Government Spending Shocks: None or some impact in BRICS?

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Abstract

There is plenty of evidence on the effects of public spending on GDP growth, but not for developing countries. 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.

Keywords: government spending, fiscal policy, multipliers, developing economies, BRICS.

JEL Codes: E62, H5

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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]

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

[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.

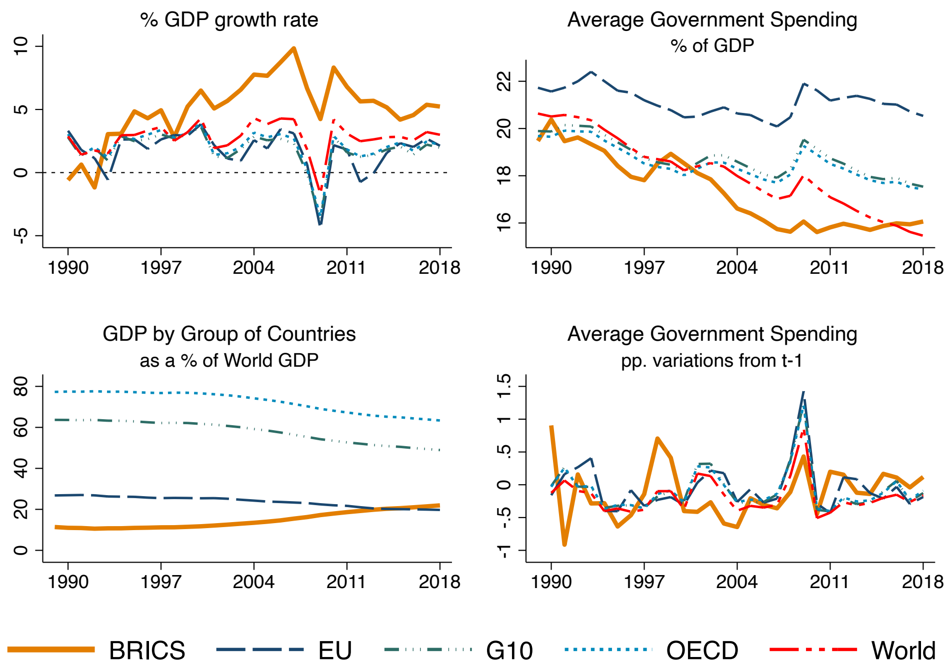

Figure 1: BRICS' GDP and government consumption annual performance compare to the EU (navy long-dashed line), G-10 (emerald three-dot dashed line), OECD (light blue very-short-dashed line), and the World (red short-and-long dashed line). The solid dark orange line represent BRICS data.

affect real GDP in Brazil, Russia, India, China, and South Africa, hereafter BRICS. Figure 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 average participation in GDP among the countries' groups, with a 16%.[3]

[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.

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

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 values 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 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 3 describes the data and methodology

[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.

employed in this paper following the results from the baseline scenario. In contrast, Section 4 describes the econometric methodology used in the alternative scenarios and the alternative specifications that characterize the robustness check. Finally, Section 5 concludes this paper.

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 eco-

[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.

nomic 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 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 policy maintains the zero lower bound.

Furthermore, Christiano, Eichenbaum, and Rebelo (2011) finds that when 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 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]

The literature suggests positive multipliers, and, in some cases, larger than unity, when it comes to advanced economies. Table 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

[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: Empirical results in Developed Economies

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% 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 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

[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.

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 2: Empirical results in Developing Economies

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.

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 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.

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 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.

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 E ective Exchange Rate
$\boldsymbol{def}$	GDP De ator 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 di erence from the quadratic trend.

$\boldsymbol{CA}$ is in levels.

Table 3: Data definition & sources.

3.1 Data

Table 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 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

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

ΔY is the GDP growth rate in percentage terms.
The variables are expressed as to-GDP ratios.

Table 4: Descriptive Statistics - *BRICS*

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 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

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

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.

3.2 Methodology

3.2.1 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:

$$Z_{i,t} = \gamma_0 + \Gamma(L)Z_{i,t} + \Gamma_i + \epsilon_{i,t} \tag{1}$$

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

[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.

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 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:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, C_{i,t}, CA_{i,t}, REER_{i,t}]^{0} \tag{2}$$

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

[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)).

				Information Criterion		
Lag	***CD***	***J***	***J p-value***	$M-BIC$	$M-AIC$	$M-HQIC$
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 5: Model and Moment Selection Criteria (MMSC)

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 following 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

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

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 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 show the response

[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.

of a one-percent increase in government spending.

3.2.2 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:

$$impact(k) = \frac{\Delta y_0}{\Delta g_0}\frac{1}{g/y} \tag{3}$$

Where equation (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 (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 (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 (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.

$$cumulative(T) = \frac{\sum_{t=0}^{T}(1+i)^{\ \ t}\Delta y_t}{\sum_{t=0}^{T}(1+i)^{\ \ t}\Delta g_t}\frac{1}{g/y} \tag{4}$$

Two main criticisms exist against the multipliers obtained through equations (3) and (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 (3) and (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 ($\frac{G_t \quad G_{t-1}}{Y_{t-1}}$) 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 (3) and (4).

3.3 Results

Figure 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 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. 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.

