UNIVERSITY OF SÃO PAULO (USP)
SCHOOL OF ECONOMICS, ADMINISTRATION AND ACCOUNTING (FEA)
DEPARTMENT OF ECONOMY (IPE-USP)
GRADUATE PROGRAM IN ECONOMICS

RAPHAEL PINTO FERNANDES

GOVERNMENT SPENDING MULTIPLIER AND REGIONAL ECONOMIC GROWTH: A GENERAL EQUILIBRIUM ANALYSIS

MULTIPLICADOR DE GASTOS DO GOVERNO E CRESCIMENTO ECONÔMICO REGIONAL: UMA ANÁLISE DE EQUILÍBRIO GERAL

São Paulo
2020

Prof. Dr. Vahan Agopyan

Reitor da Universidade de São Paulo

Prof. Dr. Fábio Frezatti

Diretor da Faculdade de Economia, Administração e Contabilidade

Prof. Dr. José Carlos de Souza Santos

Chefe do Departamento de Economia

Prof. Dr. Ariaster Baumgratz Chimeli

Coordenador do Programa de Pós-Graduação em Economia

RAPHAEL PINTO FERNANDES

GOVERNMENT SPENDING MULTIPLIER AND REGIONAL ECONOMIC GROWTH: A GENERAL EQUILIBRIUM ANALYSIS

Dissertação apresentada ao Programa de Pós-Graduação em Economia do Departamento de Economia, Administração e Contabilidade da Universidade de São Paulo, como requisito para a obtenção do título de Mestre em Ciências.

Orientador: Prof. Dr. Eduardo Amaral Haddad

Versão Corrigida

(versão original disponível na Biblioteca da Faculdade de Economia, Administração e Contabilidade)

São Paulo

2020

Ficha Catalográfica

F636g Fernandes, Raphael Pinto

Government Spending Multiplier and Regional Economic Growth: A General Equilibrium Analysis / Raphael Pinto Fernandes – São Paulo, 2020.

127 f.

Orientador: Prof. Dr. Eduardo Amaral Haddad.

Dissertação (Mestrado) – Programa de Pós-Graduação em Economia, Universidade de São Paulo (USP), 2020.

1. Multiplicador dos gastos do governo. 2. Crescimento econômico regional. 3. Equilíbrio geral computável. I. Universidade de São Paulo. Faculdade de Economia, Administração e Contabilidade. II. Haddad, Eduardo Amaral. III. Título.

RAPHAEL PINTO FERNANDES

GOVERNMENT SPENDING MULTIPLIER AND REGIONAL ECONOMIC GROWTH: A GENERAL EQUILIBRIUM ANALYSIS

Master Dissertation presented to the Department of Economics of the School of Economics, Administration and Accounting of the University of São Paulo (FEA-USP) for obtaining the degree of Master of Science.

São Paulo, 02 de Outubro de 2020.

Prof. Dr. Eduardo Amaral Haddad
Advisor

Profa. Dra. Fabiana Fontes Rocha
Internal Member

Prof. Dr. Fernando Salgueiro Perobelli
External Member

Prof. Dr. Alexandre Alves Porsse
External Member

This work is dedicated to the people who accompanied me throughout my life: my parents Lúcia and Ronan. I also dedicate it to my brothers, family, and friends, who supported me and always believed in me. To all minorities that fight against inequality and for their rights. For a better and more equalitarian Brazil and the world.

ACKNOWLEDGMENTS

I would like to thank everyone who somehow contributed not only to the preparation and completion of this work but also to the conclusion of this stage of my life.

I must say that I am forever grateful to my parents, Lucia, and Ronan for everything they did for me. Not only for the opportunity that I was given but also for your unconditional support, affection, love, and incentives, which allowed me to get here. I must also thank my brothers, Renan and Vinícius, my grandparents, godparents, uncles, and cousins. They have always supported me and made themselves available to help me in the moments I needed. Special thanks to my uncle Alan and aunt Lucilene for receiving me in São Paulo and helping me in the process of change. I am also grateful to Louise and Helen, my soul sisters, and Henrique, friends who accompany me ever since I was born.

Thanks to longtime friends from high school (Anny, Dudu, Caio, Lucas, Piñeiro, both Gabriels, Breno, Santiago, Carol, Clarissa and Bruna) and friends from college in Rio (Marcus, Nina, Bruno, Miguel, Cello, Thati, Duda, Lorena, Vinicius and Marcio). They understand the importance of this master's degree and how much I changed moving to São Paulo. Even though you were distant, you were always with me. Bernardo, Laura and Lia, for all the emotional and academic support, accompanied my anguish with the ANPEC result and all my master's degree. Marcelo, thank you for being my friend and soothing, for supporting me in the most challenging moment of my life. You were the best shoulder I could rely on in the first year of this journey.

I also thank the friends I made in the master's, which I will certainly take for life. I thank you for the daily contact, help, shelter, and advice, for all the times that you were thrilled with my victory comforted me when everything seemed lost. I am grateful to the group that I found among the department colleagues, the "Fiéis of Deusnise." Our identification was tremendous; special thanks to Eduarda, Karina, Denise, Tha, Pedro, Eduardo Silva, Eduardo Sanguinet, and Lúcia. I am grateful to my classmates who entered USP with me for working so hard to arrive at this long-awaited moment. Among these, special thanks to Lucas Cardoso, roommate and partner in this quarantine; Bruno Pimenta, friend, roommate, cinema and orientation partner; Nickolas, and Liz, for being incredible people, who supported me at the worst times and help me never give up; Marina, Luquinhas, Vinícius, Germano, Pedro, Júlia, special thanks to you. To Débora, I am very grateful for the friendship we have developed. You have all been essential to my journey. To Inácio, thank you for being a great reference in research. You have explained and helped me several times that I needed in the elaboration of this work. In São Paulo, thanks to my ex-roomate Lucas and my friends Bruno, Freddy, Mayeni, Rebecca and André.

Thanks also to all professors and professionals who have gone through my academic life. Without everyone’s effort, understanding, and assistance, I certainly would not be here today. I would particularly like to praise Professor Eduardo Amaral Haddad, my advisor, for all the teachings, care, and empathy in this challenging journey. I am most indebted to you. Thank you for trusting me, for relieving my mood with your light manner and comments, for showing me the best side of the research. Thank you for making my dreams come true, traveling to Chile and the NARSC Congress, my first international congress. Besides, I am grateful for your dedication and assistance in developing this and my training as an economist. He offered me unbounded assistance by sharing his experiences and encouraging me whenever difficulties arose.

Moreover, it gratifies me that I have him as a dear friend I long to keep throughout the years. I am also thankful to other teachers who helped me prepare this work: Alexandre Porsse, Carlos Roberto Azzoni, Fernando Perobelli, Fabiana Rocha, André Chagas, and Ariaster Chimelli. I am grateful for all your comments. I thank The University of Sao Paulo Regional and Urban Economics Lab (NEREUS) as a whole.

I thank all the people of my current job at the São Paulo State Secretariat for Economic Development for their understanding and empathy in this very symbolic and critical moment. I would particularly like to thank Karina Bugarin, for her friendship, reference in leadership, and economics knowledge. I also emphasize my gratitude to Claudia Cerqueira, Mariel Deak, Adriana Tedesco, Patrick Nasser, and Juliana. Thanks to all of you for such learning and understanding. I am also grateful to Raphael in this final moment for all the support, affection, friendship, and encouragement.

I am incredibly thankful to the University of São Paulo (USP) for providing me with excellent training for the researcher I intend to be. I thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) for my financing. I am also grateful to the Federal University of Rio de Janeiro (UFRJ). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. This study was financed in part by the Fundação Instituto de Pesquisas Econômicas (FIPE). I am also grateful to all the population of São Paulo state, which was the main contributor through tax payments.

Lastly, I want to praise myself because I did not surrender even through the most challenging times.

“If all the economists were laid end to end, they would never reach a conclusion.”

(George Bernard Shaw)

RESUMO

Fernandes, R. P. **Multiplicador de Gastos do Governo e Crescimento Econômico Regional: uma análise de Equilíbrio Geral**. Dissertação (Mestrado) – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, 2020.

As diferenças nas taxas de crescimento e nos níveis de atividade econômica dentro de um país motivaram a busca de estratégias para reduzir as disparidades regionais. Nos estágios iniciais, a concentração da atividade econômica afeta positivamente o crescimento nacional e aumenta a desigualdade regional. No entanto, após um certo nível de concentração regional, os aumentos desta reduziriam o crescimento nacional. A política fiscal focalizada em regiões menos desenvolvidas configura-se como uma estrutura de política para o desenvolvimento destas. Porém, não há consenso na literatura sobre o papel da política fiscal e ainda existem estudos limitados quantificando os efeitos multiplicadores no nível local, especialmente nos países em desenvolvimento. Este debate foi revitalizado após a crise financeira global do final dos anos 2000, dada a incapacidade da política monetária de combater a recessão. De uma perspectiva regional, a heterogeneidade na transmissão de um choque causa efeitos variados entre regiões de um país devido a diferenciais na estrutura produtiva e de interdependência. Diante do exposto, o objetivo deste trabalho é analisar os impactos dos gastos do Governo Federal no crescimento econômico regional, procurando responder quais políticas gerariam o maior efeito multiplicador do produto. Esse objetivo será alcançado por meio de uma análise de equilíbrio geral computável (CGE) para o Brasil, mensurando os impactos tanto do ponto de vista agregado quanto do regional. Nesse sentido, esta dissertação oferece outra perspectiva sobre o efeito multiplicador: a princípio, calculando para cada estado o multiplicador de gastos do governo Federal; segundo, decompõe o multiplicador total em seu efeito intrarregional e interregional. Portanto, como uma prévia dos resultados, o multiplicador é maior em áreas empobrecidas e sensível à abertura comercial. Por fim, fornece evidências de que não há *trade-offs* entre mitigar as disparidades regionais e promover o crescimento nacional e, consequentemente, os gastos do governo poderiam ser usados para o desenvolvimento regional.

Palavras-chave: Multiplicador dos gastos do governo. Crescimento econômico regional. Equilíbrio geral computável.

Código JEL: H72; E62; R58; C68

ABSTRACT

Fernandes, R. P. **Government Spending Multiplier and Regional Economic Growth: A General Equilibrium Analysis**. Thesis (Master) – School of Economics, Administration and Accounting, University of São Paulo, São Paulo, 2020.

The differences in growth rates and economic activity levels between regions within a country motivated the search for strategies to reduce regional disparities. At the initial stages of development, economic activity concentration positively affects national growth rates while raising regional inequality. However, after reaching a certain regional concentration level, increases in the latter would dampen national growth. The fiscal policy aimed at lagging regions configures as a regional policy for their development. Nonetheless, there is no consensus in the economic literature about fiscal policy's role, and there are still limited studies quantifying the multiplier effects at the local level, especially in developing countries. The global financial crisis of the late 2000s revitalized this debate, given the monetary policy's inability to counter the falling of economic levels. From a regional perspective, the heterogeneity in the transmission of a fiscal impulse causes varied effects between regions within a country due to differentials in productive structure and interdependence. In this context, the objective of this thesis is to analyze the impacts of Federal Government spending on the Brazilian regional economic growth. Thus, we seek to answer which policies would generate the highest multiplier effect on output. This objective will be achieved through a computable general equilibrium analysis (CGE) for the Brazilian economy, which will measure the impacts from both the aggregate and the regional perspectives. In this sense, this thesis offers another perspective on the multiplier effect: at first, by calculating for each state its Federal Government Spending Multiplier; secondly, it decomposes the total multiplier in its intraregional effect and the interregional effect. Therefore, as a preview of results, we found that the multiplier is higher in more impoverished areas and sensitive to trade openness. Lastly, it provides evidence that there is no trade-off between mitigating regional disparities and fostering national growth, and consequently, government spending could be used for regional development.

Key-words: Government spending multiplier. Regional economic growth. Computable general equilibrium.

JEL Classification: H72; E62; R58; C68

LIST OF FIGURES

LIST OF TABLES

SUMMARY

1. INTRODUCTION

Chinn (2013) defines the multiplier of government spending at the most elementary level as a change in output to a change in a given fiscal instrument, which may consist of government spending on goods and services, investments, government transfers, or taxes and tariff revenues.

The debate about government spending multiplier and the role of fiscal policy was revitalized after the global financial crisis of the late 2000s (Acconcia et al., 2014; Hory, 2016; Pyun and Rhee, 2014). At the dawn of the 2007-2009 global financial crisis, most developed nations (US, European Union) implemented fiscal expansion packages at record levels to counteract the economic downturn. According to the authors, Central Banks adopted such measures given monetary policy's inability to cope with the fall in activity level since interest rates had already reached zero lower bounds.[1]

From a regional perspective, the heterogeneity in the transmission of a fiscal impulse causes varied effects between regions of the same country because of the differences in the productive structure and the particular interdependence relations (Acconcia et al., 2014). Hence, understanding the effect of government spending multiplier within regions of the same monetary union has become the interest of several studies such as Farhi and Werning (2016) and Nakamura and Steinsson (2014). However, the literature quantifying this impact is still limited, especially for underdeveloped and emerging economies (Corbi et al., 2018).

The analysis of the magnitude of the government spending multiplier at local levels is essential for a better understanding of the regional development policy effects (Moretti, 2010). Nevertheless, there is no consensus in the literature about the multiplier effect's role in promoting economic growth (Ilzetzki et al., 2013; Dall'erba and Llamosas-Rosas, 2014).[2] In a seminal paper of the impacts of public expenditure, Aschauer (1989) brings essential considerations on the role the government plays in the course of economic growth and productivity improvement, by its public investment decisions - specifically, additions to the stock of infrastructure structures such as highways, streets, and water systems. However, government consumption negatively affected the growth of output in G-7 countries during the same period.

On the other hand, economic growth is concentrating by nature: Kuznets (1955) argued

---

[1] Zero lower bounds interest rates were significant constraints to monetary policy, in which there was no room for additional cuts to counter the economic recession, as presented by Gust et al. (2017).

[2] There is a significant divergence in the economic literature on the relationship between fiscal policy and economic development. Different theoretical approaches (such as neoclassical growth theory, endogenous growth theories, and New Keynesian models) produce different results. Nonetheless, there is also a significant discrepancy in the impacts of each fiscal policy instrument. For more details, see Boueri, Rocha, and Rodopoulos (2015).

that growth promoted inequality. Williamson (1965) introduced a regional perspective to the subject, arguing that economies of scale and agglomeration would positively affect the early stages of development, concentrating economic activity in space, perpetuating regional disparities.[3] Aroca, Azzoni, and Sarrias (2018) argue that, in more advanced stages, there would be diminishing returns, in which increased agglomeration would reduce national growth. Such a result would also be valid from the regional perspective of the distribution of activities, culminating in the trade-off between regional equity and national growth. Even though once countries reached a certain regional concentration level, increases in concentration would undermine national economic growth. At this level, the trade-off equity and efficiency would cease, which would be the case for regional development policies. [4] From this point on, promoting regional equity policies through support and assistance to areas lagging in the development process would have a positive effect on national growth, as highlighted by Aroca, Azzoni, and Sarrias (2018). Also, Rodrígues-Pose (2018) points out that regional development policy aimed at less developed regions increases output at both national and local levels since these regions' resources are underutilized.

In this context, the objective of this paper is to analyze the impact of different scenarios of government spending allocation on the Brazilian regional economic growth, considering both the effects in the region itself and the spatial spillovers from the production structure. Thus, we seek to answer which policies would generate the highest multiplier effect on regional output and whether there is a trade-off between regional equity and national growth. The scope of the work will also analyze the potential of government spending concerning the reduction of regional inequalities in Brazil, important debate for the convergence of the more impoverished regions to income levels, and similar economic structure to the most developed areas of the country.

We will achieve this objective utilizing a Computable General Equilibrium Analysis (CGE) for the Brazilian economy, which will measure the impacts of each proposed scenario on variables of macroeconomic interest (e.g., output, prices, and welfare) from both the aggregate perspective and the regional perspective. We will use the CGE modeling because it takes into account the interrelationships between all the variables considered, allowing to capture the direct and indirect effects of changes in economic policies and provides numerical solutions for all endogenous variables, making it possible to analyze the effects of economic

---

[3] New Economic Geography models will study the relationship between growth and concentration, where concentration would imply increased growth. Besides, there would also be a reverse causation process where growth would reinforce concentration. For more details, see Fujita and Thisse (2003).

[4] Several authors will discuss the existence of a trade-off between equity and efficiency. For details of a retrospective of this debate, see Osberg (1995).

policy changes (Fochezatto, 2006).

At first, we adopted a generalized and uniform increase in Federal Government spending in each state by 1% - marginal value chosen for simulation purposes to analyze the effect on interest variables. We found that the government spending multiplier is higher in most of the states in the North and Northeast regions, being the highest in Acre (0.927), Piauí (0.896), Paraíba (0.877), Roraima (0.864), and Amapá (0.845). The lowest multiplier turned to be in Distrito Federal (0.558), associated with its economic structure.

Moreover, according to the theoretical and empirical literature of the government spending multiplier, structural and conjuncture factors directly influence the multiplier magnitude. Therefore, we propose sensitivity analyzes for the parameters associated with these relevant factors (e.g., the degree of trade openness, measured by the export demand elasticities and Armington's substitution elasticity to the Rest of the World and from other states) to assess the reaction of the government spending multiplier to variations in it (Ilzetzki et al. 2013, Batini et al., 2014). In consonance with the literature, an increase in import penetration causes lower estimations of the local multipliers of government spending. However, when analyzing solo increases in the interregional substitution elasticity, most of the states in the South, Southeast, and Center-West regions present a higher multiplier and vice versa.

We specify as counter-factual simulations a 10% increase in Federal government spending; an increase in government spending proportional to 1% of the Gross Regional Product (GRP) in each region; and the effect of the 1% increase in Regional Government spending uniformly in each region. Our estimations of the local government spending multipliers remain with a similar pattern in other Government Spending scenarios, being more prominent in the North and Northeast regions, except for the state of Amazonas. Further, we obtain evidence that Federal Government Spending could be used for regional development since the regional concentration indicators diminish post-simulation. According to equity and efficiency criteria, we tested different allocation scenarios for the expansion package announced on 2/4/2020 of R$ 147.3 billion (Porsse et al. (2020)). We use the respective shares of population, poverty, and State Participation Fund (FPE) allocation in each state as criteria (Haddad et al. (2018b)). Our results suggest there is no trade-off between regional equity and national growth, even when utilizing shares favoring wealthier states.

The remainder of this study is structured as follows: Section 2 and 3 revisit the theoretical and empirical literature of the government spending multiplier and describes the CGE model used in simulations; Section 4 introduces and analyzes data from the Brazilian case, whose simulation results we will address in section 5.

2. THEORETICAL REFERENCE

In this section, we will introduce the traditional macro-econometric (e.g., dynamic general equilibrium models (DSGE) and Vector Auto Regression (VAR) approaches) literature on government spending multiplier, both at the national and local level. At the national level, we will focus on the economy's characteristics, which determine the multiplier. Then, we will argue the necessity to understand local-level multipliers. Lastly, we will analyze the literature on input-output and CGE models of fiscal policy and the multiplier effect, emphasizing our approach's gains.

2.1. MULTIPLIERS IN THE TRADITIONAL MACROECONOMIC LITERATURE

There is no consensus in the literature on the nature, magnitude, and impacts on government spending multiplier or fiscal policy efficacy.[5] For Chinn (2013), different economic approaches, calculation methods (examples such as DSGE, VAR, and other small form econometric techniques), and data availability cause this divergence about the multiplier. The government variable contemplated may modify the multiplier results and the influence of fiscal policy on output and growth.

2.1.1. Determinants of the national multiplier

The traditional macroeconomic literature regarding fiscal multipliers focuses on its determinants, categorizing the structural characteristics and conjuncture factors. Region-specific policy issues prompt the shift in locus to comprehend the local-level transmission of fiscal policy and its multipliers.

Batini et al. (2014) point out that understanding the multiplier effect is necessary for economic policy formulation: erroneous estimations can lead countries to pursue unattainable fiscal targets, which affects the government's credibility. Furthermore, the authors point out that inaccurate multiplier estimates can drive consecutive rounds of fiscal contraction that culminate in low growth, deflation, and the maintenance of this cycle.

Thus, several authors try to analyze the characteristics of an economy that would

[5] The estimation of the government spending multiplier presents practical difficulties, such as the endogeneity of government spending, the formation of expectations about taxation and future spending, and the monetary policy reaction, as pointed out by Fahri and Werning (2016).

determine the multiplier.[6] Batini et al. (2014) identify two types of multiplier size determinants: the country's structural characteristics in question and conjuncture factors that cause the multiplier to deviate from normal levels. Among the structural factors is price rigidity in the labor market (countries have higher multipliers if rigidity decreases wage flexibility, as rigid wages amplify the output response to demand shocks).

Furthermore, Ilzetzki et al. (2013) emphasize as structural factors: the degree of trade openness, in which countries with less propensity to import tend to have higher multipliers as demand leaks are smaller; the current exchange rate regime, since floating exchange rate nations have smaller multipliers because currency appreciation offsets the fiscal stimulus; and debt level, associated with increases in debt-to-Gross Domestic Product (GDP) ratio producing lower fiscal multipliers.

Corsetti et al. (2012) conclude that the country's level of financial development also determines the multiplier, in which the higher credit / GDP ratio, the greater will be the multiplier, whereas Hory (2016) and Ilzetzki et al. (2013) find that the multiplier is higher in developed economies – although fiscal multipliers in Emerging economies are more sensitive to an improvement of the determinants considered above.

As conjuncture factors, Corsetti et al. (2012) highlight the state of the economic cycle (the multiplier of government spending is higher in periods of low economic activity, with policy recommendation being the expansion of expenditure during recessions as a way to sustain demand and profits to increase employment). Pyun and Rhee (2014) and Nakamura and Steinsson (2014) discuss the degree of monetary policy accommodation to fiscal shocks: the more accommodative monetary policy, i.e., lower and constant interest rates, the higher would be the multiplier[7] .

Belatedly, Batini et al. (2014) argue that permanent fiscal policy measures would have a more significant effect on output than transitory ones. Furthermore, due to hysteresis phenomena and liquidity constraints, fiscal shocks during recessions or periods of output below their potential level would be amplified, as would coordination between monetary and fiscal policy (falling interest rates with fiscal stimulus packages) increase the persistence of the fiscal impulse.

---

[6] For more details on the determinants of the fiscal multiplier, the methodology employed, and their results at the national level government spending multiplier, see Hory (2016).

[7] Pyun and Rhee (2014) conclude that the multiplier was higher when combining expansive monetary and fiscal policies, following a policy framework, either passive or active, as in Leeper (1991). A fiscal policy that does not care about debt would be active, and so, for the model to be solved, monetary policy should be passive (less importance for inflationary stability) to achieve stabilization of the economic cycle. Thus, the fiscal expansion would increase consumption in this scenario of policy interaction, minimize the crowding-out effect, and, consequently, obtain a higher multiplier.

Nevertheless, recent literature on the positive effects of fiscal policy emphasized the role of nominal interest rate constrained by the zero lower bound (ZLB), in which the government spending multiplier on output can be substantially larger than one, as pointed by Christiano, Eichenbaum, and Rebelo (2011).[8] Moreover, Carillo and Poilly (2013) highlight that during a liquidity trap, government spending expansion reduces the real interest rate, leading to a period of cheap credit and thus encouraging private investment, yielding a significant government spending multiplier consequently.

For the Brazilian national multiplier specifically, Holland et al. (2019) obtain estimates of the government spending multiplier close to zero, regardless of the approaches and the specifications, while controlling for the state of the economy, nonlinearity approach, and the role of the monetary policy.

It is important to highlight two other factors that will determine the multiplier magnitude: the quality of Public expenditures, as in Aschauer (1989). Expenditures are generally classified as "productive" or "unproductive" based on their effect on economic activity, whereas the first has a positive impact and the latter a negative impact on economic growth. Thus, current government spending classifies as unproductive. For an extensive literature review on the level, composition, and financing of public spending and its economic growth effects, see Afonso, Ebert, Schuknecht, and Thone (2005). In this thesis, we will not focus on Public Finance literature regarding the quality of spending. Also, the Government spending multiplier would be sensitive to how the expenditure was financed. If the government spending is funded by increasing taxes, the Government Multiplier would be lower, occurring the “so-called Ricardian equivalence”[9]. Another option regarding the finance of the multiplier is the balance budget multiplier.[10] The simulations considered in this dissertation suppose Government Spending is debt-funded.

2.1.2. The necessity to understand the local multiplier

The literature presented so far discusses the multiplier of government spending at the national level. Recently, yet, there has been a need for understanding this effect at the local

[8] When monetary policy is unconstrained, estimates from time-series data of the government spending multiplier tend to be below 1, as in Barro (1981) and Blanchard and Perotti (2002).

[9] The theory argues that consumers will save any money they receive to pay for the future tax increases they expect. For more details, see Ricciuti (2003).

[10] Haavelmo (1945) argues that increases in Government Spending accompanied by the rise in taxes can generate positive multipliers and have expansionary effects in the economy, depending on who is taxed and the consumer’s low-income families possess higher marginal consumption propensity.

level, as Acconcia et al. (2014) point out. For the authors, region-specific policy issues prompt the shift in focus: Understanding the effectiveness of fiscal policy in addressing recessionary shocks in specific locations is crucial, which would lead to the redistribution of fiscal resources across regions from the same country. Moreover, crises and recessions are not evenly distributed across the territory, so different regions would have to make different intensity adjustments. When comparing national economies with regional economies, the latter are much more open to trade than the former.[11] Hence, Moretti (2010) argues that the magnitude of local multipliers is essential for the planning of regional economic development policies.

Domański and Gwosdz (2010) bring considerations about the effects of local multipliers on local economic development. First, the authors point out that the more contained the multiplier effect within a region, i.e., the higher its intraregional effect, the more prominent its potential for economic growth. On the other hand, the multiplier effect would spread beyond the region of origin through the exchange structure between regions. More developed regions with a higher degree of diversification would tend to capture more the multiplier effect by the effect on local income and the better capacity to respond to demand shocks. Nevertheless, it is noteworthy that the externalities arising from the multiplier effects on other regions are not necessarily positive: raising government spending in a given region may lead to an increase in relative prices and thus factors mobility and increase in imports, undermining its growth.

Chodorow-Reich (2019) suggests three channels of transmission of local multipliers. The first one would be the Expenditure Switching, as buying local products increases local prices relative to prices in other regions, deteriorating terms of trade and causing a substitution for goods and services produced in other regions - depending on the elasticity of substitution between locally and non-locally produced goods. Second, the author points out the Income Effect, in which the increase in government spending causes an increase in local income, which will be used in both goods produced inside the region and outside of it. Third, the factor mobility channel, where a fiscally stimulated area demands more factors, attracts labor and capital from other regions towards itself. Furthermore, due to the government spending nature, the income effect tends to be positive, i.e., fewer leaks to other regions. Additionally, the substitution effect will happen in other regions, as their demand and prices rise even if the increase in government spending was not initially in them. Lastly, factor mobility has less impact when considering

[11] Converting local multipliers to aggregate multipliers is difficult, as emphasized by Fishback and Kachanovskaya (2015). The local multiplier does not effortlessly transform into the national multiplier due to externalities that occur outside the stimulated fiscal region's territorial boundaries. Nonetheless, Chodorow-Reich (2019) states that the local multiplier is a lower limit for a specific type of national multiplier, which is the multiplier of a closed economy, with no monetary policy responses to fiscal impulses and a debt-financed deficit, reflecting the high degree of trade openness of local economies.

temporary shocks or the short-run, considering fixed capital and migratory flows from one region to another occurring on a smaller scale.

The empirical literature on government spending multiplier (both nationally and regionally) focuses on the US and OECD member countries.[12] Therefore, as pointed out by Corbi et al. (2018), the literature quantifying this effect for developing and low-income economies is still meager. The authors estimate the impact of federal transfers to municipalities that induce municipal spending and their impact on the Brazilian formal labor market. As an identification strategy, the amount of transfers varies abruptly proportionately to a predetermined criterion of resident population size. Hence, the authors obtain local multipliers around 1.3-2.0, consistent with other literature estimates. Besides, the impact of transfers on employment is centered in the service sector and is more pronounced among less financially developed municipalities. Serrato and Wingender (2016) employed a similar methodology for the U.S. and found a local income multiplier of government spending between 1.7 and 2. The authors concluded that federal spending has broader impacts in low-growth areas. [13]

2.2. FISCAL POLICY AND MULTIPLIERS IN IO AND CGE MODELS

The empirical literature of the fiscal multiplier has two major strands, with different results: the dynamic general equilibrium models (DSGE) with nominal prices or wage rigidities, also referred to as "New Keynesian" models, and Vector Auto Regression (VAR) models.

According to Pusch (2012), in New Keynesian models without liquidity-constrained consumers, a fiscal expansion will raise output, inflation, and the real interest rate, crowding out consumption, while the effect on investment may depend on other assumptions. The resulting multiplier is, consequently, typically smaller than unity. However, if monetary policy is constrained by the ZLB, even in the absence of liquidity-constrained agents, the fiscal multiplier can be larger than one. Whereas in the VAR literature, until recently, the estimation of the impact of government spending shocks on output also reached sharply varying conclusions depending on the exogeineity assumptions and method used to separate genuine unexpected shocks to government spending. Hence, implicitly, it involves hypotheses about the

[12] For more details on the empirical literature of local multipliers, see Chodorow-Reich (2019), where the author summarizes the most recent contributions on the subject by highlighting identification strategy, geographic aspects, financing issues, and persistence of the fiscal shock.
[13] In the empirical literature, Fahri and Werning (2016) show that states or regions within a country offer alternatives with plausibly exogenous variations in spending. In these studies, local government spending is in tandem with transfers from external sources, e.g., federal transfers in Brazil. Thus, the authors stress that these spending multiplier estimates combine both government spending and transfers.

response of monetary policy. Further, many empirical studies have drawbacks in that they probably underestimate fiscal spending multipliers by employing linear estimation techniques for time series data.

2.2.1. Input-output model literature on Fiscal Multipliers

The use of input-output modeling presents a calculation of multipliers that do not necessitate premises about the working of monetary policy and address this problem using data, reflecting the production structure of the economy each year and imposes much less structure on the data. However, Leung and Secrieru (2012) conclude that the main drawback is that the analysis is static and relies on restrictive assumptions such as fixed input-output coefficients (i.e., Leontief technology). Hence, the IO approach is subject to the Lucas critique: as shocks shift prices, agents cannot adjust[14].

Pusch (2012) observes government spending multipliers varying between 1.4 and 1.8 for many members of the European Union. Further, the author obtains estimates of the multiplier effect for different forms of government spending, such as:

a. the multiplier of general government spending;
b. the multiplier of government consumption solo;
c. the multiplier of expenditures on construction as a proxy for public investment;
d. and transfers multipliers with an effect on household consumption and welfare.

The author exposes that the fiscal spending multiplier for construction is the highest for many EU members, ranging between 1.3 and 2.2. Secondly, he finds relatively high multipliers for fiscal spending on public consumption, ranging from 1.2 to 2.3. Thirdly, fiscal multipliers for welfare transfers are low compared to other spending multipliers, ranging from 1.0 to 1.9. Furthermore, smaller EU members present high fiscal spending multipliers, particularly in construction and public consumption multipliers.[15]

Chen et al. (2016) estimated the short-run effects of the 4 trillion yuan stimulus package on China’s GDP in the global financial crisis in 2009 for two scenarios. The authors calculated the impacts using the traditional open input-output model (in which all household consumption is exogenous), the semi-closed input-output model (in which all household consumption is endogenous), and a new model assuming that the model parameters were not affected by the

[14] The Lucas critique precedes the micro-foundations of modern macroeconomics by introducing the rational expectations theory. For more details, see Lucas (1976).

[15] The author emphasize that his paper did not consider any cross-border spillover effects or possible feedback-loops on the state of expectations of private businesses. Under these circumstances, its calculations may represent conservative estimates of actual multipliers.

stimulus package. For the new model, the authors obtain a GDP multiplier of 0.852 (the traditional input-output model yields a GDP multiplier equal to 0.781, and the semi-closed model yield a GDP multiplier of 1.003). This multiplier is lower than one because part of the stimulus package will induce additional imports, which do not generate Chinese Value-Added (VA). As a sensitivity analysis, Chen et al. create a scenario in which households decide to decrease their endogenous consumption because they feel that higher taxes will compensate for the government expenditures at a later stage. A reduction of the endogenous consumption coefficients of 10% (for all consumption categories) leads to a GDP multiplier that is lower than that of the standard input-output model.

Besides estimating the multiplier of government spending, the input-output approach can also measure the redistributive and sectorial impact of other fiscal policy instruments. Haddad et al. (2013) investigate the role interregional transfers play in the redistribution of activities in the country, using an interregional input-output approach. The authors find regional value-added multipliers fluctuating between 0.97 – 3.46. In the case of São Paulo, for instance, for each BRL 1.00 received from the Federal Government – and considering the transfers to other States as well – the state generates BRL 3.46 in value-added. The authors find higher multipliers in wealthier states and conclude that interregional government transfers present a clear, favorable regional impact. Since it targets impoverished regions, it produces a de-concentration effect. This effect is augmented if government expenditures follow the proposed transfer mechanisms. At last, the authors emphasize the role played by the existing economic structure, showing that interregional linkages within the Brazilian economy operate favoring the more developed regions of the country, as there are relevant leakages from lagging regions to more developed regions.

Azzoni et al. (2007) simulate the capacity of social policies to reduce personal and regional inequality in the Brazilian economy through the pro-poor “Bolsa Família” program, which is a social program that provides direct income transfers to the poor (with per capita income between BRL 60,01 and BRL 120,00) and extremely low-income households (with per capita income below BRL 60,00). The results show that in the short-run, the “Bolsa Família” program has proven to deliver positive results, both at the personal income level and at the regional concentration level. Solving inequality problems, however, might need other mid and long-run policies that could improve the competitiveness of lagging regions. This expenditure increases national GDP by 2.96%, averaging 0.74% per year. In regional terms, the Northeast region is the most affected, with a GDP increase of 7.2% (1.8% per year, on average), 2.4 times the national increase. The North region is second, with a 3.35% increase in GDP. Another simulation is carried, considering that total government expenditure is constant and that the extra payment to families is subtracted from other current expenditures. The impact on national GDP becomes negative, -0.48%. The authors highlight that if expanded government expenditures in social transfers hurt other investment-related programs, it will threaten future growth.

Fernandes and Guilhoto (2015) investigate another utilization of fiscal policy with the IO model. The authors investigate the short-run effects on the Brazilian economy of Taxes over industrialized products (IPI) reduction in the automotive sector between 2008 and 2009. Using the input-output matrix analysis and considering the hypothesis that the IPI tax generated an increase in demand in the sector of 13.4 % during the year 2009, the results of the impact analysis indicate that the effects on the Brazilian economy would be an increase of more than R$32 billion in gross production, around R$10 billion in GDP and more than 211 thousand jobs. Thus, the short-run responses to countercyclical fiscal policy operated helped to mitigate the negative impacts of the financial crisis in the Brazilian economy that year.

Leung and Secrieru (2012) compare multipliers considering real-financial linkages, constructing the Financial Social Accounting Matrix (FSAM), where financial flows are endogenous. The authors made exogeneity assumptions on government spending and the rest of the world, concluding that financial flows amplify the effect of a final demand shock on Canadian output, exhibiting GDP multipliers around 1.3-1.7 in general.

2.2.2. Fiscal policy and multipliers in CGE modeling

Fochezatto (2006) points out that the growing use of computable general equilibrium (CGE) models enable the modeling, to a greater or lesser extent, of the complex interdependence between the institutions and the agents that make up the economy. The main applications of CGE models are in the investigation of topics related to international trade, income distribution, external shocks, tax, and fiscal policies for development strategies. Several recent applications seek to incorporate more than one economy in the analysis, attempting to understand the transmission of policy changes connecting countries and regions.

The author accentuates some features of the computable general equilibrium models. They are built on concrete microeconomic bases since it is necessary to specify the agents (consumers, producers, investors, government, and the rest of the world) through behavior equations. Second, they have internal consistency between all variables, as they derive from a necessarily consistent and coherent database. Third, they provide numerical solutions for all endogenous variables, making it possible to analyze the effects of economic policy changes. Finally, they consider the interrelationships between all the variables considered, capturing the direct and indirect effects of economic policy changes. These are the main reasons why these models are adequate instruments to analyze changes in economic policies, which tend to cause complex and challenging effects to identify.

Nonetheless, CGE models have an empirical base of a social accounting matrix, which guarantee the coherence of the set of interdependencies contained in them. Furthermore, the model, when contemplating intersectoral transactions, captures all price changes resulting from policy changes. Hence, these models provide crucial lessons for policymakers, as they make it possible to compare, in quantitative terms, the relative importance of the results of economic policies and the identification of who wins and who loses (Fochezatto (2006)).

CGE models assess the outcomes of various classes of fiscal policy, such as government spending (Horridge et al. (1995); Haddad et al. (2018a)), interregional transfers (Haddad et al. (2018b)) and tax policy (Porsse et al. (2007); Tourinho et al. (2004)). It is imperative to highlight that most authors compute only the percentage changes in GDP, Gross Regional Product (GRP), and other macroeconomic variables of interest from the simulation, not the fiscal multiplier effect.

Tourinho et al. (2004) assess the long-run economic impact of three policies that are part of the Reform of the Brazilian tax system in the Brazilian economy. In their results, the GDP is scarcely affected. Porsse (2005) uses a specific version of the B-MARIA model, the B-MARIA-RS model, for the economy of the state of Rio Grande do Sul, with a government finance module (revenues, expenses, and budget deficits). The author examines whether tax competition can generate welfare gains under different fiscal closures in a long-run simulation environment.[16] Porsse et al. (2007) use a general equilibrium approach to evaluate the effects of a regional tax incentive program for attracting investments. The analysis focuses mainly on the financing of new private investments through tax revenue relief and public investment expenditures by regional and federal governments. The results show that the effects on the employment and household welfare of consumers have been positive for the region implementing such an incentive policy, namely the State of Rio Grande do Sul. Nevertheless, the effect on real GDP may not follow the same course, which could occur mainly because of the state's specialized pattern of production.

Horridge et al. (1995) analyze the impact of increased South African government spending using an EGC model under different financing (foreign financing, tax financing, and

[16] For more details on Fiscal Competition, see Wildasin (2003).

domestic borrowing). In a short-run closure and under external financing, with exogenous investment, the author finds that an increase in government spending of 10% causes expansion of consumption (2.46%) and GDP (1.94%), reduction of exports, and stimulus to imports due to real appreciation. As prices rise, producers' real wages fall (-0.29%). However, if government spending increases co-occurring the increase in taxes, the effect on consumption and product decreases – from -0.25% to 1.58% – depending on the type of tax used to fund the debt. Also, if restrictions on trade balance deficits accompany the increase in government spending (i.e., domestic financing), investment adjusts and falls sharply.

Abayasiri-Silva and Horridge (1999) model a 10% reduction in government spending on the Australian economy through a CGE model that allows economies of scale and imperfect competition. In the short-run, the capital stock, real investment, and consumption are exogeneous, and the labor supply is elastic, with the real fixed wage. In all simulations, the reduction in government spending causes a fall in employment in sectors of public administration and services, as the government is labor-intensive, and consequently, a drop in GDP. Moreover, the fall in spending causes a decrease in domestic prices, resulting in a real depreciation: this induces an increase in exports in the short-run with a decline in imports. In the long-run, on the other hand, capital stock, real investment, and real consumption are endogenous, while the rate of return on capital and employment (allowing intersectoral mobility) are fixed. In this case, the fall in government spending increases investment, consumption, and GDP in all simulations.

