Considering an alternative variable that determines the periods of low growth and high growth of the country's economy, this section provides evidence in favor of the government spending cumulative multipliers found in the previous section. Likewise, the robustness check reaffirmed that the 1% increase in government spending is unproductive given that the evidence suggests that GDP would increase by less than 0.92% in the case of recessions.

3.5 Conclusions

In this paper, I estimate the government spending effects on the economic growth of Ecuador for the period between 1991Q1 and 2019Q4. This period includes two different economic stages in Ecuador, pre-and post-dollarization in the late 1990s after the 1998 financial crisis. To estimate the effects, I calculated the government spending multiplier using Jordà's (2005) local projection method that serves as the basis for Ramey and Zubairy's (2018) one-step regression estimation. Furthermore, the baseline model includes the distinction of recession and expansion periods following the equation of the transition index introduced in the literature by Auerbach and Gorodnichenko (2012). The previous section considered modifying the economic activity index for the change in international prices of a barrel of oil given the Ecuadorian oil dependence.

The results obtained are contrasted with the estimates and discussions of previous works that address the effects of fiscal policy in Ecuador. Here, the impact and cumulative multipliers at the 4-year horizon are positive and different from zeros for both the linear and the state-dependent cases. The only exception is the cumulative multiplier in expansion times that is negative and not statistically different from zero in the 90% confidence interval. In addition, it is worth emphasizing that the multipliers after four years are statistically different between periods of expansion and recession. Therefore, in a recession, GDP increases by \$ 0.62 after an exogenous increase in government spending of one dollar. On the other hand, in expansions, GDP presents a negative effect but not different from zero. In either case, the public dollar consumed could be considered non-productive and in line with the Ricardian Equivalence.

Moreover, the baseline model results are in line with what the literature review suggests for the case of developing economies. For Ecuador, an upper-middle-income developing country, the multipliers below one and in the range obtained in previous work from panels of emerging economies.

Nevertheless, the present work presents two specific limitations that will serve as extensions for the future. The first limitation is that the different types of public spending are not distinguished. The literature suggests differences in the effects of a public consumption shock compared to a public investment shock. Second, this study does not include aspects related to the country's fiscal and oil revenues. These revenues present an opportunity to unravel the implications of the budgetary policy taken by the government during the last decade.

Appendix A

Political variables visualization

A.1 Political Strength

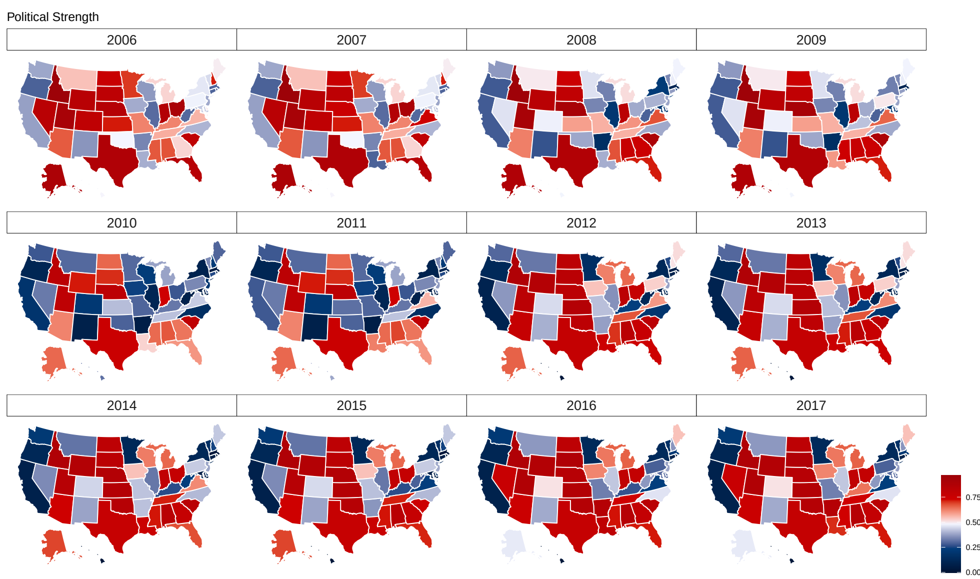

Figure A.1: Political Strength over 2006-2017 by US State.

Political Strength includes the party or majority all of the State offices, the US President and US Congress.

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VITA

Ivan Davila Fadul was born and raised in Guayaquil, Ecuador, in 1986. In this city, he graduated from Javier High School, a school from the Society of Jesus. Then, in 2008 he received a Bachelor's Degree in Economics from the ESPOL Polytechnic University and a Master's Degree in Economics from the University of Missouri in 2020. He hopes to receive his Doctorate Degree in Economics from the University of Missouri in the Summer of 2021.