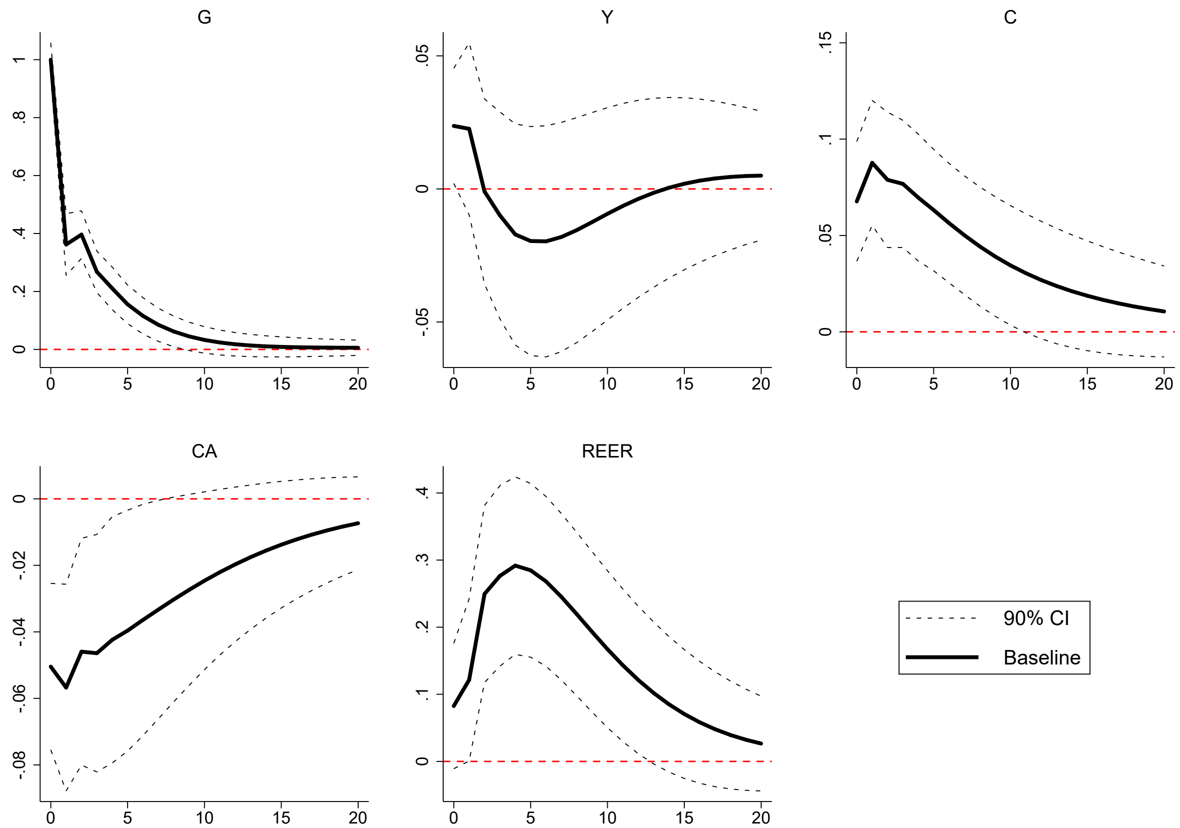

Figure 2: Impulse response functions to a 1% increase in government spending. Thick solid black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

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 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

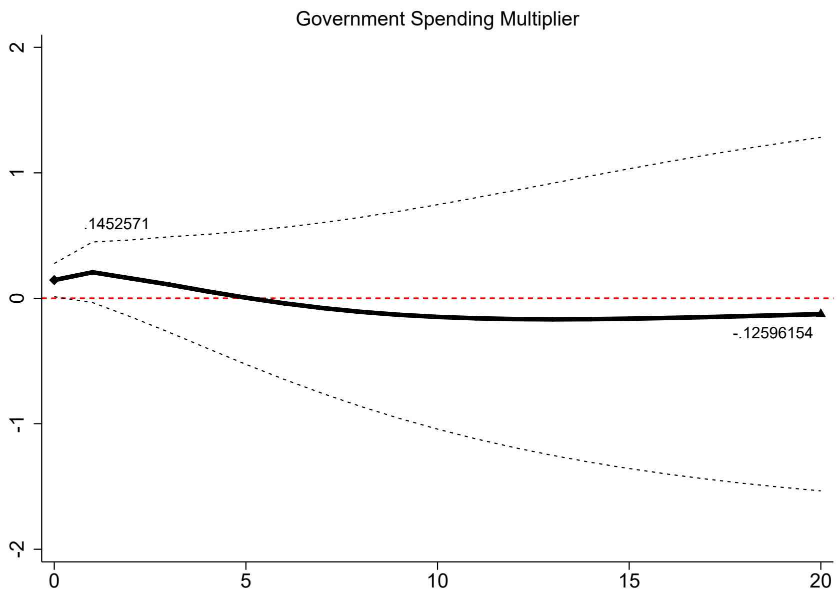

Figure 3: Impact and cumulative government spending multiplier following the baseline scenario specification. Thick solid black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

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 (3) and (4), respectively, which correspond to the post-estimation transformation process used in the literature.

Following equation (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 output will increase by 0.145% on impact.

In contrast, for estimating the cumulative multiplier following (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.

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.

4.1 Omitting or Adding Control Variables

In this part, I evaluate three different specifications proposed by three previous works. Table 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-

Comparable to	$Z_{i,t}$
AS-I: *Ilzetzki et al. (2013)*	$[G_{i,t}, Y_{i,t}, CA_{i,t}, REER_{i,t}]^0$
AS-II: *Yuan and Chen (2015)*	$[G_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]^0$
AS-III: *Jawadi et al. (2016)*	$[G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]^0$

Table 6: Vector $Z_{i,t}$ under different specifications

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.