Furthermore, Haddad et al. (2018a) used a multiregional CGE model for the Greek economy, calibrated for two specific periods (pre-crisis and post-crisis), to investigate the cyclical component of government spending. The authors estimate both intraregional multipliers (increased spending in the region and its effect on that region's GRP) and interregional ones (increased spending in the region and the effect on GRPs of other regions in the country). The authors observed intraregional multipliers ranging from 0.50 to 0.85. Nonetheless, the interregional multiplier is negative, given the supply-constrained short-run environment in this cost-competitiveness approach.[17] The rise of local prices also affects the international trade balance, hampering international exports and increasing import penetration as expected. The total multiplier for Greek regions varies among 0.26-0.46, against the national

[17] The sign of this effect remains ambiguous, according to Lopéz et al. (2017). The authors find a positive spillover effect of spending at the municipal level for Spain, and Cohen et al. (2004) find positive spillovers by analyzing public infrastructure spending. Baicker (2005) finds positive spillover of government spending on health at the state level. Auerbach et al. (2019) find evidence of the negative spillover effect of government spending 100 to 150 miles away or further. Since we are considering states, negative spillovers occur. However, it is essential to emphasize that the authors find a positive spillover effect from government spending considering neighboring cities.

input-output multiplier of 1.76 in 2010 and 1.93 in 2013. In the IO approach, the non-occurrence of general equilibrium effects inflates the multiplier calculation.

The authors concluded that the fiscal multiplier is a function of local structural characteristics of the economy and policy reaction parameters. There is a strong positive correlation between the aggregate share of primary factors in total costs and the nationwide, source-specific shock multipliers. Nonetheless, the correlation between the regional ratio of labor payments to capital payments and the local multipliers was meaningful in both years and more relevant in 2013. The results suggest that national output is more influenced by the overall value-added content in regional production systems, while local effects depend more heavily on regional suppliers' ability to respond promptly to the local demand shocks.

In Haddad et al. (2018b), the multiregional CGE model was also used but calibrated for the Colombian economy. The authors propose different criteria for the distribution of Central Government interregional transfers correspondingly to the principles of equity and efficiency (population share, extreme poverty, and fiscal gap as criteria to redistribute the Government transfer) and their respective impacts on regional and national growth. The authors find that using the population criteria favors national growth and improves regional concentration. The other scenarios proposed have suggested that fiscal transfers result in a significant increase in regional GDP in those areas that benefit from net increases in resources, reducing regional disparities.

After introducing the foremost hindrances and gains with the CGE modeling to analyze the local multiplier, the next section introduces the methodology used to establish the present study, the principal characteristics of the interregional CGE model used, and the method to calculate the government spending multipliers in this structure.

3. METHODOLOGY

General equilibrium models assess the balance of the economy in an environment where all agents are interacting simultaneously. The lack of computational capacity made it impossible to develop a system capable of analyzing the economy as a whole for an extended period; consequently, this modeling was solely a theoretical possibility. In 1960, Johansen established practical studies with general equilibrium models, analyzing the multi-sectoral growth of Norway's economy through the country's input-output matrix (Dixon and Parmenter, 1996).

With the advancement of computational power, it became possible to analyze very complex General Equilibrium (CGE) models, spreading this tool as an instrument for policy analysis and evaluation.

The most common approach to solving general equilibrium problems follows the Johansen / Euler methodology. A vector of variables V of size n represents the characteristics of the economy so that:

$$F(V) = 0 \quad (1)$$

F is a vector of m functions that characterize the interactions between economic variables. For the system to have a solution, it must have more variables than equations: $n > m$. There are $(n - m)$ exogenous variables; m endogenous variables; and a vector of known variables Vi, such that:

$$F(V_i) = 0 \quad (2)$$

The vector of initial variables (Vi) can be divided into two parts, namely, exogenous variables (V1) and endogenous variables (V2). A simulation with a general equilibrium model consists of applying a shock to the exogenous variables and finding the new equilibrium point for the endogenous variables in the system.[18]

After this brief introduction to general equilibrium models, the next section will present the model we will use for this research.

---

[18] For a more detailed description of this type of model and its mathematical structure, see Dixon and Parmenter (1996).

3.1. INTERREGIONAL CGE MODEL FOR THE BRAZILIAN ECONOMY

In this section, we present the structure of the interregional General Equilibrium Model for Brazil, the Brazilian Multisectoral and Regional and Interregional Analysis Model B-MARIA, which was first formulated in Haddad (1999) and corresponded to the first fully applied and calibrated interregional model for the analysis of the Brazilian economy.[19]

The general equilibrium model used will be the model B-MARIA-27, as in Haddad (2004), with linearized solutions of the equations that describe the economy. Both models are part of the Australian tradition of modeling in general equilibrium; they are Johansen-type models, with solutions in growth rates.

The model used includes the 27 regions of Brazil (the 26 states and the DF) and 67 sectors of the economy, correspondingly to data from the Input-Output Matrix (IO) and Regional Accounts provided by the Brazilian Institute of Statistics and Geography (IBGE) for 2015. Tables 28 and 29 in the appendix list regions and sectors considered in this thesis.

The economic agents are modeled at the regional level, and the model follows a bottom-up approach, i.e., national aggregates arises from the regional results of the shocks under analysis. The agents in each region are producers, investors, a representative family, and a regional government. Besides, there is a Federal Government and the external sector that interact with each of the regions. The productive sectors use three primary local factors (land, capital, and labor). Household consumption, investment, exports, consumption by regional governments, and the Federal Government constitutes the Final Demand. Regional governments are the sources of demand and spending exclusively local, encompassing the state and municipal spheres of public administration in each region.

Every region represented by the model will have a representative consumer, a representative investor, regional governments, and each sector’s producers. Each agent in each sector and region can purchase or sell products to others, inside and outside their region. The annex in section 9 specifies the model with more details.

3.1.1. Theoretical aspects and the core of the BMARIA model

The fundamental behavioral equations of the optimizing agents (producers, families, investors, Government) of the economy and their problems and the market-clearing

[19] Subsequently, several advances were made in this model to incorporate new variables and structures specific to each particular analysis. For further details on the development of this model family, see Vassalo (2015).

(simultaneous balance between supply and demand of each good and service) establishes the core of the model.

Additionally, the core also determines several regional and national aggregates, such as aggregate employment, trade balance, and price indices. We will describe the main characteristics of the model and its agents in the forthcoming sections, as presented in Haddad (2004).

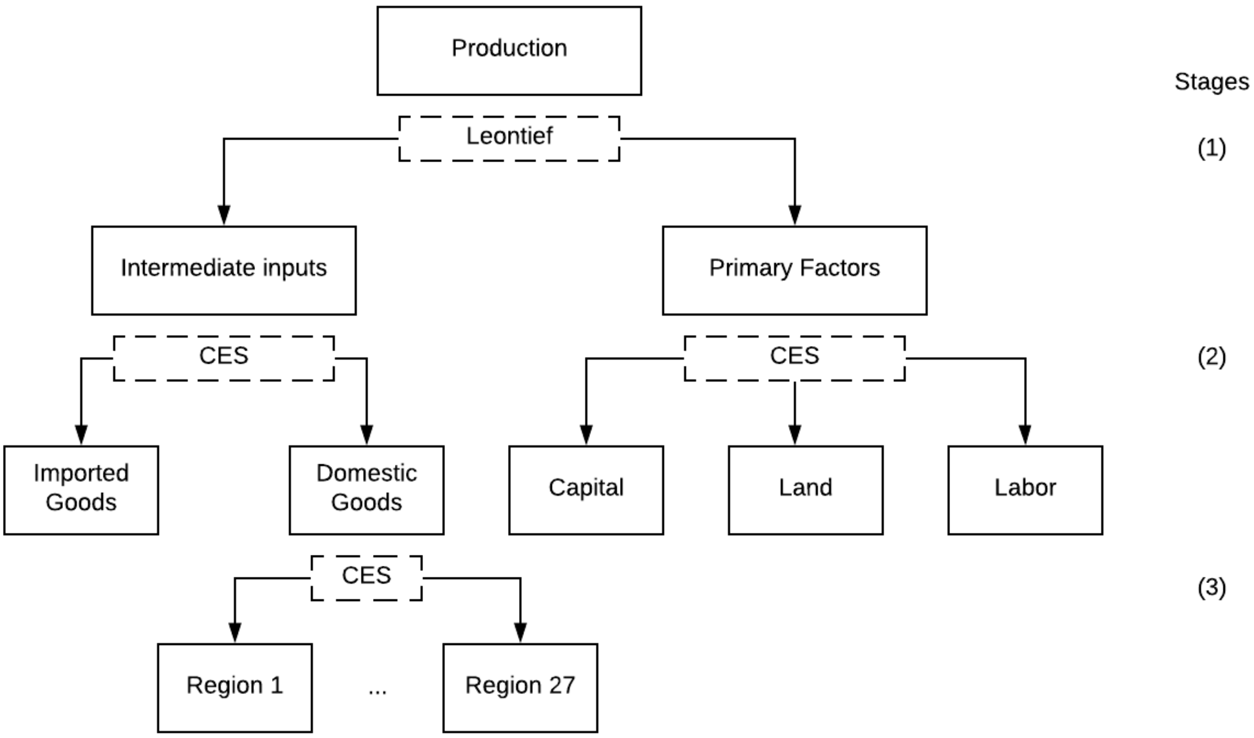
3.1.1.1. Producers

The model assumes a representative firm in each sector per region, producing only one type of product. Firms minimize their costs through a nested production technology structure modeled in three stages, as Figure 1 depicts.

In the first stage, the hypothesis of fixed proportions of intermediate inputs and primary factors is adopted through a Leontief function. Then, imported intermediate inputs are considered imperfect substitutes for those produced domestically, i.e., the Armington hypothesis. On the side of the primary factors, a CES function (Constant Elasticity of Substitution) determines the quantity of each of the three economic factors (capital, labor, and land). This function may be affected or not by scale effects, depending on the parameter setting. In the third stage, domestic inputs are divided between the different producing regions of the country.

The Armington elasticity captures the effect of replacing a locally produced good with one produced externally, measuring the propensity of a consumer to change the origin of the goods consumed by it in response to a variation in the relationship between the price of that good produced locally and its import price. In this study, we will use the Armington elasticities estimated by Faria and Haddad (2014), as shown in Table 29 in the Appendix.

Figure 1. Nested Production Structure



Source: Elaborated by the authors based on Haddad (2004)

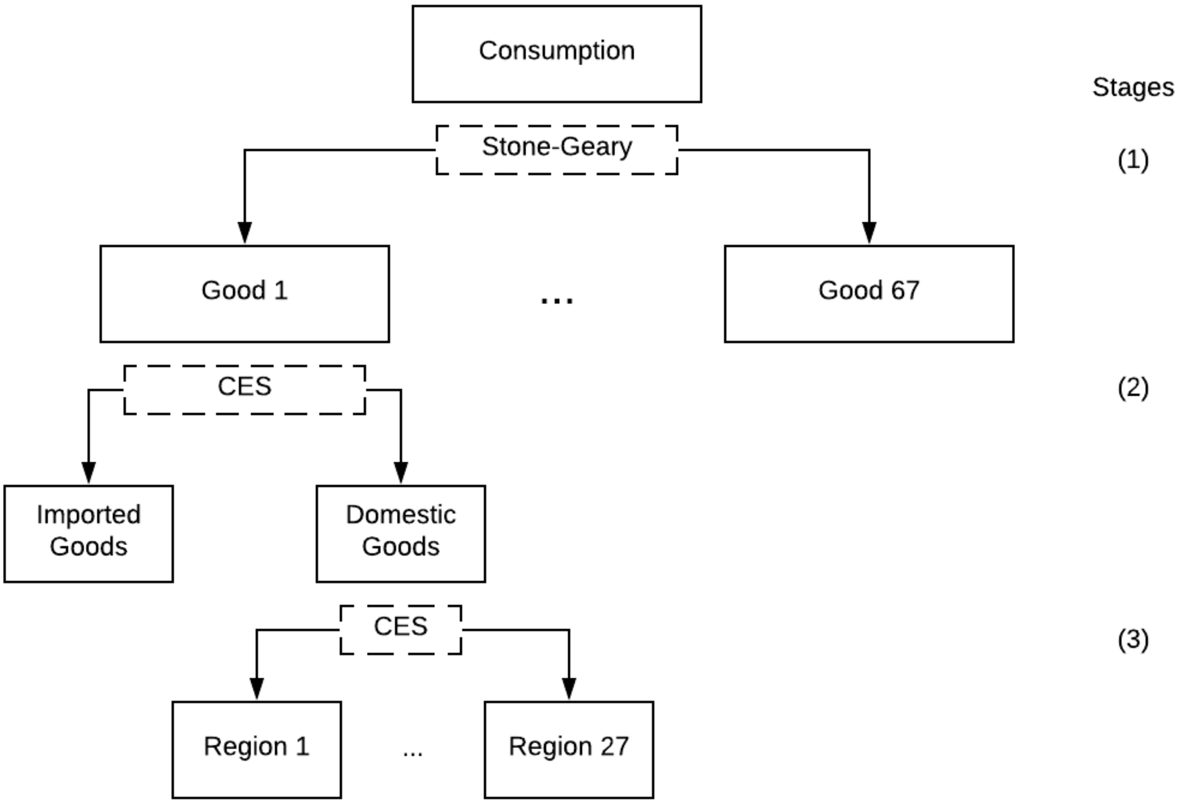
3.1.1.2. Families

Consumers maximize their utility subject to their disposable income, through a nested utility function of the Stone-Geary / CES, as Figure 2 depicts. In the first stage, the choice occurs between the different goods available by the Stone-Geary function.[20] In the second stage, consumers choose between goods from domestic or foreign regions. In the last stage, firms of the different producing regions select domestic goods.

The model assumes assumptions of competitive markets, in which firms and consumers are price takers.

[20] In the Stone-Geary utility function, the representative family gains utility only after a certain level of subsistence consumption.

Figure 2. Families' nested utility function



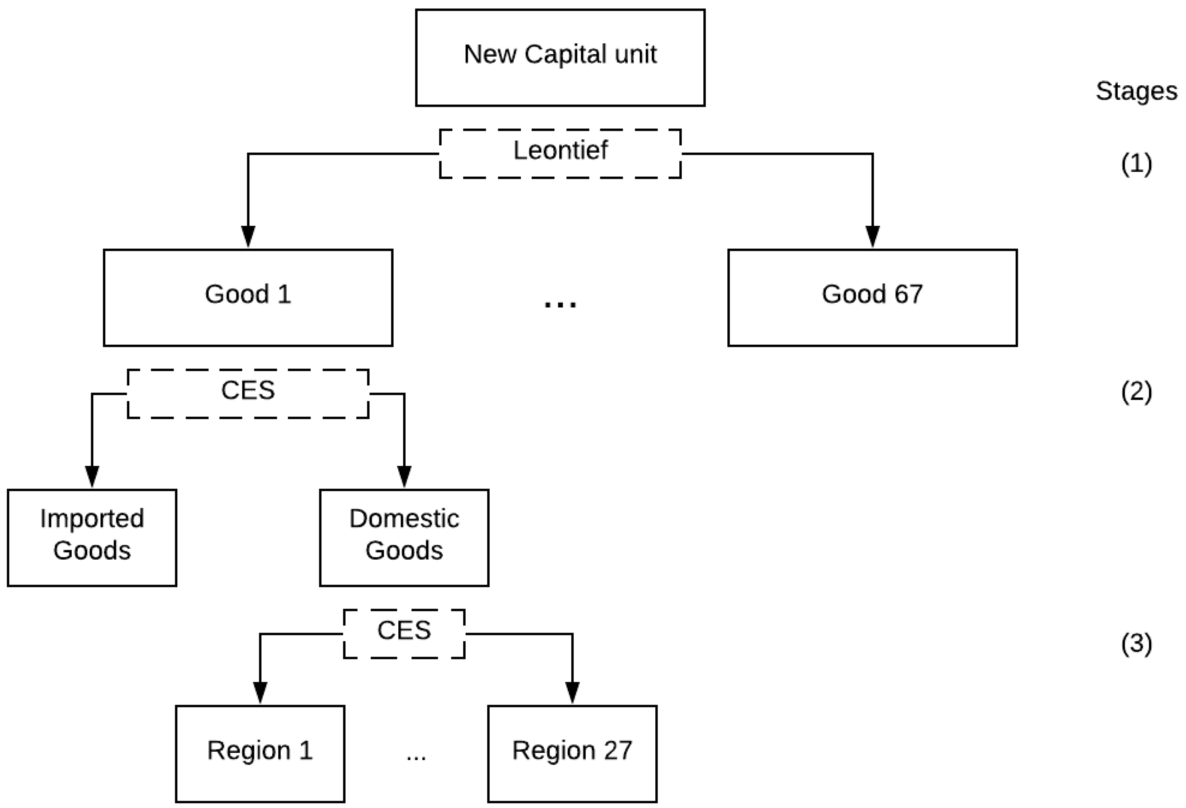
Source: Elaborated by the authors based on Haddad (2004)

3.1.1.3. Investors

For the creation of new capital units, investors in the economy have a model similar to that of producers. The first level of their function is also a Leontief function of fixed proportions; yet, unlike firms, at this stage, primary factors are not used, only intermediate goods, as Figure 3 describes. In the second stage of the function, intermediate goods are selected, through a CES, from domestic or imported producers. In the third stage, domestic goods from the different producing regions are considered imperfect substitutes, and a CES selects how much each region will utilize.

Investment demand generates pressure on the primary factors only indirectly since the investment production function does not directly use them. The block of capital accumulation equations determines the level of investment in capital goods by the regional sector. In this thesis, we will focus on the short-run; therefore, investment and capital are exogenous.

Figure 3. Investor optimization structure



Source: Elaborated by the authors based on Haddad (2004)

3.1.1.4. Exporters

The sixty-seven economy products are classified as tradeable (goods of a tradition of export) or non-tradeable (goods that are not exported). A downwardly sloping curve defines external demand for each traditionally exported domestic good in the international price of the good itself. The F. O. B. (Free on Board) price of each regional export product defines elasticities of external demand for each good. It is essential to stress that the elasticities are different between goods, though constant between regions, which assumes that an external consumer does not have preferences between the different regions of Brazil.[21]

[21] Perobelli (2004) relaxes this hypothesis, introducing elasticities, econometrically estimated, differentiated by good and by region.

3.1.1.5. Government

The Government's demand for public goods in the B-MARIA-27 model starts from identifying public goods consumption by the regional and federal governments, obtained from the input-product matrix. Especially in this thesis, we will focus on the federal government demand, explaining its equation in the model.

In the model, sector 15 of the Regional Accounts from IBGE (Public Administration, Social Security, defense, education, and public health) concentrates the Government's consumption, that is, public goods provided by it. Equation 3 shows the variation of Federal Government consumption to real tariff revenues, as in Haddad et al. (2018a):

$$x_{(is)}^{(6)r} = taxrev + f_{(is)}^{(6)r} + f^{(6)r} + f^{(6)} \quad (3)$$

Where $x_{(is)}^{(6)r}$ is the Federal Government demand in region *r* for good *i* in from region *s*; $f_{(is)}^{(6)r}$, $f^{(6)r}$ e $f^{(6)}$ are, respectively, commodity and source-specific shift term for federal governments expenditures in region *r*, shift term for federal governments expenditures in region *r*, and an overall shift term for federal governments expenditures; and *taxrev* refers to the percentage change in aggregate real revenue from indirect taxes. A positive shock in $f^{(6)r}$ corresponds to an elevation of some magnitude in the Federal Government spending in region *r*, which suffered the shock. Nonetheless, the Regional Government corresponds to state and municipality levels summed together, with the superscript 5 identifying its user.

3.1.1.6. Capital accumulation and Investment Demand

Capital accumulation and investment block establish the relationship between both variables. There are two configurations of the model for comparative static exercises that allow its use in short-run and long-run simulations. The modeling is primarily concerned with the sector and regional allocation of investment expenditure. Furthermore, the model does not have the objective of explaining the investment expansion path over time. Hence, the main interest is to capture the impacts of shocks in allocating current investment spending across sectors and regions.

3.1.1.7. Labor Market, regional migration and demography module

Given the specification of the labor market's functioning, the labor supply can be determined by interregional wage differentials or by regional unemployment rates, and demographic variables are usually defined exogenously. The regional population is exogenous, and at least one of the regional labor market variables is determined endogenously: regional unemployment, regional participation rate, or relative regional salary, depending on the chosen closure.[22]

3.1.1.8. Other definitions

Other definitions contained in the central module of the CGE model include tax rates, basic and market prices for goods, tax revenue, margins, national (GDP) and regional (GRP) product components, regional and national price indices, prices of factors, employment aggregates and specifications of wage equations.

3.1.2. Welfare measures

The B-MARIA model can capture welfare variations resulting from interventions in the economy through the calculus of the Equivalent Variation (EV) of consumers from each region.

Mas-Colell et al. (1995) describe the EV as the variation in a consumer's budget allocation that brings him the same variation in utility caused by the policy's implementation under scrutiny. For homogeneous linear utility functions, EV can be written, for a given region, as (Haddad, 2004):

$$EV^r = \left(\frac{U^r(1) - U^r}{U^r}\right) I^r \qquad (4)$$

Where $U^r(1)$ is the counter-factual utility level, i.e., after the policy change, U^r is the referential or benchmark utility level, that is, before the policy change, and I^r is the disposable income benchmark to reference prices; superscript *r* refers to specific regions.

[22] Haddad (2004) argues that in another specification, regional unemployment, regional participation rate, or regional wages are exogenous and regional migration is determined endogenously, and, thus, also the regional population.

The EV has the same sign of the direction of change in well-being: for a gain (loss) of welfare, its sign is positive (negative).In addition to regional measures, we can calculate an aggregate (national) measure by merely adding the various EV^r for all r.

Another welfare measure refers to the Relative Equivalent Variation (REV), defined as the percentage change in the referential income that the representative family would need to reach the level of counter-factual utility considering the reference prices (Haddad, 2004). That is:

$$REV^r = \frac{EV^r}{I^r} \quad (5)$$

3.2. CALIBRATION AND CLOSURE

Prior to the simulation, we must perform the model's calibration process to impose a mathematical structure for the practical implementation of the model. Notwithstanding, we must stipulate the simulation environment, which is called the closure step in CGE models, short or long-run.[23]

3.2.1. Data in the BMARIA model

Firstly, an interregional input-output matrix for Brazil (2015), with estimates of flows between model regions. We need to complete the information on demographic data to estimate labor supply, employment level, and population coefficients. By last, the various elasticities (regional trade, international trade, substitution between primary productive factors, among others) are called "behavioral parameters" (Haddad, 2004).[24]

The University of São Paulo Regional and Urban Economics Lab (NEREUS) of the Faculty of Economics and Administration of the University of São Paulo (FEA-USP) developed the interregional input-product matrix for 2015. The construction of such a database follows the IIOAS method described in Gonçalves Júnior, Haddad, and Nascimento (2017).

The forthcoming section in this thesis will bring some considerations and analyses of the interregional input-output system estimated for the Brazilian economy.

---

[23] As the model works with relative prices, we have to select some price variables as numeraire. The options in the literature fall on the consumer price index or the exchange rate. In this work, the simulations were carried out with the exchange rate as numeraire and exogenous with zero shocks. Thus, no exchange policy is defined as exogenously or endogenously determined to obtain any trade surplus or inflation target. For more details, see Haddad (2004).

[24] Empirical estimates for some of these elasticities are not available in the literature. So, we have set values employed in similar models. For more details, see Haddad (2004) and Haddad et al. (2018a).

3.2.2. Closures in the simulation

This thesis's focus will be on short-run closure, in which capital stock and the real wages are exogenous, and employment and return on capital are endogenous. While in the long-run closure, the opposite happens. Furthermore, migration between regions happens only in the long-run. In the short-run closure, labor mobility occurs between sectors in the same region, whereas in the long-run, unemployment is exogenous, so workers move between regions to meet the level of unemployment.

In addition to the hypothesis of intersectoral and interregional immobility of capital, this closure specifies regional population and fixed labor supply, constant regional wage differentials, and fixed national real wages. Regional employment is a function of the wage rate assumptions, which indirectly determine regional unemployment rates. On the demand side, investment spending is exogenous – firms cannot reevaluate investment decisions in the short-run. Household consumption follows its disposable income, and government consumption, at both levels, follows real tariff revenues.

The government spending impact will be calculated for comparative static purposes as proposed by this modeling. Any inter-temporal considerations in the behavior of agents are exempt from the analysis. Hence, there is no need to worry about long-run reversals of short-run relative price changes from the temporary demand shock (Haddad et al., 2018a).

In this sense, this thesis will focus on the short-term impact of fiscal measures on GDP. By focusing on GDP, we do not address other essential variables, such as employment, social outcomes, and fiscal sustainability. The literature shows that a permanent discretionary change in indirect taxes, government consumption, and transfers have only short-term output effects, typically vanishing within five years. On the spending side, investment has the highest short-term multiplier, followed by government wages and government purchases (Batini et al.,2014). There is less consensus about the size of short-term multipliers. For now, our primary aim is to estimate the government spending multiplier for each Brazilian state. That is the reason we chose the short-run environment of simulation.

3.3. MULTIPLIERS' CALCULUS

Through this paper, we plan to assess the effects of different exogenous shocks on Federal Government spending on macroeconomic variables of interest to calculate the multiplier for each of the Brazilian states.

After the simulations, our main concern is to investigate the impact on the Gross Regional Product (GRP) of each region and the national Gross Domestic Product (GDP) so that we can estimate the local and national multipliers of government spending, as in Haddad et al. (2018a). We will follow a bottom-up approach, i.e., the effect on national GDP will be the sum of the impact on GRP of the 27 regions, ensuring consistency between local and national multiplier. Since the simulation involves different shock sources, it is possible to isolate variations in the output according to the region receiving government demand shock. This way elucidates the overflows of local government spending to the other model regions, capturing spillovers. Mathematically, as proposed by Haddad et al. (2018a):

$$\Delta \mathrm{GRP}^r = GRP^r \times grp^r \quad (6)$$

$$\Delta \mathrm{GDP} = \sum_r \Delta GRP^r \quad (7)$$

$$\sum_s \Delta GRP^r{}_s = \frac{\Delta \mathrm{GRP}^r}{\Delta \mathrm{GOV}^1} + \frac{\Delta \mathrm{GRP}^r}{\Delta \mathrm{GOV}^2} + \cdots + \frac{\Delta \mathrm{GRP}^r}{\Delta \mathrm{GOV}^s} \quad (8)$$

Where (6) denotes the impact in the GRP (grp^r is the percentage change that the regional product in region *r* suffered from the exogenous shock of government spending in *r*), (7) the impact on national GDP, and (8) the spillovers from government spending in each region on the income of region *r*.

The local (or intraregional) multiplier is how much the output of the region that received the increased spending increased considering only the variation in spending in the region that received the shock, expressed by (9). The national multiplier related to increases in spending in a given region is given by (10). Finally, by disregarding the effects of increased spending on region r on the region itself, we obtain the interregional multiplier, as in Equation (11).

$$\mathrm{K}_{(s)}^{(r)} = \frac{\Delta \mathrm{GRP}^r}{\Delta \mathrm{GOV}^s}, \; r = s \quad (9)$$

$$\mathrm{K}_{(s)}^{(\cdot)} = \frac{\sum_r \Delta GRP_s^r}{\Delta \mathrm{GOV}^s} \quad (10)$$

$$\mathrm{K}_{(s)}^{(t)} = \frac{\sum_t \Delta GRP_s^t}{\Delta \mathrm{GOV}^s}, \; t \neq s \quad (11)$$

In the next section, we exhibit indicators of regional concentration in Brazil. We display the regional and sectoral composition of government spending and how it compounds each state's GRP. We conduct analyzes from the interregional input-output matrix estimated for 2015 to recognize regional and sectoral interdependence and comprehend the structure of Government spending that will serve as data for the simulations presented in section 5.

4. THE BRAZILIAN ECONOMY

In this section, we will present data on GDP, GDP per capita, and population of the country to illustrate the high degree of regional inequality in Brazil. Likewise, the level and composition of government spending in the country will be briefly studied. Lastly, we will grant some analyzes of the interregional input-output matrix used to calibrate the CGE model.

4.1. REGIONAL INEQUALITY AND GOVERNMENT SPENDING IN BRAZIL

According to the data in Table 1 presented in Azzoni and Haddad (2018), there is a significant and persistent degree of production concentration and economic dynamics in the South-Southeast regions of the country, which together occupy only 17.7% of the Brazilian territory. The Southeast region concentrated 44.5% and 42.1% of the population and 63.0% and 54.9% of the national income in 1940 and 2010/2014. Despite losing share in GDP, as pointed out by the data, it still configures as the foremost engine of the Brazilian economy.

Meanwhile, the region with the most significant territorial dimension (North) corresponded to only 5.3% of national income in 2014 and 8.3% of the population in 2010. Conversely, Northeast Region corresponded to 18.3% of the territory, 35.0% of the population, and 16.9% of national income in 1939-1940. In 2014, the region represented 13.9% of GDP. It is also worth highlighting the Midwest region’s impressive growth in terms of participation in GDP, which went from 2.1% in 1939 to 9.4% in 2014.

Table 1. Population and income in Brazilian regions

Region	Share of national territory (%)	Share of population (%)		Share of national income (%)	
		1940	2010	1939	2014
North	45.3	3.9	8.3	2.7	5.3
Northeast	18.3	35.0	27.8	16.9	13.9
Southeast	10.9	44.5	42.1	63.0	54.9
South	6.8	13.9	14.4	15.3	16.4
Center-West	18.9	2.7	7.4	2.1	9.4

Source: Azzoni and Haddad (2018)

Table 2 presents the results of the Brazilian Regional Accounts for 2015. Six states (São Paulo, Rio de Janeiro, Minas Gerais, Paraná, Rio Grande do Sul, and Santa Catarina) concentrated approximately 69% of Brazilian GDP in the year, all in the South-Southeast axis. In terms of value-added, the results remain similar to the GDP. Considering GDP per capita, the Federal District presented the highest ratio relative to the national average (2.5), followed by the states of São Paulo (1.5) and Rio de Janeiro (1.4). Nonetheless, all states in the North and Northeast regions were below the Brazilian national average in this criterion, with the five lowest ratios of GDP per capita of the state relative to the national GDP per capita belonging to the Northeast (Ceará, Paraíba, Alagoas, Piauí, and Maranhão, in this order).

Table 2. Basic socioeconomic indicators for Brazil, 2015

UF	GDP		GDP per capita		Value-Added		Population	
	Current Value (R$ 1,000,000)	Share (%)	Current Value	GDP per capita UF / GDP per capita Brazil	Current Value (R$ 1,000,000)	Share (%)	Census 2010	Share (%)
SP	1,939,890	32.4	43,695	1.5	1,626,004	31.5	41,262,200	21.6
RJ	659,137	11.0	39,827	1.4	556,399	10.8	15,989,929	8.4
MG	519,326	8.7	24,885	0.8	457,443	8.9	19,597,330	10.3
PR	376,960	6.3	33,769	1.2	326,631	6.3	10,444,526	5.5
RS	381,985	6.2	33,960	1.2	333,418	6.5	10,693,929	5.6
SC	249,073	4.2	36,525	1.2	209,670	4.1	6,248,436	3.3
BA	245,025	4.1	16,116	0.5	215,986	4.2	14,016,906	7.3
DF	215,613	3.6	73,971	2.5	186,294	3.6	2,570,160	1.3
GO	173,632	2.9	26,265	0.9	154,573	3.0	6,003,788	3.1
PE	156,955	2.6	16,795	0.6	134,500	2.6	8,796,448	4.6
PA	130,883	2.2	16,010	0.5	118,312	2.3	7,581,051	4.0
CE	130,621	2.2	14,669	0.5	114,643	2.2	8,452,381	4.4
ES	120,363	2.0	30,627	1.0	100,490	1.9	3,514,952	1.8
MT	107,418	1.8	32,895	1.1	97,598	1.9	3,035,122	1.6
AM	86,560	1.4	21,979	0.7	72,695	1.4	3,483,985	1.8
MS	83,082	1.4	31,337	1.1	74,317	1.4	2,449,024	1.3
MA	78,475	1.3	11,366	0.4	69,856	1.4	6,574,789	3.4
RN	57,520	1.0	16,632	0.6	51,184	1.0	3,168,027	1.7
PB	56,140	0.9	14,133	0.5	50,105	1.0	3,766,528	2.0
AL	46,364	0.8	13,878	0.5	42,261	0.8	3,120,494	1.6
PI	39,148	0.7	12,219	0.4	35,069	0.7	3,118,360	1.6
RO	36,563	0.6	20,678	0.7	32,574	0.6	1,562,409	0.8
SE	38,554	0.6	17,189	0.6	34,509	0.7	2,068,017	1.1
TO	28,930	0.5	19,094	0.7	26,296	0.5	1,383,445	0.7
AC	13,622	0.2	16,953	0.6	12,443	0.2	733,559	0.4
RR	10,354	0.2	20,477	0.7	9,441	0.2	450,479	0.2
AP	13,861	0.2	18,080	0.6	12,891	0.3	669,526	0.4
Brazil	**5,996,054**	**100**	**29,326**	**1.0**	**5,155,601**	**100**	**190,755,800**	**100**

Source: Regional Accounts from IBGE

Given the above, it is easy to discern the heterogeneity and the high degree of regional disparity existing in the country. According to Haddad et al. (2013), the Federal Government's regional growth agenda for 2010-2013 consisted of isolated subsidies and industrial incentives for growing centers and constitutional transfers to less developed regions and rural areas through regional funds.[25]

To comprehend the role of government spending in each state, Figure 4(a) reveals its distribution in the Brazilian states. Whereas most of the federal government spending concentrates on the Southeast region, it is necessary to analyze its significance to each state separately. Likewise, Figure 4(b) exhibits the ratio of Government expenditure to Value-Added using municipal GDP data provided by IBGE for 2015. The North and Northeast states (except Amazonas, Pará, Ceará, and Pernambuco) have a higher share of expenditures than the national average (24.9%), especially Roraima (48.3%) and Amapá (43.7%). Hence, these economies rely on government spending and possess a less diversified production structure, with a smaller industry proportion in its gross value-added. Also, Distrito Federal (44.7%) has an expressive share of its value-added consisting of government spending. Nevertheless, Brazil's most dynamic state, SP (10.1%), has the lowest share of government spending in its value-added, as exposed in Table 30 in the Appendix.

Rocha and Giuberti (2007) analyzed the relationship between the composition of state government spending and the economic growth of Brazilian states during the period 1986-2003. The authors used the estimation technique via panel data with fixed effects, in which the plots of each of the expenditure components in the total government expenditure appear as the explanatory variables. This modeling includes the share of government spending in GDP to control for level effects. The authors conclude that government spending on defense, education, transportation, and communication positively influences growth. Furthermore, both the relationship between current government spending and capital expenditure with economic growth is positive and nonlinear. Hence, government consumption spending may not be as harmful as the literature argues, as long as it is within the 61% limit of budget spending.

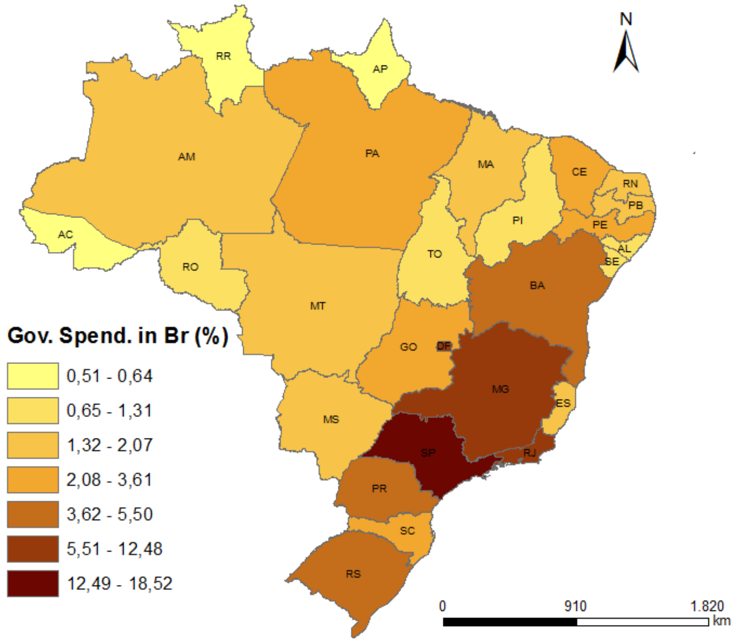
Correspondingly, Neduziak and Correia (2017) estimate that the total expenditure to GDP ratio showed a positive and significant correlation with the Brazilian states' economic growth. Government spending on housing, urbanism, assistance, and social security positively affected economic growth. Additionally, the result of introducing a dummy variable for the years in which the Fiscal Responsibility Law (LRF) was in force demonstrated that the imposition of fiscal rules has helped promote an environment conducive to more growth.[26]

[25] For more details regarding regional development fund policies, see IPEA (2017). The State Participation Fund (FPE) in 2015 allocated 85% of its resources to the least developed regions (52.4% to the Northeast, 25.4% to the North and 7.2% to the Midwest), according to the Federal Audit Court (TCU).

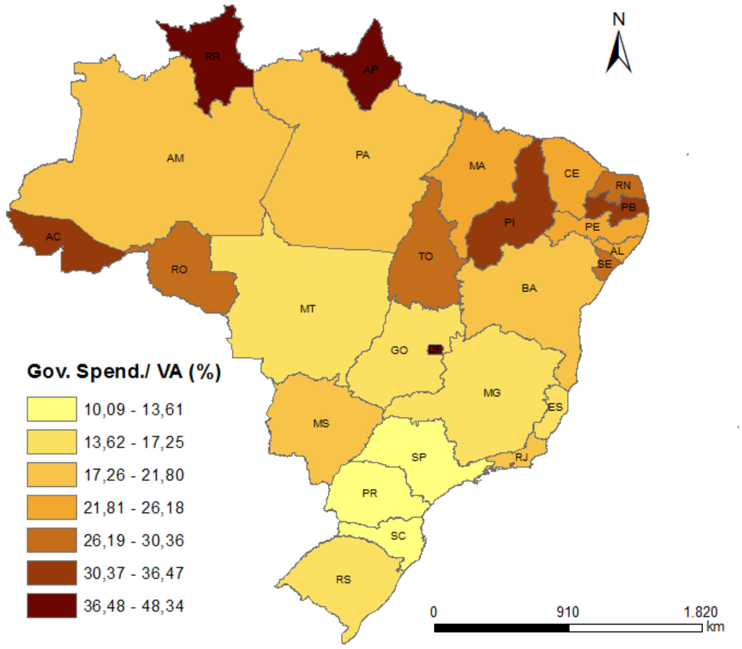
[26] The Fiscal Responsibility Law was created to define a spending limit on states and municipalities proportionately to the amount of taxes collected by these entities of the Brazilian Federation. For more details on the LRF, see Rocha and Giuberti (2004).

Figure 4. Government Spending in the Brazilian states to the

(a) Total Federal Gov. Spending in Brazil



(b) Total Federal Gov. Spending in Brazil



Source: Elaborated by the authors with data from IBGE

As shown in Table 30 in the Appendix, current government spending dominates all states, where the national average for this year was 89.9%, and the lowest value was for the state of Rio de Janeiro (84.5%). As exposed in Table 29, Brazilian states would be above the limit at which increased current expenditures promote economic growth (61.0%). Besides, the largest share for all states comes from personnel expenses and charges. Conversely, other current expenses are transfers to states and DF and municipalities, variables with greater participation of this group. Likewise, the low level of investments is noteworthy, with an average of 6.0% in the year.

In summary, from this brief review of the Brazilian economy, it is possible to assert the necessity for regional policies striving to overcome the extensive degree of regional inequality. The next section will confer more information regarding the Brazilian economic structure through examinations of the interregional input-output system estimated for 2015.

4.2. INTERREGIONAL INPUT-OUTPUT SYSTEM FOR BRAZIL, 2015

Input-output modeling, also called interindustry analysis, is pointed out by Miller and Blair (2009) as an appropriate method to investigate the interdependence of industries in an economy. Henceforth, to assess the selected area's economic impacts, interregional input-output modeling has proven to be the most appropriate tool for analyzing the related economic indicators.