4.1.1 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 (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:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, CA_{i,t}, REER_{i,t}]^{0} \tag{5}$$

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 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 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 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

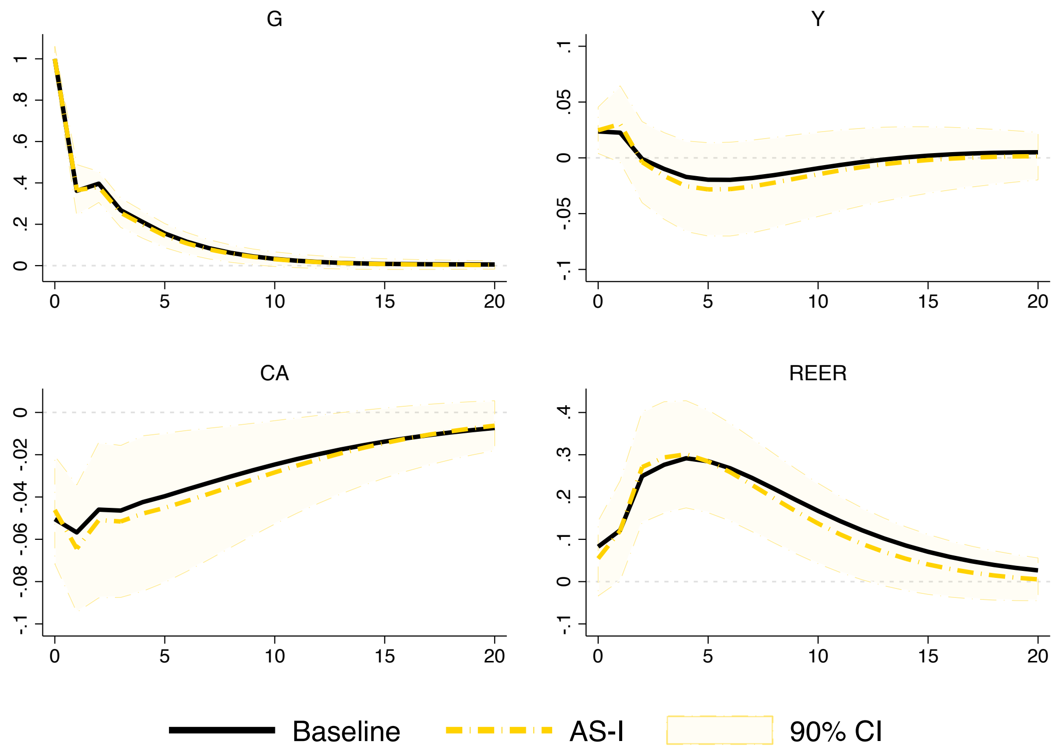

Figure 4: Impulse response functions to a 1% increase in government spending. Gold dashed line represents point estimates following Ilzetzki et al.'s (2013) specification. The thick solid black line represents point estimates of the baseline scenario, and the gold-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

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.

4.1.2 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:

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]^{0} \quad (6)$$

Following these vector representations, and subsequently applying equations (3) and (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 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

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

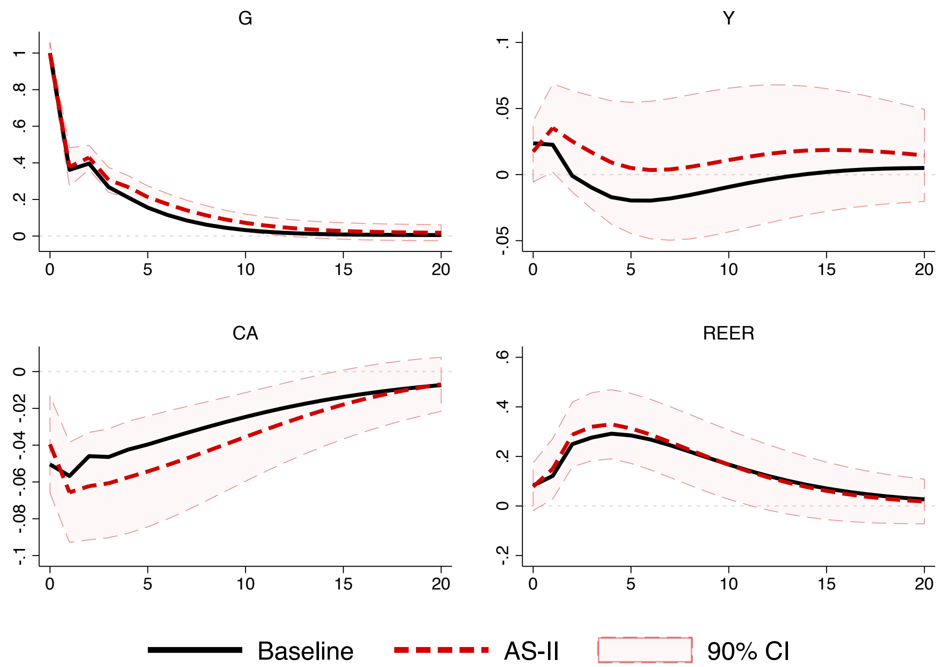

Figure 5: Impulse response functions to a 1% increase in government spending $\boldsymbol{G}$ ordered 1^{st}. Thick solid black line represents point estimates of the baseline scenario. Dashed red line represents point estimates following following Yuan and Chen's (2015) specification, and the red-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

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 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, 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.

4.1.3 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.

$$Z_{i,t} = [G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]^{0} \qquad (7)$$

Despite including the change in the specification and the declaration of $\boldsymbol{FFR}$ as exogenous; both models, Jawadi et al. (2016) and specification (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 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 (7).

In the left panel of Figure 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 (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,

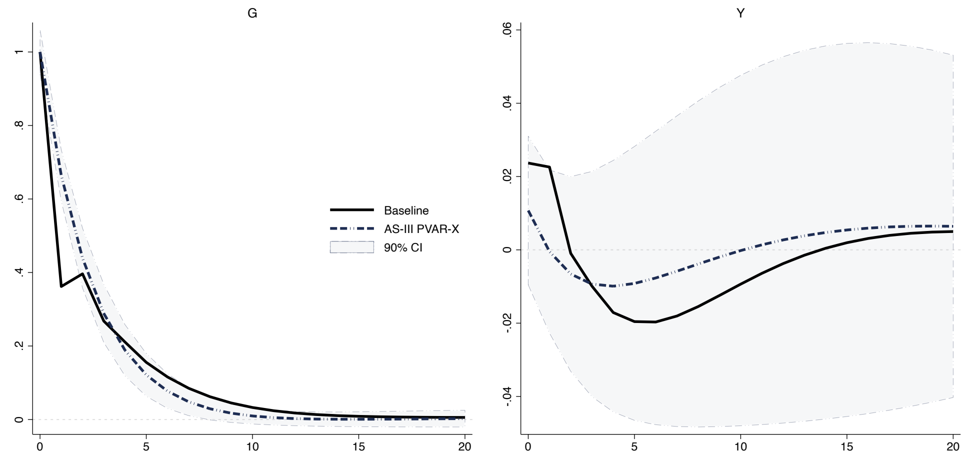

Figure 6: Impulse response functions to a 1 unit shock in government spending $\boldsymbol{G}$ ordered 1^{st} and $\boldsymbol{FFR}$ is declared exogenous. Thick solid black line represents point estimates of the baseline scenario. Dark navy dotted-dashed line represents point estimates following Jawadi et al.'s (2016) specification, and dark navy-colored area is the 90% confidence area after 1,000 Monte Carlo draws

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.

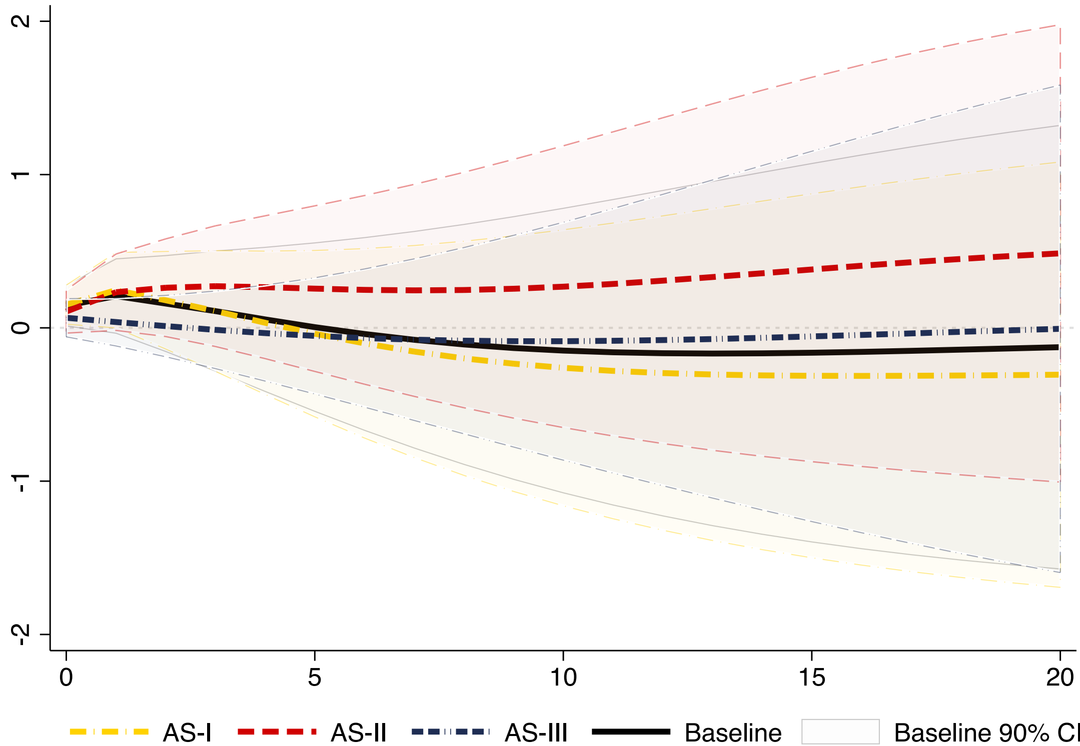

Figure 7: Government Spending Multipliers for the Alternative Specifications. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-I (gold), AS-II (red), and AS-III (navy) alternative specification with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

4.1.4 Estimated Government Spending Multipliers

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

In the $\boldsymbol{AS-I}$ case, following equation (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 (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.

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 4.1.3.

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 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:

$$Z_{i,t} = [\ \text{scal}_{i,t}, Y_{i,t}, \pi_{i,t}, \Delta M1_{i,t}, ir_{i,t}, CA_{i,t}, REER_{i,t}]^{0} \tag{8}$$

Figure 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 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