As in Haddad et al. (2017), the estimation of the Interregional Input-Output Matrix for Brazil is based on the Interregional Input-Output Adjustment System (IIOAS) method. The IIOAS method was developed to estimate interregional input-output systems under conditions of limited information. In Brazil's case, we have used data from national and regional accounts provided by IBGE for 2015. The data consist mainly of the Supply and Use Tables (SUT) at the national level and regional data on sectoral GRP and regional macroaggregates from Regional Accounts from IBGE. Additionally, for the shares, we essentially used employment data from the Annual Social Information Report (in Portuguese, Relação Anual de Informações Sociais, RAIS).[27]

Figure 5 shows the schematic structure for the interregional Input-Output Matrix estimated for Brazil in 2015, as presented in Haddad et al. (2017).

[27] For more extended explanations concerning the IIOAS method estimation, see Haddad et al. (2017).

Figure 5. Schematic representation of the Interregional Input-Output System estimated for Brazil, 2015

(R$ million)

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Households	Exports	Reg. Government	Fed. Government
	Size	J x Q	J x Q	Q	I	Q	Q
Basic Flows*	I X S	4,707,005	1,017,617	3,325,709	767,032	913,040	358,176
Taxes	I X S	364,263	51,780	422,161	99	1,348	535
Labor Payments	I	2,672,020					
Capital	I	2,424,832					
Other Costs	I	58,749					

Make	I
Q	10,226,869

**Margins are within the basic flows*

Note

J = 67 sectors

I = 67 products

Q = 27 regions

S = 28 regions (domestic and import)

Source: Elaborated by the authors based on Haddad et al. (2017)

4.2.1. Theoretical IO Model

This section will briefly present the input-output model and the construction of the Leontief Matrix. The use makes most of the analysis with the IO modeling through the Leontief Matrix. We will follow the estimation as in Haddad et al. (2017) and Haddad et al. (2020).

Considering the intersectoral and interregional flows to two hypothetical regions L and M, with two sectors *i* and *j* respectively, we have:

Z_{ij}^{LL} – Monetary flow from sector *i* to sector *j* in region L;

Z_{ij}^{ML} – Cash flow from sector *i* in region M to sector *j* in region L.

After defining the monetary flows, it is possible to assemble the Z matrix:

$$Z = \begin{bmatrix} Z^{LL} & Z^{LM} \\ Z^{ML} & Z^{MM} \end{bmatrix} \qquad (12)$$

Wherein:

Z^{LL} and Z^{MM} are intraregional monetary flows and,

Z^{LM} and Z^{ML} are interregional monetary flows.

Hence, considering the definitions in equation (12), the interregional input-output model can be written as:

$$X_i^L = z_{ii}^{LL} + z_{ij}^{LL} + z_{ii}^{LM} + z_{ij}^{LM} + Y_i^L \quad (13)$$

Such that:

$$Y_i^L = Y_i^{LL} + Y_i^{LM} \quad (14)$$

X_i^L is the total output of sector i in the region L, Y_i^{LL} and Y_i^{LM} are respectively the intra and interregional demands of sector *i* and Y_i^L is the total final demand for sector i in region L.

The technical production coefficients can be defined in the matrix form:[28]

$$A^{LL} = Z^{LL}(X^L)^{-1} \quad (15)$$

Where

$$a_{ij}^{LL} = \frac{z_{ij}^{LL}}{X_j^L} \text{ and } a_{ij}^{LM} = \frac{z_{ij}^{LM}}{X_j^M} \quad (16)$$

From this, it has been that in the national input-product system:

$$(I - A)X = Y \quad (17)$$

$$X = (I - A)^{-1}Y = BY \quad (18)$$

Where Y is the final demand and B is Leontief's inverse. Given the above, the conventional input-output model, described by Equations 17 and 18, can be used in an interregional system such as:

$$X = \begin{pmatrix} X^1 \\ \cdots \\ X^r \end{pmatrix}; Y = \begin{pmatrix} Y^1 \\ \cdots \\ Y^r \end{pmatrix}; A = \begin{pmatrix} A^{11} & \cdots & A^{1r} \\ \vdots & \ddots & \vdots \\ A^{r1} & \cdots & A^{rr} \end{pmatrix}; B = \begin{pmatrix} B^{11} & \cdots & B^{1r} \\ \vdots & \ddots & \vdots \\ B^{r1} & \cdots & B^{rr} \end{pmatrix} \quad (19)$$

And

$$\begin{aligned} X^1 &= B^{11}Y^1 + \cdots + B^{1r}Y^r \\ &\cdots \\ X^r &= B^{r1}Y^1 + \cdots + B^{rr}Y^r \end{aligned} \quad (20)$$

Furthermore, we may consider different components of Y, which includes demands originating in the specific regions, V, and abroad, e. We obtain information on final demand

[28] For more details of the direct coefficients, its applications, and extensive use of them in the IO model, see Miller and Blair (2009).

from origin s in the IIOS BR, allowing us to treat V as a matrix that provides the monetary values of final demand expenditures from the domestic regions in Brazil and the foreign region.

$$V = \begin{pmatrix} V^{11} & \cdots & V^{1r} \\ \vdots & \ddots & \vdots \\ V^{r1} & \cdots & V^{rr} \end{pmatrix}; \text{and } e = \begin{pmatrix} e^{1} \\ \cdots \\ e^{r} \end{pmatrix} \quad (21)$$

Therefore, we can rewrite equation (20) as:

$$\begin{aligned} X^1 &= B^{11}(V^{11} + \cdots V^{r1} + e^1) + \cdots + B^{1r}(V^{1r} + \cdots + V^{rr} + e^r) \\ &\cdots \\ X^r &= B^{r1}(V^{11} + \cdots V^{r1} + e^1) + \cdots + B^{rr}(V^{1r} + \cdots + V^{rr} + e^r) \end{aligned} \quad (22)$$

From equation (22), we can then compute the final demand contribution from different origins on regional output. It is clear from (22) that regional output depends, among others, on demand originated in the region, on the degree of interregional integration and demand from outside the region.

4.2.2. Output multipliers analysis from the Leontief Matrix

An output multiplier is defined for each sector *j*, in each region *r*, as the total value of production in all sectors and all regions of the economy necessary to satisfy the value's worth of final demand for sector *j*'s output. As in Haddad et al. (2017) and Haddad et al. (2020), we compute the column multipliers derived from matrix B to obtain the output multiplier, following the procedure proposed by Miller and Blair (2009).

Further, the multiplier effect separates decomposes between intraregional (internal multiplier) and interregional (external multiplier) effects, the former representing the impacts on the outputs of sectors within the region where the final demand change increased; and the latter showing the impacts on the other regions of the system (interregional spillover effects).

Table 3 shows the intraregional and interregional shares for the average total output multipliers of the 26 states of Brazil plus its Federal District (DF). Moreover, it exhibits the equivalent shares for the direct and indirect effects of a unit change in final demand in each sector in each region net of the initial injection (the total output multiplier effect net of the initial change). The values are shown in percentage terms, providing insights into the degree of dependence of each region on the other regions.

São Paulo, Amazonas, and Rio Grande do Sul are the most autonomous regions; the average flow-on effects from a unit change in final sectoral demand are among the highest. For São Paulo, 82% of the total multiplier effect, and 60% of the net effect stays within its territory. Notwithstanding, for the majority of the country, the degree of regional self-sufficiency is much lower, and the intraregional flow-on effects, on average, are much lower than the total interregional effects. Distrito Federal and the states in the North and Northeast regions exhibit the total interregional approximately at 70%.

Table 3. Regional Percentage Distribution of the Average Total and Net Output Multipliers: Brazil, 2015

UF	*Simple decomposition*		*Net decomposition*	
	Intraregional	*Interregional*	*Intraregional*	*Interregional*
Rondonia	0.69	0.31	0.31	0.69
Acre	0.72	0.28	0.31	0.69
Amazonas	0.79	0.21	0.53	0.47
Roraima	0.75	0.25	0.30	0.70
Pará	0.72	0.28	0.35	0.65
Amapá	0.77	0.23	0.31	0.69
Tocantins	0.67	0.33	0.29	0.71
Maranhão	0.71	0.29	0.35	0.65
Piauí	0.68	0.32	0.30	0.70
Ceará	0.74	0.26	0.42	0.58
Rio Grande do Norte	0.72	0.28	0.38	0.62
Paraíba	0.69	0.31	0.30	0.70
Pernambuco	0.73	0.27	0.42	0.58
Alagoas	0.74	0.26	0.35	0.65
Sergipe	0.74	0.26	0.38	0.62
Bahia	0.74	0.26	0.45	0.55
Minas Gerais	0.74	0.26	0.43	0.57
Espírito Santo	0.71	0.29	0.37	0.63
Rio de Janeiro	0.76	0.24	0.46	0.54
São Paulo	0.82	0.18	0.60	0.40
Paraná	0.74	0.26	0.43	0.57
Santa Catarina	0.74	0.26	0.43	0.57
Rio Grande do Sul	0.77	0.23	0.49	0.51
Mato Grosso do Sul	0.70	0.30	0.35	0.65
Mato Grosso	0.71	0.29	0.41	0.59
Goiás	0.70	0.30	0.36	0.64
Distrito Federal	0.70	0.30	0.29	0.71

Source: Elaborated by the authors based on Haddad et al. (2017) and Haddad et al. (2020)

4.2.3. Output decomposition analysis by the origin of Final Demand

Following equation (22), we decompose regional output (for each region) and estimate the contributions of the components of final demand from different areas. Table 4 exhibits the results. As expected, the main contributions to the final demand of a region are given by itself, so the highest values in the table are on the diagonal, i.e., the intraregional component.

The Brazilian states with a higher share of their production associated with their final demand are Roraima (84.65%) and Acre (77.82%). Haddad et al. (2017) encounter the same result for the Brazilian input-output estimated for 2011. According to the authors, this may be since the referred states are distant from the country's large productive centers in the Southeast region, which hamper the trade of goods with higher value-added. Furthermore, the referred states present an industrial park still in formation, essentially focused on their internal supply.

Conversely, the states whose final internal demand corresponds to a lesser fraction of GRP are Mato Grosso (36.43%), Amazonas (40.69%), Mato Grosso do Sul (42.13%), Paraná (42.21%), and Espírito Santo (42.94%). The State of Amazonas mainly due to the Manaus Free Trade Zone and its petrochemical industry, Mato Grosso and Mato Grosso do Sul due to agricultural production for export and Espírito Santo, primarily due to the oil, minerals, and cellulose industry. Further, these states display a higher share of their production linked to exports to the rest of the world.

It is worth noting the importance of the state of São Paulo, with a 22.29% contribution to the country's final demand. In sequence, the rest of the world's demand (14.89%) for the Brazilian production and the states of Rio de Janeiro (9.13%) and Minas Gerais (8.26%) contribute the most to the final Brazilian demand.

Table 4. Components of Decomposition of Regional Output Based on the Sources of Final Demand: Brazil, 2015 (in %))

UF	Origin of Final Demand																												
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	RoW	Total
RO	58.47%	0.68%	1.09%	0.17%	0.73%	0.11%	0.11%	0.41%	0.25%	0.62%	0.25%	0.28%	0.67%	0.18%	0.16%	1.03%	2.70%	0.49%	2.43%	8.49%	1.55%	1.13%	2.12%	0.46%	1.02%	0.81%	1.22%	12.36%	100.00%
AC	1.24%	77.82%	1.14%	0.13%	0.56%	0.15%	0.10%	0.44%	0.20%	0.57%	0.25%	0.25%	0.61%	0.22%	0.14%	0.86%	1.51%	0.33%	1.74%	4.27%	0.90%	0.60%	1.22%	0.27%	0.44%	0.52%	0.79%	2.72%	100.00%
AM	1.19%	0.45%	40.69%	0.69%	3.45%	0.40%	0.40%	1.53%	0.75%	1.99%	0.83%	0.83%	2.16%	0.50%	0.45%	3.09%	3.73%	1.01%	4.05%	11.23%	1.90%	1.62%	2.33%	0.68%	1.40%	1.87%	2.10%	8.67%	100.00%
RR	0.30%	0.09%	2.37%	84.65%	0.52%	0.06%	0.06%	0.33%	0.11%	0.23%	0.17%	0.18%	0.39%	0.09%	0.08%	0.46%	0.93%	0.24%	1.41%	2.57%	0.63%	0.42%	1.04%	0.20%	0.21%	0.27%	0.49%	1.51%	100.00%
PA	0.22%	0.08%	0.36%	0.07%	59.39%	0.25%	0.39%	0.56%	0.51%	0.87%	0.31%	0.33%	0.83%	0.18%	0.17%	0.79%	1.50%	0.34%	1.61%	4.65%	0.84%	0.60%	1.04%	0.21%	0.35%	0.70%	1.03%	21.81%	100.00%
AP	0.11%	0.07%	0.24%	0.04%	0.76%	82.89%	0.12%	0.45%	0.36%	0.44%	0.26%	0.25%	0.46%	0.12%	0.11%	0.72%	1.20%	0.25%	1.63%	3.21%	0.74%	0.45%	1.08%	0.21%	0.17%	0.31%	0.77%	2.60%	100.00%
TO	0.22%	0.07%	0.61%	0.07%	2.43%	0.20%	55.09%	2.24%	0.72%	1.18%	0.45%	0.48%	1.15%	0.31%	0.30%	2.75%	2.46%	0.55%	2.90%	6.29%	1.10%	0.83%	1.44%	0.30%	0.42%	1.19%	2.60%	11.66%	100.00%
MA	0.19%	0.06%	0.34%	0.06%	2.89%	0.19%	0.60%	62.60%	2.09%	1.68%	0.66%	0.62%	1.28%	0.30%	0.28%	1.53%	1.92%	0.47%	2.64%	5.23%	1.10%	0.83%	1.53%	0.29%	0.34%	0.67%	1.22%	8.39%	100.00%
PI	0.21%	0.07%	0.35%	0.10%	1.64%	0.25%	0.33%	3.14%	68.46%	2.68%	1.25%	0.79%	1.76%	0.46%	0.41%	2.32%	1.27%	0.50%	1.69%	3.27%	0.61%	0.54%	0.81%	0.17%	0.31%	0.54%	1.22%	4.87%	100.00%
CE	0.20%	0.08%	0.38%	0.07%	1.33%	0.17%	0.25%	1.94%	1.59%	69.54%	1.16%	1.34%	3.21%	0.27%	0.21%	2.18%	1.58%	0.35%	1.17%	3.85%	0.76%	0.37%	0.84%	0.22%	0.27%	0.59%	1.15%	4.94%	100.00%
RN	0.17%	0.07%	0.43%	0.08%	0.88%	0.16%	0.10%	1.17%	0.72%	4.18%	66.05%	4.05%	4.17%	0.39%	0.31%	2.21%	1.03%	0.49%	1.63%	3.53%	0.46%	0.47%	0.96%	0.12%	0.18%	0.34%	1.42%	4.22%	100.00%
PB	0.23%	0.07%	0.31%	0.05%	0.88%	0.15%	0.17%	1.19%	0.62%	1.92%	2.77%	67.80%	5.66%	1.14%	0.43%	2.21%	1.44%	0.52%	1.68%	3.76%	0.61%	0.53%	0.90%	0.18%	0.26%	0.49%	1.34%	2.68%	100.00%
PE	0.26%	0.09%	0.39%	0.08%	1.20%	0.15%	0.24%	1.64%	1.26%	2.43%	2.24%	4.17%	60.11%	1.67%	0.71%	4.36%	1.99%	0.50%	1.81%	5.15%	0.71%	0.45%	1.03%	0.24%	0.37%	0.75%	1.46%	4.53%	100.00%
AL	0.23%	0.13%	0.50%	0.07%	1.08%	0.15%	0.23%	1.06%	0.78%	1.42%	1.17%	1.98%	4.93%	57.30%	1.07%	4.68%	2.71%	0.49%	2.12%	5.03%	0.82%	0.54%	1.37%	0.34%	0.38%	0.86%	1.63%	6.93%	100.00%
SE	0.29%	0.10%	0.44%	0.09%	1.30%	0.18%	0.22%	1.15%	0.71%	1.57%	0.78%	1.06%	2.81%	1.41%	62.12%	4.70%	2.20%	0.74%	2.48%	5.10%	0.87%	0.75%	1.39%	0.27%	0.38%	0.74%	1.57%	4.58%	100.00%
BA	0.15%	0.06%	0.31%	0.07%	0.76%	0.11%	0.21%	0.68%	0.69%	1.40%	0.52%	0.55%	1.73%	0.55%	0.94%	54.15%	3.35%	1.39%	3.47%	7.35%	1.17%	0.89%	1.85%	0.41%	0.60%	1.34%	2.92%	12.39%	100.00%
MG	0.30%	0.11%	0.42%	0.09%	0.94%	0.13%	0.23%	0.70%	0.33%	0.88%	0.38%	0.40%	0.95%	0.31%	0.30%	1.62%	52.44%	0.77%	3.35%	9.28%	1.46%	1.16%	1.35%	0.47%	0.64%	2.19%	1.73%	17.07%	100.00%
ES	0.21%	0.08%	0.36%	0.07%	1.18%	0.12%	0.20%	0.90%	0.52%	0.80%	0.34%	0.46%	0.95%	0.31%	0.27%	3.34%	4.05%	42.94%	6.40%	7.34%	1.25%	1.06%	1.40%	0.39%	0.51%	1.10%	1.42%	22.02%	100.00%
RJ	0.23%	0.07%	0.33%	0.07%	0.60%	0.10%	0.21%	0.51%	0.33%	0.65%	0.30%	0.41%	0.78%	0.26%	0.20%	1.82%	4.38%	0.95%	51.06%	10.88%	1.87%	1.57%	2.06%	0.54%	0.73%	1.29%	2.07%	15.72%	100.00%
SP	0.41%	0.13%	0.56%	0.12%	1.12%	0.16%	0.34%	0.83%	0.43%	1.06%	0.46%	0.54%	1.16%	0.36%	0.30%	2.31%	5.34%	0.86%	5.76%	48.63%	3.78%	2.00%	2.75%	1.05%	0.95%	1.21%	1.02%	16.38%	100.00%
PR	0.32%	0.10%	0.41%	0.08%	0.71%	0.11%	0.18%	0.52%	0.28%	0.73%	0.30%	0.35%	0.76%	0.24%	0.21%	1.51%	3.07%	0.72%	4.21%	17.02%	42.21%	2.78%	2.29%	0.65%	0.58%	1.09%	1.55%	17.01%	100.00%
SC	0.21%	0.06%	0.35%	0.07%	0.62%	0.10%	0.22%	0.83%	0.38%	0.52%	0.22%	0.37%	0.61%	0.19%	0.20%	1.52%	2.91%	0.48%	2.93%	12.45%	3.72%	47.36%	4.33%	0.52%	0.63%	1.15%	1.51%	15.55%	100.00%
RS	0.34%	0.10%	0.51%	0.10%	0.95%	0.16%	0.26%	1.00%	0.42%	0.85%	0.39%	0.49%	0.91%	0.27%	0.25%	1.77%	2.62%	0.67%	3.14%	9.78%	2.16%	2.31%	48.95%	0.53%	0.77%	1.18%	1.32%	17.79%	100.00%
MS	0.45%	0.15%	0.68%	0.12%	1.00%	0.18%	0.21%	0.70%	0.35%	0.82%	0.36%	0.40%	0.89%	0.28%	0.24%	1.64%	2.96%	0.77%	3.87%	13.99%	2.27%	1.68%	2.57%	42.13%	0.83%	1.45%	1.76%	17.26%	100.00%
MT	0.86%	0.24%	1.28%	0.16%	1.41%	0.19%	0.28%	0.92%	0.44%	1.12%	0.45%	0.51%	1.16%	0.31%	0.29%	2.35%	3.36%	0.72%	3.62%	8.46%	1.54%	1.24%	2.16%	0.55%	36.43%	1.64%	2.41%	25.90%	100.00%
GO	0.37%	0.13%	0.57%	0.13%	1.34%	0.18%	0.40%	0.99%	0.46%	0.96%	0.40%	0.42%	1.03%	0.33%	0.29%	1.44%	4.71%	0.85%	3.64%	11.08%	1.18%	1.22%	1.81%	0.45%	0.82%	47.28%	5.81%	11.74%	100.00%
DF	0.55%	0.17%	0.58%	0.14%	1.60%	0.30%	0.56%	1.26%	0.62%	1.45%	0.79%	0.82%	1.73%	0.58%	0.54%	2.00%	4.03%	0.96%	4.13%	5.57%	1.23%	1.33%	1.96%	0.50%	1.00%	3.84%	60.37%	1.41%	100.00%
Brazil	**0.68%**	**0.25%**	**1.16%**	**0.22%**	**2.20%**	**0.29%**	**0.53%**	**1.56%**	**0.87%**	**2.35%**	**1.05%**	**1.14%**	**2.66%**	**0.73%**	**0.66%**	**4.38%**	**8.26%**	**1.61%**	**9.13%**	**22.29%**	**5.08%**	**3.49%**	**5.40%**	**1.27%**	**1.56%**	**2.77%**	**3.51%**	**14.89%**	**100.00%**

Source: Elaborated by the authors based on Haddad et al. (2017) and Haddad et al. (2020)

4.2.4. Decomposition of Government Demand in the IO Matrix

In this subsection, we will exhibit the regional and sectoral composition of government demand in the estimated interregional input-output matrix.

In the sectoral aspect, government demand for all regions focuses on sectors 60, 61, 63, and 64, sectors of public administration and defense, public education, public health, and private health, respectively. Table 5 exhibits sectoral results. The public administration and defense sector corresponds to approximately 56.0% of Government Demand in all regions, followed by public education (24.4% on average) and public health (14.9% on average).

Table 5. Sectoral composition of Government Demand: Brazil, 2015 (in R$ million)

UF/ Sector	60	61	63	64	Other
RO	6,868.45	2,951.57	1,796.22	353.21	110.9214739
AC	3,442.80	1,478.72	899.88	177.00	54.73729603
AM	11,025.58	4,743.27	2,886.74	567.58	172.4545985
RR	3,462.98	1,487.03	904.93	178.01	54.67467047
PA	19,544.19	8,403.68	5,114.29	1,005.60	312.5734418
AP	4,271.58	1,834.40	1,116.32	219.58	67.52183503
TO	6,052.64	2,600.95	1,582.84	311.27	97.23513164
MA	13,862.64	5,958.82	3,626.38	713.00	221.7260875
PI	8,831.28	3,794.50	2,309.20	454.06	139.1215425
CE	20,558.88	8,837.69	5,378.46	1,057.54	323.9709749
RN	11,276.93	4,845.76	2,948.97	579.94	178.7251148
PB	12,648.75	5,434.10	3,306.99	650.28	201.6201116
PE	24,244.61	10,424.22	6,344.02	1,247.51	382.6290028
AL	8,063.91	3,465.63	2,109.07	414.75	128.3833671
SE	7,262.59	3,121.04	1,899.36	373.60	114.7876697
BA	33,542.40	14,435.46	8,785.28	1,727.34	532.1309499
MG	59,729.18	25,704.61	15,644.03	3,075.75	940.3441106
ES	12,017.10	5,172.47	3,148.01	618.94	188.7690298
RJ	83,735.87	36,011.68	21,916.86	4,310.02	1296.960734
SP	123,910.15	53,438.86	32,527.27	6,395.59	1893.704044
PR	33,134.26	14,273.45	8,687.28	1,707.94	522.2032728
SC	21,594.40	9,296.48	5,658.07	1,112.32	345.2437004
RS	36,873.19	15,878.95	9,664.27	1,900.30	583.6921933
MS	10,316.25	4,438.42	2,701.22	531.09	165.9636225
MT	12,457.29	5,363.37	3,264.14	641.79	201.6290955
GO	18,571.46	7,994.99	4,865.82	956.61	281.3906231
DF	63,200.29	27,141.01	16,516.88	3,250.50	962.5260256
Total	670,499.66	288,531.14	175,602.80	34,531.12	10,475.64

Source: Elaborated by the authors

Table 6. Regional Composition of Local Government Spending by Origin of Government Spending: Brazil, 2015 (percentage results)

Source of Goods	Origin of Government Demand																										
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	82.50%	0.43%	0.28%	0.08%	0.37%	0.05%	0.04%	0.11%	0.19%	0.14%	0.17%	0.18%	0.19%	0.05%	0.04%	0.16%	1.86%	0.13%	2.16%	3.91%	1.83%	0.93%	2.32%	0.62%	0.48%	0.16%	0.64%	100.00%
AC	1.01%	90.59%	0.36%	0.07%	0.22%	0.11%	0.04%	0.22%	0.13%	0.22%	0.15%	0.12%	0.17%	0.13%	0.05%	0.20%	0.66%	0.13%	1.04%	1.47%	0.62%	0.34%	0.90%	0.21%	0.20%	0.09%	0.56%	100.00%
AM	0.23%	0.10%	87.46%	0.24%	0.62%	0.09%	0.06%	0.15%	0.26%	0.16%	0.23%	0.25%	0.25%	0.05%	0.05%	0.24%	1.17%	0.10%	1.86%	2.20%	1.18%	0.65%	1.32%	0.39%	0.16%	0.10%	0.43%	100.00%
RR	0.25%	0.06%	1.42%	90.32%	0.35%	0.05%	0.03%	0.23%	0.09%	0.08%	0.13%	0.13%	0.15%	0.06%	0.04%	0.15%	0.66%	0.13%	1.39%	1.40%	0.59%	0.34%	1.10%	0.21%	0.11%	0.08%	0.45%	100.00%
PA	0.16%	0.04%	0.15%	0.04%	92.65%	0.21%	0.19%	0.29%	0.34%	0.36%	0.19%	0.19%	0.26%	0.10%	0.06%	0.20%	0.48%	0.11%	0.67%	1.05%	0.42%	0.24%	0.53%	0.12%	0.13%	0.11%	0.70%	100.00%
AP	0.07%	0.04%	0.08%	0.02%	0.59%	87.56%	0.07%	0.26%	0.43%	0.23%	0.30%	0.26%	0.24%	0.07%	0.05%	0.23%	1.13%	0.12%	2.16%	2.30%	0.95%	0.46%	1.38%	0.28%	0.08%	0.10%	0.55%	100.00%
TO	0.13%	0.02%	0.12%	0.02%	0.85%	0.12%	86.26%	1.14%	0.46%	0.35%	0.21%	0.20%	0.25%	0.14%	0.07%	0.56%	0.94%	0.19%	1.56%	1.88%	0.69%	0.40%	0.86%	0.19%	0.15%	0.19%	2.06%	100.00%
MA	0.09%	0.03%	0.09%	0.03%	2.17%	0.12%	0.43%	73.11%	3.29%	0.84%	0.85%	0.70%	0.71%	0.17%	0.15%	0.53%	1.99%	0.22%	3.90%	3.94%	1.61%	0.95%	2.20%	0.43%	0.16%	0.19%	1.08%	100.00%
PI	0.26%	0.10%	0.35%	0.15%	1.51%	0.42%	0.39%	3.87%	73.39%	3.50%	2.15%	1.19%	2.13%	0.77%	0.58%	2.66%	0.63%	0.43%	1.20%	1.17%	0.42%	0.45%	0.53%	0.11%	0.31%	0.25%	1.08%	100.00%
CE	0.10%	0.03%	0.11%	0.03%	0.54%	0.10%	0.10%	1.02%	1.64%	84.20%	1.08%	1.17%	1.43%	0.13%	0.07%	0.71%	1.22%	0.14%	0.95%	1.98%	0.87%	0.23%	0.78%	0.25%	0.09%	0.12%	0.91%	100.00%
RN	0.18%	0.02%	0.36%	0.03%	0.42%	0.22%	0.03%	1.57%	0.84%	4.63%	80.19%	2.08%	1.40%	0.45%	0.10%	1.37%	0.33%	0.50%	0.75%	1.06%	0.12%	0.12%	0.42%	0.03%	0.05%	0.05%	2.64%	100.00%
PB	0.27%	0.03%	0.17%	0.02%	0.44%	0.18%	0.07%	1.36%	0.63%	1.59%	1.91%	81.34%	2.33%	1.42%	0.18%	1.03%	0.71%	0.41%	1.04%	1.32%	0.37%	0.23%	0.51%	0.12%	0.13%	0.12%	2.07%	100.00%
PE	0.17%	0.02%	0.13%	0.03%	0.35%	0.11%	0.07%	1.11%	0.95%	1.13%	1.29%	2.52%	83.96%	1.33%	0.23%	1.46%	0.68%	0.18%	0.68%	1.13%	0.30%	0.10%	0.40%	0.11%	0.10%	0.10%	1.36%	100.00%
AL	0.09%	0.06%	0.08%	0.02%	0.53%	0.08%	0.10%	0.46%	1.00%	0.53%	1.39%	2.32%	2.85%	76.20%	0.57%	1.41%	2.55%	0.15%	2.14%	2.80%	0.83%	0.33%	1.38%	0.47%	0.13%	0.21%	1.30%	100.00%
SE	0.18%	0.03%	0.16%	0.03%	0.48%	0.13%	0.07%	0.73%	0.59%	0.71%	0.50%	0.63%	0.90%	1.10%	82.88%	1.63%	1.22%	0.36%	2.00%	1.87%	0.58%	0.36%	0.91%	0.19%	0.11%	0.12%	1.54%	100.00%
BA	0.03%	0.01%	0.06%	0.02%	0.18%	0.04%	0.05%	0.18%	0.54%	0.37%	0.30%	0.28%	0.47%	0.21%	0.32%	80.84%	2.46%	0.56%	3.26%	3.37%	1.02%	0.54%	1.71%	0.38%	0.15%	0.22%	2.43%	100.00%
MG	0.20%	0.06%	0.18%	0.06%	0.32%	0.12%	0.11%	0.37%	0.14%	0.41%	0.27%	0.26%	0.42%	0.24%	0.18%	0.77%	86.65%	0.37%	1.64%	2.64%	0.83%	0.58%	0.57%	0.26%	0.31%	0.58%	1.45%	100.00%
ES	0.09%	0.02%	0.09%	0.03%	0.35%	0.06%	0.06%	0.45%	0.33%	0.23%	0.17%	0.25%	0.26%	0.18%	0.10%	1.32%	2.64%	79.89%	7.00%	2.68%	0.86%	0.57%	0.77%	0.27%	0.15%	0.18%	1.01%	100.00%
RJ	0.13%	0.02%	0.14%	0.03%	0.12%	0.08%	0.07%	0.26%	0.16%	0.28%	0.15%	0.20%	0.23%	0.20%	0.09%	1.05%	2.11%	0.81%	82.48%	5.14%	0.81%	0.57%	0.67%	0.22%	0.33%	0.29%	3.37%	100.00%
SP	0.26%	0.06%	0.23%	0.09%	0.33%	0.14%	0.16%	0.38%	0.17%	0.43%	0.24%	0.30%	0.40%	0.23%	0.11%	0.89%	1.97%	0.35%	2.91%	84.11%	2.45%	0.86%	1.05%	0.56%	0.40%	0.23%	0.68%	100.00%
PR	0.39%	0.06%	0.23%	0.07%	0.26%	0.13%	0.09%	0.39%	0.15%	0.39%	0.16%	0.19%	0.28%	0.21%	0.11%	0.76%	1.03%	0.57%	1.75%	6.06%	80.22%	1.74%	1.10%	0.35%	0.37%	0.29%	2.64%	100.00%
SC	0.23%	0.02%	0.20%	0.04%	0.19%	0.11%	0.10%	0.86%	0.29%	0.21%	0.06%	0.16%	0.13%	0.14%	0.06%	0.65%	1.07%	0.33%	0.93%	4.12%	2.56%	80.87%	2.68%	0.27%	0.37%	0.27%	3.10%	100.00%
RS	0.44%	0.12%	0.51%	0.19%	0.56%	0.28%	0.29%	0.94%	0.18%	0.70%	0.53%	0.69%	0.85%	0.37%	0.30%	1.85%	0.80%	0.50%	1.13%	2.15%	1.14%	2.03%	80.86%	0.24%	0.79%	0.48%	1.07%	100.00%
MS	0.53%	0.16%	0.45%	0.14%	0.54%	0.22%	0.15%	0.54%	0.15%	0.48%	0.33%	0.33%	0.51%	0.26%	0.18%	0.97%	0.78%	0.44%	1.28%	3.36%	1.01%	0.88%	0.92%	82.52%	0.69%	0.48%	1.70%	100.00%
MT	0.47%	0.07%	0.20%	0.05%	0.33%	0.08%	0.07%	0.28%	0.19%	0.20%	0.13%	0.14%	0.16%	0.08%	0.04%	0.31%	1.07%	0.18%	1.58%	2.01%	0.92%	0.57%	1.26%	0.37%	87.61%	0.19%	1.44%	100.00%
GO	0.18%	0.05%	0.14%	0.05%	0.42%	0.09%	0.14%	0.39%	0.24%	0.24%	0.16%	0.16%	0.23%	0.13%	0.07%	0.27%	2.27%	0.27%	1.90%	3.51%	0.58%	0.54%	0.97%	0.30%	0.26%	81.03%	5.40%	100.00%
DF	0.58%	0.19%	0.45%	0.16%	1.21%	0.36%	0.58%	1.09%	0.46%	1.50%	0.95%	0.94%	1.81%	0.69%	0.63%	2.01%	3.86%	0.88%	4.96%	5.59%	1.38%	1.42%	2.01%	0.53%	1.03%	2.97%	61.77%	100.00%
Brazil	**1.02%**	**0.51%**	**1.64%**	**0.52%**	**2.91%**	**0.64%**	**0.90%**	**2.07%**	**1.32%**	**3.07%**	**1.68%**	**1.89%**	**3.61%**	**1.20%**	**1.08%**	**5.00%**	**8.91%**	**1.79%**	**12.48%**	**18.49%**	**4.94%**	**3.22%**	**5.50%**	**1.54%**	**1.86%**	**2.77%**	**9.42%**	**100.00%**

Source: Elaborated by the authors

Table 7. Regional Composition of Local Government spending, by the source of goods: Brazil, 2015 (percentage results)

Source of Goods	Origin of Government Demand																										
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF
RO	74.01%	0.77%	0.15%	0.14%	0.12%	0.07%	0.04%	0.05%	0.13%	0.04%	0.09%	0.09%	0.05%	0.04%	0.04%	0.03%	0.19%	0.07%	0.16%	0.19%	0.34%	0.26%	0.39%	0.37%	0.24%	0.05%	0.06%
AC	0.48%	86.06%	0.11%	0.07%	0.04%	0.09%	0.02%	0.05%	0.05%	0.03%	0.04%	0.03%	0.02%	0.05%	0.02%	0.02%	0.04%	0.03%	0.04%	0.04%	0.06%	0.05%	0.08%	0.07%	0.05%	0.02%	0.03%
AM	0.36%	0.31%	85.63%	0.75%	0.34%	0.23%	0.10%	0.11%	0.32%	0.08%	0.22%	0.21%	0.11%	0.06%	0.07%	0.08%	0.21%	0.09%	0.24%	0.19%	0.39%	0.32%	0.39%	0.40%	0.14%	0.06%	0.07%
RR	0.12%	0.06%	0.42%	84.91%	0.06%	0.04%	0.02%	0.05%	0.03%	0.01%	0.04%	0.03%	0.02%	0.02%	0.02%	0.01%	0.04%	0.03%	0.05%	0.04%	0.06%	0.05%	0.10%	0.07%	0.03%	0.01%	0.02%
PA	0.41%	0.21%	0.24%	0.22%	83.36%	0.86%	0.54%	0.36%	0.68%	0.30%	0.29%	0.26%	0.19%	0.22%	0.15%	0.11%	0.14%	0.16%	0.14%	0.15%	0.22%	0.20%	0.25%	0.20%	0.19%	0.10%	0.20%
AP	0.04%	0.04%	0.03%	0.02%	0.11%	75.19%	0.04%	0.07%	0.18%	0.04%	0.10%	0.08%	0.04%	0.03%	0.03%	0.03%	0.07%	0.04%	0.09%	0.07%	0.10%	0.08%	0.14%	0.10%	0.02%	0.02%	0.03%
TO	0.11%	0.04%	0.06%	0.04%	0.24%	0.16%	79.59%	0.46%	0.29%	0.09%	0.10%	0.09%	0.06%	0.09%	0.05%	0.09%	0.09%	0.09%	0.10%	0.08%	0.12%	0.10%	0.13%	0.10%	0.07%	0.06%	0.18%
MA	0.18%	0.12%	0.11%	0.10%	1.49%	0.38%	0.95%	70.66%	5.00%	0.55%	1.00%	0.74%	0.39%	0.28%	0.28%	0.21%	0.45%	0.25%	0.62%	0.43%	0.65%	0.59%	0.80%	0.56%	0.18%	0.14%	0.23%
PI	0.31%	0.25%	0.26%	0.37%	0.65%	0.82%	0.54%	2.34%	69.59%	1.43%	1.60%	0.79%	0.74%	0.80%	0.67%	0.66%	0.09%	0.30%	0.12%	0.08%	0.11%	0.17%	0.12%	0.09%	0.21%	0.11%	0.14%
CE	0.27%	0.15%	0.19%	0.15%	0.53%	0.46%	0.31%	1.41%	3.54%	78.10%	1.82%	1.76%	1.13%	0.31%	0.18%	0.41%	0.39%	0.22%	0.22%	0.30%	0.50%	0.20%	0.40%	0.46%	0.14%	0.12%	0.27%
RN	0.27%	0.07%	0.34%	0.08%	0.22%	0.53%	0.05%	1.16%	0.98%	2.30%	72.57%	1.68%	0.59%	0.57%	0.15%	0.42%	0.06%	0.43%	0.09%	0.09%	0.04%	0.06%	0.12%	0.03%	0.04%	0.03%	0.43%
PB	0.44%	0.10%	0.17%	0.06%	0.25%	0.47%	0.13%	1.09%	0.80%	0.86%	1.89%	71.79%	1.07%	1.96%	0.27%	0.34%	0.13%	0.38%	0.14%	0.12%	0.13%	0.12%	0.15%	0.13%	0.12%	0.07%	0.37%
PE	0.60%	0.17%	0.27%	0.18%	0.42%	0.59%	0.26%	1.88%	2.52%	1.29%	2.68%	4.68%	81.29%	3.88%	0.73%	1.02%	0.27%	0.35%	0.19%	0.21%	0.21%	0.11%	0.25%	0.25%	0.20%	0.13%	0.51%
AL	0.10%	0.14%	0.06%	0.04%	0.20%	0.13%	0.13%	0.25%	0.86%	0.20%	0.94%	1.39%	0.89%	71.55%	0.60%	0.32%	0.32%	0.10%	0.19%	0.17%	0.19%	0.12%	0.28%	0.35%	0.08%	0.08%	0.16%
SE	0.19%	0.06%	0.10%	0.06%	0.17%	0.22%	0.08%	0.37%	0.47%	0.24%	0.31%	0.35%	0.26%	0.96%	80.74%	0.34%	0.14%	0.21%	0.17%	0.11%	0.12%	0.12%	0.18%	0.13%	0.06%	0.05%	0.17%
BA	0.14%	0.11%	0.18%	0.15%	0.30%	0.32%	0.28%	0.42%	2.00%	0.59%	0.88%	0.72%	0.64%	0.85%	1.45%	79.48%	1.36%	1.54%	1.29%	0.90%	1.01%	0.82%	1.53%	1.22%	0.41%	0.39%	1.27%
MG	1.65%	1.03%	0.90%	1.03%	0.90%	1.50%	1.04%	1.47%	0.87%	1.11%	1.31%	1.16%	0.97%	1.64%	1.37%	1.27%	80.55%	1.73%	1.09%	1.18%	1.39%	1.50%	0.85%	1.39%	1.40%	1.74%	1.28%
ES	0.14%	0.07%	0.09%	0.09%	0.20%	0.16%	0.12%	0.36%	0.41%	0.13%	0.17%	0.22%	0.12%	0.24%	0.15%	0.44%	0.49%	74.03%	0.93%	0.24%	0.29%	0.29%	0.23%	0.29%	0.13%	0.11%	0.18%
RJ	1.62%	0.47%	1.06%	0.75%	0.51%	1.64%	0.94%	1.60%	1.53%	1.13%	1.12%	1.30%	0.78%	2.08%	1.02%	2.63%	2.96%	5.64%	82.60%	3.47%	2.04%	2.20%	1.53%	1.78%	2.20%	1.31%	4.47%
SP	4.62%	2.20%	2.58%	3.19%	2.12%	3.94%	3.37%	3.38%	2.44%	2.63%	2.66%	2.93%	2.06%	3.51%	1.96%	3.31%	4.10%	3.57%	4.32%	84.31%	9.20%	4.98%	3.53%	6.80%	4.02%	1.52%	1.33%
PR	1.79%	0.57%	0.66%	0.59%	0.41%	0.97%	0.45%	0.87%	0.54%	0.60%	0.45%	0.46%	0.37%	0.83%	0.47%	0.71%	0.54%	1.47%	0.65%	1.53%	75.56%	2.51%	0.93%	1.07%	0.93%	0.48%	1.30%
SC	0.66%	0.12%	0.36%	0.21%	0.19%	0.52%	0.32%	1.24%	0.66%	0.21%	0.11%	0.25%	0.11%	0.35%	0.16%	0.39%	0.36%	0.54%	0.22%	0.66%	1.55%	74.92%	1.45%	0.53%	0.59%	0.29%	0.98%
RS	2.34%	1.27%	1.70%	1.96%	1.04%	2.37%	1.73%	2.49%	0.75%	1.26%	1.72%	2.01%	1.29%	1.67%	1.52%	2.03%	0.49%	1.54%	0.50%	0.64%	1.27%	3.45%	80.42%	0.86%	2.32%	0.96%	0.62%
MS	0.75%	0.46%	0.39%	0.39%	0.27%	0.50%	0.24%	0.38%	0.16%	0.23%	0.28%	0.25%	0.20%	0.32%	0.25%	0.28%	0.13%	0.35%	0.15%	0.26%	0.30%	0.39%	0.24%	77.48%	0.54%	0.25%	0.26%
MT	0.76%	0.24%	0.21%	0.16%	0.19%	0.20%	0.13%	0.22%	0.24%	0.11%	0.13%	0.12%	0.07%	0.12%	0.07%	0.10%	0.20%	0.17%	0.21%	0.18%	0.31%	0.29%	0.38%	0.40%	78.25%	0.11%	0.25%
GO	0.46%	0.24%	0.23%	0.26%	0.39%	0.39%	0.41%	0.51%	0.49%	0.21%	0.26%	0.23%	0.17%	0.29%	0.18%	0.14%	0.68%	0.40%	0.41%	0.51%	0.31%	0.45%	0.47%	0.52%	0.38%	78.11%	1.53%
DF	7.19%	4.66%	3.51%	4.03%	5.29%	7.26%	8.17%	6.75%	4.47%	6.23%	7.20%	6.37%	6.37%	7.28%	7.42%	5.13%	5.52%	6.27%	5.06%	3.85%	3.55%	5.63%	4.65%	4.36%	7.06%	13.69%	83.64%
Brazil	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Elaborated by the authors

In the regional aspect, table 6 displays the regional composition of Government demand for 2015. Government demand is massively concentrated within the territory, as highlighted by the diagonal. For all regions except Piaui, Government Demand exceeds 70.0% in the intraregional aspect. The intraregional features still preponderate if we consider the source of the goods that goes to the Government Demand of each region, as depicted by Table 7. Conversely, as expected, the South-Southeast concentrates the destination of the country's Government demand (55%), emphasizing the highest demand in the state of São Paulo (18%).