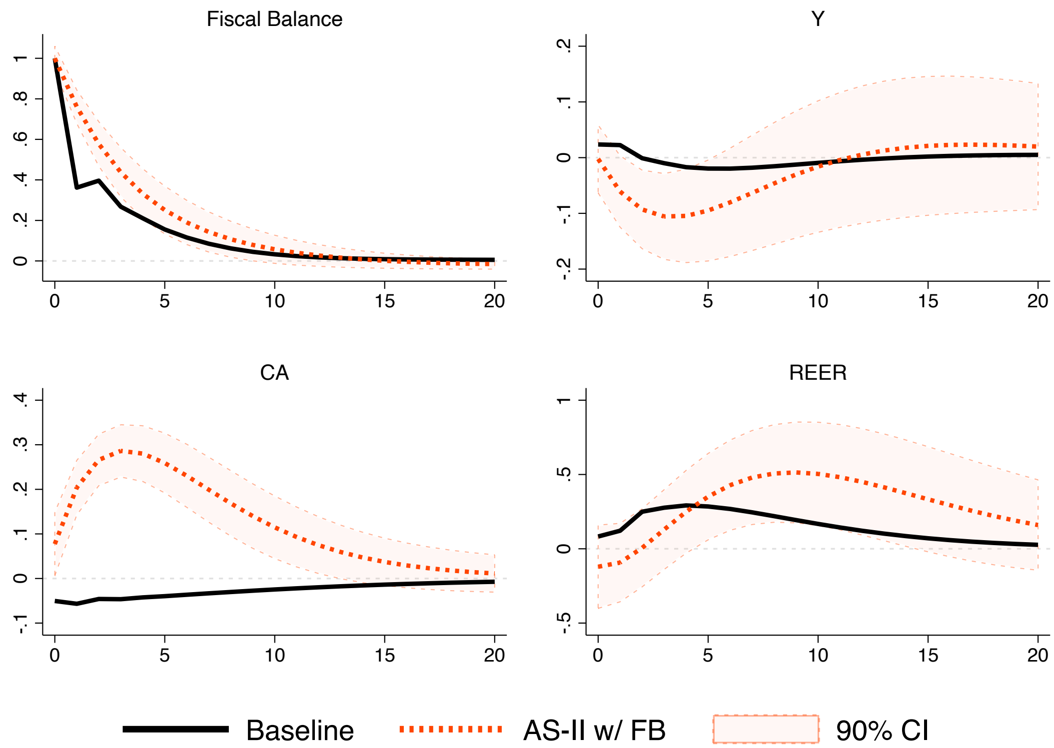

Figure 8: Impulse Response Functions to a 1% increase in $\boldsymbol{fiscal}$ ordered 1st. Thick solid black line represents point estimates of the baseline scenario. Dashed dark orange line represents point estimates following AS-II specification, and the dark orange-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

$\boldsymbol{FFR}$ 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:

$$Z_{i,t} = [FFR_t, G_{i,t}, Y_{i,t}, \pi_{i,t}, M1_{i,t}, ir_{i,t}]' \tag{9}$$

Figure 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 (9). The response of $\boldsymbol{G}$ on itself shows an increase in government spending

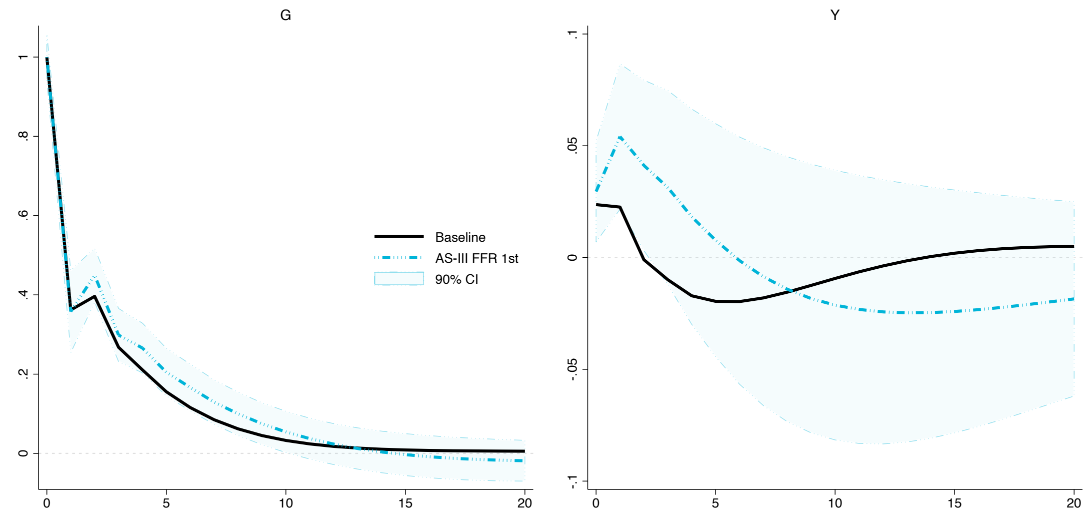

Figure 9: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$, when $\boldsymbol{FFR}$ ordered 1$^{\text{st}}$. Thick solid black line represents point estimates of the baseline scenario. Light blue line represents point estimates following following AS-III specification, and the light blue-colored area is the 90% confidence region after 1,000 Monte Carlo draws.

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 signifi-

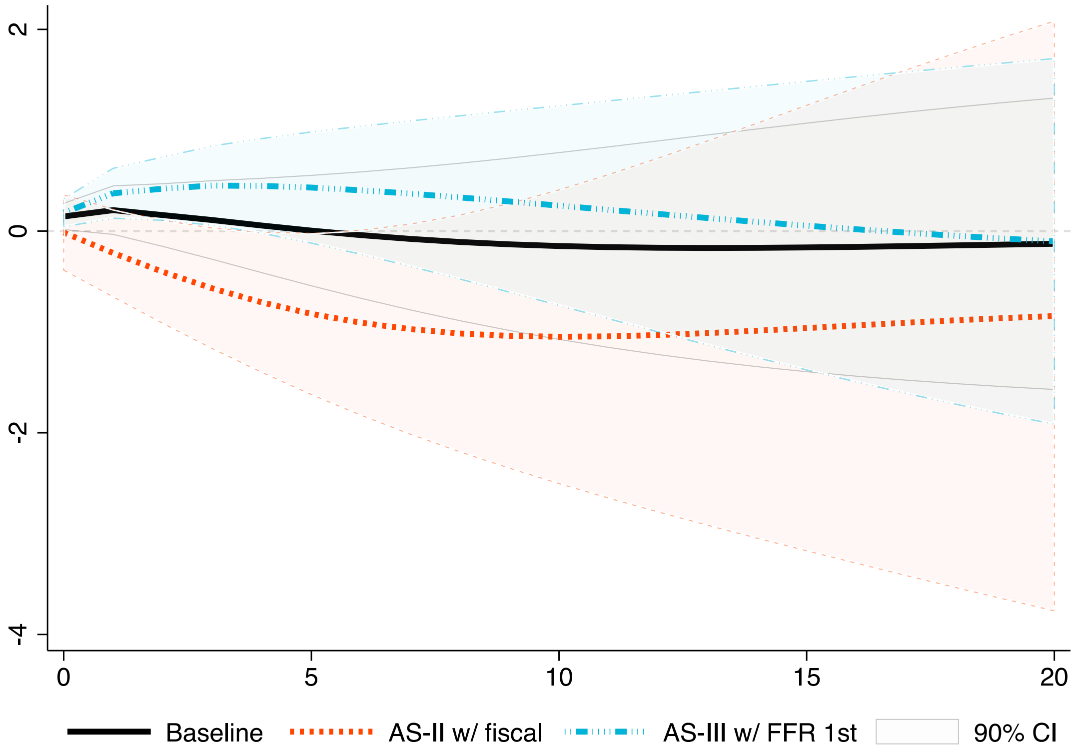

Figure 10: Government Spending Multipliers for the Alternative Fiscal and Monetary Policy Variables Aspects. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-II (dark orange) with $\boldsymbol{fiscal}$ ordered 1^{st}, and AS-III (light blue) with $\boldsymbol{fiscal}$ ordered 1^{st} alternative specifications with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

cantly different from zero. Therefore, an expansive effect on the economy in the long-run.

Figure 10 shows the estimates of government spending multipliers under the specifications (8) and (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 3rd and positive until the 16th 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 3.3 are robust to the inclusion of the $\boldsymbol{FFR}$ ordered first.

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 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

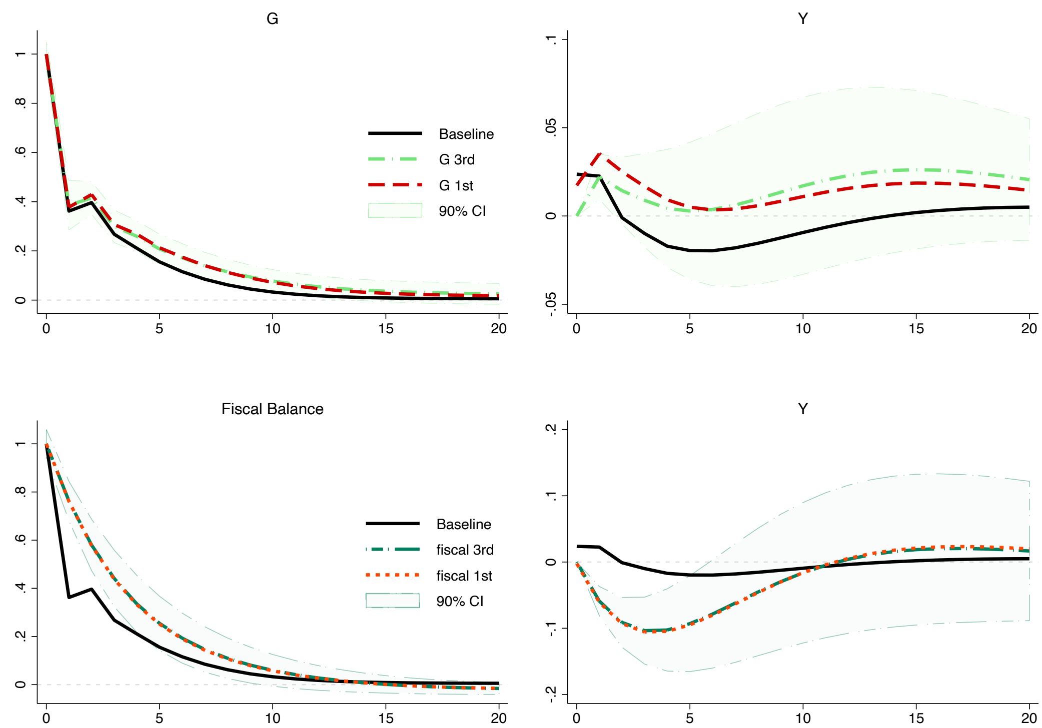

Figure 11: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$ or $\boldsymbol{fiscal}$ ordered in 3rd position. Thick solid black line represents point estimates of the baseline scenario. Light green and green lines represent point estimates when $\boldsymbol{G}$ or $\boldsymbol{fiscal}$ as fiscal policy instrument, respectively. Colored areas are the 90% confidence region after 1,000 Monte Carlo draws.

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

Figure 12 is divided horizontally into two sub-panels. First, in the upper panels, the

[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.