4.2.5. Government Spending Multiplier in the IO approach

We can calculate the Government spending multiplier in the input-output model by multiplying the Leontief matrix with the Government spending demand vectors for each region.

We will consider the Government's spending vector as the initial injection for each region; this will be the direct effect in the model, which occurs directly from the economic activity interaction. Indirect impacts are the changes in inter-industry acquisitions as they respond to new demands of directly affected industries. Induced forces reflect changes in households' spending as income increases or decreases due to production changes through variations in households' disposable income.

The direct and indirect effects connect with the intersectoral flows. As Miller and Blair (2009), we obtain the direct effect from the product between matrix A of technical coefficients and Government spending. The indirect effect is captured by multiplying the Leontief matrix with the expenditure vector, discounting the direct and initial effect.

The type I effect considers both the direct and indirect effect of a change in final demand, which is a variation in Government Demand. The induced effect associates with the increase in household income and consumption due to the increase in a sector's demand. This effect is calculated with the endogenization of the consumption and labor income in the input-output system (closed Leontief matrix), capturing the impacts induced in the economic system by this transmission channel.

We obtain the total effect by multiplying the Leontief matrix with household consumption and labor income with the Government spending vectors. Hence, the multiplier is the result of the total effect divided by the initial effect.

Table 8 splits the amount in R$ millions and the contribution of each effect in the composition of the total effect. All results are in terms of value-added. The Government spending multiplier for Brazil is 2.34. The most massive multiplier comes from the Federal

District (2.71), a region where government spending accounts for approximately 45% of GDP. In contrast, the state of Amapá has the lowest multiplier (2.19). For all regions, the initial effect and induced stand out in the composition of the total effect, oscillating among 40-50% each in the regions. If we discount the initial effect, we obtain a net multiplier, in which the induced effect will prevail.

Table 8. Magnitude and Composition of the Effects of Government Spending

UF	Magnitude of the Effects of Government Spending (R$ million)					Composition of the Total Effect				
	Initial	Direct	Indirect	Induced	Total	Initial	Direct	Indirect	Induced	**Gov. Multiplier**
RO	9,450.50	1,313.20	669.21	9,734.87	21,167.78	1.000	0.139	0.071	1.030	**2.24**
AC	4,618.09	739.56	354.89	4,774.93	10,487.47	1.000	0.160	0.077	1.034	**2.27**
AM	14,159.77	2,568.27	1,346.69	14,260.07	32,334.80	1.000	0.181	0.095	1.007	**2.28**
RR	4,645.85	744.01	355.38	4,888.66	10,633.90	1.000	0.160	0.076	1.052	**2.29**
PA	26,725.01	3,920.11	1,906.10	27,483.17	60,034.40	1.000	0.147	0.071	1.028	**2.25**
AP	6,111.17	714.92	343.90	6,188.29	13,358.28	1.000	0.117	0.056	1.013	**2.19**
TO	8,103.92	1,289.05	638.55	8,252.16	18,283.68	1.000	0.159	0.079	1.018	**2.26**
MA	18,129.89	3,159.50	1,586.71	18,503.13	41,379.23	1.000	0.174	0.088	1.021	**2.28**
PI	11,887.24	1,869.02	911.70	12,559.78	27,227.74	1.000	0.157	0.077	1.057	**2.29**
CE	27,695.02	4,261.56	2,157.73	29,286.50	63,400.82	1.000	0.154	0.078	1.057	**2.29**
RN	15,112.88	2,413.01	1,179.05	15,637.13	34,342.07	1.000	0.160	0.078	1.035	**2.27**
PB	17,383.22	2,457.18	1,233.40	17,923.18	38,996.97	1.000	0.141	0.071	1.031	**2.24**
PE	31,433.52	5,522.85	2,932.61	33,482.74	73,371.72	1.000	0.176	0.093	1.065	**2.33**
AL	10,800.56	1,705.99	856.57	10,907.77	24,270.89	1.000	0.158	0.079	1.010	**2.25**
SE	9,406.19	1,742.75	826.60	10,015.42	21,990.96	1.000	0.185	0.088	1.065	**2.34**
BA	42,888.33	8,031.43	4,161.91	45,277.49	100,359.16	1.000	0.187	0.097	1.056	**2.34**
MG	79,876.70	12,692.33	6,418.80	82,618.10	181,605.93	1.000	0.159	0.080	1.034	**2.27**
ES	16,082.59	2,505.74	1,301.19	15,913.66	35,803.17	1.000	0.156	0.081	0.989	**2.23**
RJ	105,535.33	19,929.71	11,207.70	114,135.68	250,808.43	1.000	0.189	0.106	1.081	**2.38**
SP	157,473.14	29,848.29	15,706.35	166,801.09	369,828.86	1.000	0.190	0.100	1.059	**2.35**
PR	43,439.31	7,456.74	3,797.99	45,159.90	99,853.95	1.000	0.172	0.087	1.040	**2.30**
SC	28,133.33	4,889.34	2,558.08	29,201.62	64,782.37	1.000	0.174	0.091	1.038	**2.30**
RS	47,763.40	8,516.70	4,413.65	49,121.31	109,815.05	1.000	0.178	0.092	1.028	**2.30**
MS	13,717.04	2,236.95	1,128.69	14,074.94	31,157.63	1.000	0.163	0.082	1.026	**2.27**
MT	16,953.72	2,420.34	1,300.82	16,521.22	37,196.09	1.000	0.143	0.077	0.974	**2.19**
GO	23,562.07	4,585.51	2,314.39	24,531.59	54,993.57	1.000	0.195	0.098	1.041	**2.33**
DF	66,009.68	23,266.50	11,128.86	78,155.47	178,560.51	1.000	0.352	0.169	1.184	**2.71**
Total	**857,097.45**	**160,800.56**	**82,737.51**	**905,409.90**	**2,006,045.42**	**1.000**	**0.188**	**0.097**	**1.056**	**2.34**

Source: Elaborated by the authors

Belatedly, Table 9 shows us whether the effect is intraregional or interregional. The effect of government spending is predominantly intraregional due to government spending concentrated within the territory that promoted the fiscal augmentation.

Table 9. Composition of the Government Spending Multiplier effect by area of influence

UF	Initial Effect (in R$ million)			Total Effect (in R$ million)			Composition of the multiplier		
	Intra	Inter	Total	Intra	Inter	Total	Intra	Inter	Total
RO	7,242.74	2,207.77	9,450.50	10,592.45	10,575.33	21,167.78	1.12	1.12	2.24
AC	4,069.61	548.48	4,618.09	6,280.57	4,206.90	10,487.47	1.36	0.91	2.27
AM	12,241.06	1,918.71	14,159.77	19,073.90	13,260.90	32,334.80	1.35	0.94	2.28
RR	4,054.01	591.84	4,645.85	5,950.76	4,683.15	10,633.90	1.28	1.01	2.29
PA	22,916.91	3,808.10	26,725.01	35,023.17	25,011.22	60,034.40	1.31	0.94	2.25
AP	4,832.16	1,279.01	6,111.17	6,991.77	6,366.51	13,358.28	1.14	1.04	2.19
TO	6,720.21	1,383.71	8,103.92	9,536.39	8,747.29	18,283.68	1.18	1.08	2.26
MA	12,925.99	5,203.90	18,129.89	18,954.24	22,424.99	41,379.23	1.05	1.24	2.28
PI	8,435.31	3,451.93	11,887.24	12,204.34	15,023.41	27,227.74	1.03	1.26	2.29
CE	22,138.32	5,556.70	27,695.02	36,903.34	26,497.47	63,400.82	1.33	0.96	2.29
RN	11,468.24	3,644.64	15,112.88	17,987.77	16,354.30	34,342.07	1.19	1.08	2.27
PB	13,147.48	4,235.74	17,383.22	18,977.53	20,019.44	38,996.97	1.09	1.15	2.24
PE	26,153.51	5,280.01	31,433.52	43,028.26	30,343.45	73,371.72	1.37	0.97	2.33
AL	7,938.53	2,862.03	10,800.56	12,269.66	12,001.23	24,270.89	1.14	1.11	2.25
SE	7,816.44	1,589.75	9,406.19	12,488.11	9,502.85	21,990.96	1.33	1.01	2.34
BA	34,565.24	8,323.09	42,888.33	55,866.70	44,492.46	100,359.16	1.30	1.04	2.34
MG	66,090.70	13,786.00	79,876.70	107,884.51	73,721.42	181,605.93	1.35	0.92	2.27
ES	12,168.64	3,913.95	16,082.59	18,827.80	16,975.38	35,803.17	1.17	1.06	2.23
RJ	88,342.27	17,193.07	105,535.33	158,820.32	91,988.10	250,808.43	1.50	0.87	2.38
SP	133,479.30	23,993.84	157,473.14	271,157.73	98,671.13	369,828.86	1.72	0.63	2.35
PR	33,563.12	9,876.19	43,439.31	56,391.63	43,462.32	99,853.95	1.30	1.00	2.30
SC	21,725.07	6,408.26	28,133.33	35,783.36	28,999.01	64,782.37	1.27	1.03	2.30
RS	38,995.55	8,767.85	47,763.40	67,275.18	42,539.87	109,815.05	1.41	0.89	2.30
MS	10,915.34	2,801.70	13,717.04	16,353.83	14,803.79	31,157.63	1.19	1.08	2.27
MT	13,777.46	3,176.26	16,953.72	20,489.73	16,706.36	37,196.09	1.21	0.99	2.19
GO	19,215.00	4,347.08	23,562.07	31,096.74	23,896.83	54,993.57	1.32	1.01	2.33
DF	51,503.00	14,506.67	66,009.68	95,265.45	83,295.06	178,560.51	1.44	1.26	2.71
Total	**696,441.19**	**160,656.26**	**857,097.45**	**1,201,475.25**	**804,570.17**	**2,006,045.42**	**-**	**-**	**2.34**

Source: Elaborated by the authors

4.2.6. Federal x Regional Government Demand separation process

Until so far, all of our analyses of the data consider Government Demand as a whole, not distinguishing between Federal or Regional Government expenditure. Using data from Intermediate Accounts of IBGE and RAIS, we open our government demand into two components: federal and regional government spending, which the latter is the sum of state and municipality expenses. We do this procedure due to our simulation purposes of the Federal Government Spending multiplier.[29] In IBGE data, we collect the Federal, State, and Municipal

[29] In the simulations, we split The non-market services produced by general Government and non-profit institutions serving households (NPISH) demand, summing part of it to the Regional Government Demand and the other part to the Federal Government Demand.

final consumption expenditures of each Government Sphere. According to RAIS, we multiply the Government Demand by each of this share and distribute public employment in all states. Thus, we get unbalanced estimates of the Government Demand in each state and Government Sphere. Last, we proceed with the RAS method of adjusting.

Table 10. Government Spending by Regional or Federal share, Brazil, 2015

State	R$ million		Government share	
	Federal	Regional	Federal	Regional
Rondônia	2,690.06	9,438.88	22.18%	77.82%
Acre	1,028.98	5,047.02	16.94%	83.06%
Amazonas	4,445.69	15,046.43	22.81%	77.19%
Roraima	2,459.52	3,650.43	40.25%	59.75%
Pará	6,895.11	27,636.40	19.97%	80.03%
Amapá	3,010.25	4,527.62	39.94%	60.06%
Tocantins	1,447.27	9,240.79	13.54%	86.46%
Maranhão	3,705.20	20,781.85	15.13%	84.87%
Piauí	2,497.09	13,090.82	16.02%	83.98%
Ceará	6,221.99	30,097.42	17.13%	82.87%
Rio Grande do Norte	5,679.86	14,234.61	28.52%	71.48%
Paraíba	4,737.44	17,593.25	21.21%	78.79%
Pernambuco	10,096.60	32,743.08	23.57%	76.43%
Alagoas	2,305.49	11,936.41	16.19%	83.81%
Sergipe	2,447.06	10,379.11	19.08%	80.92%
Bahia	10,247.56	49,080.70	17.27%	82.73%
Minas Gerais	24,257.60	81,376.37	22.96%	77.04%
Espírito Santo	4,245.78	17,011.76	19.97%	80.03%
Rio de Janeiro	62,717.94	85,275.32	42.38%	57.62%
São Paulo	27,371.31	192,308.22	12.46%	87.54%
Paraná	10,271.88	48,392.26	17.51%	82.49%
Santa Catarina	9,051.00	29,159.52	23.69%	76.31%
Rio Grande do Sul	16,424.41	48,834.66	25.17%	74.83%
Mato Grosso do Sul	4,828.67	13,408.83	26.48%	73.52%
Mato Grosso	4,186.48	17,855.45	18.99%	81.01%
Goiás	5,536.49	27,323.35	16.85%	83.15%
Distrito Federal	97,942.29	13,556.42	87.84%	12.16%
Total	**336,749.00**	**849,027.00**	**28.40%**	**71.60%**

Source: Elaborated by the authors

Conclusively, Table 11 exhibits the necessary data for the estimation of the multipliers. The Federal Government Demand considers part of the NPISH demand within it. The Value-Added comes from Regional Accounts of IBGE for the year 2015. Hence, the model will calculate the variation in Federal Government Demand, i.e., ΔGOV^r, based on the Government expenditure depicted in Table 11. The fluctuations of VA proposed by equations (6), (7), and (8) will rely on the VA column in R$ million of 2015 for each state. We calculate Location Quotient (LQ)[30] to measure the importance of the Federal Government expenditure in the composition of the value-added in each state, as equation (23) depicts:

$$LQ^r = \frac{Fed.Gov^r / VA^r}{\sum_r^{27} Fed.Gov^r / \sum_r^{27} VA^r} \quad (23)$$

The highest LQ, the more specialized that region in the analysis component. Distrito Federal presents the highest LQ (7.9606), followed by Roraima (3.8953), Amapá (3.5422), and Rio de Janeiro (1.7285). As expected, São Paulo shows the lowest dependence of Federal Government Spending in its Value-added composition, with a LQ of merely 0.2736.

Table 11. Federal Government Demand, VA and QL in Brazilian states, 2015

Region	Federal Gov. Spending* (R$ million)	Value-added in 2015 (R$ million)	Location Quotient (LQ)	Region	Federal Gov. Spending* (R$ million)	Value-added in 2015 (R$ million)	Location Quotient (LQ)
RO	2,821	32,309	1.2570	SE	2,566	34,415	1.0731
AC	1,070	12,304	1.2514	BA	10,880	215,660	0.7261
AM	4,690	72,281	0.9340	MG	26,040	457,284	0.8197
RR	2,534	9,363	3.8953	ES	4,557	100,343	0.6538
PA	7,273	117,550	0.8906	RJ	66,788	556,164	1.7285
AP	3,120	12,680	3.5422	SP	31,043	1,633,314	0.2736
TO	1,514	26,046	0.8365	PR	11,268	327,047	0.4959
MA	3,867	69,370	0.8024	SC	9,975	209,667	0.6848
PI	2,606	34,723	1.0804	RS	17,819	334,842	0.7660
CE	6,587	114,157	0.8306	MS	5,130	74,086	0.9967
RN	5,944	50,889	1.6811	MT	4,455	97,283	0.6592
PB	4,931	49,610	1.4306	GO	5,949	154,347	0.5548
PE	10,697	134,105	1.1481	DF	101,633	183,769	7.9606
AL	2,420	41,993	0.8295				
BR	**358,176**	**5,155,601**	**1.0000**				

**Includes the NPISH Demand added to the Federal Government Demand*

Source: Elaborated by the authors

4.2.7. GRP Decomposition by Final Demand Component

Lastly, Table 12 reveals the Gross Regional Product decomposition by the final demand component, including all agents' taxes. As expected, household consumption possesses the highest share in all states (62.5% of the national GDP). The interregional trade role is also noteworthy, which is much more significant than international trade for most Brazilian states.

[30] Chiang (2009) argues that the most commonly employed approach to identifying specialization is the location quotient (LQ). If the QL < 1, the variable considered is underrepresented, i.e., the region has less than its share compared to the national. For more details of the extensive applications of location quotients, see Chiang (2009).

Interregional exports and imports in Brazil account for 47.3% of the national GDP. Conclusively, interregional trade displays a much more prominent feature in the Brazilian economy, since international exports and imports represent respectively 12.8% and -14.0%.

Table 12. GRP Decomposition, Brazil, 2015 (R$ million)

State	Household consumption	Investment	Reg. Gov. Spending	Fed. Gov. Spending	Interregional exports	Interregional imports	International exports	International imports	GRP
RO	26,862.95	9,307.93	9,878.98	2,825.92	13,338.58	-24,375.68	3,555.50	-3,995.95	37,984.36
AC	9,923.43	2,441.74	5,238.92	1,071.37	3,100.64	-7,068.77	99.68	-1,101.60	14,150.09
AM	51,587.95	12,800.90	15,833.04	4,697.39	63,916.59	-43,155.55	3,120.61	-24,082.85	85,905.62
RR	7,588.88	2,162.83	3,757.23	2,537.56	1,565.95	-6,052.24	37.73	-825.10	11,090.42
PA	87,080.08	36,374.88	29,076.49	7,284.37	33,203.30	-74,468.63	29,165.72	-15,307.92	136,704.41
AP	10,861.93	3,700.18	4,687.31	3,125.33	2,039.85	-8,761.47	197.46	-1,199.75	15,281.92
TO	21,589.61	5,594.65	9,646.64	1,516.14	12,517.25	-20,880.66	3,021.70	-3,061.56	30,238.34
MA	65,986.95	21,191.61	21,651.44	3,873.31	28,020.21	-56,806.90	5,019.76	-9,212.52	81,452.28
PI	35,922.21	10,486.16	13,635.85	2,609.70	12,283.85	-31,567.14	1,553.22	-4,358.77	41,202.56
CE	97,810.36	33,623.85	31,776.67	6,598.08	38,573.85	-66,768.20	4,575.53	-14,905.65	133,676.36
RN	41,692.59	14,395.00	14,867.53	5,953.58	19,826.29	-32,963.65	1,272.63	-6,506.00	59,958.43
PB	49,316.34	11,767.06	18,282.60	4,938.72	18,970.86	-41,054.14	534.45	-5,603.00	58,699.14
PE	113,190.74	32,683.60	34,591.51	10,714.03	68,656.02	-87,306.10	3,819.65	-19,525.11	157,226.83
AL	31,455.15	7,682.94	12,501.74	2,423.84	19,555.01	-25,340.14	1,816.19	-3,988.99	47,764.80
SE	25,611.28	9,406.02	10,860.18	2,569.97	15,488.93	-21,731.84	382.83	-4,252.24	39,580.74
BA	192,918.64	57,082.76	51,955.14	10,897.83	119,858.52	-158,762.58	24,871.58	-40,839.85	256,422.03
MG	377,175.22	104,292.59	87,020.11	26,079.68	229,203.28	-294,037.47	82,370.34	-77,304.31	537,468.28
ES	73,453.87	19,564.70	18,191.35	4,564.60	60,159.13	-66,912.78	23,332.64	-16,773.35	116,433.91
RJ	378,170.69	113,510.52	90,514.94	66,891.26	291,330.34	-281,922.97	81,624.20	-85,923.38	650,786.10
SP	1,053,399.88	293,610.50	216,481.52	31,093.43	936,294.06	-626,729.31	269,418.56	-285,834.70	1,875,588.78
PR	235,233.80	64,108.77	52,805.86	11,285.86	233,018.02	-216,100.64	58,763.97	-56,365.39	380,337.51
SC	160,760.70	45,535.97	31,957.71	9,991.21	126,178.63	-127,824.80	32,142.07	-34,276.31	244,663.08
RS	257,628.94	57,541.18	52,740.35	17,846.42	177,544.19	-179,723.69	68,323.85	-58,689.03	390,514.06
MS	55,851.26	15,452.45	14,200.16	5,137.23	51,258.68	-58,015.39	13,522.27	-10,272.29	86,551.71
MT	62,309.92	23,382.79	18,941.26	4,462.18	67,066.99	-74,105.41	36,054.94	-16,632.87	114,632.52
GO	119,700.45	41,869.79	29,248.56	5,958.88	102,861.69	-111,700.65	17,477.27	-24,145.48	179,133.29
DF	104,786.16	19,824.94	14,045.04	101,763.00	87,656.57	-89,350.52	1,056.64	-16,610.77	212,338.64
BR	**3,747,869.96**	**1,069,396.31**	**914,388.12**	**358,710.88**	**2,833,487.29**	**-2,833,487.33**	**767,131.00**	**-841,594.74**	**5,995,786.22**

Note: All results presented in this table include taxes and we omit change in inventories

Source: Elaborated by the authors

From this brief review of Brazilian data presented, the next section will calculate the effect of an increase in the Federal Government spending, and the fiscal multipliers associated with the simulation. This procedure will be by the CGE model presented in section 3. The results of this section are relevant to reveal the nature of government spending and provide a better understanding of the inter-dependence between Brazilian regions. Also, we can test the effectiveness of Federal Government Spending as a policy for Brazilian regional growth and whether there would be any trade-offs between national growth and regional equity.

5. SIMULATION AND RESULTS

In our simulation, we compute output (value-added) multipliers based on an overall increase in government spending equivalent to 1 percent of the Federal Government spending in each of the Brazilian states. The proposed simulation is a technical CGE exercise to analyze how the variables react to a marginal increase in government spending in our short-run simulation environment. This simulation corresponds to a temporary deficit-financed increase in government spending in the Brazilian economy, in which it is not considered other financing possibilities such as foreign borrowing or tax- financing, as in Horridge and Parmenter (1995).

We impose regional changes in $f^{(6)r}$, the shift term for Federal government spending in region r, such that:

$$\Delta\text{GOV}^{r} = (0{,}01) \times GOV^{r} \qquad (24)$$

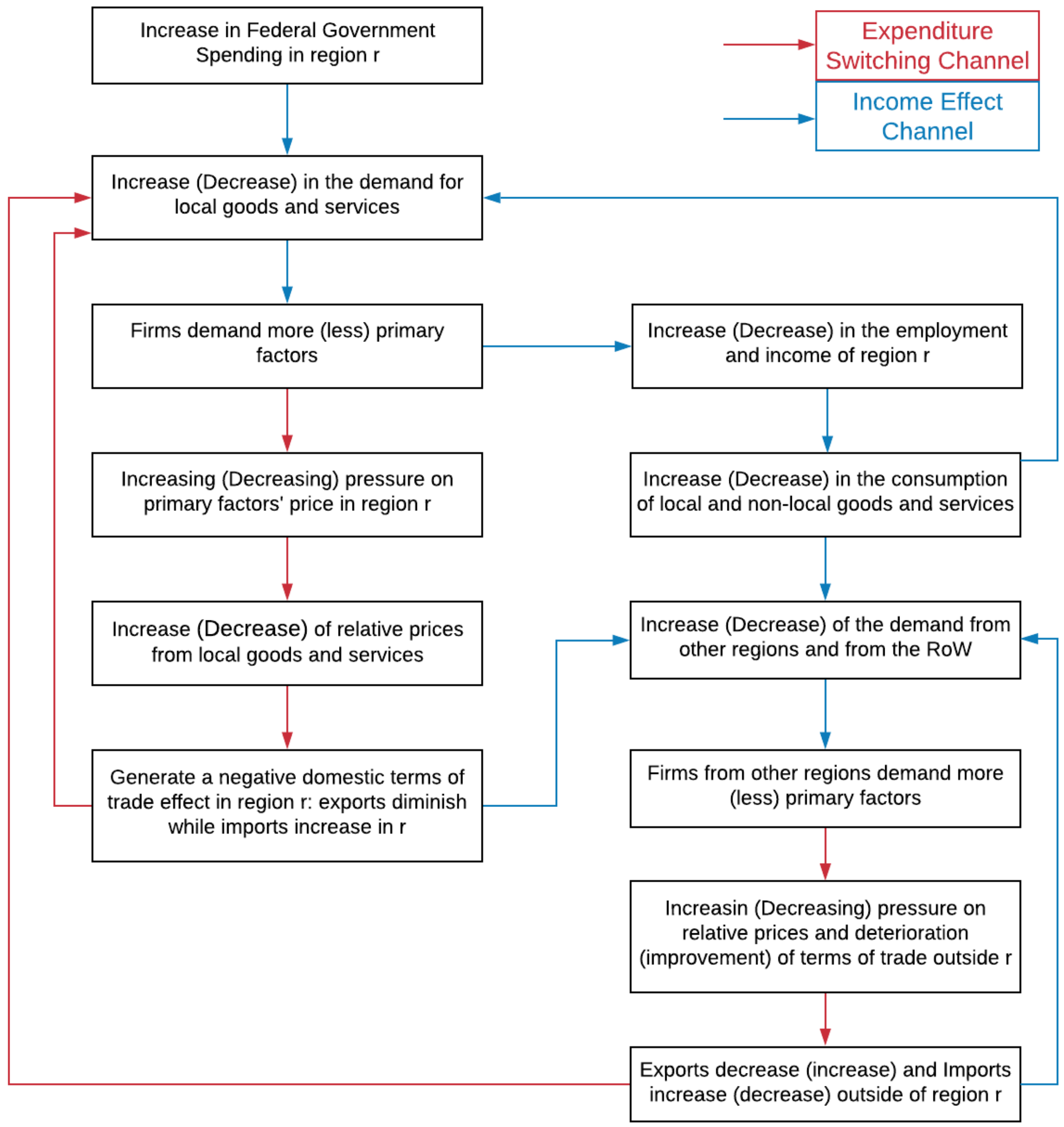
Where ΔGOV^{r} is the ordinary change in government spending in region r. Figures 13(a) and 13 (b) in the Appendix show the variation in the Federal Government Spending and GRP in each region. Our short-run simulation of the 1% uniform increase in Federal Government expenditure equals R$ 3,582 million or 0.07% of the national GDP and provokes the national GRP to expand by R$2,378 million. The results reported throughout this entire section were obtained using the GEMPACK economic modeling software (Horridge et al. (2018)).

5.1. CAUSAL RELATIONSHIPS IN THE SIMULATION

Increased Federal Government demand in region *r* causes an elevation of income in region *r* (“local income effect channel”), accompanied by a rise in prices in region *r*, which in turn will lead to a decrease in exports and an increase in imports from the shocked region. An increase in imports from region *r* means an increase in exports from other regions of the country and from the rest of the world (RoW), which will cause an appreciation in the relative prices of other regions (“price effect channel” or “interregional substitution effect”).

We expect that the first channel makes the intraregional multiplier positive and prevail over the second in the effect of government spending in the region itself, though, for interregional multipliers, we expect the preponderance of the second channel given the intrinsically local composition of government spending, and consequently, these multipliers would be negative (Chodorow-Reich, 2019; Haddad et al., 2018a). Figure 6 describes the transmission mechanism of the expansion in federal government spending and enables analyzing the exposed causal relationships.

Figure 6. Main causal relationships of the increase in Federal Government spending



Source: Elaborated by the authors

5.2. SIMULATION RESULTS

In this session, we will begin analyzing the macroeconomic effects of the proposed simulation of an uniform 1% increase in Federal Government Spending. Then, we will introduce the model's multipliers' calculus, welfare implications, and regional concentration indicators of our proposed simulation.

5.2.1. Macroeconomic implications of the simulation

Due to the nature of government spending, which is heavily concentrated in the services sector and within its territory[31], the intraregional multiplier is positive. Increases in government spending in region *r* provokes local income and employment growth and, therefore, consumption. Also, the expansion of government expenditure generates a rise in prices in the stimulated region. Thus, we have a positive "income effect," as suggested by Chodorow-Reich (2019). However, the upward prices in region *r* induce the elevation of imports and the decrease in exports, representing more demand for other regions. Likewise, prices will ascend and dampen the economic activity boost in all other regions, prompting the interregional multiplier to be negative ("Expenditure switching channel").

The expansion of Federal Government spending causes the rise in all price index, factors' income, and tariff revenue, as table 13 shows. Therefore, real household consumption and real GDP improves. Nevertheless, the export volume reduces due to relative price deterioration, while the import volume advances (expenditure switching channel). Further, the proposed simulation does not impact aggregate capital stock and investment expenditure under our short-run closure. As shown in the Appendix in Tables 31 to 38, all regions present an increase in real household consumption, aggregate value-added, imports in international trade, and revenue from taxes. Also, all regions suffer a decline in its international exports. However, in the interregional flows, there is a heterogeneous impact from the increase in government spending, as shown in Table 31 in the Appendix; except for Rio de Janeiro and Distrito Federal, all states in the South, Southeast, and Center-West regions manifest an increase in interregional exports. The interregional imports decrease for São Paulo, Amazonas, Pará, Espírito Santo, Mato Grosso, and the states in the South region (namely Paraná, Santa Catarina, and Rio Grande do Sul) of the country, as depicted in Table 32.

We also highlight the shrinkage in Aggregate Regional Government Demand by our simulation, related to Federalism questions. Some authors argue that decentralization leads to an optimal provision of public services and promotes economic growth, while others emphasize the dangers of competition between sub-national governments (Lessmann, 2009). A process of fiscal decentralization, accompanied by measures to improve government quality, would be an effective strategy for reducing regional inequalities (Kyriacou et al., 2017).

---

[31] The previous section proved this argument. Moreover, Tables 31 to 38 in the Appendix provides evidence for the arguments in this discussion. The prime effect in most variables comes from the intraregional aspect, as observed in consumption, international trade, and value-added.

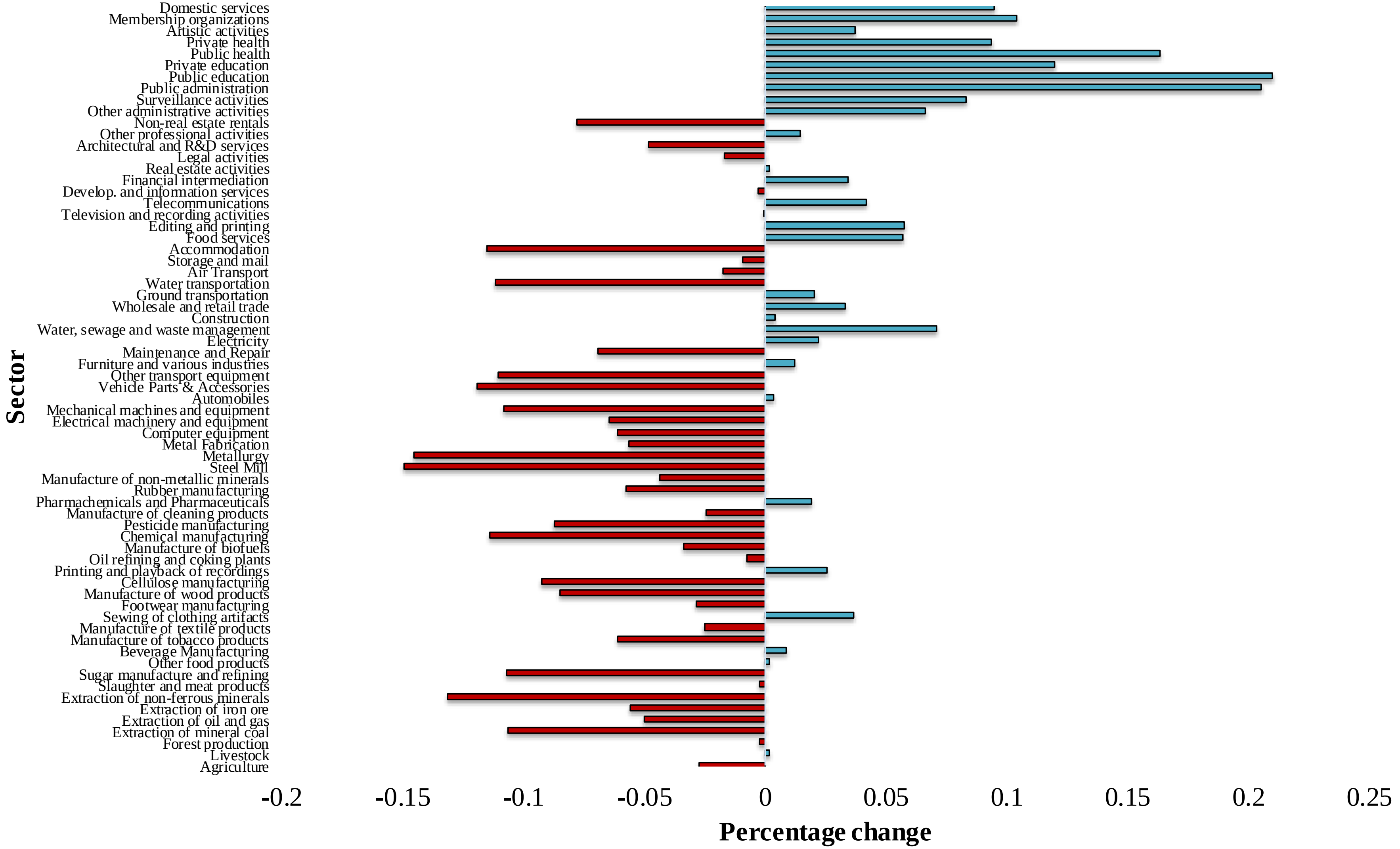
Table 13. Macro results from the simulation (in percentage change)

Macros	**Brazil**	North	Northeast	Southeast	South	Center-West
Aggregate tariff revenue	**0.1727**	0.0133	0.0330	0.0632	0.0210	0.0422
Aggregate payments to capital	**0.3967**	0.0309	0.0755	0.1430	0.0475	0.0997
Aggregate payments to labor	**0.4009**	0.0307	0.0748	0.1468	0.0468	0.1018
National average utility	**0.2513**	0.0190	0.0440	0.0945	0.0272	0.0665
National employment	**0.0782**	0.0070	0.0244	0.0264	0.0088	0.0116
Aggregate capital stock, rental weights	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000
Real GDP from expenditure side	**0.0471**	0.0036	0.0080	0.0173	0.0050	0.0131
Aggregate real investment expenditure	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000
Real Household consumption	**0.0801**	0.0066	0.0164	0.0301	0.0098	0.0172
Aggregate real regional gov. demand	**-0.0466**	-0.0014	-0.0043	-0.0191	-0.0074	-0.0144
Aggregate real Federal gov.demand	**0.9213**	0.0595	0.1315	0.3372	0.1027	0.2904
Export volume	**-0.2157**	-0.0164	-0.0403	-0.0799	-0.0263	-0.0528
Import Volume	**0.1730**	0.0130	0.0320	0.0630	0.0204	0.0445
Economy-wide terms of trade	**0.1979**	0.0151	0.0369	0.0734	0.0241	0.0484
Investment price index	**0.2381**	0.0184	0.0454	0.0860	0.0286	0.0597
Consumer price index	**0.3137**	0.0244	0.0606	0.1138	0.0378	0.0772
Export price index	**0.1979**	0.0151	0.0369	0.0734	0.0241	0.0484
Regional Gov. Demand price index	**0.3363**	0.0266	0.0648	0.1213	0.0407	0.0829
Federal Gov. Demand price index	**0.3592**	0.0262	0.0628	0.1234	0.0398	0.1071
Price index - inventories	**0.2847**	0.0009	0.0164	0.0950	0.0270	0.1454
GDP price index, expenditure side	**0.3335**	0.0259	0.0638	0.1206	0.0401	0.0831
Price index - interregional trade: total	**0.3013**	0.0232	0.0574	0.1092	0.0362	0.0752

Source: Calculated by the authors

Regarding sectoral activity, tradeable sectors are significantly negatively affected due to the rise in relative prices and deterioration of terms of trade through the expenditure switching channel. Nonetheless, services sectors, especially those related to public expenditure, rise sharply due to the income channel, as shown in Figure 7. This phenomenon occurs because services sectors are non-tradeable and mainly within the territory. Hence, the deterioration that occurred in terms of trade does not affect these sectors. We observe this industrial pattern throughout the regions of the model, as Table 14 displays. The zero effect in Table 14, represented by a yellow circle, relates to the absence of that economic activity in that region.