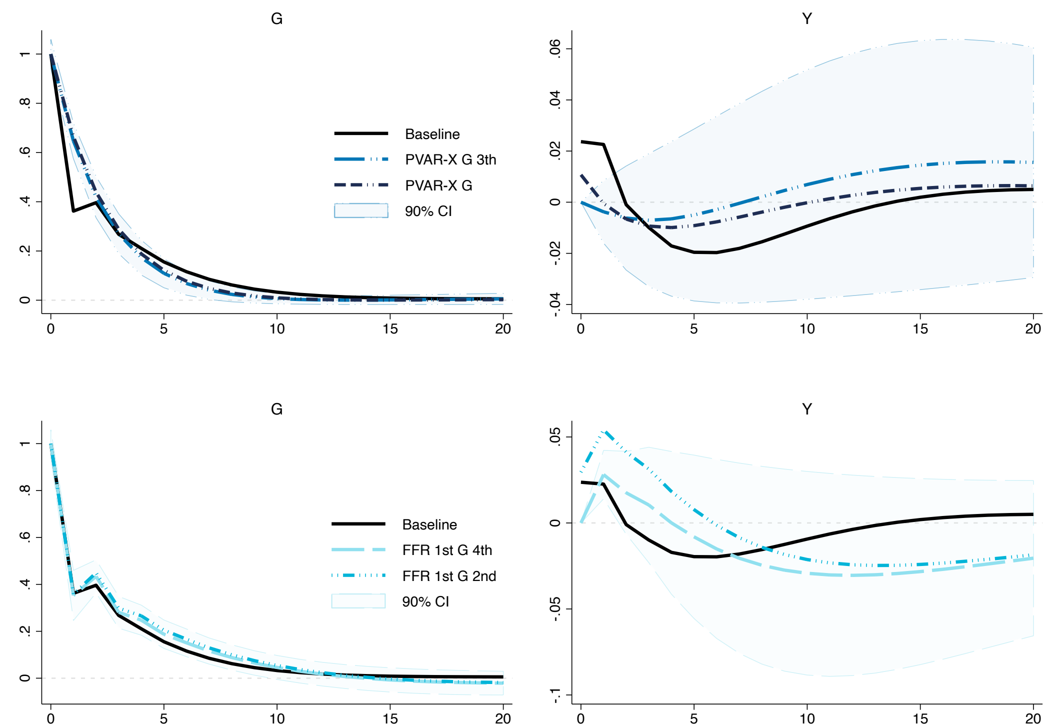

Figure 12: Impulse Response Functions to a 1% increase in $\boldsymbol{G}$ ordered in a position different from 1st. The thick solid black line represents point estimates of the baseline scenario. Light Navy and light blue lines represent point estimates when $\boldsymbol{FFR}$ is declared as exogenous or ordered 1st, respectively. Colored areas are the 90% confidence region after 1,000 Monte Carlo draws.

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 (7), (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. 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 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 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 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 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 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

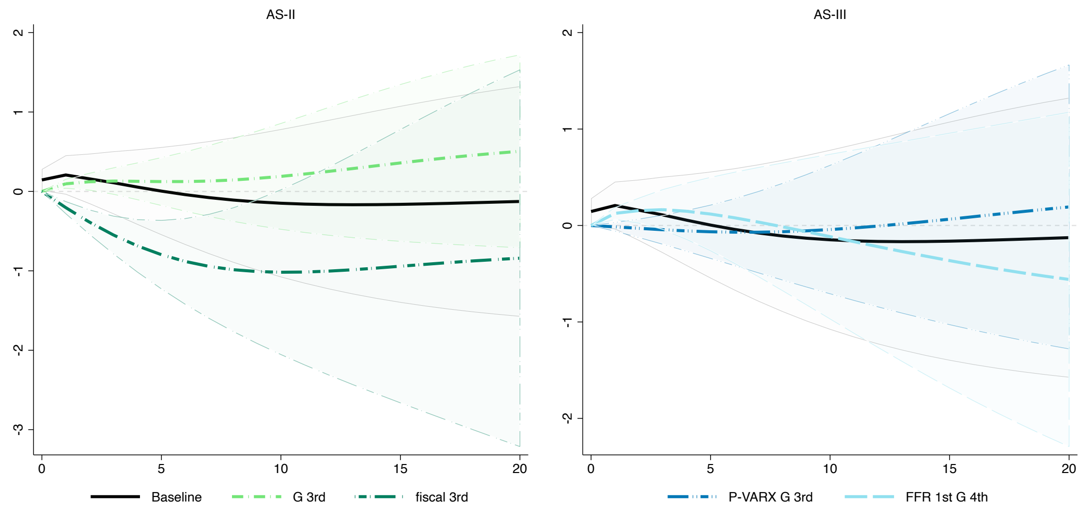

Figure 13: Government Spending Multipliers for the Alternative Ordering. Thick solid black line represents point estimates of the baseline scenario. Dashed lines are the point estimates for AS-II (green), and AS-III (navy) alternative ordering with their respective 90% confidence colored-area after 1,000 Monte Carlo draws.

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.

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

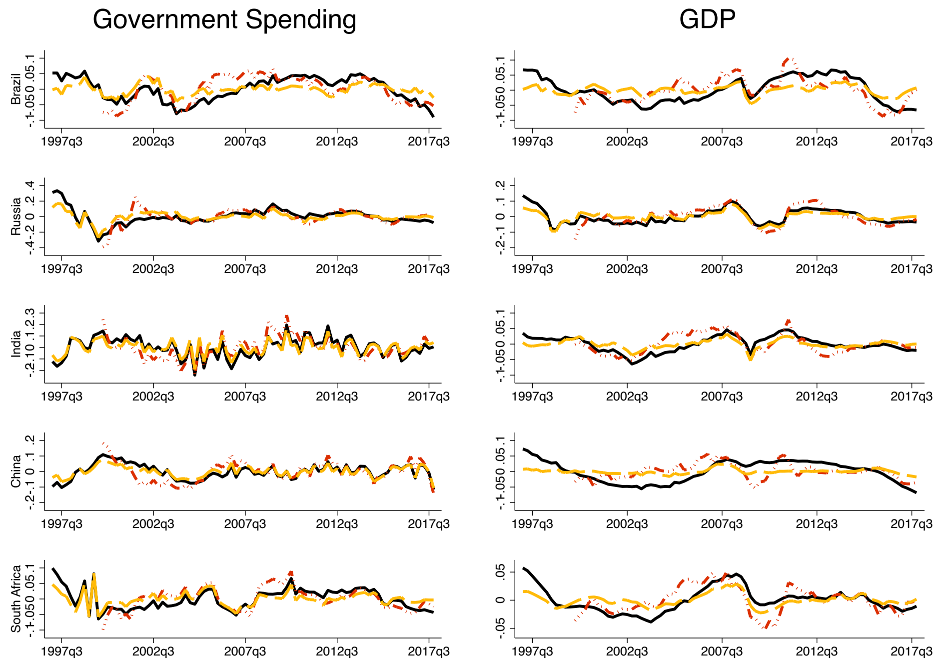

Figure 14: Cyclical component of $\boldsymbol{G}$ and $\boldsymbol{Y}$. Gold line represents point estimates using HP Filter, dark orange lines represent point estimates using Hamilton's (2018) filter, thick black line represents point estimates detrended from a quadratic trend.