Figure 7. Effects on Sectoral Activity (in percentage change)



Source: Elaborated by the authors

Table 14. Effects on Sectoral Activity (in percentage change) in each state

Sector	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	**BR**
S1	0.041	0.017	0.015	0.013	-0.020	0.013	0.035	0.025	0.027	0.017	0.024	0.016	0.018	0.018	0.017	0.024	0.035	0.029	0.012	0.024	0.028	0.024	0.027	0.030	0.041	0.028	0.011	**0.631**
S2	0.008	0.002	0.003	0.007	-0.007	0.011	0.001	0.001	0.002	0.005	0.010	0.010	0.007	0.008	0.010	0.004	0.012	0.006	0.005	0.004	0.001	0.000	0.000	0.001	0.003	0.000	0.022	**0.112**
S3	0.003	0.008	0.002	0.004	-0.002	0.002	0.000	0.001	0.021	0.008	0.002	0.000	0.001	0.000	0.002	0.001	0.002	0.000	0.000	0.005	0.003	0.003	0.002	0.002	0.004	0.001	0.003	**0.055**
S4	0.101	0.074	0.077	0.082	-0.125	0.071	0.086	0.114	0.108	0.117	0.102	0.092	0.121	0.085	0.096	0.120	0.108	0.105	0.127	0.109	0.094	0.103	0.098	0.086	0.076	0.097	0.097	**2.670**
S5	0.000	0.000	0.031	0.000	-0.036	0.000	0.039	0.035	0.038	0.045	0.042	0.035	0.074	0.038	0.046	0.047	0.037	0.039	0.054	0.048	0.039	0.040	0.034	0.000	0.039	0.032	0.061	**0.922**
S6	0.108	0.000	0.000	0.000	-0.052	0.052	0.000	0.000	0.000	0.138	0.072	0.000	0.000	0.000	0.000	0.079	0.060	0.060	0.000	0.093	0.000	0.000	0.000	0.061	0.000	0.063	0.000	**0.838**
S7	0.159	0.114	0.159	0.000	-0.115	0.162	0.152	0.168	0.148	0.200	0.153	0.168	0.165	0.124	0.000	0.144	0.148	0.158	0.169	0.150	0.147	0.142	0.130	0.127	0.136	0.138	0.162	**3.738**
S8	0.092	0.068	0.037	0.135	-0.003	0.117	0.006	0.044	0.067	0.023	0.049	0.066	0.068	0.043	0.056	0.065	0.024	0.052	0.046	0.003	0.006	0.047	0.016	0.014	0.010	0.007	0.036	**0.740**
S9	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.075	0.074	0.025	0.071	0.027	0.013	0.090	0.014	0.071	0.157	0.042	0.189	0.143	0.144	0.125	0.097	0.084	0.051	0.076	0.121	**0.658**
S10	0.031	0.034	0.032	0.094	0.004	0.094	0.009	0.031	0.046	0.019	0.057	0.050	0.053	0.016	0.035	0.009	0.039	0.033	0.040	0.003	0.061	0.007	0.030	0.028	0.009	0.008	0.074	**0.361**
S11	0.024	0.012	0.013	0.022	0.015	0.021	0.028	0.010	0.017	0.017	0.021	0.012	0.018	0.005	0.009	0.026	0.013	0.013	0.009	0.006	0.010	0.010	0.015	0.012	0.020	0.017	0.006	**0.378**
S12	0.008	0.011	0.014	0.002	-0.010	0.005	0.010	0.009	0.007	0.007	0.002	0.007	0.003	0.032	0.017	0.051	0.004	0.006	0.017	0.006	0.010	0.065	0.122	0.004	0.003	0.003	0.000	**0.367**
S13	0.014	0.000	0.023	0.041	-0.010	0.035	0.013	0.013	0.009	0.052	0.053	0.031	0.015	0.038	0.035	0.024	0.023	0.015	0.043	0.016	0.035	0.033	0.051	0.025	0.004	0.004	0.020	**0.420**
S14	0.060	0.034	0.024	0.074	0.031	0.067	0.064	0.026	0.044	0.044	0.052	0.044	0.055	0.006	0.028	0.060	0.043	0.034	0.014	0.037	0.040	0.021	0.036	0.039	0.051	0.069	0.049	**1.147**
S15	0.028	0.020	0.010	0.000	-0.037	0.000	0.088	0.014	0.013	0.068	0.032	0.037	0.009	0.006	0.013	0.009	0.003	0.000	0.002	0.030	0.138	0.057	0.023	0.147	0.023	0.026	0.011	**0.579**
S16	0.086	0.060	0.056	0.056	-0.101	0.078	0.032	0.039	0.034	0.031	0.029	0.033	0.033	0.033	0.036	0.028	0.036	0.031	0.048	0.057	0.129	0.111	0.066	0.040	0.053	0.034	0.042	**1.411**
S17	0.038	0.062	0.028	0.015	-0.142	0.000	0.029	0.124	0.021	0.022	0.008	0.017	0.024	0.059	0.029	0.151	0.173	0.127	0.074	0.085	0.103	0.079	0.116	0.136	0.035	0.027	0.005	**1.699**
S18	0.041	0.020	0.001	0.041	0.026	0.037	0.054	0.020	0.031	0.031	0.041	0.026	0.037	0.000	0.018	0.049	0.026	0.025	0.005	0.027	0.020	0.010	0.024	0.024	0.043	0.051	0.052	**0.778**
S19	0.000	0.000	0.005	0.060	0.004	0.000	0.000	0.007	0.023	0.014	0.004	0.024	0.041	0.005	0.006	0.018	0.004	0.003	0.007	0.009	0.004	0.029	0.011	0.009	0.011	0.017	0.000	**0.073**
S20	0.073	0.058	0.045	0.119	0.038	0.000	0.061	0.035	0.056	0.045	0.048	0.031	0.005	0.313	0.010	0.282	0.028	0.029	0.063	0.085	0.075	0.042	0.032	0.008	0.042	0.035	0.000	**0.272**
S21	0.102	0.076	0.089	0.084	-0.156	0.000	0.112	0.091	0.108	0.102	0.101	0.098	0.126	0.083	0.104	0.126	0.114	0.100	0.132	0.111	0.112	0.115	0.123	0.105	0.110	0.111	0.089	**2.780**
S22	0.087	0.076	0.067	0.000	-0.147	0.000	0.088	0.093	0.089	0.074	0.071	0.076	0.078	0.083	0.091	0.096	0.101	0.082	0.103	0.083	0.089	0.089	0.093	0.093	0.104	0.085	0.077	**2.214**
S23	0.001	0.003	0.010	0.038	-0.006	0.035	0.020	0.005	0.001	0.001	0.018	0.006	0.007	0.020	0.009	0.023	0.012	0.006	0.102	0.024	0.027	0.022	0.035	0.040	0.111	0.001	0.001	**0.373**
S24	0.030	0.000	0.012	0.000	0.001	0.053	0.028	0.008	0.021	0.024	0.028	0.025	0.029	0.008	0.015	0.029	0.003	0.014	0.002	0.020	0.007	0.007	0.015	0.011	0.008	0.039	0.042	**0.444**
S25	0.036	0.036	0.046	0.072	-0.053	0.088	0.025	0.056	0.035	0.037	0.053	0.035	0.043	0.056	0.049	0.067	0.049	0.106	0.132	0.052	0.055	0.060	0.069	0.049	0.032	0.033	0.032	**1.458**
S26	0.029	0.037	0.021	0.050	-0.030	0.041	0.025	0.032	0.033	0.038	0.037	0.041	0.034	0.048	0.040	0.020	0.054	0.051	0.084	0.046	0.033	0.059	0.049	0.039	0.025	0.028	0.051	**1.075**
S27	0.078	0.087	0.139	0.044	-0.147	0.000	0.059	0.147	0.057	0.072	0.064	0.067	0.085	0.065	0.065	0.090	0.149	0.234	0.241	0.109	0.131	0.121	0.094	0.085	0.061	0.154	0.060	**2.703**
S28	0.141	0.097	0.119	0.095	-0.156	0.000	0.129	0.143	0.138	0.135	0.158	0.118	0.146	0.103	0.120	0.164	0.158	0.132	0.171	0.148	0.135	0.128	0.131	0.123	0.147	0.158	0.155	**3.548**
S29	0.040	0.045	0.073	0.039	-0.063	0.084	0.026	0.058	0.044	0.048	0.035	0.042	0.057	0.057	0.062	0.039	0.054	0.063	0.087	0.054	0.054	0.061	0.059	0.043	0.034	0.035	0.032	**1.389**
S30	0.090	0.000	0.030	0.000	-0.085	0.000	0.072	0.087	0.087	0.087	0.079	0.087	0.084	0.096	0.094	0.074	0.085	0.082	0.112	0.064	0.086	0.091	0.080	0.101	0.076	0.080	0.116	**2.023**
S31	0.045	0.055	0.048	0.000	-0.092	0.000	0.032	0.143	0.050	0.064	0.068	0.050	0.091	0.082	0.059	0.042	0.069	0.052	0.106	0.059	0.063	0.092	0.059	0.048	0.040	0.044	0.063	**1.618**
S32	0.097	0.103	0.095	0.000	-0.107	0.127	0.089	0.108	0.111	0.105	0.103	0.105	0.125	0.113	0.109	0.099	0.111	0.103	0.176	0.106	0.107	0.114	0.102	0.102	0.086	0.096	0.132	**2.834**
S33	0.040	0.028	0.006	0.069	0.025	0.000	0.044	0.029	0.034	0.033	0.044	0.043	0.041	0.012	0.029	0.012	0.011	0.034	0.114	0.001	0.007	0.017	0.020	0.018	0.033	0.045	0.060	**0.595**
S34	0.051	0.058	0.067	0.022	-0.119	0.048	0.039	0.084	0.061	0.064	0.053	0.072	0.060	0.142	0.074	0.078	0.116	0.151	0.211	0.113	0.176	0.139	0.155	0.079	0.046	0.062	0.042	**2.385**
S35	0.107	0.000	0.093	0.000	-0.101	0.126	0.085	0.105	0.106	0.104	0.097	0.110	0.098	0.128	0.113	0.088	0.110	0.094	0.130	0.122	0.100	0.106	0.106	0.103	0.086	0.089	0.142	**2.647**
S36	0.028	0.013	0.002	0.017	0.010	0.023	0.037	0.008	0.019	0.019	0.026	0.018	0.026	0.004	0.009	0.032	0.013	0.010	0.003	0.014	0.014	0.003	0.010	0.016	0.023	0.035	0.040	**0.447**
S37	0.053	0.037	0.050	0.020	-0.073	0.041	0.037	0.063	0.040	0.050	0.037	0.040	0.037	0.050	0.049	0.044	0.091	0.078	0.091	0.074	0.060	0.074	0.058	0.050	0.042	0.031	0.061	**1.309**
S38	0.032	0.038	0.032	0.084	0.014	0.063	0.016	0.021	0.059	0.035	0.040	0.031	0.041	0.028	0.022	0.027	0.017	0.016	0.043	0.019	0.011	0.017	0.017	0.012	0.013	0.020	0.074	**0.840**
S39	0.101	0.101	0.087	0.138	0.045	0.161	0.056	0.066	0.149	0.094	0.098	0.099	0.116	0.082	0.084	0.087	0.047	0.056	0.116	0.051	0.035	0.061	0.060	0.052	0.062	0.094	0.196	**2.396**
S40	0.004	0.007	0.005	0.016	0.003	0.002	0.004	0.003	0.006	0.005	0.003	0.004	0.005	0.006	0.002	0.005	0.004	0.002	0.009	0.001	0.002	0.019	0.005	0.005	0.004	0.006	0.075	**0.175**
S41	0.056	0.063	0.013	0.166	0.031	0.140	0.053	0.043	0.064	0.055	0.081	0.074	0.064	0.042	0.058	0.039	0.031	0.027	0.069	0.012	0.021	0.015	0.022	0.037	0.038	0.042	0.177	**1.532**
S42	0.026	0.044	0.006	0.101	0.017	0.085	0.045	0.042	0.055	0.045	0.053	0.054	0.052	0.026	0.053	0.029	0.016	0.013	0.039	0.001	0.014	0.008	0.015	0.023	0.036	0.032	0.211	**1.142**
S43	0.132	0.032	0.074	0.009	-0.085	0.091	0.079	0.087	0.061	0.151	0.071	0.034	0.110	0.121	0.087	0.097	0.144	0.129	0.116	0.154	0.125	0.107	0.124	0.115	0.098	0.155	0.053	**2.641**
S44	0.030	0.057	0.031	0.165	0.013	0.136	0.036	0.035	0.038	0.008	0.044	0.050	0.045	0.027	0.027	0.017	0.007	0.004	0.005	0.046	0.018	0.092	0.059	0.036	0.012	0.019	0.199	**0.741**
S45	0.015	0.044	0.013	0.132	-0.014	0.070	0.030	0.018	0.059	0.029	0.042	0.053	0.045	0.012	0.036	0.016	0.004	0.029	0.006	0.037	0.002	0.032	0.003	0.009	0.020	0.021	0.214	**0.690**
S46	0.056	0.062	0.116	0.087	-0.079	0.041	0.059	0.069	0.058	0.095	0.084	0.053	0.084	0.069	0.069	0.082	0.092	0.098	0.160	0.184	0.129	0.112	0.102	0.073	0.080	0.066	0.065	**2.151**
S47	0.056	0.065	0.035	0.136	0.044	0.134	0.052	0.051	0.063	0.068	0.089	0.081	0.086	0.052	0.078	0.081	0.060	0.038	0.092	0.027	0.045	0.041	0.048	0.046	0.043	0.066	0.201	**1.877**
S48	0.080	0.081	0.050	0.230	0.059	0.129	0.076	0.067	0.074	0.067	0.091	0.083	0.077	0.061	0.079	0.080	0.067	0.047	0.135	0.027	0.046	0.059	0.066	0.094	0.055	0.099	0.273	**2.353**
S49	0.005	0.008	0.001	0.019	0.001	0.010	0.003	0.000	0.004	0.007	0.007	0.002	0.004	0.003	0.008	0.006	0.001	0.001	0.006	0.001	0.004	0.002	0.004	0.001	0.003	0.003	0.028	**0.006**
S50	0.050	0.044	0.027	0.084	0.041	0.074	0.041	0.040	0.050	0.049	0.054	0.051	0.051	0.036	0.051	0.046	0.040	0.033	0.057	0.036	0.029	0.035	0.031	0.048	0.031	0.041	0.103	**1.271**
S51	0.007	0.003	0.004	0.011	-0.004	0.004	0.004	0.004	0.005	0.006	0.004	0.005	0.005	0.004	0.005	0.005	0.007	0.006	0.009	0.013	0.019	0.008	0.012	0.003	0.007	0.001	0.132	**0.016**
S52	0.044	0.041	0.024	0.084	0.035	0.070	0.034	0.035	0.045	0.047	0.048	0.047	0.048	0.033	0.045	0.036	0.033	0.027	0.045	0.025	0.024	0.026	0.026	0.028	0.024	0.039	0.106	**1.118**
S53	0.003	0.003	0.001	0.006	0.002	0.006	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.003	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.008	**0.073**
S54	0.004	0.009	0.012	0.041	-0.011	0.034	0.007	0.002	0.006	0.007	0.004	0.014	0.015	0.001	0.002	0.009	0.010	0.015	0.036	0.028	0.019	0.013	0.010	0.008	0.001	0.000	0.116	**0.081**
S55	0.033	0.014	0.030	0.011	-0.028	0.005	0.024	0.022	0.017	0.021	0.001	0.013	0.005	0.017	0.021	0.021	0.035	0.035	0.071	0.071	0.061	0.048	0.059	0.031	0.035	0.018	0.197	**0.519**
S56	0.018	0.019	0.007	0.052	0.017	0.032	0.016	0.018	0.032	0.023	0.028	0.026	0.027	0.016	0.028	0.016	0.013	0.011	0.025	0.004	0.005	0.005	0.006	0.011	0.011	0.019	0.143	**0.630**
S57	0.069	0.051	0.063	0.033	-0.074	0.041	0.054	0.059	0.056	0.066	0.062	0.054	0.066	0.053	0.070	0.070	0.071	0.071	0.099	0.088	0.073	0.074	0.068	0.058	0.061	0.055	0.009	**1.668**
S58	0.075	0.077	0.045	0.166	0.064	0.131	0.068	0.067	0.084	0.083	0.108	0.093	0.099	0.066	0.091	0.080	0.072	0.055	0.117	0.029	0.046	0.057	0.058	0.066	0.058	0.100	0.292	**2.348**
S59	0.078	0.091	0.054	0.228	0.060	0.139	0.080	0.077	0.091	0.080	0.113	0.099	0.104	0.072	0.100	0.083	0.066	0.050	0.149	0.034	0.043	0.044	0.051	0.069	0.062	0.113	0.435	**2.666**
S60	0.180	0.165	0.135	0.418	0.136	0.378	0.116	0.133	0.149	0.144	0.252	0.206	0.202	0.141	0.164	0.132	0.158	0.138	0.319	0.065	0.101	0.146	0.165	0.190	0.116	0.127	0.598	**5.173**
S61	0.189	0.172	0.133	0.426	0.144	0.403	0.144	0.135	0.162	0.152	0.251	0.220	0.211	0.147	0.178	0.153	0.177	0.145	0.351	0.065	0.144	0.192	0.179	0.216	0.134	0.193	0.733	**5.750**
S62	0.115	0.119	0.055	0.275	0.065	0.244	0.096	0.088	0.102	0.098	0.151	0.138	0.119	0.093	0.113	0.091	0.069	0.060	0.124	0.047	0.052	0.062	0.067	0.082	0.074	0.089	0.294	**2.983**
S63	0.187	0.169	0.140	0.416	0.146	0.390	0.126	0.132	0.160	0.155	0.235	0.205	0.198	0.149	0.164	0.131	0.165	0.133	0.335	0.071	0.112	0.157	0.173	0.195	0.127	0.147	0.418	**5.135**
S64	0.107	0.105	0.060	0.208	0.081	0.197	0.083	0.078	0.103	0.099	0.121	0.115	0.116	0.080	0.109	0.087	0.084	0.066	0.156	0.067	0.063	0.070	0.079	0.086	0.066	0.094	0.358	**2.939**
S65	0.053	0.055	0.027	0.122	0.039	0.097	0.039	0.038	0.049	0.051	0.083	0.064	0.063	0.039	0.057	0.041	0.044	0.033	0.061	0.002	0.026	0.036	0.038	0.043	0.031	0.042	0.289	**1.553**
S66	0.119	0.109	0.068	0.244	0.087	0.211	0.091	0.092	0.111	0.110	0.148	0.137	0.135	0.088	0.116	0.091	0.095	0.073	0.179	0.060	0.070	0.083	0.088	0.111	0.074	0.095	0.468	**3.352**
S67	0.129	0.144	0.056	0.361	0.075	0.310	0.111	0.100	0.125	0.111	0.176	0.165	0.139	0.104	0.127	0.095	0.083	0.059	0.159	0.044	0.059	0.059	0.075	0.105	0.074	0.120	0.438	**3.604**

Source: Elaborated by the authors

5.2.2. Multipliers

We calculate the output (in value-added) multipliers as the model description section through equations (9), (10), and (11). Table 15 displays the intraregional, interregional, and total multipliers for the Brazilian states.

States in North and Northeast regions, except Amazonas, exhibited the total multiplier higher than all other states. It seems that the government spending multiplier is more significant in more impoverished areas more dependente on Government Spending, similarly to other results found in the literature (Serrato and Wingender, 2017), as Figure 8 illustrates. Darker areas indicate higher multipliers. The national multiplier was 0.644 in this baseline simulation.

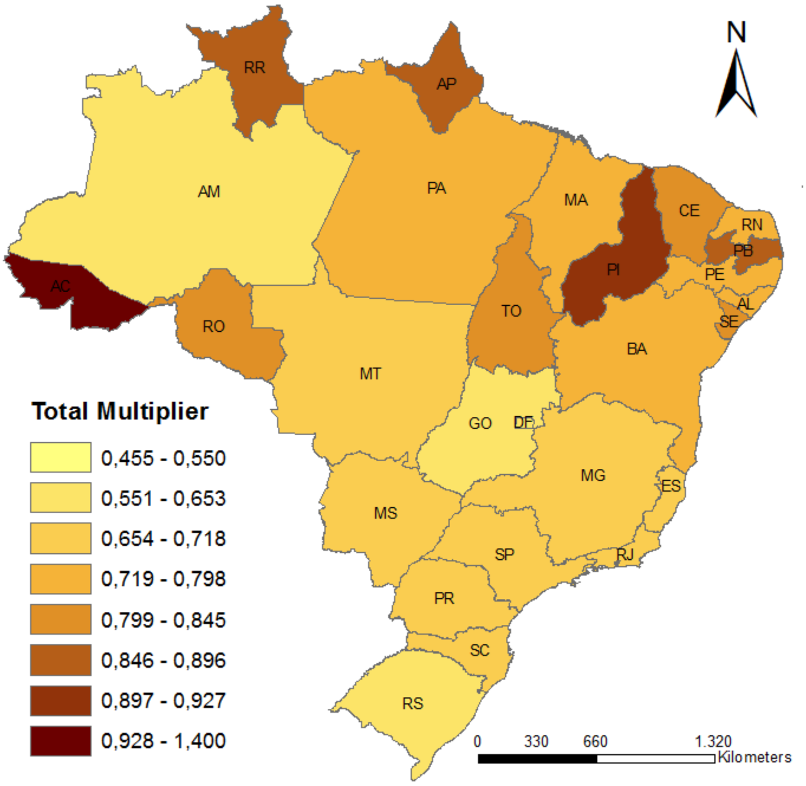
Table 15. Government Spending Output (Value-Added) Multipliers: Brazil, 2015

Origin of Government Spending	Intraregional $K_{(s)}^{(r)}$	Interregional $K_{(s)}^{(t)}$	Total $K_{(s)}^{(\bullet)}$	Origin of Government Spending	Intraregional $K_{(s)}^{(r)}$	Interregional $K_{(s)}^{(t)}$	Total $K_{(s)}^{(\bullet)}$
RO	1.035	-0.208	0.827	SE	1.037	-0.220	0.817
AC	1.188	-0.260	0.927	BA	0.961	-0.241	0.720
AM	0.802	-0.179	0.623	MG	0.930	-0.219	0.710
RR	1.094	-0.229	0.864	ES	0.902	-0.218	0.684
PA	0.983	-0.194	0.789	RJ	0.881	-0.198	0.683
AP	1.065	-0.220	0.845	SP	0.814	-0.158	0.656
TO	1.054	-0.228	0.826	PR	0.878	-0.220	0.658
MA	1.001	-0.217	0.784	SC	0.880	-0.225	0.655
PI	1.105	-0.209	0.896	RS	0.901	-0.260	0.640
CE	1.086	-0.261	0.825	MS	0.915	-0.233	0.681
RN	1.011	-0.230	0.781	MT	0.867	-0.214	0.653
PB	1.098	-0.221	0.877	GO	0.905	-0.255	0.650
PE	0.997	-0.233	0.764	DF	0.677	-0.119	0.558
AL	0.989	-0.193	0.796	-	-	-	-
BR	**-**	**-**	**0.664**				

Source: Elaborated by the authors

As in Haddad et al. (2017), the interregional multiplier is negative for all states. The price channel explained in the previous section is responsible for this finding since the real appreciation provokes an acceleration in imports. Conversely, the intraregional effect is more significant in the more impoverished states than in the wealthier states. However, lower-income areas have more imports in the interregional trade from more prosperous states and have a more prominent negative effect on the spillovers from government spending.

Figure 8. Gov. Spending Output (Value-Added) Total Multiplier: Brazil, 2015



Source: Elaborated by the authors

As in Haddad et al. (2017), for given values of the substitution elasticity, supply is more elastic as either the labor/capital ratio or the share of materials in total cost is more eminent. We compute the correlation between our multipliers with supply and demand-side features of the Brazilian economy, as in Table 16. We found a strong and positive correlation between the ratio of labor payments to the Gross Value of Production (GVP) for the intra (56.64%) and total (67.50%) multiplier. When comparing the share of total primary payments to GVP, the correlation becomes even more prominent for the intra (68.98%) and total multiplier (78.38%). Nonetheless, the interregional multiplier seems to be more correlated with demand-side variables, as the Federal Government Demand (63.86%) and the ratio of Fed. Gov. Demand/VA presents a strong and positive correlation with the latter.

We also emphasize that Federal Government Demand and Value-Added displays a Strong to moderate negative correlation with the intra and total multipliers. These results suggest that both the intra and total multipliers rely on labor payments, the overall value-added content in regional production systems, and depend more on regional suppliers' ability to respond promptly to the local demand shocks.

Table 16. Correlation between multipliers and economic variables

Economic Variables	Government Spending Multiplier		
	Intra	Inter	Total
Federal Government Demand	-63.68%	63.86%	-53.58%
Value-Added (VA)	-45.00%	36.21%	-40.71%
Fed. Gov. Demand / VA	-22.20%	50.60%	-9.64%
Population	-37.54%	23.87%	-35.98%
Labor Payments / Capital Payments	23.60%	25.97%	35.68%
Labor Payments / Total Primary Costs	31.81%	20.07%	43.34%
Labor Payments / Gross Value of Production (GVP)	56.64%	5.43%	67.50%
Total Primary Costs/ GVP	68.98%	-5.38%	78.38%

Source: Elaborated by the authors

It is worth highlighting the difference between the estimates of the total multiplier of government expenditures by the input-output approach and by the modeling of CGE. In the Input-Output modeling, the multiplier effect estimate is much higher for all regions with the absence of the price mechanism and substitution channel. The national multiplier in the input-product was 2.34, while in the EGC approach, it was 0.644.

5.2.3. Welfare implications

We evaluate the welfare implications of the uniform increase of Federal Government Spending by 1% in all regions through equations (4) and (5) presented in Session 3. Table 17 depicts the Equivalent Variation (EV) and the Relative Equivalent Variation (REV).

The EV represents the monetary change in the initial income level that a representative family would need to reach the new level of utility considering the prices in force in the initial balance. For all regions, the EV is positive; hence, all regions exhibit welfare improvements. The EV is higher for Rio de Janeiro (1,762.36 R$ million), succeeded by Distrito Federal (1,362.93 R$ million), and São Paulo (982.46 R$ million).

The REV indicates the percentage variation of the reference income that the representative family would need to reach the counter-factual utility level considering the reference prices. Thus, Distrito Federal (1.13%) displays the highest REV, followed by Roraima (0.91%) and Amapá (0.73%). These three states possess a massive part of Federal Government Spending composing their Value-Added.

Table 17. Welfare measures from the simulation

Region	EV*	REV**	Region	EV*	REV**
RO	53.34	0.30%	SE	50.79	0.26%
AC	22.97	0.33%	BA	233.62	0.21%
AM	68.88	0.19%	MG	591.14	0.25%
RR	54.87	0.91%	ES	69.54	0.15%
PA	144.09	0.26%	RJ	1,762.36	0.57%
AP	57.60	0.73%	SP	982.46	0.12%
TO	30.28	0.22%	PR	225.07	0.14%
MA	73.53	0.21%	SC	184.84	0.17%
PI	58.99	0.29%	RS	375.13	0.23%
CE	149.65	0.23%	MS	82.24	0.25%
RN	110.96	0.39%	MT	67.58	0.16%
PB	108.19	0.37%	GO	88.65	0.12%
PE	221.91	0.29%	DF	1,362.93	1.13%
AL	38.65	0.18%			
Brazil	**7,270.25**	**0.27%**			

** EV in R$ million;*

*** REV in% of referential disposable income.*

Source: Elaborated by the authors

5.2.4. Regional Concentration indicators

Regional disparities are a frequent topic in economic geography and regional economics. Assessing regional disparities is possible using concentration and dispersion indicators (Wieland (2019)). [32]

Typical measures of regional disparities are the Gini coefficient, the Hoover coefficient, and the Theil coefficient. These indicators are dimensionless, with a fixed value range, regularly between zero (indicating complete equality) and one (complete concentration). Moreover, we can formulate the indicators in an unweighted or weighted form. In the context of regional disparities, the weighting usually uses the region's proportion of the total (e.g., national) population as the Williamson index introduced.[33]

Table 18 reports regional concentration indicators before and after the increase of Federal Government Spending. We can conclude that for all indicators, the expansion of federal Government Spending provoked the fall of the indicator relative to before the simulation. Also, all indicators point out the high degree of regional concentration in Brazil, as expected.

[32] Apart from regional economics, these measures are used in several contexts, such as competition economics (market concentration of firms) or welfare economics (income inequality). For a review of the most common indicators concerning regional inequality, see Portnov, Felsenstein (2010).

[33] For a critical review of weighting or not by the regions' proportion of the total population, see Gluschenko (2018)

Table 18. Regional Concentration indicators for the simulation

Indicator	Observed GRP	Post- simulation	
		GRP	Change
Gini	0.6164495	0.61638325	-0.011%
Gini weighted	0.5448463	0.54479034	-0.010%
Hoover	0.4649975	0.46489697	-0.022%
Theil	0.7514751	0.75121125	-0.035%
CV	1.6751076	1.67463659	-0.028%
Williamson	1.2725859	1.27238936	-0.015%

Source: Elaborated by the authors using REAT toolbox in R

5.3. SENSITIVITY ANALYSIS TO PARAMETERS

As presented in section 2, the economy's structural and conjuncture factors affect the magnitude of the government spending multiplier directly. Thus, we test how our estimates of the local output (value-added) multiplier react to export performance changes or import penetration, measured by the degree of substitution between local goods and foreign goods. We chose Armington's elasticity because it assumes that products are imperfect substitutes from regional buyers. The degree of substitution of a given product is related to interregional transport cost, which affects its relative prices in a given local market. Hence, the penetration of products from different sources is tested in a specific market, a proxy for imports. Therefore, the literature argues that the increase in import penetration provokes a fall in the government multiplier effect.

Nonetheless, we test our results' sensitivity to the price elasticity of export demands, as export elasticities capture the effect of a sudden deterioration in the export performance. In our case, the increase in government spending provokes the deterioration of terms of trade, diminishing international exports. We gauge the country's external performance to shifts in relative prices and the corresponding effect in our multiplier estimates and GRP. In our simulations, we used the export price elasticities calculated by NEREUS from COMEXSTAT data.[34]

At first, we will conduct a systemic sensitivity analysis to construct confidence intervals for the change in GRP and the Total multiplier of Government Spending as in Domingues and Haddad (2005), Porsse (2005), and Haddad (2004). Then, we will conduct the sensitivity

[34] The Comex Stat is a system for querying and extracting data from Brazilian foreign trade.

analysis by directing altering the elasticities' values before the simulation, re-running the same shock up to 21 times.

5.3.1. Systematic Sensitivity Analysis (SSA)

According to Domingues and Haddad (2005), sensitivity analysis in computable general equilibrium model analysis identifies the crucial parameters for the results in question in specific simulations with a CGE model. The systematic sensitivity analysis (SSA) consisted of testing the numerical structure of the model, considering, alternatively for each set, intervals of a standard deviation (estimated) for the parameters, with triangular, symmetric, and joint distribution.[35]

Two sets of critical parameters in the simulations performed are the regional trade elasticities used in the model's Armington structures[36] and the export demand elasticities. In the first case, the B-MARIA-27 model employs such elasticities for three groups of users (producers, investors, and families) in the substitution between the goods of the 27 domestic regions. The elasticities used are differentiated by good, but not by category of use. In total, 67 regional trade elasticities are used in the model. For the Armington's elasticities of substitution considered separately (interregional or domestic/foreign), the model calculated six simulations against 402 simulations necessary if we suppose independent distributions. Considering both Armington's elasticities varying together, the model was resolved 12 times (against 804 simulations under independent distributions). Finally, we test our result for the export elasticity for the demand, measured by the exp_elast coefficient. The model performs two simulations against 134 if the elasticities do not vary together. The test established a 50% interval for the substitution parameters through Stroud's method for Gaussian quadratures.[37]

The reported confidence intervals are obtained through the estimated mean and standard deviation, using Chebychev's inequality, as in Domingues and Haddad (2005) and Porsse (2005). Chebychev's inequality implies bounds of 4.47 standards deviations from the mean for a 95% confidence interval. If the sign of this confidence interval changes or is too large for the analyzed variable, we may conclude that it is particularly sensitive to the parameter in question,

[35] According to Domingues and Haddad (2005), a more computationally economical alternative was to establish joint distributions by commodity, which decreased the number of simulations. The results obtained with this alternative were quite similar to independent distribution. Therefore, for computational issues, we rely on joint distributions in this thesis.

[36] As in Domingues and Haddad (2005), the degree of substitution between domestic and foreign measured by Armington's elasticity is half the adopted for interregional flows, due to international trade is more inelastic than intranational trade.

[37] For more details on Gaussian Quadratures, see Domingues and Haddad (2005).

i.e., less robust.

Subsequently, Tables 19 to 22 report the results of the systematic sensitivity analysis from our shock in Federal Government Spending. We compute the estimates for the real GDP and the total multiplier. It is essential to emphasize that SSA does not open the simulation results by the contribution of each region to the national effect, which is a vital feature to calculate the multiplier. Hence, we stipulate intervals for the GRP (transforming the percentage changes in level) through Chebychev's inequality. Then we use each region's contribution to the overall effect of that region in the baseline simulation as a proxy to distinguish the shock by subtotals.

In some cases, however, qualitative changes can be noticed for the systematic sensitivity analysis with both the Armington elasticities and the export demand elasticities: the direction of the effects on output growth in the state of São Paulo is not conclusive in all simulations. These results suggest that the multiplier effect for the state of São Paulo has significant intervals, showing the importance of substitution parameters and the export demand elasticities for the region's result. Also, when analyzing the domestic/foreign Armington elasticities, the state of Amazonas displays significant variation in its GRP and, consequently, on its multiplier effect.

In general, the results are more robust when investigating the interregional Armington elasticity and export demand elasticities. Furthermore, except for São Paulo and Amazonas, the amplitude is relatively low, as Tables 19 to 22 depict.

Table 19. Sensitivity Analysis – Armington's Interregional elasticity of substitution

Origin of Government Spending	GRP (in percentage change)		ΔGRP (R$ million)		Total Multiplier		
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Range
RO	0.07269	0.07351	22.629	24.079	0.802	0.853	0.051
AC	0.08313	0.08961	9.914	9.951	0.927	0.930	0.003
AM	0.02114	0.02477	27.509	30.926	0.587	0.659	0.073
RR	0.25584	0.26884	21.815	22.020	0.861	0.869	0.008
PA	0.03515	0.03623	55.791	59.022	0.767	0.811	0.044
AP	0.23137	0.23994	25.866	26.949	0.829	0.864	0.035
TO	0.05124	0.05388	12.406	12.627	0.820	0.834	0.015
MA	0.04254	0.04509	29.604	31.150	0.766	0.806	0.040
PI	0.07070	0.07640	22.961	23.806	0.881	0.913	0.032
CE	0.05795	0.06109	52.742	56.064	0.801	0.851	0.050
RN	0.10746	0.11424	45.383	47.570	0.764	0.800	0.037
PB	0.10055	0.10896	42.686	43.915	0.866	0.891	0.025
PE	0.07614	0.08256	81.303	82.412	0.760	0.770	0.010
AL	0.04318	0.04909	18.717	19.871	0.773	0.821	0.048
SE	0.06442	0.07006	20.979	21.007	0.818	0.819	0.001
BA	0.03752	0.03890	75.585	81.221	0.695	0.747	0.052
MG	0.03715	0.03743	177.565	192.568	0.682	0.740	0.058
ES	0.01961	0.02154	30.987	31.354	0.680	0.688	0.008
RJ	0.08906	0.09148	443.880	469.676	0.665	0.703	0.039
SP	0.00246	0.00915	58.720	343.673	0.189	1.107	0.918
PR	0.01515	0.01886	66.224	81.724	0.588	0.725	0.138
SC	0.01955	0.02231	62.733	67.858	0.629	0.680	0.051
RS	0.03002	0.03203	111.525	116.744	0.626	0.655	0.029
MS	0.04806	0.04985	34.693	35.281	0.676	0.688	0.011
MT	0.02795	0.03015	28.991	29.172	0.651	0.655	0.004
GO	0.03636	0.04033	38.746	38.808	0.651	0.652	0.001
DF	0.33088	0.36404	559.557	577.343	0.551	0.568	0.018
BR	**0.04361**	**0.04865**	**2,248.181**	**2,508.122**	**0.628**	**0.700**	**0.073**

Source: Elaborated by the authors

Table 20. Sensitivity Analysis – Armington's Domestic/Foreign elasticity of substitution

Origin of Government Spending	GRP (in percentage change)		ΔGRP (R$ million)		Total Multiplier		
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Range
RO	0.07257	0.07364	21.828	24.818	0.774	0.880	0.106
AC	0.08557	0.08709	9.154	10.664	0.856	0.997	0.141
AM	0.01243	0.03375	14.293	44.492	0.305	0.949	0.644
RR	0.26097	0.26360	20.579	23.184	0.812	0.915	0.103
PA	0.03413	0.03725	55.312	59.273	0.760	0.815	0.054
AP	0.23489	0.23630	24.301	28.410	0.779	0.910	0.132
TO	0.05182	0.05327	11.726	13.261	0.775	0.876	0.101
MA	0.04246	0.04517	27.898	32.702	0.721	0.846	0.124
PI	0.07168	0.07541	21.137	25.500	0.811	0.978	0.167
CE	0.05535	0.06377	52.682	55.946	0.800	0.849	0.050
RN	0.10755	0.11417	42.606	50.123	0.717	0.843	0.126
PB	0.10229	0.10717	39.107	47.239	0.793	0.958	0.165
PE	0.07403	0.08472	79.644	83.755	0.745	0.783	0.038
AL	0.04567	0.04653	17.642	20.832	0.729	0.861	0.132
SE	0.06410	0.07039	20.156	21.750	0.786	0.848	0.062
BA	0.03424	0.04228	76.239	80.482	0.701	0.740	0.039
MG	0.03431	0.04036	181.105	188.993	0.695	0.726	0.030
ES	0.01819	0.02308	29.585	32.861	0.649	0.721	0.072
RJ	0.08630	0.09435	443.438	469.311	0.664	0.703	0.039
SP	0.00010	0.01177	-40.650	453.960	-0.131	1.462	1.593
PR	0.01382	0.02032	61.301	87.232	0.544	0.774	0.230
SC	0.01716	0.02483	55.424	75.482	0.556	0.757	0.201
RS	0.02796	0.03419	112.470	115.720	0.631	0.649	0.018
MS	0.04843	0.04945	33.097	36.759	0.645	0.717	0.071
MT	0.02862	0.02953	27.082	31.043	0.608	0.697	0.089
GO	0.03461	0.04210	38.446	38.944	0.646	0.655	0.008
DF	0.34436	0.34999	527.040	606.828	0.519	0.597	0.079
BR	**0.04208**	**0.05029**	**2,169.612**	**2,592.593**	**0.606**	**0.724**	**0.118**

Source: Elaborated by the authors

Table 21. Sensitivity Analysis – Armington's both Interregional and Domestic/Foreign elasticity of substitution

Origin of Government Spending	GRP (in percentage change)		ΔGRP (R$ million)		Total Multiplier		
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Range
RO	0.07242	0.07377	21.657	25.009	0.768	0.886	0.119
AC	0.08306	0.08970	9.423	10.422	0.881	0.974	0.093
AM	0.01228	0.03388	14.398	44.381	0.307	0.946	0.639
RR	0.25571	0.26894	20.934	22.861	0.826	0.902	0.076
PA	0.03403	0.03731	54.779	59.826	0.753	0.823	0.069
AP	0.23129	0.24003	24.529	28.233	0.786	0.905	0.119
TO	0.05106	0.05407	11.837	13.176	0.782	0.870	0.088
MA	0.04198	0.04569	27.892	32.808	0.721	0.848	0.127
PI	0.07017	0.07697	21.378	25.335	0.820	0.972	0.152
CE	0.05510	0.06404	52.133	56.642	0.791	0.860	0.068
RN	0.10618	0.11564	42.671	50.204	0.718	0.845	0.127
PB	0.09992	0.10965	39.712	46.791	0.805	0.949	0.144
PE	0.07321	0.08563	79.671	84.006	0.745	0.785	0.041
AL	0.04315	0.04913	18.751	19.797	0.775	0.818	0.043
SE	0.06307	0.07151	20.317	21.658	0.792	0.844	0.052
BA	0.03420	0.04233	77.484	79.421	0.712	0.730	0.018
MG	0.03432	0.04035	183.580	186.714	0.705	0.717	0.012
ES	0.01799	0.02324	29.692	32.725	0.652	0.718	0.067
RJ	0.08614	0.09452	439.004	474.348	0.657	0.710	0.053
SP	-0.00084	0.01260	-80.438	489.022	-0.259	1.575	1.834
PR	0.01331	0.02078	59.182	89.096	0.525	0.791	0.265
SC	0.01690	0.02505	55.275	75.536	0.554	0.757	0.203
RS	0.02778	0.03433	113.834	114.416	0.639	0.642	0.003
MS	0.04793	0.04999	33.301	36.614	0.649	0.714	0.065
MT	0.02784	0.03025	27.673	30.415	0.621	0.683	0.062
GO	0.03417	0.04262	38.627	38.939	0.649	0.655	0.005
DF	0.33062	0.36434	549.602	586.259	0.541	0.577	0.036
BR	**0.04104**	**0.05131**	**2,116.037**	**2,645.515**	**0.591**	**0.739**	**0.148**

Source: Elaborated by the authors

Table 22. Sensitivity Analysis – Export demand elasticity

Origin of Government Spending	GRP (in percentage change)		ΔGRP (R$ million)		Total Multiplier		
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Range
RO	0.06647	0.08004	23.206	23.508	0.822	0.833	0.011
AC	0.08564	0.08699	8.684	11.102	0.812	1.038	0.226
AM	0.01953	0.02620	27.143	30.838	0.579	0.658	0.079
RR	0.25928	0.26519	19.866	23.835	0.784	0.941	0.157
PA	0.03187	0.03986	57.369	57.783	0.789	0.794	0.006
AP	0.23368	0.23740	23.305	29.326	0.747	0.940	0.193
TO	0.04957	0.05571	11.930	13.080	0.788	0.864	0.076
MA	0.04209	0.04562	26.316	34.249	0.681	0.886	0.205
PI	0.07319	0.07387	18.878	27.657	0.724	1.061	0.337
CE	0.05722	0.06183	46.720	61.624	0.709	0.935	0.226
RN	0.11032	0.11125	37.875	54.594	0.637	0.919	0.281
PB	0.10448	0.10487	34.786	51.332	0.706	1.041	0.336
PE	0.07761	0.08103	69.597	93.363	0.651	0.873	0.222
AL	0.04271	0.04965	18.208	20.295	0.752	0.839	0.086
SE	0.06710	0.06729	17.827	23.976	0.695	0.934	0.240
BA	0.03395	0.04266	76.701	80.007	0.705	0.735	0.030
MG	0.03188	0.04300	173.060	197.860	0.665	0.760	0.095
ES	0.01661	0.02490	28.003	34.833	0.614	0.764	0.150
RJ	0.08385	0.09694	439.791	472.692	0.658	0.708	0.049
SP	-0.00236	0.01436	-143.835	562.702	-0.463	1.813	2.276
PR	0.00891	0.02553	35.368	114.667	0.314	1.018	0.704
SC	0.01312	0.02907	41.178	90.429	0.413	0.907	0.494
RS	0.02426	0.03812	100.028	128.982	0.561	0.724	0.162
MS	0.04179	0.05653	31.561	38.632	0.615	0.753	0.138
MT	0.02284	0.03579	24.591	34.099	0.552	0.765	0.213
GO	0.03270	0.04418	38.073	39.408	0.640	0.662	0.022
DF	0.34645	0.34779	500.237	632.160	0.492	0.622	0.130
BR	**0.04005**	**0.05246**	**2,065.036**	**2,704.462**	**0.577**	**0.755**	**0.179**

Source: Elaborated by the authors

5.3.2. Qualitative analysis

At first, we conduct a sensitivity investigation to both the interregional and domestic-foreign (i.e., the imports from the Rest of the World) substitution elasticities of Armington, which captures the replacement of locally produced goods with those produced externally.[38]

Accordingly to the literature, the output multiplier reacts inversely to the advance in imports: if we increase the replacement of a locally produced good with one produced outside, all of the multipliers calculated diminish, i.e., the adverse interregional effects become more negative and vice-versa. Therefore, the expenditure switching channel intensifies. Likewise, the intraregional multiplier grows when we simulate the proposed shock in equation (24) with lower elasticities, the local income effect strengthens.

Table 23 reveals how the macro variables of our simulation react to these substitution elasticities between local goods and external ones: as we expand the elasticities of substitution, the rise of prices and factors' income weakens, and so does the effect on the real GDP and real household consumption. Furthermore, the substitution price elasticities prompt a sturdy advance in the import volume while lessening the export volume's negative effect due to the lesser effect in the price index. Figure 9 depicts the sensitivity of our estimates of the local multiplier to several scenarios of interregional and domestic/foreign trade elasticities. Therefore, the substitution elasticities increase provokes the expansion of the expenditure switching channel and the decline of the income effect channel.

[38] As pointed out by Faria and Haddad (2014), the estimates of the interregional trade elasticities have the expected negative sign, indicating that the higher transaction costs of products are associated with lower trade flows since that variable plays the role of restricting trade while signaling the intrinsic difficulties in each flow between the source and destination pairs.

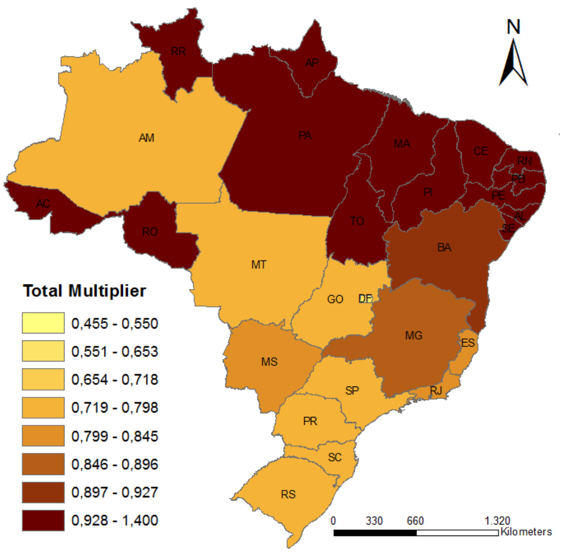
Table 23. Sensitivity analysis of the substitution elasticities of import (both interregional and domestic/foreign) - Macro results (in percentage change)

Macros for Brazil	0.1x	0.2x	0.5x	**1x**	2.0x	5.0x	10.0x	Adjust.
Aggregate tariff revenue	0.0581	0.0767	0.1212	**0.1727**	0.2342	0.3112	0.3539	↑
Aggregate payments to capital	0.5702	0.5414	0.4733	**0.3967**	0.3080	0.2003	0.1401	↓
Aggregate payments to labor	0.5531	0.5280	0.4684	**0.4009**	0.3224	0.2273	0.1747	↓
National average utility	0.2846	0.2798	0.2670	**0.2513**	0.2322	0.2096	0.1997	↓
National employment	0.0904	0.0885	0.0838	**0.0782**	0.0717	0.0645	0.0616	↓
Aggregate capital stock, rental weights	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	●
Real GDP from expenditure side	0.0538	0.0528	0.0502	**0.0471**	0.0434	0.0391	0.0373	↓
Aggregate real investment expenditure	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	●
Real Household consumption	0.0920	0.0903	0.0857	**0.0801**	0.0735	0.0660	0.0629	↓
Aggregate real regional gov. demand	-0.0532	-0.0521	-0.0496	**-0.0466**	-0.0429	-0.0368	-0.0316	↑
Aggregate real Federal gov.demand	0.8883	0.8947	0.9081	**0.9213**	0.9356	0.9536	0.9652	↑
Export volume	-0.3221	-0.3049	-0.2634	**-0.2157**	-0.1602	-0.0934	-0.0573	↑
Import Volume	0.0539	0.0738	0.1205	**0.1730**	0.2339	0.3093	0.3539	↑
Economy-wide terms of trade	0.2966	0.2806	0.2421	**0.1979**	0.1465	0.0849	0.0518	↓
Investment price index	0.3540	0.3346	0.2891	**0.2381**	0.1792	0.1082	0.0691	↓
Consumer price index	0.4529	0.4297	0.3751	**0.3137**	0.2424	0.1555	0.1065	↓
Export price index	0.2966	0.2806	0.2421	**0.1979**	0.1465	0.0849	0.0518	↓
Regional Gov. Demand price index	0.4772	0.4536	0.3982	**0.3363**	0.2649	0.1785	0.1304	↓
Federal Gov. Demand price index	0.5137	0.4870	0.4260	**0.3592**	0.2834	0.1925	0.1419	↓
Price index - inventories	0.4626	0.4288	0.3572	**0.2847**	0.2074	0.1193	0.0724	↓
GDP price index, expenditure side	0.4830	0.4581	0.3995	**0.3335**	0.2572	0.1647	0.1130	↓
Price index - interregional trade: total	0.4431	0.4193	0.3636	**0.3013**	0.2295	0.1432	0.0956	↓

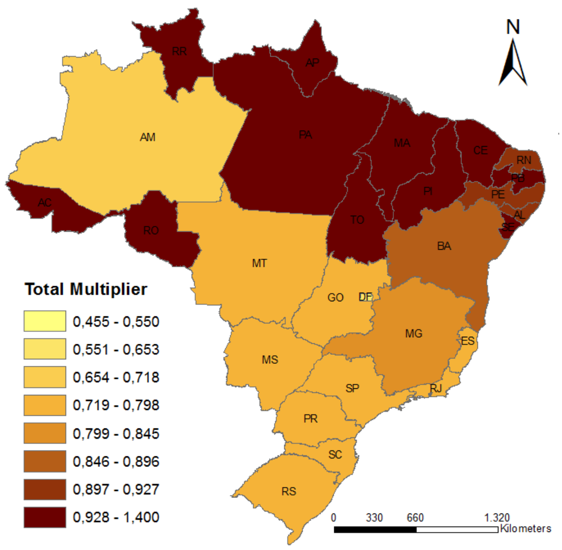
Source: Elaborated by the authors

Figure 9. The reaction of the local (total) multiplier to changes in price elasticity of both imports from other states and of the RoW

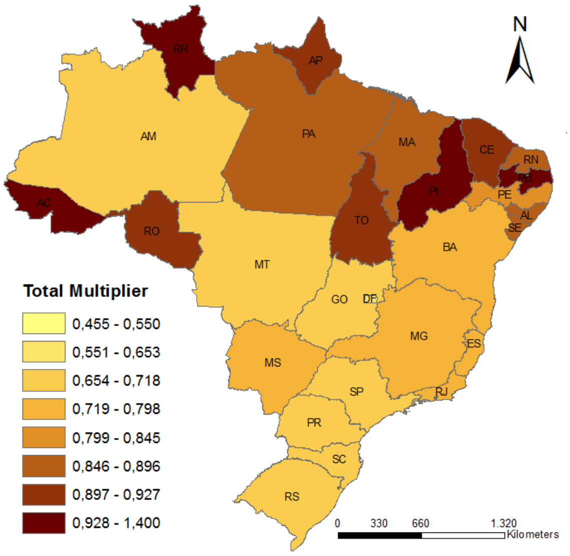
(a) 0.1x



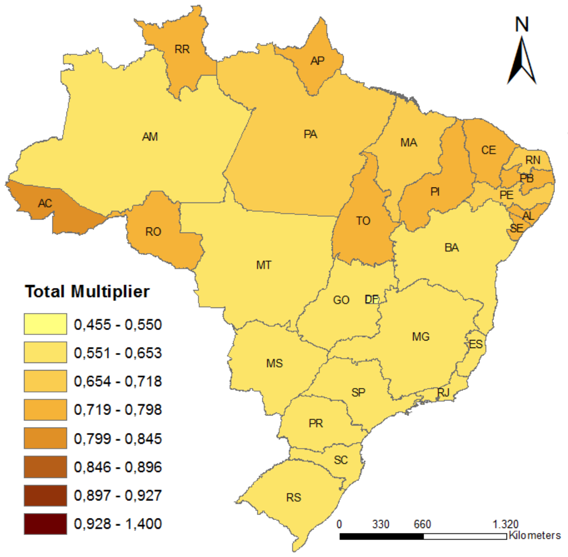
(b) 0.2x



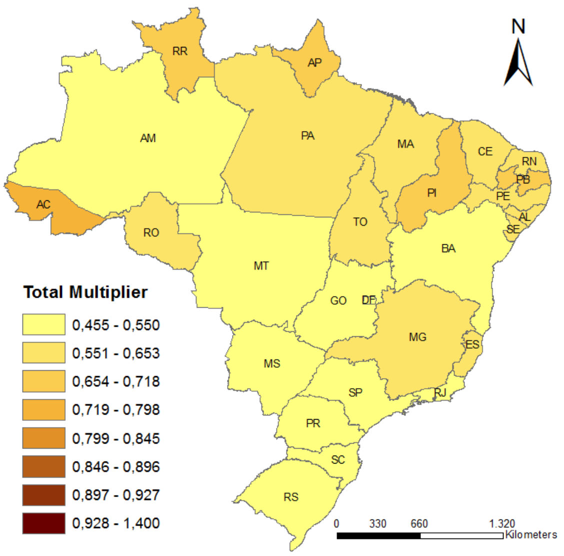
(c) 0.5x



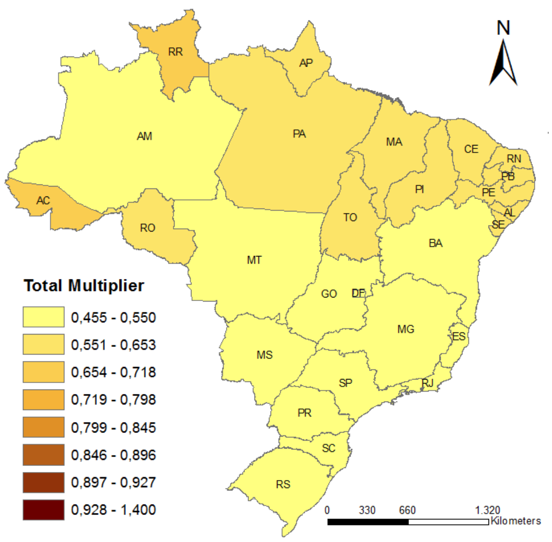
(d) 2.0x



(e) 5.0x



(f) 10.0x



Source: Elaborated by the authors

In the Appendix, tables 40, 41, and 42 describe the intra, inter, and total multipliers when increasing both substitution elasticities simultaneously.

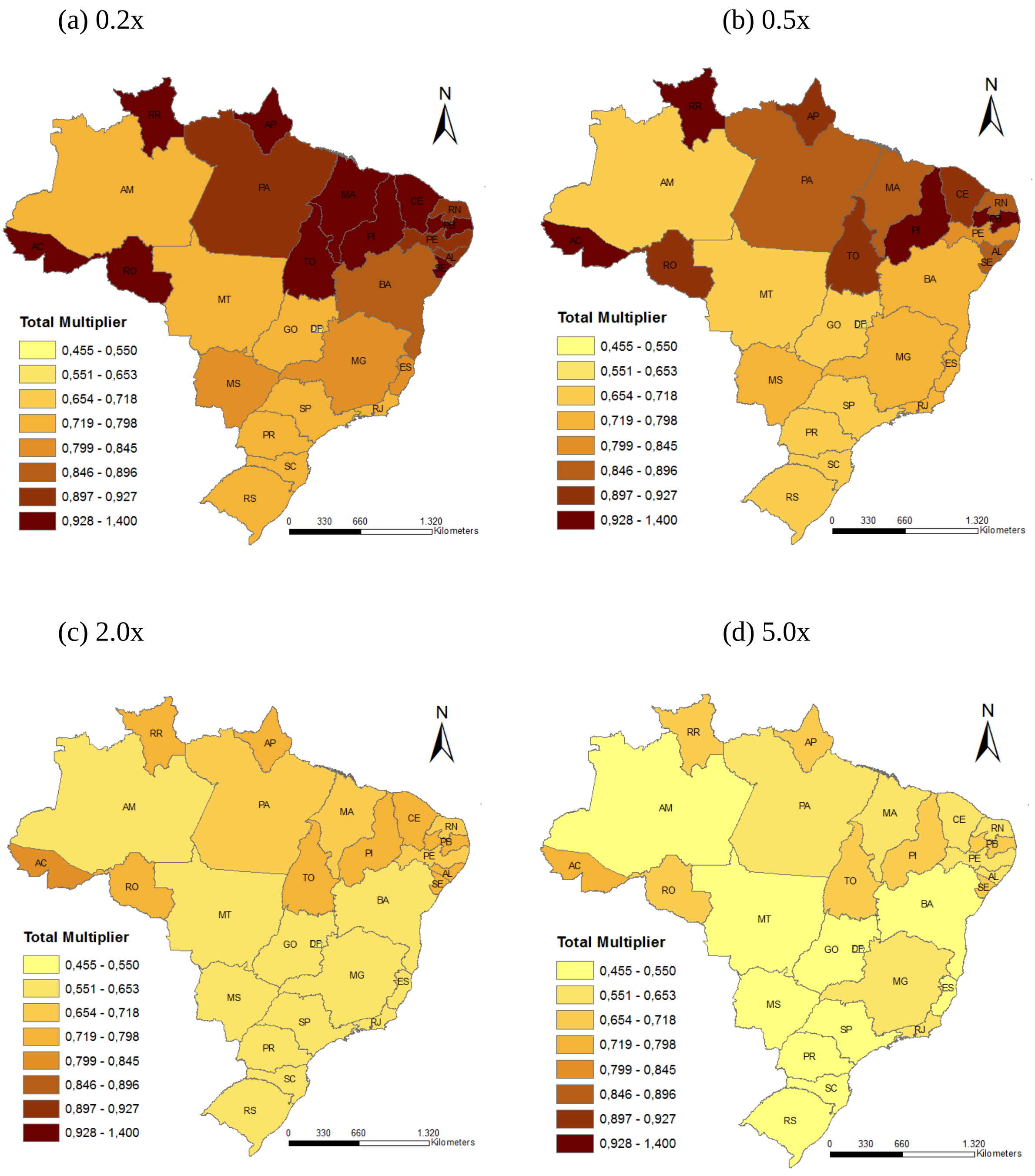
When we analyze the elasticities separately, we conclude that our local multipliers' estimations are more sensitive to the domestic-foreign than the interregional elasticities solo. Increasing two times the domestic-foreign elasticity causes a higher deviation of the multiplier when compared to the sensitivity of the interregional elasticity. Furthermore, for the imports from the Rest of the World (RoW), the results remain for all states: increases in the domestic-foreign substitution elasticity provokes the growth of imports, thus dwindling the intra multipliers and the income effect channel. The expenditure switching channel is responsible for increasing the inter multiplier when boosting the substitution elasticities from the RoW, though it remains negative. Consequently, we observe the decrease in real consumption, utility (welfare measure), and real GDP as the domestic-foreign Armington's elasticity increases. Thus, the total multiplier diminishes.

However, when increasing the interregional elasticity of imports, we observe for the national aggregates, a tiny increase in factor payments, real consumption, utility, real GDP, and import volume. Also, we emphasize that the fluctuation of both macro variables and multiplier effects are less prominent than compared to the domestic-foreign elasticity. At the state level, we observe a more heterogeneous effect. For all regions, the interregional multiplier's negative effect becomes less severe, and the intra multiplier in general diminishes. Therefore, the total multiplier effect for the majority of the North (except Amazonas) and Northeast states continue to display an inverse relationship, rising when import elasticities decline.

Nonetheless, for states in South and Center-West regions, improvements in the interregional Armington's elasticity provokes an elevation of the total government spending multiplier. Conversely, in the Southeast region, Minas Gerais and Rio de Janeiro manifest lower multipliers as the elasticity rises, while Espirito Santo is the opposite. Lastly, the wealthiest state, São Paulo, still displays an uncertain effect: the total multiplier diminishes when considering variations in the elasticity between 0.5 and 5 but improves for 0x elasticity.

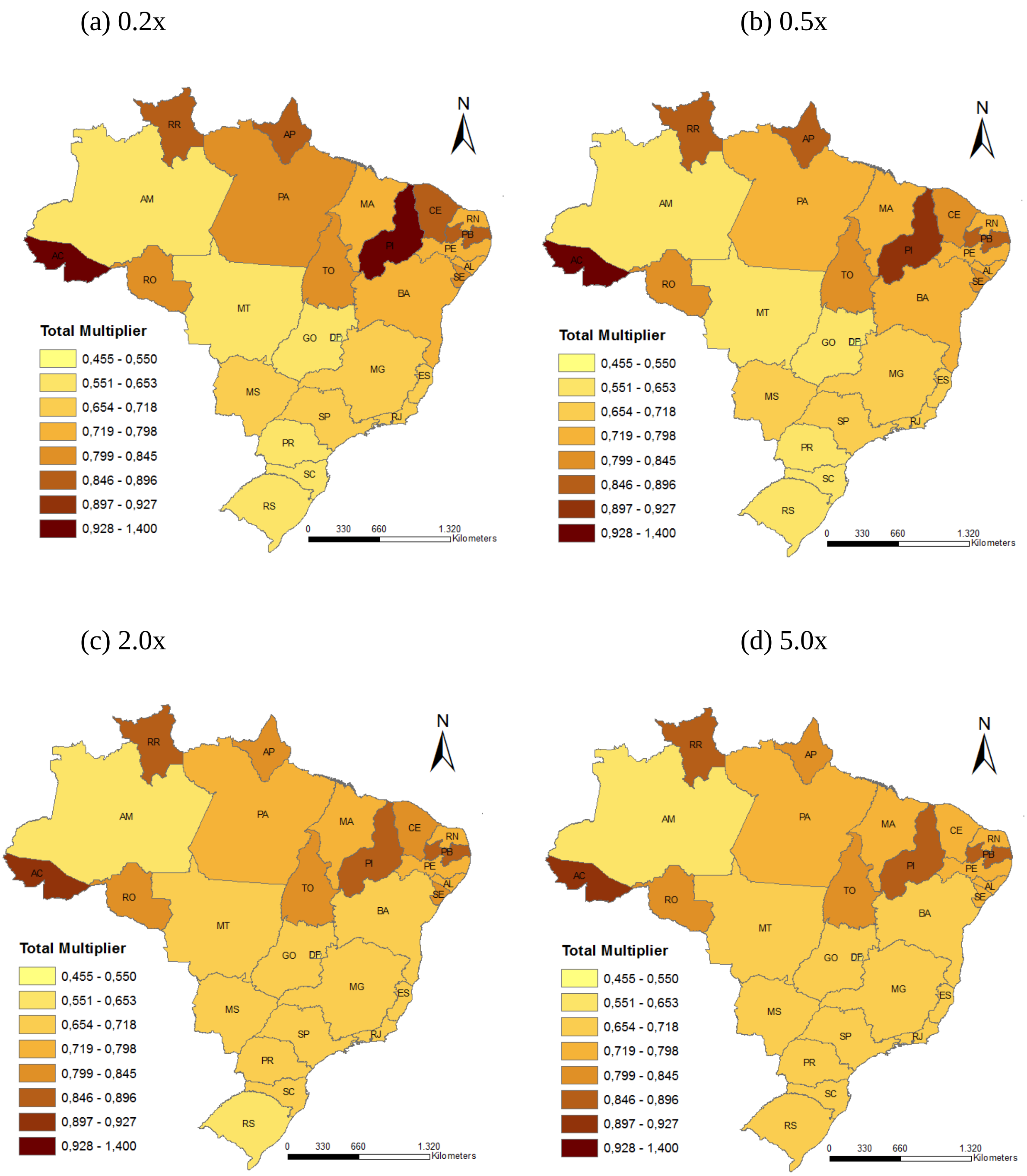
Expanding the export demand elasticity means that exports are more sensitive to the terms of trade deterioration provoked by our simulation. Therefore, it provokes the fall in all prices index and the contraction in the import and export volume due to the terms of trade deterioration, which becomes even more costly. Hence, we observe a shrinkage in real consumption, utility, tariff revenues, primary factor payments, and real GDP. At the state level, the variation in GRP and total multiplier effect are tinier uniformly as the export demand elasticity raise, representing the weakening of the income channel effect. Figure 10, Figure 11, and Figure 12, respectively, exhibit each analysis's results separated, and Tables 39 to 42 in the Appendix provides a better description of the elasticities investigation.

Figure 10. The reaction of the local (total) multiplier to changes in substitution elasticity of domestic/ import



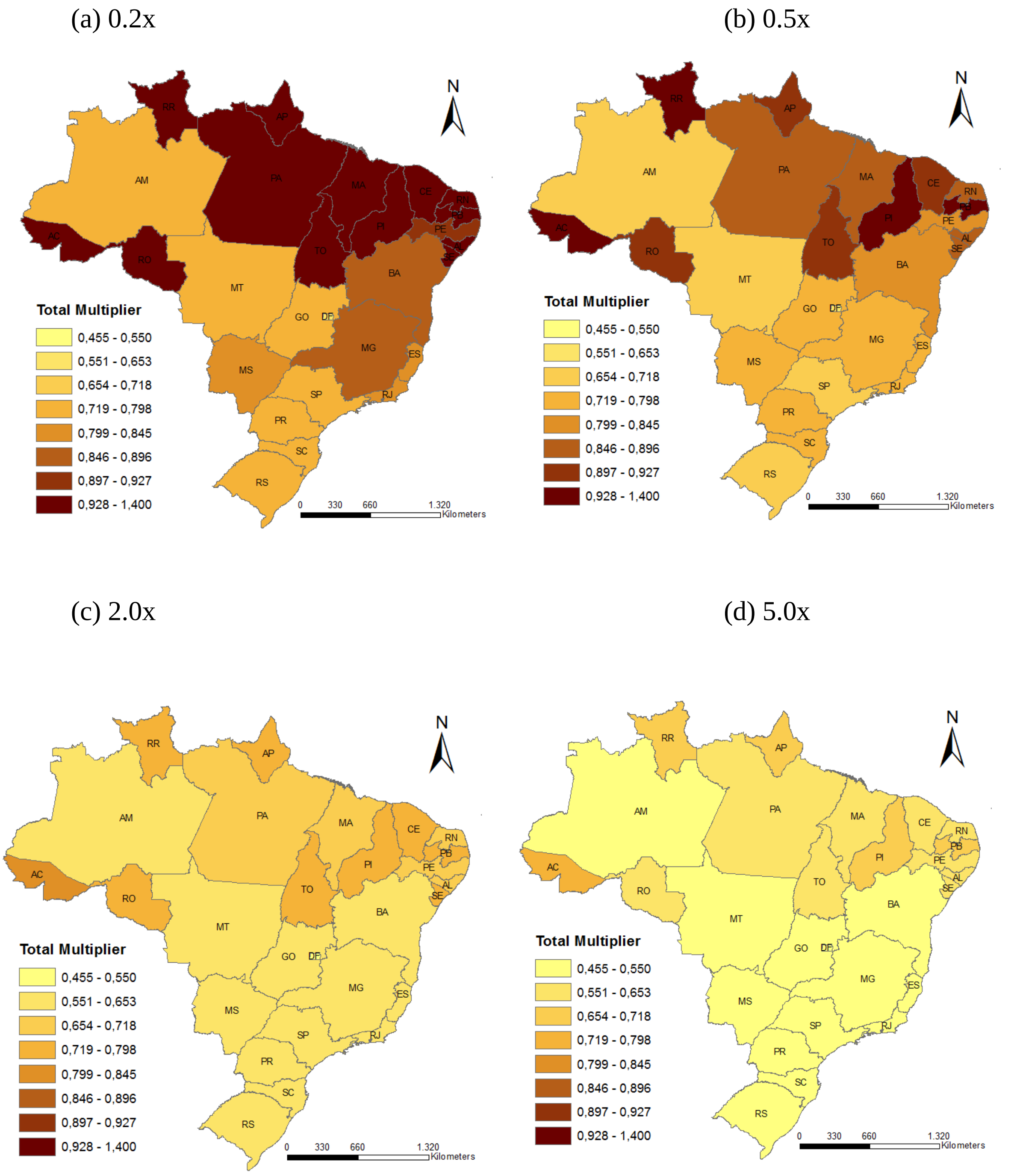
Source: Elaborated by the authors

Figure 11. The reaction of the local (total) multiplier to changes in substitution elasticity of interregional imports



Source: Elaborated by the authors

Figure 12. The reaction of the local (total) multiplier to changes in export demand elasticity



Source: Elaborated by the authors

5.4. COUNTER-FACTUAL SIMULATIONS

In addition to the analysis of a 1% increase in Federal Government spending, we propose other simulations to verify whether our multipliers' estimate has a similar pattern to that presented. We calculated the effect of the 10% increase in Federal government spending, as in Horridge et al. (1995); the effect of the increase in government spending proportional to 1% of the GRP in each region, as in Haddad et al. (2018a); and the effect of the 1% increase in Regional Government spending (BAS 5) uniformly in each region. In this way, we measure how the multiplier changes according to the scale of government spending. Moreover, we can verify whether local government spending has more significant effects on the GRP.

Nonetheless, we calculate the effect of a fiscal expansion package proposed by the Federal Government on 4/2/2020, as in Porsse et al. (2020), to counteract the global pandemic COVID-19's economic recession (Walker et al., 2020).[39] Policymakers performed records countercyclical policy throughout the world, as lockdown measures to contain the virus's spread forced people to stay at home, severely affecting commerce and service sectors. (Casado et al., 2020; Benmelech and Tzur-Ilan, 2020). Central banks used monetary policy, mainly through lower interest rates, to promote the market, whereas Governments injected fiscal packages to stimulate their economies. In this recession scenario, studies on fiscal policy impact will gain focus in the years to come.

According to equity and efficiency criteria as in Haddad et al. (2018b), we tested different allocation scenarios for this expansion package, measured at R$ 147 billion. We use the respective shares of population, poverty, and State Participation Fund (FPE) allocation in each state as criteria to distribute the resources.[40]

5.4.1. Alternative government spending simulations

Utilizing the same closure, we propose alternative scenarios for increasing government spending, according to equations (25), (26), and (27).

$$\Delta \mathrm{GOV}^r = (0{,}10) \times GOV^r \qquad (25)$$

$$\Delta \mathrm{GOV}^r = (0{,}01) \times GRP^r \qquad (26)$$

[39] As in Porsse et al. (2020), we simulate the effect of fiscal policy that will impact the primary result. For more details, see Porsse et al. (2020) and Observatório IBRE de Política Fiscal.

[40] The State Participation Fund (FPE) is a transfer of financial resources from the Union to the States, redistributing revenue and assisting the federative units that have less capacity to collect their funds. The Federal Audit Court (TCU) defines each state's portion based on factors such as population, land area, and per capita income.

$$\Delta \text{GOV}^r = (0{,}01) \times REG.GOV^r \quad (27)$$

Equation (25) describes the 10% increase in Federal Government spending and is called Simulation 2. In this simulation, the 10% increase in Federal Government Spending represents 0.7% of the 2015 Value-Added (R$ 35.8 billion).

Equation (26) simulates the proportional increase in Federal Government spending by 1% of each region's Value-Added and, consequently, will represent 1% of the 2015 National Value-Added (R$ 51.5 billion) entitled Simulation 3.

Finally, equation (27) shows the effect of the uniform increase of 1% in Regional Government Spending for each state, corresponding to 0.18% of the Value-Added of (2015), designated as Simulation 4. As with our base simulation presented in the previous sessions, all results will be presented in terms of Value-Added to measure the effect on production, without taxes and other distortions.

Table 24 shows the results of these three alternative simulations. We can see that the multiplier effect's pattern remains remarkably similar among all Government Spending scenarios: the total (value-added) multiplier is higher in more impoverished areas (North and Northeast states, except for Amazonas).

The intra multiplier remains positive and prevalent due to the income effect. For simulations 2 and 3, the inter multiplier remains negative due to the channel of expenditure switching. Contrarily, simulation 4 possesses a different nature from all other simulations presented due to the Regional Government expenditures. In simulation 4, when analyzing the interregional effect, some spillovers are positive or less negative in absolute value than all other simulations presented, showing that increasing local government spending can have benign effects on adjacent economies; therefore, expenditure switching would not occur. Also, given the sectoral composition focused on public administration, health, and education services, the interregional multiplier is low due to fewer spillovers. We should also highlight that each state's total multiplier and the national multiplier related to Simulation 4 are higher than all other scenarios. We should better explore these mechanisms in future work through public finances literature.

Table 24. Variations in Government spending, GRP, and multiplier effect in the alternative simulations

State	Simulation 1					Simulation 2					Simulation 3					Simulation 4				
	ΔGOV	ΔGRP	Multipliers			ΔGOV	ΔGRP	Multipliers			ΔGOV	ΔGRP	Multipliers			ΔGOV	ΔGRP	Multipliers		
			Intra	Inter	Total			Intra	Inter	Total			Intra	Inter	Total			Intra	Inter	Total
RO	28.21	23.34	1.035	-0.208	0.827	282.14	230.60	1.030	-0.212	0.817	323.09	252.79	0.989	-0.206	0.782	98.79	82.18	0.806	0.026	0.832
AC	10.70	9.92	1.188	-0.260	0.927	106.97	97.92	1.180	-0.265	0.915	123.04	107.39	1.128	-0.255	0.873	52.39	48.73	1.063	-0.133	0.930
AM	46.90	29.22	0.802	-0.179	0.623	469.01	289.96	0.800	-0.182	0.618	722.81	433.78	0.779	-0.179	0.600	158.33	99.15	0.673	-0.047	0.626
RR	25.34	21.90	1.094	-0.229	0.864	253.37	214.86	1.084	-0.236	0.848	93.63	64.97	0.884	-0.190	0.694	37.57	32.76	0.961	-0.090	0.872
PA	72.73	57.39	0.983	-0.194	0.789	727.34	569.33	0.981	-0.198	0.783	1,175.50	908.47	0.971	-0.198	0.773	290.77	229.76	0.831	-0.041	0.790
AP	31.20	26.38	1.065	-0.220	0.845	312.04	258.00	1.054	-0.227	0.827	126.80	103.99	1.042	-0.222	0.820	46.88	40.16	0.853	0.004	0.857
TO	15.14	12.50	1.054	-0.228	0.826	151.37	123.69	1.049	-0.232	0.817	260.46	209.47	1.037	-0.232	0.804	96.47	79.97	0.869	-0.040	0.829
MA	38.67	30.33	1.001	-0.217	0.784	386.71	299.56	0.997	-0.222	0.775	693.70	506.67	0.944	-0.214	0.730	216.52	170.46	0.754	0.033	0.787
PI	26.06	23.35	1.105	-0.209	0.896	260.63	230.20	1.100	-0.216	0.883	347.23	298.12	1.073	-0.214	0.859	136.36	122.98	0.848	0.054	0.902
CE	65.87	54.33	1.086	-0.261	0.825	658.74	536.24	1.079	-0.265	0.814	1,141.57	906.84	1.057	-0.263	0.794	317.77	262.63	0.908	-0.081	0.826
RN	59.44	46.41	1.011	-0.230	0.781	594.36	456.92	1.004	-0.236	0.769	508.89	365.34	0.939	-0.221	0.718	148.68	116.62	0.782	0.002	0.784
PB	49.31	43.22	1.098	-0.221	0.877	493.07	425.49	1.091	-0.228	0.863	496.10	424.31	1.084	-0.228	0.855	182.83	161.39	0.861	0.022	0.883
PE	106.97	81.72	0.997	-0.233	0.764	1,069.67	805.55	0.990	-0.237	0.753	1,341.05	963.34	0.947	-0.229	0.718	345.93	265.01	0.837	-0.071	0.766
AL	24.20	19.26	0.989	-0.193	0.796	241.99	190.37	0.984	-0.197	0.787	419.93	322.30	0.964	-0.196	0.768	125.02	98.95	0.739	0.052	0.791
SE	25.66	20.96	1.037	-0.220	0.817	256.57	207.21	1.031	-0.224	0.808	344.15	268.52	0.999	-0.219	0.780	108.60	88.72	0.869	-0.052	0.817
BA	108.80	78.31	0.961	-0.241	0.720	1,087.96	774.31	0.957	-0.245	0.712	2,156.60	1,464.49	0.917	-0.238	0.679	519.56	376.21	0.789	-0.064	0.724
MG	260.40	184.97	0.930	-0.219	0.710	2,603.99	1,832.62	0.927	-0.223	0.704	4,572.84	3,104.01	0.897	-0.218	0.679	870.22	620.51	0.768	-0.055	0.713
ES	45.57	31.18	0.902	-0.218	0.684	455.74	309.47	0.900	-0.221	0.679	1,003.43	678.58	0.900	-0.224	0.676	181.92	124.45	0.680	0.005	0.684
RJ	667.88	456.48	0.881	-0.198	0.683	6,678.79	4,512.32	0.876	-0.201	0.676	5,561.64	3,610.58	0.843	-0.194	0.649	905.19	620.23	0.741	-0.056	0.685
SP	310.43	203.56	0.814	-0.158	0.656	3,104.27	2,019.89	0.811	-0.160	0.651	16,333.14	10,441.38	0.800	-0.161	0.639	2,164.85	1,418.26	0.691	-0.036	0.655
PR	112.68	74.10	0.878	-0.220	0.658	1,126.81	735.42	0.875	-0.223	0.653	3,270.47	2,120.71	0.875	-0.226	0.648	528.07	348.04	0.675	-0.016	0.659
SC	99.75	65.36	0.880	-0.225	0.655	997.51	648.44	0.878	-0.228	0.650	2,096.67	1,355.21	0.877	-0.231	0.646	319.59	210.03	0.669	-0.011	0.657
RS	178.19	114.10	0.901	-0.260	0.640	1,781.89	1,131.11	0.898	-0.263	0.635	3,348.42	2,026.91	0.860	-0.255	0.605	527.42	338.32	0.729	-0.087	0.641
MS	51.30	34.96	0.915	-0.233	0.681	512.99	346.57	0.912	-0.237	0.676	740.86	483.45	0.885	-0.233	0.653	142.01	97.06	0.721	-0.038	0.684
MT	44.55	29.10	0.867	-0.214	0.653	445.50	289.11	0.866	-0.217	0.649	972.83	605.61	0.834	-0.212	0.623	189.42	124.40	0.677	-0.020	0.657
GO	59.49	38.69	0.905	-0.255	0.650	594.90	382.20	0.901	-0.258	0.642	1,543.47	952.02	0.868	-0.251	0.617	292.49	190.46	0.720	-0.068	0.651
DF	1016.33	567.45	0.677	-0.119	0.558	10,163.30	5,548.34	0.669	-0.123	0.546	1,837.69	560.76	0.373	-0.068	0.305	140.46	78.31	0.534	0.023	0.557
BR	**3581.76**	**2378.49**	**-**	**-**	**0.664**	**35,817.61**	**23,465.73**	**-**	**-**	**0.655**	**51,556.01**	**33,540.02**	**-**	**-**	**0.651**	**9,144.12**	**6,445.77**	**-**	**-**	**0.705**

Note: ΔGOV and ΔGRP in R$ million

Source: Elaborated by the authors

5.4.2. Equity and efficiency scenarios

In addition to estimating the magnitude of the multiplier effect of government spending on output for each state in Brazil, this study proposed to analyze whether the effectiveness of Federal Government spending as a regional policy tool to reduce the country's substantial degree of regional inequality and either if there would be a trade-off between national growth and the reduction of regional inequalities (Aroca, Azzoni and Sarrias, 2018).

On April 2, 2020, the Federal Government proposed a fiscal and credit expansion package for states, municipalities, and the private sector whose impact on the primary would be R$ 147.3 billion. In this way, we will analyze the impacts of different allocation scenarios for this fiscal expansion in the states. Porsse et al. (2020) analyze this fiscal policy shock as a whole through a dynamic CGE model, combined with other supply restriction shocks that this paper does not intend to analyze.