(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 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 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 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.

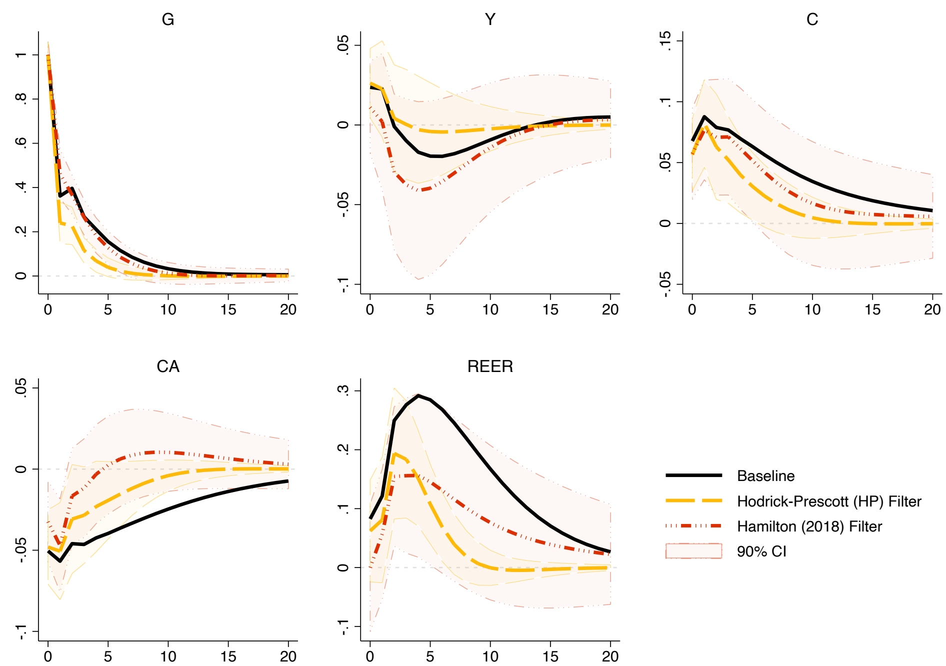

Figure 15: Impulse response functions to a 1 unit shock in government spending $\boldsymbol{G}$. Gold line represents point estimates using HP Filter, dark orange lines represent point estimates using Hamilton's (2018) filter, thick black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

In Figure 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.

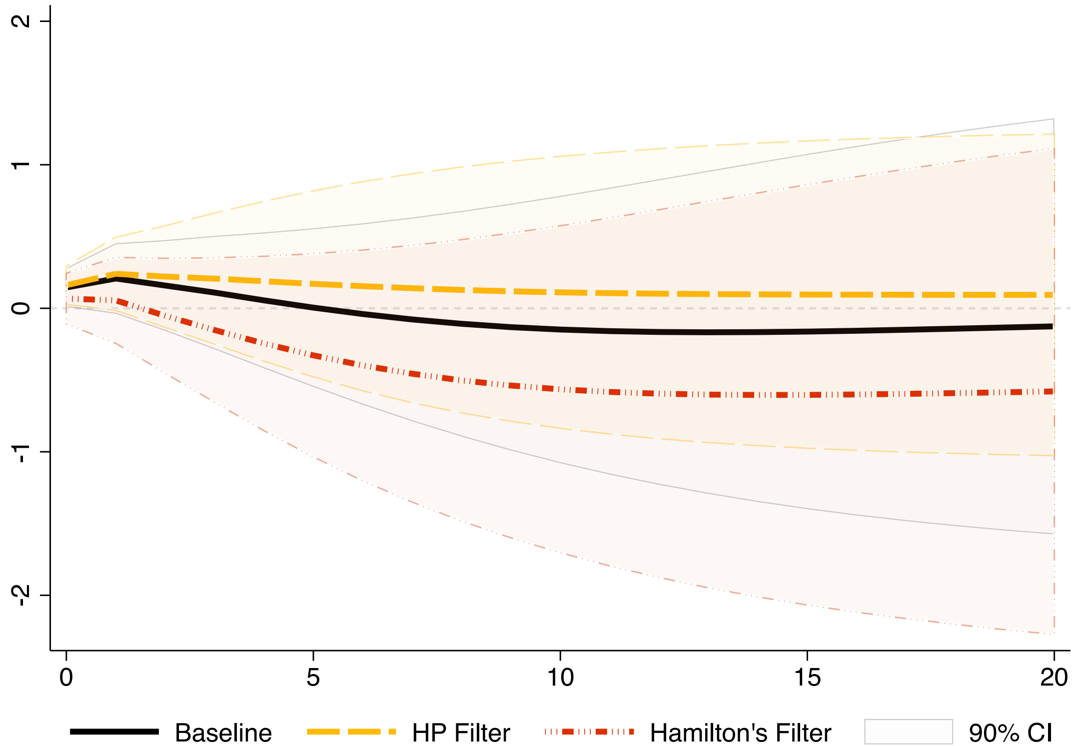

Figure 16: Impact and cumulative government spending multiplier. Gold line represents point estimates using HP Filter, dark orange line represents point estimates using Hamilton's (2018) filter, thick black line represents point estimates of the baseline scenario, and dashed lines are the 90% confidence bands after 1,000 Monte Carlo draws.

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 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 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.

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.

	Impact	Cumulative	Peak 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

⋆ Signi cantly di erent from zero in a 90% con dence band.

Table 7: Multipliers - Summary

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 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.

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