Haddad et al. (2018b) will be the basis for the construction of the scenarios. We proposed a scenario using the proportion of each state's population to distribute the R$ 147 billion. As presented in section 4, the population concentrates in wealthier regions; therefore, this scenario would promote the Southeast and South areas. Conversely, the scenario based on the poverty rate of each state (Proportion of people with per capita household income less than the US$ 5.5 PPC 2011 (%)) based on the IBGE’s Synthesis of Social Indicators (SIS) 2015, reveals that states in the North and Northeast would receive a larger share, and thus, it would be related to a more equitable policy. Moreover, we tested the distribution of resources based on the Percentage of Participation defined by LC 62/89 on FPE 2020. In this scenario, the states with the lowest tax revenue capacity and with the lowest GDP would receive a larger share, and consequently, this would be an allocation rule based on the equity principle.

Table 25 shows the three proposed scenarios. Darker areas indicate the density of the column's effect, while lighter areas correspond to minor effects in each column. It is possible to see that the population criteria favor the states of the South and Southeast, as shown by the columns of variation in government spending and GRP. São Paulo receives the most substantial government expenditure, followed by Minas Gerais, Rio de Janeiro, Rio Grande do Sul, and Paraná. Nonetheless, the poverty and FPE criteria favor states in the North and Northeast, as they receive more resources and display more significant variations in their GRP. For the poverty criteria, the state of Maranhão is the primary recipient of government spending, followed by Alagoas, Ceará, Acre, Pará, and Amazonas. Lastly, under the FPE allocation criteria, Bahia receives the most considerable contribution, followed by Ceará, Maranhão, Pernambuco, and Pará.

We observe that the most significant variation of the national GDP is related to the FPE criterion (R$ 99.4 billion), followed by the Population criterion (R$ 98.8 billion) and the Poverty criterion by last. This result indicates that there would be no trade-off between the reduction of regional inequality and national growth.

Moreover, Table 25 reveals that the structure of the total multiplier of Government spending remains the same as that of our base simulation: the total multiplier effect remains predominant for the states of the North and Northeast regions, except for Amazonas. The income channel is the primary reason for the positive value of the intraregional multiplier, and the expenditure switching relates to the negative interregional multiplier. Government expenditure persists in increasing prices and deteriorating terms of trade, causing adverse spillover effects.

Table 25. Equity and efficiency criteria: alterations in government spending, GRP, and multipliers.

State	Simulation 1					Population Criteria						Poverty Criteria						FPE Criteria					
	ΔGOV	ΔGRP	Multipliers Intra	Multipliers Inter	Multipliers Total	Pop. Share	ΔGOV	ΔGRP	Multipliers Intra	Multipliers Inter	Multipliers Total	Pov. Share	ΔGOV	ΔGRP	Multipliers Intra	Multipliers Inter	Multipliers Total	FPE. Share	ΔGOV	ΔGRP	Multipliers Intra	Multipliers Inter	Multipliers Total
RO	28	23	1.035	-0.208	0.827	0.8%	1,206	944	1.014	-0.232	0.782	3.5%	5,165	3,679	0.984	-0.272	0.712	2.8%	4,147	3,027	0.992	-0.262	0.730
AC	11	10	1.188	-0.260	0.927	0.4%	566	491	1.154	-0.288	0.867	5.5%	8,085	4,338	1.001	-0.464	0.537	3.4%	5,039	3,260	1.050	-0.403	0.647
AM	47	29	0.802	-0.179	0.623	1.8%	2,690	1,610	0.796	-0.197	0.599	5.5%	8,047	4,534	0.787	-0.223	0.563	2.8%	4,110	2,404	0.792	-0.207	0.585
RR	25	22	1.094	-0.229	0.864	0.2%	348	287	1.072	-0.248	0.824	3.8%	5,620	3,456	0.965	-0.350	0.615	2.5%	3,654	2,492	1.000	-0.318	0.682
PA	73	57	0.983	-0.194	0.789	4.0%	5,854	4,374	0.970	-0.223	0.747	5.5%	8,053	5,793	0.954	-0.235	0.719	6.1%	9,003	6,484	0.960	-0.239	0.720
AP	31	26	1.065	-0.220	0.845	0.4%	517	412	1.039	-0.242	0.796	5.0%	7,438	4,053	0.914	-0.369	0.545	3.4%	5,026	3,107	0.949	-0.330	0.618
TO	15	13	1.054	-0.228	0.826	0.7%	1,068	832	1.036	-0.257	0.779	4.2%	6,255	4,364	1.009	-0.312	0.698	4.3%	6,393	4,442	1.010	-0.315	0.695
MA	39	30	1.001	-0.217	0.784	3.4%	5,077	3,640	0.977	-0.260	0.717	6.5%	9,522	6,421	0.960	-0.286	0.674	7.2%	10,632	7,103	0.960	-0.292	0.668
PI	26	23	1.105	-0.209	0.896	1.6%	2,408	1,977	1.077	-0.256	0.821	4.8%	7,085	5,346	1.045	-0.290	0.755	4.3%	6,365	4,836	1.051	-0.292	0.760
CE	66	54	1.086	-0.261	0.825	4.4%	6,527	4,920	1.049	-0.295	0.754	5.5%	8,085	5,848	1.029	-0.306	0.723	7.3%	10,807	7,705	1.029	-0.316	0.713
RN	59	46	1.011	-0.230	0.781	1.7%	2,446	1,767	0.984	-0.262	0.722	4.3%	6,322	4,230	0.958	-0.289	0.669	4.2%	6,154	4,121	0.961	-0.292	0.670
PB	49	43	1.098	-0.221	0.877	2.0%	2,908	2,333	1.065	-0.263	0.802	4.7%	6,913	5,160	1.039	-0.293	0.746	4.8%	7,054	5,247	1.041	-0.297	0.744
PE	107	82	0.997	-0.233	0.764	4.6%	6,793	4,768	0.964	-0.262	0.702	4.9%	7,279	4,926	0.951	-0.274	0.677	6.9%	10,164	6,783	0.948	-0.280	0.667
AL	24	19	0.989	-0.193	0.796	1.6%	2,410	1,776	0.965	-0.228	0.737	6.1%	9,024	5,881	0.929	-0.277	0.652	4.2%	6,128	4,168	0.942	-0.262	0.680
SE	26	21	1.037	-0.220	0.817	1.1%	1,597	1,223	1.012	-0.246	0.766	4.9%	7,280	5,014	0.976	-0.287	0.689	4.2%	6,121	4,293	0.984	-0.283	0.701
BA	109	78	0.961	-0.241	0.720	7.3%	10,824	7,270	0.943	-0.271	0.672	4.9%	7,153	4,734	0.929	-0.267	0.662	9.4%	13,841	9,085	0.936	-0.279	0.656
MG	260	185	0.930	-0.219	0.710	10.3%	15,133	10,275	0.918	-0.239	0.679	2.3%	3,388	2,314	0.917	-0.234	0.683	4.5%	6,561	4,473	0.917	-0.236	0.682
ES	46	31	0.902	-0.218	0.684	1.8%	2,714	1,791	0.897	-0.237	0.660	2.7%	3,930	2,556	0.890	-0.240	0.650	1.5%	2,210	1,453	0.894	-0.237	0.658
RJ	668	456	0.881	-0.198	0.683	8.4%	12,347	8,161	0.870	-0.209	0.661	2.1%	3,093	1,776	0.753	-0.178	0.574	1.5%	2,250	1,498	0.872	-0.207	0.666
SP	310	204	0.814	-0.158	0.656	21.6%	31,862	20,081	0.800	-0.170	0.630	1.5%	2,169	1,175	0.685	-0.144	0.541	1.0%	1,473	930	0.799	-0.168	0.631
PR	113	74	0.878	-0.220	0.658	5.5%	8,065	5,103	0.870	-0.237	0.633	1.6%	2,392	1,503	0.858	-0.229	0.629	2.9%	4,247	2,695	0.868	-0.234	0.635
SC	100	65	0.880	-0.225	0.655	3.3%	4,825	3,049	0.872	-0.240	0.632	1.0%	1,501	950	0.867	-0.235	0.633	1.3%	1,885	1,196	0.871	-0.237	0.634
RS	178	114	0.901	-0.260	0.640	5.6%	8,258	5,077	0.892	-0.277	0.615	1.4%	2,007	1,207	0.868	-0.266	0.602	2.4%	3,469	2,133	0.890	-0.275	0.615
MS	51	35	0.915	-0.233	0.681	1.3%	1,891	1,241	0.908	-0.252	0.656	2.1%	3,151	2,024	0.897	-0.255	0.642	1.3%	1,962	1,280	0.905	-0.253	0.652
MT	45	29	0.867	-0.214	0.653	1.6%	2,344	1,487	0.866	-0.232	0.634	2.0%	2,957	1,840	0.856	-0.233	0.622	2.3%	3,400	2,126	0.862	-0.237	0.626
GO	59	39	0.905	-0.255	0.650	3.1%	4,636	2,858	0.890	-0.274	0.616	2.0%	2,971	1,791	0.869	-0.266	0.603	2.8%	4,188	2,561	0.886	-0.275	0.612
DF	1,016	567	0.677	-0.119	0.558	1.3%	1,985	1,062	0.666	-0.131	0.535	1.6%	2,415	1,081	0.557	-0.109	0.448	0.7%	1,017	540	0.663	-0.131	0.532
BR	**3,582**	**2,378**	**-**	**-**	**0.664**	**100%**	**147,300**	**98,809**	**-**	**-**	**0.671**	**100%**	**147,300**	**95,994**	**-**	**-**	**0.652**	**100.0%**	**147,300**	**99,444**	**-**	**-**	**0.675**

Note: ΔGOV and ΔGRP in R$ million

Source: Elaborated by the authors

As for regional concentration, the effects are favorable, as Tables 26 and 27 indicate. In all scenarios, we observe that the increase in Government Spending is responsible for promoting the share on GDP of North and Northeast regions while diminishing national shares from the more developed areas. The Northeast region increases its national GDP share in all scenarios: from 14.45% to 14.74% in population criteria, 15.09% in poverty criteria, and 15.19% in the FPE criteria. The North region moves from 5.48% to 5.55% of the national GDP with population criteria, 5.96% with poverty, and 5.88% through FPE criteria. Oppositely, The Southeast region loses share but continues being the most significant contribution to the national GDP. We emphasize that even in the population scenario, the Southeast region loses share in the national GDP (-0.23%), although the loss of the region is more prominent in poverty (-0.83%) and FPE criteria (-085%). Hence, the expansion of Government Spending displays a favorable regional impact, and it seems that there is no trade-off between equity and efficiency, ever since the GDP growth in FPE criteria promotes the growth of impoverished areas while still managing to foster national growth.

To investigate even further, table 26 reveals regional concentration indicators. All scenarios manifest better indicators compared to the indicators of observed data before the simulation. Moreover, as expected, poverty and FPE scenarios exhibit more considerable changes than the population criteria.

Table 26. Regional concentration indicators from the proposed scenarios

Indicator	Observed 2015	Population Criteria		Poverty Criteria		FPE Criteria	
		GRP	Change	GRP	Change	GRP	Change
Gini	0.616450	0.613504	-0.48%	0.602296	-2.30%	0.604046	-2.01%
Gini weighted	0.544846	0.542714	-0.39%	0.540523	-0.79%	0.539780	-0.93%
Hoover	0.464998	0.462610	-0.51%	0.454360	-2.29%	0.455480	-2.05%
Theil	0.751475	0.742280	-1.22%	0.689905	-8.19%	0.700070	-6.84%
CV	1.675108	1.663605	-0.69%	1.640204	-2.08%	1.640141	-2.09%
Williamson	1.272586	1.267707	-0.38%	1.263449	-0.72%	1.261699	-0.86%

Source: Elaborated by the authors using REAT toolbox in R

Table 27. Shares in Value-added from the proposed scenarios

State	Before simulation		Population Criteria			Poverty Criteria			FPE Criteria		
	GRP	Share	GRP	Share	Change	GRP	Share	Change	GRP	Share	Change
RO	32,309	0.63%	33,252.434	0.63%	0.01%	35,988.211	0.69%	0.06%	35,336.102	0.67%	0.05%
AC	12,304	0.24%	12,794.611	0.24%	0.00%	16,641.735	0.32%	0.08%	15,564.062	0.30%	0.06%
AM	72,281	1.40%	73,891.951	1.41%	0.00%	76,815.112	1.46%	0.06%	74,685.757	1.42%	0.02%
RR	9,363	0.18%	9,649.444	0.18%	0.00%	12,818.811	0.24%	0.06%	11,854.251	0.23%	0.04%
PA	117,550	2.28%	121,923.814	2.32%	0.04%	123,342.869	2.35%	0.07%	124,034.241	2.36%	0.08%
AP	12,680	0.25%	13,091.441	0.25%	0.00%	16,732.577	0.32%	0.07%	15,786.658	0.30%	0.05%
TO	26,046	0.51%	26,878.841	0.51%	0.01%	30,410.690	0.58%	0.07%	30,488.619	0.58%	0.07%
MA	69,370	1.35%	73,009.893	1.39%	0.04%	75,790.960	1.44%	0.10%	76,472.938	1.46%	0.11%
PI	34,723	0.67%	36,699.564	0.70%	0.02%	40,069.258	0.76%	0.09%	39,558.476	0.75%	0.08%
CE	114,157	2.21%	119,076.761	2.27%	0.05%	120,004.230	2.29%	0.07%	121,861.595	2.32%	0.10%
RN	50,889	0.99%	52,656.407	1.00%	0.02%	55,119.195	1.05%	0.06%	55,010.757	1.05%	0.06%
PB	49,610	0.96%	51,943.200	0.99%	0.03%	54,769.755	1.04%	0.08%	54,857.201	1.04%	0.08%
PE	134,105	2.60%	138,872.757	2.64%	0.04%	139,030.900	2.65%	0.05%	140,887.227	2.68%	0.08%
AL	41,993	0.81%	43,768.962	0.83%	0.02%	47,874.016	0.91%	0.10%	46,161.515	0.88%	0.06%
SE	34,415	0.67%	35,637.731	0.68%	0.01%	39,428.668	0.75%	0.08%	38,707.726	0.74%	0.07%
BA	215,660	4.18%	222,930.330	4.24%	0.06%	220,394.522	4.20%	0.01%	224,745.261	4.28%	0.09%
MG	457,284	8.87%	467,559.722	8.90%	0.03%	459,598.320	8.75%	-0.12%	461,756.879	8.79%	-0.08%
ES	100,343	1.95%	102,133.768	1.94%	0.00%	102,898.738	1.96%	0.01%	101,796.189	1.94%	-0.01%
RJ	556,164	10.79%	564,325.154	10.74%	-0.05%	557,940.440	10.62%	-0.16%	557,661.734	10.61%	-0.18%
SP	1,633,314	31.68%	1,653,394.881	31.47%	-0.21%	1,634,488.611	31.12%	-0.56%	1,634,243.884	31.10%	-0.58%
PR	327,047	6.34%	332,150.367	6.32%	-0.02%	328,550.789	6.26%	-0.09%	329,742.205	6.27%	-0.07%
SC	209,667	4.07%	212,716.498	4.05%	-0.02%	210,616.990	4.01%	-0.06%	210,863.289	4.01%	-0.05%
RS	334,842	6.49%	339,918.463	6.47%	-0.03%	336,049.303	6.40%	-0.10%	336,975.052	6.41%	-0.08%
MS	74,086	1.44%	75,327.143	1.43%	0.00%	76,110.609	1.45%	0.01%	75,366.045	1.43%	0.00%
MT	97,283	1.89%	98,769.723	1.88%	-0.01%	99,122.394	1.89%	0.00%	99,409.257	1.89%	0.00%
GO	154,347	2.99%	157,204.988	2.99%	0.00%	156,137.973	2.97%	-0.02%	156,908.720	2.99%	-0.01%
DF	183,769	3.56%	184,830.961	3.52%	-0.05%	184,849.776	3.52%	-0.04%	184,309.235	3.51%	-0.06%
BR	**5,155,601**	**100%**	**5,254,409.812**	**100%**	-	**5,251,595.452**	**100%**	-	**5,255,044.872**	**100%**	-

Note: ΔGOV and ΔGRP in R$ million

Source: Elaborated by the authors

6. CONCLUSION

Through this work, we provided evidence that the government spending multiplier is higher in the North and Northeast states, more impoverished states and regions with a minor share of the Value-added in the Brazilian economy, as Table 29 depicts. These states are more dependent on government spending in the composition of their and GRP and possess a less diversified productive structure. The pattern of the government spending multiplier is similar in all of our simulations, which reinforces our conclusions. Also, in the Input-Output modeling, the multiplier effect estimate is much higher for all regions with the absence of the price mechanism trhough the substitution channel. The national multiplier in the input-product was 2.34, while in the EGC approach, it was 0.644.

The baseline simulation of this thesis considered a 1% uniform increase in Federal Government Spending in all states. We observe that the expansion of government spending provokes a rise in all price indexes, as the economic theory predicts. Also, it causes the expansion of production. Thus, we have the expenditure switching channel provoking the deterioration of terms of trade, diminishing exports while increasing imports, and the income effect channel raising consumption and income in all regions. The latter is associated with the positive intra multiplier, while the former relates to the negative interregional multiplier. Moreover, an increase in government spending is responsible for welfare gains measured by the positive EV and the gains in utility. Nonetheless, our baseline simulation also illustrates that government spending possesses regional effects since all regional concentration indicators diminish post-simulation.

When evaluating how the government spending multiplier reacts to variations in substitution elasticity of imports, our results were consistent with other estimates in the literature: increases in import penetration (both from other regions of the country and the RoW, provokes the diminishing of the local multiplier and vice-versa. Nonetheless, when analyzing the sensitivity to the interregional import elasticity, our results suggest possible gainers with the interregional trade (mainly South and Center-West regions). Our sensitivity analysis to export demand elasticities reveals the resilience of exporters in the face of a sudden deterioration caused by increased government spending. As export demand elasticities increased, the lesser is the multiplier, since fewer products are offered in the national Market, reducing both price and income channels effects.

Another goal of this paper was to evaluate whether government spending could be used as a regional development tool. As our results show, all regional concentration indicators diminish in all of our scenarios. These equity or efficiency criteria would attempt to analyze the impacts of regional policies of Government expenditure to balance disparities within Brazil. Therefore, it seems there is no trade-off between fostering national growth while managing to reduce regional disparities since our simulations considering FPE criteria displays both the national income and the GRP higher for more impoverished states. Conclusively, Government spending could be used as a regional development policy. Our results may vary depending on how the goverment spending is funded, which we intend to incorporate in later analysis.

This work contributes to the literature on government spending multiplier in several ways. First, we provided evidence of the local multiplier from government spending for a large emerging Market, providing estimates of the multiplier effect for Brazilian states, as the literature quantifying this impact is still limited, especially for underdeveloped economies (Corbi et al. (2018)). We corroborate the findings in Ilzetzki et al. (2013) by emphasizing the role of trade openness in the transmission of government spending. Moreover, our estimates of the multiplier effect align with the literature as that federal spending has more significant impacts in low-growth areas (Serrato and Wingender (2016); Corbi et al. (2018)). Lastly, we provide through a CGE analysis, with solid microeconomic foundations, consistent and coherent database, taking into account the interrelationships between all the variables considered, the magnitude of the government spending multiplier at local levels, an essential question for the literature of regional development (Moretti, 2010).

A future research agenda that we can explore consists of (i) introducing a public finances module to measure the sensitivity of our multipliers under different financing options (foreign financing, tax financing, and domestic borrowing) and the effect on Public Finances (Government Revenues and expenditures, debt to GDP ratio), as in Porsse (2005); Horridge et al. (1995); (ii) distinguish the multiplier between Government instruments (e.g., public investment, infrastructure investment, tax incentives, and transfers to aid more impoverished families (Aschauer (1989); Pusch (2012)); (iii) the introduction of dynamics, to better comprehend the government spending multiplier and macro effects of the simulation throughout time; (iv) analyze patterns of the government spending multiplier in the business cycle to measure the efficacy of countercyclical regional policies and address how does the fiscal multiplier responds to different periods in time (Corsetti et al. (2012); Batini et al. (2014)) and (v) ultimately, perform sensitivity analyses to other relevant parameters (e.g., price rigidity in labor markets) and other essential features of the economy (e.g., the degree of monetary policy accommodation, as in Nakamura and Steinsson (2014); Christiano et al. (2011)).

7. REFERENCES

ABAYASIRI-SILVA, Kaludura; HORRIDGE, Mark. **The effects of current fiscal restraint on the Australian economy: An applied general equilibrium analysis with imperfect competition**. 1999.

ACCONCIA, Antonio; CORSETTI, Giancarlo; SIMONELLI, Saverio. Mafia and public spending: Evidence on the fiscal multiplier from a quasi-experiment. **American Economic Review**, v. 104, n. 7, p. 2185-2209, 2014.

AFONSO, António; EBERT, Werner; SCHUKNECHT, Ludger; THONE, Michael. **Quality of public finances and growth**. European Central Bank, Feb. 2005. (Working Paper Series, n., 438).

AROCA, Patricio; AZZONI, Carlos; SARRIAS, Mauricio. Regional concentration and national economic growth in Brazil and Chile. **Letters in Spatial and Resource Sciences**, v. 11, n. 3, p. 343-359, 2018.

ASCHAUER, David Alan. Is public expenditure productive?. **Journal of monetary economics**, v. 23, n. 2, p. 177-200, 1989.

AUERBACH, Alan J.; GORODNICHENKO, Yuriy; MURPHY, Daniel. **Local fiscal multipliers and fiscal spillovers in the United States**. National Bureau of Economic Research, 2019

AZZONI, Carlos; GUILHOTO, Joaquim; HADDAD, Eduardo; HEWINGS, Geoffrey; LAES, Marco; MOREIRA, Guilherme (2007). Social policies, personal and regional income inequality in Brazil: An IO analysis of the Bolsa Família Program. **Encontro Nacional de Economia**, v. 35, 2007.

AZZONI, Carlos; HADDAD, Eduardo. Regional Disparities. In: BAER, W.; AZZONI, C.R.; AMMAN, E. (Ed.). **The Oxford Handbook of the Brazilian Economy.** USA: Oxford University Press, 2018.

BAICKER, Katherine. The spillover effects of state spending. **Journal of public economics**, v. 89, n. 2-3, p. 529-544, 2005.

BARRO, Robert J. Output effects of government purchases. **Journal of Political Economy**, v. 89, n. 6, p. 1086-1121, 1981.

BATINI, Nicoletta; EYRAUD, Luc; FORNI, Lorenzo; WEBER, Anke. **Fiscal multipliers: Size, determinants, and use in macroeconomic projections**. International Monetary Fund, 2014.

BENMELECH, Efraim; TZUR-ILAN, Nitzan. The determinants of fiscal and monetary policies during the COVID-19 crisis. **NBER Working Paper**, n. w27461, 2020.

BLANCHARD, Olivier; PEROTTI, Roberto. An empirical characterization of the dynamic effects of changes in government spending and taxes on output. **The Quarterly Journal of Economics**, v. 117, n. 4, p. 1329-1368, 2002.

BOUERI, Rogério; ROCHA, Fabiana Fontes; RODOPOULOS, Fabiana Magalhães Almeida. **Avaliação da qualidade do gasto público e mensuração da eficiência**. 2015.

BRASIL. Secretaria do Tesouro Nacional (STN). **Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro (Siconfi)**, disponível em <https://siconfi.tesouro.gov.br/siconfi/pages/public/consulta_finbra/finbra_list.jsf>, access in 19 mar. 2019.

CASADO, Miguel; GLENNON, Britta; LANE, Julia; McQUOWN, David; RICH, Daniel; WEINBERG, Bruce. **The Effect of Fiscal Stimulus: Evidence from COVID-19**. National Bureau of Economic Research, 2020.

CHEN, Quanrun; DIETZENBACHER, Erik; LOS, Bart; YANG, Cuihong. Modeling the short-run effect of fiscal stimuli on GDP: A new semi-closed input-output model. **Economic Modelling**, v. 58, p. 52-63, 2016.

CHIANG, Shu-hen. Location quotient and trade. **The Annals of Regional Science**, v. 43, n. 2, p. 399-414, 2009.

CHINN, Menzie David. Fiscal multipliers. **La Follette School of Public Affairs Working Paper**, n. 2015-002, 2013.

CHODOROW-REICH, Gabriel. Geographic cross-sectional fiscal multipliers: What have we learned?. **American Economic Journal: Economic Policy**, 2019.

COHEN, Jeffrey P.; PAUL, Catherine J. Morrison. Public infrastructure investment, interstate spatial spillovers, and manufacturing costs. **Review of Economics and Statistics**, v. 86, n. 2, p. 551-560, 2004.

CORBI, Raphael B.; PAPAIOANNOU, Elias; SURICO, Paolo. Regional Transfer Multipliers. **The Review of Economic Studies**, 2018.

CORSETTI, Giancarlo; MEIER, Andre; MÜLLER, Gernot. What determines government spending multipliers?. **Economic Policy**, v. 27, n. 72, p. 521-565, 2012.

CHRISTIANO, Lawrence; EICHENBAUM, Martin; REBELO, Sergio. When is the government spending multiplier large?. **Journal of Political Economy**, v. 119, n. 1, p. 78-121, 2011.

DALL'ERBA, Sandy; LLAMOSAS-ROSAS, Irving. Spatial policy for growth and equity. **Handbook of Regional Science**, p. 353-371, 2014.

DIXON, Peter; PARMENTER, Brian. Computable general equilibrium modelling for policy analysis and forecasting. In: AMMAN, Hans M. et al..**Handbook of computational economics**. v. 1, p. 3-85. Amsterdam: Elsevier, 1996.

DOMAŃSKI, Bolesław; GWOSDZ, Krzysztof. Multiplier effects in local and regional development. **Quaestiones Geographicae**, v. 29, n. 2, p. 27-37, 2010.

DOMINGUES, Edson; HADDAD, Eduardo. Sensitivity analysis in computable general equilibrium models: an application for the regional effects of the Free Trade Area of the

Americas (FTAA). **Brazilian Review of Econometrics**, v. 25, n. 1, p. 115-137, 2005.

FARIA, Weslem; HADDAD, Eduardo. Estimação das elasticidades de substituição do comércio regional do Brasil. **Nova Economia**, v. 24, n. 1, p. 141-168, 2014.

FARHI, Emmanuel; WERNING, Iván. Fiscal multipliers: Liquidity traps and currency unions. In: **Handbook of Macroeconomics**. Elsevier, 2016. p. 2417-2492.

FERNANDES, Carlândia; GUILHOTO, Joaquim. Análise de Impacto de Curto Prazo da Política Fiscal: Redução do IPI no Período 2008-2009. **Análise Econômica**, v. 33, n. 64, 2015.

FISHBACK, Price; KACHANOVSKAYA, Valentina. The multiplier for federal spending in the States during the Great Depression. **The Journal of Economic History**, v. 75, n. 1, p. 125-162, 2015.

FOCHEZATTO, Adelar. Modelos de equilíbrio geral aplicados na análise de políticas fiscais: uma revisão da literatura. **Análise–Revista de Administração da PUCRS**, v. 16, n. 1, 2006.

FUJITA, Masahisa; THISSE, Jacques-François. Does geographical agglomeration foster economic growth? And who gains and loses from it?. **The Japanese Economic Review**, v. 54, n. 2, p. 121-145, 2003.

GLUSCHENKO, Konstantin. Measuring regional inequality: to weight or not to weight?. **Spatial Economic Analysis**, v. 13, n. 1, p. 36-59, 2018.

GUST, Christopher; HERBST, Edward; LÓPEZ-SALIDO, David; SMITH, Matthew. The Empirical Implications of the Interest-Rate Lower Bound. **American Economic Review**, 107 (7): 1971-2006, 2017.

HAAVELMO, Trygve. Multiplier effects of a balanced budget. **Econometrica: Journal of the Econometric Society**, p. 311-318, 1945.

HADDAD, Eduardo A. **Regional inequality and structural changes: lessons from the Brazilian experience**. Ashgate Pub Ltd, 1999.

HADDAD, Eduardo. **Retornos crescentes, custos de transporte e crescimento regional.** São Paulo, 2004. Tese (Livre-Docência). Faculdade de Economia, Administração e Contabilidade da Universidade de São Paulo.

HADDAD, Eduardo; LUQUE, Carlos; LIMA, Gilberto; SAKURAI, Sergio; COSTA, Silvio. Impact Assessment of Interregional Government Transfers: Lessons from the Brazil Experience. In: **Regional Problems and Policies in Latin America**. Springer, Berlin, Heidelberg, 2013. p. 475-493.

HADDAD, Eduardo; JÚNIOR, Carlos; NASCIMENTO, Thiago. Matriz Interestadual De Insumo-Produto Para o Brasil: Uma Aplicação do Método IIOAS. **Revista Brasileira de Estudos Regionais e Urbanos**, v. 11, n. 4, p. 424-446, 2017.

HADDAD, Eduardo; COTARELLI, Natalia; VALE, Vinicius. **On the Numerical Structure of Local and Nationwide Government Spending Multipliers: What Can We Learn from**

the Greek Crisis?. University of São Paulo (FEA-USP), 2018a.

HADDAD, Eduardo; GALVIS, Luis; ARAÚJO-JUNIOR, Inácio; VALE, Vinicius. **Impact Assessment of Scenarios of Interregional Transfers in Colombia**. Banco de la Republica de Colombia, 2018b.

HADDAD, Eduardo; COTARELLI, Natalia; SIMONATO, Thiago; VALE, Vinicius; VISENTIN, Jaqueline. The Grand Tour: Keynes and Goodwin go to Greece. **Journal of Economic Structures**, v. 9, p. 1-21, 2020.

HOLLAND, Marcio; MARÇAL, Emerson; DE PRINCE, Diogo. Is fiscal policy effective in Brazil? An empirical analysis. **The Quarterly Review of Economics and Finance**, 2019.

HORRIDGE, Mark; PARMENTER, Brian; CAMERON, Martin; JOUBERT, Riaan; SULEMAN, Areef; JONGH, Dawie. **The macroeconomic, industrial, distributional and regional effects of government spending programs in South Africa**. Centre of Policy Studies (CoPS), 1995.

Horridge J.M., Jerie M., Mustakinov D. & Schiffmann F. (2018), **GEMPACK manual**, GEMPACK Software, ISBN 978-1-921654-34-3

HORY, Marie-Pierre. Fiscal multipliers in Emerging Market Economies: can we learn something from Advanced Economies?. **International Economics**, v. 146, p. 59-84, 2016.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Contas Regionais**, 2015.

IPEA – INSTITUTO DE PESQUISA ECONÔMICA APLICADA. **Avaliação de políticas públicas no Brasil**: uma análise da Política Nacional de Desenvolvimento Regional (PNDR), Vol 3, 2017.

ILZETZKI, Ethan; MENDOZA, Enrique G.; VÉGH, Carlos A. How big (small?) are fiscal multipliers?. **Journal of monetary economics**, v. 60, n. 2, p. 239-254, 2013.

KUZNETS, Simon. Economic growth and income inequality. **The American economic review**, v. 45, n. 1, p. 1-28, 1955.

KYRIACOU, Andreas P.; MUINELO-GALLO, Leonel; ROCA-SAGALÉS, Oriol. Regional inequalities, fiscal decentralization and government quality. **Regional Studies**, v. 51, n. 6, p. 945-957, 2017.

LEEPER, Eric. Equilibria under ‘active’ and ‘passive’ monetary and fiscal policies. **Journal of Monetary Economics**, v. 27, n. 1, p. 129-147, 1991.

LESSMANN, Christian. Fiscal decentralization and regional disparity: evidence from cross-section and panel data. **Environment and Planning A**, v. 41, n. 10, p. 2455-2473, 2009.

LEUNG, Danny; SECRIERU, Oana. Real-financial linkages in the Canadian economy: an input-output approach. **Economic Systems Research**, v. 24, n. 2, p. 195-223, 2012.

LÓPEZ, Fernando; MARTÍNEZ-ORTIZ, Pedro; CEGARRA-NAVARRO, Juan-Gabriel.

Spatial spillovers in public expenditure on a municipal level in Spain. **The Annals of Regional Science**, v. 58, n. 1, p. 39-65, 2017.

LUCAS, Robert. Econometric policy evaluation: A critique. In: **Carnegie-Rochester conference series on public policy**. 1976. p. 19-46.

MAS-COLELL, Andreu; WHINSTON, Michael; GREEN, Jerry. **Microeconomic theory**. New York: Oxford university press, 1995.

MILLER, Ronald; BLAIR, Peter. **Input-output analysis: foundations and extensions**. Cambridge university press, 2009.

MORETTI, Enrico. Local Multipliers. In: **American Economic Review: Papers & Proceedings**. 2010. p. 1-7.

NAKAMURA, Emi; STEINSSON, Jon. Fiscal stimulus in a monetary union: Evidence from US regions. **American Economic Review**, v. 104, n. 3, p. 753-92, 2014.

NEDUZIAK, Luiz Carlos; CORREIA, Fernando. Alocação dos gastos públicos e crescimento econômico: um estudo em painel para os estados brasileiros. **Revista de Administração Pública**, v. 51, n. 4, p. 616-632, 2017.

OSBERG, Lars. The equity/efficiency trade-off in retrospect. **Canadian Business Economics**, 1995.

PEROBELLI, Fernando. **Análise espacial das interações econômicas entre os estados brasileiros**. 2004. Tese de Doutorado. Universidade de São Paulo.

PORSSE, Alexandre. **Competição tributária regional, externalidades fiscais e federalismo no Brasil: uma abordagem de equilíbrio geral computável**. 2005. Tese (Doutorado em Economia) – Programa de PósGraduação de Economia, Universidade Federal do Rio Grande do Sul, 2005

PORSSE, Alexandre; HADDAD, Eduardo; RIBEIRO, Eduardo Pontual. Economic effects of regional tax incentives: a general equilibrium approach. **Latin American Business Review**, v. 7, n. 3-4, p. 195-216, 2007.

PORSSE, Alexandre; SOUZA, Kênia; Carvalho, Terciane; VALE, Vinicius. lmpactos Econômicos do COVID-19 no Brasil. **Nota Técnica NEDUR-UFPR No 01-2020**, Núcleo de Estudos em Desenvolvimento Urbano e Regional (NEDUR) da Universidade Federal do Paraná, Curitiba, Abril/2020.

PORTNOV, Boris; FELSENSTEIN, Daniel. On the suitability of income inequality measures for regional analysis: Some evidence from simulation analysis and bootstrapping tests. **Socio-Economic Planning Sciences**, v. 44, n. 4, p. 212-219, 2010.

PUSCH, Toralf. Fiscal spending multiplier calculations based on input-output tables–an application to EU member states. **European Journal of Economics and Economic Policies: Intervention**, v. 9, n. 1, p. 129-144, 2012.

PYUN, Ju Hyun; RHEE, Dong-Eun. Fiscal multipliers during the global financial crisis: fiscal and monetary interaction matters. **Contemporary Economic Policy**, v. 33, n. 1, p. 207-220, 2015.

RICCIUTI, Roberto. Assessing Ricardian equivalence. **Journal of Economic Surveys**, v. 17, n. 1, p. 55-78, 2003.

ROCHA, Fabiana; GIUBERTI, Ana Carolina. Composição do gasto público e crescimento econômico: uma avaliação macroeconômica da qualidade dos gastos dos Estados brasileiros. **Economia Aplicada**, v. 11, n. 4, p. 463-485, 2007.

ROCHA, Fabiana; GIUBERTI, Ana Carolina. **Consenso político com relação à necessidade de disciplina fiscal dos Estados: um estudo da Lei de Responsabilidade Fiscal.** Em: Tesouro Nacional. (Org.). Finanças Públicas. Brasília.: Editora Universidade de Brasília, p. 801-840, 2004.

RODRÍGUEZ-POSE, Andrés. The revenge of the places that don't matter (and what to do about it). **Cambridge Journal of Regions, Economy and Society**, v. 11, n. 1, p. 189-209, 2018.

SERRATO, Juan Carlos Suárez; WINGENDER, Philippe. **Estimating local fiscal multipliers**. National Bureau of Economic Research, 2016.

TOURINHO, Octávio; ALVES, Yann; SILVA, Napoleão. Implicações econômicas da reforma tributária: análise com um modelo CGE. **Revista Brasileira de Economia**, v. 64, n. 3, p. 307-340, 2010.

VASSALLO, Moisés Diniz. **Análise de impactos econômicos setoriais e regionais decorrentes de investimentos em infraestrutura de transportes**. 2015. Tese de Doutorado. Universidade de São Paulo.

WALKER, Patrick G.T.; WHITTAKER, Charles.; WATSON, Oliver;. et al. **The Global Impact of COVID-19 and Strategies for Mitigation and Suppression.** WHO Collaborating Centre for Infectious Disease Modelling, MRC Centre for Global Infectious Disease Analysis, Abdul Latif Jameel Institute for Disease and Emergency Analytics, Imperial College London, 2020.

WIELAND, Thomas. REAT: A Regional Economic Analysis Toolbox for R. **Region**, v. 6, n. 3, p. R1-R57, 2019.

WILDASIN, David. Fiscal competition: an introduction. **Journal of public economic theory**, v. 5, n. 2, p. 169-176, 2003.

WILLIAMSON, Jeffrey G. Regional inequality and the process of national development: a description of the patterns. **Economic development and cultural change**, v. 13, n. 4, Part 2, p. 1-84, 1965.

8. APPENDIX

Table 28. List of Regions

Region	UF	State	Region	UF	State
North	RO	Rondônia	Northeast	SE	Sergipe
North	AC	Acre	Northeast	BA	Bahia
North	AM	Amazonas	Southeast	MG	Minas Gerais
North	RR	Roraima	Southeast	ES	Espírito Santo
North	PA	Pará	Southeast	RJ	Rio de Janeiro
North	AP	Amapá	Southeast	SP	São Paulo
North	TO	Tocantins	South	PR	Paraná
Northeast	MA	Maranhão	South	SC	Santa Catarina
Northeast	PI	Piauí	South	RS	Rio Grande do Sul
Northeast	CE	Ceará	Center-West	MS	Mato Grosso do Sul
Northeast	RN	Rio Grande do Norte	Center-West	MT	Mato Grosso
Northeast	PB	Paraíba	Center-West	GO	Goiás
Northeast	PE	Pernambuco	Center-West	DF	Distrito Federal
Northeast	AL	Alagoas			

Table 29. List of Sectors, Armington's elasticities, and Export Demand elasticities

Code	Sector	Armington Elasticity	Export Elasticity of Demand	Code	Sector	Armington Elasticity	Export Elasticity of Demand
S1	Agriculture	-1.7289	-1.3900	S38	Electricity	-2.212338	-0.9460
S2	Livestock	-1.9605	-0.8950	S39	Water, sewage and waste management	-2.213440	-0.9460
S3	Forest production	-1.7788	-1.0420	S40	Construction	-2.355050	-0.9460
S4	Extraction of mineral coal	-1.7313	-1.2710	S41	Wholesale and retail trade	-2.335912	-0.9460
S5	Extraction of oil and gas	-1.5469	-0.5790	S42	Ground transportation	-2.135322	-0.9460
S6	Extraction of iron ore	-1.1305	-0.5790	S43	Water transportation	-2.037574	-0.9460
S7	Extraction of non-ferrous minerals	-1.3137	-0.5790	S44	Air Transport	-2.347265	-0.9460
S8	Slaughter and meat products	-1.7480	-1.1380	S45	Storage and mail	-2.343258	-0.9460
S9	Sugar manufacture and refining	-1.2643	-1.5880	S46	Accommodation	-2.249197	-0.9460
S10	Other food products	-1.9648	-1.4370	S47	Food services	-2.249935	-0.9460
S11	Beverage Manufacturing	-2.5024	-1.7000	S48	Editing and printing	-2.172909	-0.9460
S12	Manufacture of tobacco products	-2.0157	-1.4370	S49	Television and recording activities	-2.174867	-0.9460
S13	Manufacture of textile products	-2.2007	-1.0070	S50	Telecommunications	-2.174008	-0.9460
S14	Sewing of clothing artifacts	-2.1059	-0.8240	S51	Develop. and information services	-2.176942	-0.9460
S15	Footwear manufacturing	-2.1102	-0.7890	S52	Financial intermediation	-2.122143	-0.9460
S16	Manufacture of wood products	-2.1421	-1.2920	S53	Real estate activities	-1.804294	-0.9460
S17	Cellulose manufacturing	-1.6172	-1.3910	S54	Legal activities	-2.325637	-0.9460
S18	Printing and playback of recordings	-2.0380	-0.9460	S55	Architectural and R&D services	-2.319320	-0.9460
S19	Oil refining and coking plants	-1.1344	-2.4690	S56	Other professional activities	-2.325002	-0.9460
S20	Manufacture of biofuels	-1.2534	-2.4690	S57	Non-real estate rentals	-2.279791	-0.9460
S21	Chemical manufacturing	-1.8531	-1.1490	S58	Other administrative activities	-2.323889	-0.9460
S22	Pesticide manufacturing	-1.9394	-1.0690	S59	Surveillance activities	-2.325760	-0.9460
S23	Manufacture of cleaning products	-2.1029	-1.4620	S60	Public administration	-2.373935	-0.9460
S24	Pharmachemicals and Pharmaceuticals	-1.9059	-0.5700	S61	Public education	-2.057048	-0.9460
S25	Rubber manufacturing	-1.9205	-1.1520	S62	Private education	-2.171176	-0.9460
S26	Manufacture of non-metallic minerals	-2.0580	-1.1820	S63	Public health	-1.973165	-0.9460
S27	Steel Mill	-0.8453	-1.5580	S64	Private health	-1.778640	-0.9460
S28	Metallurgy	-2.2704	-1.0280	S65	Artistic activities	-2.288818	-0.9460
S29	Metal Fabrication	-1.9168	-0.9680	S66	Membership organizations	-2.153057	-0.9460
S30	Computer equipment	-2.0579	-0.6100	S67	Domestic services	-1.905000	-0.9460
S31	Electrical machinery and equipment	-1.6750	-0.8920				
S32	Mechanical machines and equipment	-1.8690	-0.8220				
S33	Automobiles	-0.9927	-0.6910				
S34	Vehicle Parts & Accessories	-1.7405	-1.3750				
S35	Other transport equipment	-2.1628	-0.6360				
S36	Furniture and various industries	-1.9617	-0.5980				
S37	Maintenance and Repair	-1.8678	-0.9460				

Source: Elaborated by the authors based on Faria and Haddad (2014) and NEREUS

Table 30. Composition of the Value-Added per sector and Government Spending by category in 2015 per UF (%)

UF	Value-Added				Current Expenditures			Capital Expenditures		
	Farming	Industry	Services *	Gov. Spending **	Personnel and Social charges	Interest and debt charges	Other current expenditures	Investiment	Financial inversion	Debt amortization
AC	10.8	10.0	42.7	36.5	46.4	3.6	37.4	7.6	0.1	5.0
AL	11.5	15.2	48.1	25.2	51.7	3.2	31.1	6.5	0.5	7.1
AM	8.0	33.3	38.7	20.0	44.5	2.3	44.4	5.8	0.4	2.7
AP	2.1	12.9	41.4	43.7	52.5	3.3	31.1	10.7	0.3	2.1
BA	8.3	22.1	49.1	20.5	51.8	1.6	37.6	5.8	0.7	2.4
CE	4.5	19.6	52.3	23.7	46.5	1.9	36.6	11.2	0.6	3.2
DF	0.3	5.4	49.6	44.7	71.0	0.8	24.6	2.4	0.3	0.9
ES	3.8	31.1	49.4	15.8	61.6	2.1	26.2	4.4	3.9	1.8
GO	10.4	24.5	49.2	15.9	57.2	4.6	23.4	6.8	0.4	7.5
MA	10.4	19.6	43.8	26.2	51.4	2.4	36.1	7.0	0.0	3.0
MG	5.3	26.1	51.3	17.2	51.1	3.9	36.7	3.7	0.5	4.1
MS	18.4	22.0	41.3	18.3	50.0	1.9	37.0	4.4	0.0	6.7
MT	19.8	17.5	45.8	16.9	65.6	3.3	20.9	5.9	0.1	4.2
PA	12.3	28.0	37.9	21.8	55.1	1.1	34.4	6.5	0.9	1.9
PB	3.8	17.2	45.7	33.3	55.5	1.8	30.5	8.3	0.8	3.1
PE	3.9	20.0	52.3	23.8	51.8	2.2	38.3	3.8	1.1	2.8
PI	7.8	13.6	45.4	33.2	63.1	1.7	24.5	6.6	0.7	3.3
PR	9.0	25.4	52.2	13.4	42.4	2.2	49.5	2.8	0.5	2.5
RJ	0.5	23.6	56.0	19.9	33.5	5.8	45.2	10.2	0.1	5.2
RN	3.2	21.0	46.8	29.1	64.0	0.9	26.4	3.9	3.5	1.4
RO	13.4	18.5	40.3	27.8	53.6	0.7	34.8	8.8	0.2	1.9
RR	5.5	9.5	36.7	48.3	49.8	3.3	36.2	6.0	1.7	2.9
RS	9.4	23.2	52.8	14.6	60.9	3.0	30.9	1.2	0.3	3.8
SC	6.0	28.7	51.7	13.6	58.6	4.2	25.1	7.9	0.5	3.6
SE	5.0	22.7	44.5	27.8	63.6	2.3	26.2	4.5	0.2	3.2
SP	1.6	21.9	66.4	10.1	47.6	4.4	38.6	4.1	2.0	3.3
TO	13.0	14.5	42.1	30.4	59.7	2.1	29.2	4.6	0.1	4.4
Brazil	**5.0**	**22.5**	**55.3**	**17.2**	**50.9**	**3.4**	**36.1**	**5.1**	**1.0**	**3.5**

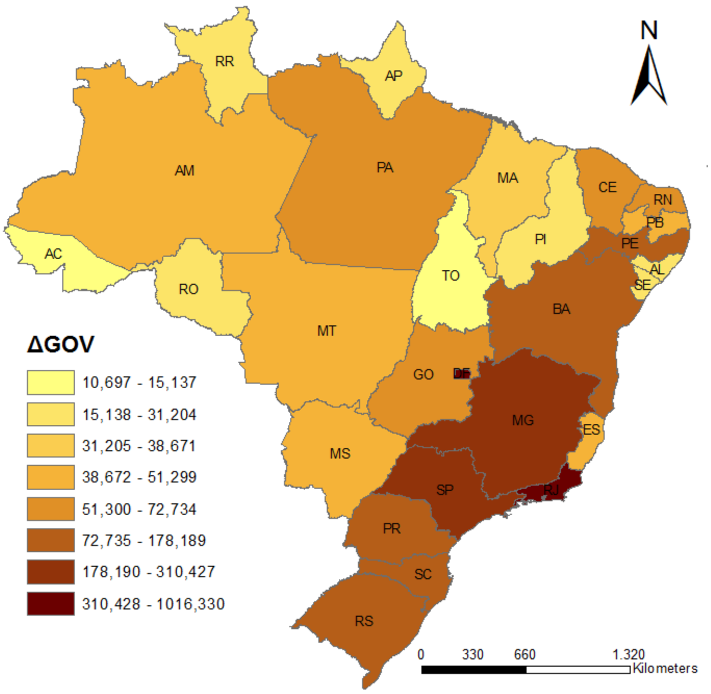
** Services except administration, defense, social security and education and public health*

*** Administration, defense, social security and education and public health*

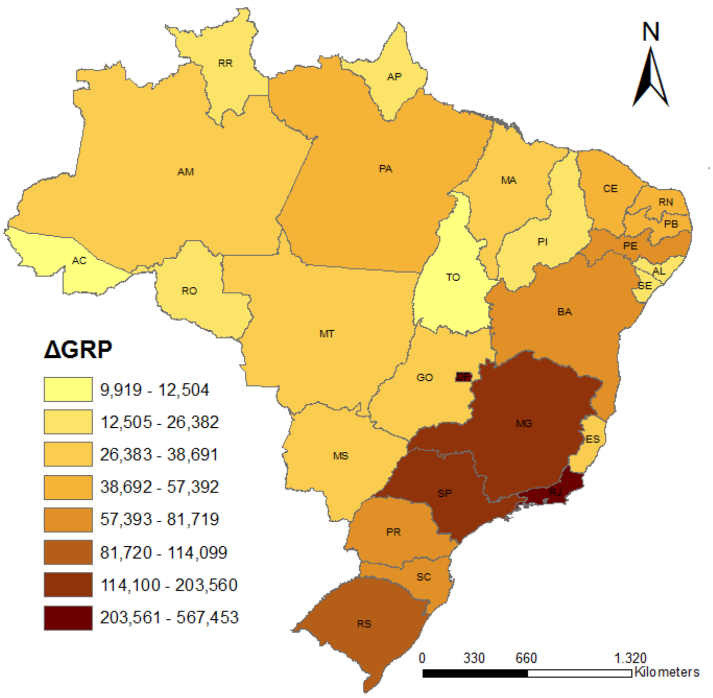
Source: Elaborated by the authors with data from IBGE and Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro (Siconfi).

Figure 13. ΔGOV and ΔGRP (in million R$)

(a) ΔGOV: 1% increase means…



(b) ΔGOV causes GRP to increase by



Source: Elaborated by the authors

Table 31. Impact on Exports Volume in Interregional Trade, by Origin of Exports: Brazil, 2015 (in percentage change)

Origin of exports	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	-0.0256	0.0019	0.0020	0.0013	0.0012	0.0005	0.0002	0.0006	0.0004	0.0008	0.0006	0.0007	0.0012	0.0002	0.0003	0.0013	0.0024	0.0004	0.0039	0.0020	0.0005	0.0007	0.0014	0.0004	0.0008	0.0006	0.0088	0.0096
AC	0.0029	-0.0558	0.0029	0.0014	0.0011	0.0009	0.0002	0.0007	0.0005	0.0007	0.0006	0.0007	0.0011	0.0002	0.0003	0.0011	0.0010	0.0002	0.0009	0.0002	-0.0001	0.0000	0.0005	0.0002	0.0004	0.0004	0.0067	-0.0301
AM	0.0003	0.0001	-0.0109	0.0012	0.0006	0.0003	0.0000	0.0001	0.0001	0.0000	-0.0001	0.0000	0.0001	-0.0001	0.0000	-0.0002	-0.0014	-0.0001	-0.0025	-0.0011	-0.0006	-0.0004	-0.0008	-0.0003	-0.0002	-0.0002	0.0000	-0.0160
RR	0.0008	0.0005	0.0082	-0.1363	0.0010	0.0003	0.0001	0.0005	0.0001	-0.0002	0.0001	0.0002	0.0001	0.0000	0.0000	-0.0002	-0.0011	-0.0001	-0.0019	-0.0015	-0.0007	-0.0005	-0.0005	-0.0001	0.0001	-0.0001	0.0029	-0.1283
PA	0.0007	0.0003	0.0009	0.0007	-0.0263	0.0016	0.0008	0.0010	0.0015	0.0016	0.0012	0.0013	0.0021	0.0003	0.0004	0.0014	0.0022	0.0004	0.0044	0.0020	0.0006	0.0007	0.0015	0.0004	0.0004	0.0007	0.0116	0.0144
AP	0.0004	0.0004	0.0009	0.0006	0.0025	-0.1188	0.0004	0.0015	0.0014	0.0010	0.0011	0.0011	0.0014	0.0002	0.0003	0.0014	0.0001	0.0002	-0.0002	-0.0007	-0.0005	-0.0003	-0.0001	0.0000	0.0001	0.0002	0.0134	-0.0920
TO	0.0005	0.0002	0.0009	0.0005	0.0037	0.0009	-0.0258	0.0028	0.0015	0.0017	0.0014	0.0014	0.0024	0.0004	0.0006	0.0035	0.0032	0.0006	0.0059	0.0022	0.0007	0.0008	0.0016	0.0005	0.0005	0.0011	0.0168	0.0306
MA	0.0003	0.0001	0.0004	0.0003	0.0039	0.0008	0.0007	-0.0218	0.0030	0.0018	0.0011	0.0012	0.0017	0.0003	0.0004	0.0014	0.0001	0.0002	-0.0006	-0.0003	-0.0004	-0.0002	-0.0004	0.0000	0.0001	0.0002	0.0065	0.0006
PI	0.0003	0.0001	0.0004	0.0005	0.0027	0.0010	0.0005	0.0043	-0.0278	0.0033	0.0025	0.0020	0.0026	0.0004	0.0006	0.0023	0.0003	0.0002	0.0006	-0.0002	-0.0002	-0.0001	0.0000	0.0000	0.0001	0.0002	0.0078	0.0044
CE	0.0004	0.0002	0.0007	0.0005	0.0026	0.0009	0.0004	0.0033	0.0036	-0.0330	0.0031	0.0040	0.0067	0.0005	0.0004	0.0032	0.0013	0.0003	0.0013	0.0007	0.0000	0.0002	0.0006	0.0002	0.0002	0.0005	0.0114	0.0141
RN	0.0002	0.0001	0.0004	0.0004	0.0011	0.0005	0.0001	0.0012	0.0013	0.0037	-0.0444	0.0100	0.0069	0.0005	0.0005	0.0021	0.0001	0.0001	0.0014	0.0002	-0.0001	0.0001	0.0003	0.0000	0.0000	0.0001	0.0047	-0.0085
PB	0.0002	0.0001	0.0003	0.0003	0.0012	0.0005	0.0002	0.0013	0.0012	0.0022	0.0061	-0.0409	0.0092	0.0008	0.0008	0.0024	0.0004	0.0001	0.0003	-0.0001	-0.0002	-0.0001	0.0001	0.0000	0.0001	0.0002	0.0043	-0.0088
PE	0.0003	0.0001	0.0004	0.0003	0.0013	0.0005	0.0002	0.0016	0.0019	0.0022	0.0041	0.0076	-0.0325	0.0012	0.0009	0.0037	0.0009	0.0003	0.0012	0.0005	0.0000	0.0001	0.0004	0.0001	0.0001	0.0003	0.0076	0.0054
AL	0.0003	0.0002	0.0005	0.0003	0.0011	0.0005	0.0002	0.0012	0.0010	0.0015	0.0017	0.0032	0.0057	-0.0230	0.0013	0.0043	0.0006	0.0002	0.0000	-0.0001	-0.0002	-0.0001	-0.0001	0.0000	0.0002	0.0003	0.0082	0.0090
SE	0.0002	0.0001	0.0003	0.0003	0.0012	0.0004	0.0002	0.0010	0.0009	0.0013	0.0013	0.0019	0.0033	0.0009	-0.0299	0.0034	0.0000	0.0002	-0.0004	-0.0005	-0.0003	-0.0002	-0.0001	-0.0001	0.0000	0.0001	0.0050	-0.0094
BA	0.0002	0.0001	0.0003	0.0003	0.0008	0.0004	0.0002	0.0007	0.0010	0.0012	0.0008	0.0009	0.0019	0.0004	0.0012	-0.0170	0.0022	0.0008	0.0030	0.0010	0.0002	0.0003	0.0009	0.0003	0.0003	0.0008	0.0182	0.0210
MG	0.0004	0.0002	0.0005	0.0004	0.0011	0.0005	0.0003	0.0007	0.0005	0.0008	0.0007	0.0007	0.0012	0.0003	0.0004	0.0014	-0.0209	0.0004	0.0033	0.0016	0.0004	0.0006	0.0009	0.0005	0.0004	0.0014	0.0123	0.0110
ES	0.0001	0.0001	0.0003	0.0002	0.0009	0.0002	0.0001	0.0007	0.0006	0.0004	0.0004	0.0006	0.0008	0.0002	0.0003	0.0025	0.0023	-0.0143	0.0054	0.0006	0.0000	0.0002	0.0002	0.0001	0.0002	0.0004	0.0069	0.0103
RJ	0.0003	0.0001	0.0003	0.0003	0.0005	0.0003	0.0002	0.0004	0.0004	0.0004	0.0005	0.0006	0.0008	0.0002	0.0002	0.0014	0.0038	0.0004	-0.0436	0.0021	0.0007	0.0009	0.0014	0.0005	0.0004	0.0007	0.0111	-0.0147
SP	0.0006	0.0002	0.0007	0.0005	0.0012	0.0005	0.0004	0.0008	0.0006	0.0010	0.0009	0.0010	0.0016	0.0004	0.0004	0.0022	0.0054	0.0006	0.0092	-0.0080	0.0018	0.0014	0.0028	0.0013	0.0007	0.0007	0.0094	0.0385
PR	0.0004	0.0002	0.0005	0.0003	0.0007	0.0003	0.0002	0.0004	0.0003	0.0006	0.0005	0.0006	0.0009	0.0002	0.0002	0.0012	0.0026	0.0004	0.0059	0.0036	-0.0104	0.0016	0.0019	0.0007	0.0004	0.0006	0.0080	0.0229
SC	0.0001	0.0000	0.0003	0.0002	0.0003	0.0002	0.0002	0.0005	0.0003	0.0001	0.0001	0.0004	0.0003	0.0001	0.0001	0.0008	0.0015	0.0001	0.0018	0.0019	0.0012	-0.0155	0.0031	0.0004	0.0003	0.0004	0.0048	0.0039
RS	0.0005	0.0002	0.0006	0.0005	0.0011	0.0005	0.0003	0.0010	0.0007	0.0009	0.0007	0.0009	0.0013	0.0003	0.0003	0.0016	0.0029	0.0005	0.0054	0.0028	0.0012	0.0013	-0.0196	0.0007	0.0005	0.0007	0.0097	0.0173
MS	0.0006	0.0003	0.0008	0.0006	0.0013	0.0006	0.0003	0.0008	0.0006	0.0009	0.0008	0.0009	0.0014	0.0003	0.0003	0.0016	0.0029	0.0006	0.0064	0.0034	0.0011	0.0012	0.0023	-0.0178	0.0006	0.0010	0.0110	0.0245
MT	0.0016	0.0006	0.0018	0.0011	0.0025	0.0010	0.0005	0.0015	0.0010	0.0019	0.0016	0.0017	0.0028	0.0006	0.0006	0.0034	0.0056	0.0009	0.0107	0.0045	0.0017	0.0017	0.0033	0.0011	-0.0131	0.0016	0.0202	0.0622
GO	0.0005	0.0002	0.0007	0.0006	0.0015	0.0006	0.0004	0.0010	0.0007	0.0010	0.0008	0.0008	0.0015	0.0003	0.0004	0.0013	0.0037	0.0006	0.0055	0.0028	0.0006	0.0008	0.0015	0.0005	0.0006	-0.0124	0.0267	0.0433
DF	0.0005	0.0002	0.0003	0.0005	0.0011	0.0007	0.0004	0.0009	0.0006	0.0008	0.0006	0.0009	0.0011	0.0002	0.0004	0.0004	-0.0007	0.0001	-0.0047	-0.0022	-0.0010	-0.0007	-0.0012	-0.0003	0.0000	0.0012	-0.1601	-0.1600

Source: Elaborated by the authors

Table 32. Impact on Imports Volume in Interregional Trade, by Destination of Imports: Brazil, 2015 (in percentage change)

Destination of imports	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0756	0.0005	-0.0001	0.0000	-0.0009	-0.0004	-0.0003	-0.0007	-0.0005	-0.0010	-0.0007	-0.0009	-0.0015	-0.0004	-0.0004	-0.0017	-0.0028	-0.0006	-0.0049	-0.0029	-0.0006	-0.0006	-0.0006	-0.0004	-0.0007	-0.0010	-0.0129	**0.0385**
AC	0.0007	0.1130	0.0004	0.0000	-0.0008	0.0000	-0.0002	-0.0003	-0.0003	-0.0006	-0.0005	-0.0007	-0.0011	-0.0003	-0.0003	-0.0012	-0.0034	-0.0004	-0.0040	-0.0032	-0.0010	-0.0007	-0.0009	-0.0008	-0.0008	-0.0010	-0.0114	**0.0802**
AM	-0.0006	-0.0003	0.0531	-0.0003	-0.0010	-0.0004	-0.0005	-0.0010	-0.0007	-0.0016	-0.0013	-0.0013	-0.0022	-0.0006	-0.0006	-0.0028	-0.0065	-0.0010	-0.0113	-0.0063	-0.0023	-0.0019	-0.0037	-0.0013	-0.0015	-0.0016	-0.0166	**-0.0160**
RR	-0.0003	-0.0002	0.0020	0.3192	-0.0008	-0.0005	-0.0003	-0.0005	-0.0006	-0.0012	-0.0009	-0.0009	-0.0017	-0.0004	-0.0005	-0.0019	-0.0041	-0.0006	-0.0053	-0.0040	-0.0011	-0.0010	-0.0011	-0.0008	-0.0009	-0.0014	-0.0183	**0.2722**
PA	-0.0005	-0.0002	-0.0009	-0.0005	0.0569	-0.0002	-0.0004	-0.0015	-0.0006	-0.0015	-0.0012	-0.0013	-0.0023	-0.0005	-0.0006	-0.0025	-0.0055	-0.0010	-0.0097	-0.0052	-0.0019	-0.0017	-0.0032	-0.0011	-0.0010	-0.0013	-0.0150	**-0.0043**
AP	-0.0003	-0.0001	-0.0006	-0.0003	-0.0006	0.2245	-0.0002	-0.0005	-0.0001	-0.0009	-0.0003	-0.0005	-0.0012	-0.0003	-0.0003	-0.0013	-0.0024	-0.0005	-0.0022	-0.0023	-0.0005	-0.0006	-0.0006	-0.0005	-0.0007	-0.0010	-0.0141	**0.1914**
TO	-0.0002	-0.0001	-0.0002	-0.0002	0.0005	0.0001	0.0556	0.0008	0.0001	-0.0005	-0.0002	-0.0005	-0.0008	-0.0002	-0.0002	-0.0003	-0.0033	-0.0004	-0.0050	-0.0040	-0.0011	-0.0011	-0.0019	-0.0007	-0.0005	-0.0009	-0.0024	**0.0325**
MA	-0.0003	-0.0002	-0.0005	-0.0004	0.0026	-0.0001	0.0000	0.0532	0.0026	-0.0010	0.0002	-0.0004	-0.0016	-0.0004	-0.0003	-0.0015	-0.0029	-0.0007	-0.0007	-0.0026	-0.0005	-0.0008	-0.0010	-0.0005	-0.0007	-0.0011	-0.0118	**0.0287**
PI	-0.0001	-0.0001	-0.0002	0.0000	0.0006	0.0003	-0.0001	0.0017	0.0774	-0.0002	0.0013	-0.0002	-0.0014	-0.0001	-0.0001	-0.0006	-0.0031	-0.0004	-0.0044	-0.0032	-0.0010	-0.0009	-0.0018	-0.0006	-0.0005	-0.0008	-0.0076	**0.0539**
CE	-0.0002	-0.0001	-0.0003	-0.0002	0.0001	0.0000	-0.0001	0.0007	0.0013	0.0549	0.0005	0.0009	0.0015	-0.0003	-0.0004	-0.0007	-0.0027	-0.0005	-0.0059	-0.0030	-0.0008	-0.0009	-0.0016	-0.0005	-0.0005	-0.0007	-0.0078	**0.0330**
RN	-0.0002	-0.0001	-0.0001	-0.0002	-0.0005	0.0001	-0.0003	0.0005	0.0001	0.0036	0.0970	0.0032	0.0002	-0.0003	-0.0003	-0.0003	-0.0039	-0.0001	-0.0067	-0.0034	-0.0014	-0.0011	-0.0021	-0.0008	-0.0006	-0.0009	-0.0034	**0.0780**
PB	0.0001	-0.0001	-0.0002	-0.0002	-0.0001	0.0002	-0.0002	0.0009	0.0002	0.0004	0.0021	0.0996	0.0005	0.0010	-0.0002	-0.0001	-0.0026	0.0000	-0.0051	-0.0027	-0.0010	-0.0008	-0.0016	-0.0005	-0.0004	-0.0006	-0.0014	**0.0873**
PE	-0.0001	-0.0001	-0.0003	-0.0001	-0.0001	0.0000	-0.0001	0.0006	0.0008	0.0000	0.0018	0.0036	0.0659	0.0007	0.0000	0.0008	-0.0026	-0.0003	-0.0053	-0.0027	-0.0010	-0.0009	-0.0016	-0.0005	-0.0004	-0.0006	-0.0050	**0.0525**
AL	-0.0003	-0.0001	-0.0004	-0.0003	-0.0003	-0.0002	-0.0002	-0.0002	0.0002	-0.0004	0.0012	0.0015	0.0020	0.0460	0.0002	0.0002	-0.0021	-0.0006	-0.0056	-0.0032	-0.0012	-0.0012	-0.0015	-0.0004	-0.0005	-0.0008	-0.0073	**0.0247**
SE	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	0.0000	-0.0002	0.0001	0.0001	0.0001	0.0003	0.0001	0.0003	0.0006	0.0683	-0.0004	-0.0034	-0.0003	-0.0048	-0.0032	-0.0012	-0.0010	-0.0016	-0.0006	-0.0006	-0.0009	-0.0074	**0.0439**
BA	-0.0006	-0.0002	-0.0007	-0.0004	-0.0011	-0.0005	-0.0004	-0.0008	-0.0003	-0.0010	-0.0009	-0.0012	-0.0021	-0.0005	0.0001	0.0444	-0.0034	-0.0005	-0.0078	-0.0047	-0.0017	-0.0015	-0.0021	-0.0007	-0.0007	-0.0007	0.0001	**0.0099**
MG	-0.0004	-0.0001	-0.0005	-0.0003	-0.0008	-0.0003	-0.0003	-0.0006	-0.0005	-0.0009	-0.0007	-0.0009	-0.0014	-0.0003	-0.0003	-0.0020	0.0452	-0.0007	-0.0117	-0.0056	-0.0019	-0.0015	-0.0030	-0.0008	-0.0006	-0.0005	-0.0081	**0.0005**
ES	-0.0006	-0.0002	-0.0007	-0.0005	-0.0010	-0.0005	-0.0003	-0.0006	-0.0005	-0.0013	-0.0011	-0.0011	-0.0019	-0.0004	-0.0005	-0.0017	-0.0042	0.0302	-0.0051	-0.0054	-0.0022	-0.0017	-0.0035	-0.0010	-0.0008	-0.0012	-0.0128	**-0.0206**
RJ	-0.0004	-0.0002	-0.0006	-0.0004	-0.0011	-0.0004	-0.0003	-0.0007	-0.0005	-0.0010	-0.0009	-0.0008	-0.0016	-0.0003	-0.0004	-0.0015	-0.0025	-0.0004	0.0806	-0.0033	-0.0016	-0.0010	-0.0023	-0.0007	-0.0005	-0.0007	-0.0019	**0.0547**
SP	-0.0004	-0.0002	-0.0006	-0.0003	-0.0011	-0.0004	-0.0002	-0.0008	-0.0006	-0.0011	-0.0009	-0.0010	-0.0017	-0.0003	-0.0004	-0.0020	-0.0039	-0.0007	-0.0099	0.0078	-0.0018	-0.0016	-0.0029	-0.0006	-0.0006	-0.0012	-0.0129	**-0.0405**
PR	-0.0003	-0.0002	-0.0006	-0.0004	-0.0012	-0.0004	-0.0003	-0.0008	-0.0006	-0.0011	-0.0009	-0.0010	-0.0017	-0.0003	-0.0004	-0.0019	-0.0046	-0.0005	-0.0087	-0.0043	0.0195	-0.0010	-0.0028	-0.0008	-0.0006	-0.0008	-0.0058	**-0.0226**
SC	-0.0006	-0.0003	-0.0007	-0.0005	-0.0014	-0.0005	-0.0003	-0.0006	-0.0006	-0.0013	-0.0012	-0.0011	-0.0020	-0.0004	-0.0005	-0.0022	-0.0052	-0.0008	-0.0121	-0.0049	-0.0018	0.0315	-0.0021	-0.0010	-0.0007	-0.0010	-0.0086	**-0.0209**
RS	-0.0004	-0.0002	-0.0005	-0.0003	-0.0012	-0.0003	-0.0003	-0.0005	-0.0006	-0.0011	-0.0009	-0.0009	-0.0017	-0.0004	-0.0004	-0.0021	-0.0056	-0.0007	-0.0124	-0.0065	-0.0022	-0.0018	0.0413	-0.0011	-0.0006	-0.0010	-0.0130	**-0.0156**
MS	0.0000	0.0000	-0.0002	-0.0001	-0.0004	-0.0001	-0.0002	-0.0004	-0.0003	-0.0007	-0.0005	-0.0007	-0.0011	-0.0002	-0.0002	-0.0015	-0.0041	-0.0004	-0.0078	-0.0044	-0.0015	-0.0010	-0.0019	0.0520	-0.0003	-0.0005	-0.0044	**0.0191**
MT	0.0001	0.0000	0.0000	-0.0001	-0.0006	-0.0002	-0.0002	-0.0005	-0.0004	-0.0008	-0.0007	-0.0008	-0.0014	-0.0003	-0.0003	-0.0016	-0.0044	-0.0006	-0.0091	-0.0051	-0.0018	-0.0015	-0.0027	-0.0008	0.0268	-0.0008	-0.0071	**-0.0148**
GO	-0.0001	-0.0001	-0.0002	0.0000	-0.0002	0.0000	-0.0001	-0.0002	-0.0002	-0.0005	-0.0003	-0.0005	-0.0008	-0.0002	-0.0002	-0.0014	-0.0029	-0.0003	-0.0054	-0.0020	-0.0013	-0.0009	-0.0017	-0.0006	-0.0004	0.0258	0.0064	**0.0120**
DF	0.0007	0.0001	0.0002	0.0001	0.0013	0.0006	0.0003	0.0008	0.0004	0.0011	0.0011	0.0008	0.0017	0.0004	0.0005	0.0000	0.0033	0.0006	0.0055	0.0024	0.0003	0.0011	0.0015	0.0003	0.0005	0.0024	0.4041	**0.4321**

Source: Elaborated by the authors

Table 33. Impact on Domestic Terms of Trade, by Region: Brazil, 2015 (in percentage change)

Region	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0168	0.0003	0.0000	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0004	0.0007	0.0001	0.0019	0.0004	0.0002	0.0004	0.0006	0.0000	-0.0001	-0.0001	-0.0021	**0.0198**
AC	0.0001	0.0320	0.0001	0.0000	-0.0004	0.0000	-0.0001	-0.0002	-0.0001	-0.0002	-0.0002	-0.0002	-0.0004	-0.0002	-0.0001	-0.0004	-0.0018	-0.0002	-0.0016	-0.0021	-0.0007	-0.0005	-0.0008	-0.0006	-0.0005	-0.0006	-0.0088	**0.0113**
AM	-0.0009	-0.0004	0.0062	-0.0008	-0.0019	-0.0008	-0.0005	-0.0014	-0.0010	-0.0021	-0.0018	-0.0018	-0.0031	-0.0007	-0.0008	-0.0034	-0.0078	-0.0012	-0.0148	-0.0079	-0.0030	-0.0026	-0.0051	-0.0016	-0.0015	-0.0018	-0.0197	**-0.0826**
RR	-0.0003	-0.0001	0.0004	0.0896	-0.0006	-0.0003	-0.0002	-0.0004	-0.0004	-0.0007	-0.0005	-0.0005	-0.0009	-0.0002	-0.0003	-0.0011	-0.0027	-0.0004	-0.0034	-0.0032	-0.0010	-0.0009	-0.0015	-0.0006	-0.0006	-0.0009	-0.0113	**0.0571**
PA	-0.0004	-0.0002	-0.0008	-0.0004	0.0140	-0.0002	-0.0003	-0.0011	-0.0004	-0.0010	-0.0008	-0.0008	-0.0015	-0.0004	-0.0004	-0.0017	-0.0037	-0.0007	-0.0063	-0.0038	-0.0014	-0.0012	-0.0025	-0.0008	-0.0007	-0.0010	-0.0127	**-0.0310**
AP	0.0001	0.0000	-0.0002	0.0000	0.0001	0.0846	0.0000	0.0001	0.0002	0.0000	0.0002	0.0002	0.0003	0.0000	0.0000	0.0004	0.0006	0.0001	0.0031	0.0004	0.0004	0.0003	0.0006	0.0000	-0.0001	-0.0001	-0.0041	**0.0873**
TO	-0.0001	0.0000	0.0000	-0.0001	0.0004	0.0001	0.0142	0.0003	0.0001	-0.0001	0.0000	-0.0001	-0.0002	-0.0001	0.0000	0.0004	-0.0012	-0.0001	-0.0018	-0.0022	-0.0006	-0.0005	-0.0010	-0.0003	-0.0003	-0.0004	-0.0030	**0.0032**
MA	-0.0003	-0.0001	-0.0004	-0.0002	0.0008	-0.0001	-0.0001	0.0154	0.0008	-0.0008	-0.0003	-0.0005	-0.0013	-0.0003	-0.0003	-0.0010	-0.0024	-0.0005	-0.0023	-0.0024	-0.0007	-0.0009	-0.0016	-0.0005	-0.0005	-0.0008	-0.0098	**-0.0109**
PI	-0.0002	-0.0001	-0.0004	-0.0001	-0.0004	-0.0001	-0.0002	-0.0004	0.0176	-0.0011	0.0000	-0.0006	-0.0017	-0.0003	-0.0003	-0.0012	-0.0028	-0.0005	-0.0049	-0.0030	-0.0010	-0.0010	-0.0020	-0.0006	-0.0004	-0.0007	-0.0094	**-0.0158**
CE	0.0000	0.0000	0.0000	0.0001	0.0005	0.0002	0.0000	0.0006	0.0008	0.0199	0.0003	0.0007	0.0012	0.0000	-0.0001	0.0003	-0.0002	0.0000	-0.0003	-0.0005	0.0000	0.0000	-0.0001	0.0000	-0.0001	-0.0001	-0.0026	**0.0208**
RN	-0.0002	-0.0001	-0.0003	-0.0001	-0.0005	-0.0001	-0.0002	-0.0001	-0.0002	0.0007	0.0264	0.0010	-0.0009	-0.0004	-0.0003	-0.0007	-0.0026	-0.0002	-0.0041	-0.0025	-0.0010	-0.0007	-0.0015	-0.0005	-0.0004	-0.0006	-0.0062	**0.0039**
PB	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0001	-0.0001	0.0002	0.0000	-0.0002	0.0002	0.0242	-0.0008	0.0000	-0.0001	0.0001	-0.0008	0.0000	-0.0014	-0.0011	-0.0003	-0.0003	-0.0007	-0.0002	-0.0002	-0.0002	-0.0027	**0.0157**
PE	0.0000	0.0000	-0.0001	0.0000	0.0002	0.0001	0.0000	0.0004	0.0004	0.0000	0.0009	0.0018	0.0193	0.0002	0.0001	0.0008	-0.0004	0.0000	-0.0009	-0.0006	-0.0002	-0.0002	-0.0003	-0.0001	-0.0001	-0.0001	-0.0024	**0.0187**
AL	-0.0002	0.0000	-0.0002	-0.0002	-0.0002	-0.0001	-0.0001	0.0000	0.0002	0.0000	0.0008	0.0011	0.0014	0.0155	0.0002	0.0007	-0.0015	-0.0003	-0.0037	-0.0024	-0.0009	-0.0008	-0.0012	-0.0003	-0.0003	-0.0005	-0.0069	**-0.0001**
SE	-0.0001	-0.0001	-0.0002	-0.0001	-0.0002	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0001	0.0180	-0.0006	-0.0023	-0.0002	-0.0034	-0.0023	-0.0009	-0.0007	-0.0013	-0.0004	-0.0004	-0.0006	-0.0072	**-0.0034**
BA	-0.0005	-0.0002	-0.0007	-0.0004	-0.0011	-0.0005	-0.0003	-0.0008	-0.0005	-0.0011	-0.0010	-0.0011	-0.0021	-0.0005	-0.0003	0.0086	-0.0039	-0.0007	-0.0083	-0.0045	-0.0017	-0.0015	-0.0026	-0.0008	-0.0007	-0.0008	-0.0070	**-0.0345**
MG	-0.0002	-0.0001	-0.0003	-0.0001	-0.0004	-0.0002	-0.0001	-0.0003	-0.0002	-0.0004	-0.0003	-0.0004	-0.0007	-0.0002	-0.0002	-0.0010	0.0099	-0.0004	-0.0062	-0.0031	-0.0010	-0.0008	-0.0015	-0.0004	-0.0003	-0.0003	-0.0061	**-0.0154**
ES	-0.0004	-0.0001	-0.0005	-0.0003	-0.0007	-0.0003	-0.0002	-0.0004	-0.0003	-0.0008	-0.0007	-0.0007	-0.0012	-0.0003	-0.0003	-0.0013	-0.0029	0.0081	-0.0047	-0.0036	-0.0014	-0.0011	-0.0023	-0.0007	-0.0005	-0.0007	-0.0093	**-0.0275**
RJ	-0.0002	-0.0001	-0.0003	-0.0002	-0.0005	-0.0002	-0.0001	-0.0003	-0.0002	-0.0004	-0.0003	-0.0003	-0.0006	-0.0001	-0.0002	-0.0007	-0.0011	-0.0003	0.0224	-0.0019	-0.0008	-0.0004	-0.0010	-0.0003	-0.0002	-0.0003	-0.0020	**0.0093**
SP	0.0002	0.0001	0.0002	0.0002	0.0005	0.0002	0.0001	0.0003	0.0002	0.0005	0.0004	0.0004	0.0007	0.0002	0.0001	0.0008	0.0016	0.0002	0.0016	0.0060	0.0004	0.0004	0.0008	0.0004	0.0002	0.0001	0.0004	**0.0174**
PR	-0.0001	-0.0001	-0.0002	-0.0001	-0.0004	-0.0001	-0.0001	-0.0003	-0.0002	-0.0004	-0.0003	-0.0003	-0.0005	-0.0001	-0.0001	-0.0006	-0.0016	-0.0002	-0.0032	-0.0020	0.0055	-0.0005	-0.0011	-0.0003	-0.0002	-0.0002	-0.0022	**-0.0099**
SC	-0.0002	-0.0001	-0.0003	-0.0001	-0.0004	-0.0002	-0.0001	-0.0002	-0.0002	-0.0004	-0.0003	-0.0003	-0.0006	-0.0001	-0.0001	-0.0006	-0.0018	-0.0003	-0.0046	-0.0021	-0.0008	0.0083	-0.0008	-0.0004	-0.0003	-0.0003	-0.0044	**-0.0118**
RS	-0.0002	-0.0001	-0.0003	-0.0001	-0.0005	-0.0002	-0.0001	-0.0003	-0.0002	-0.0004	-0.0004	-0.0003	-0.0007	-0.0002	-0.0002	-0.0010	-0.0024	-0.0003	-0.0058	-0.0033	-0.0011	-0.0011	0.0106	-0.0006	-0.0003	-0.0005	-0.0069	**-0.0167**
MS	-0.0002	-0.0001	-0.0003	-0.0002	-0.0005	-0.0002	-0.0002	-0.0004	-0.0003	-0.0006	-0.0004	-0.0005	-0.0008	-0.0002	-0.0002	-0.0011	-0.0027	-0.0003	-0.0053	-0.0034	-0.0012	-0.0008	-0.0015	0.0103	-0.0003	-0.0004	-0.0053	**-0.0172**
MT	0.0001	0.0000	0.0001	0.0000	-0.0001	-0.0001	-0.0001	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003	-0.0006	-0.0002	-0.0001	-0.0006	-0.0022	-0.0003	-0.0051	-0.0032	-0.0011	-0.0009	-0.0016	-0.0005	0.0071	-0.0004	-0.0041	**-0.0152**
GO	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	-0.0001	0.0000	-0.0001	-0.0001	0.0000	0.0000	-0.0005	-0.0011	-0.0001	-0.0019	-0.0006	-0.0005	-0.0003	-0.0006	-0.0002	-0.0001	0.0073	0.0015	**0.0027**
DF	0.0005	0.0002	0.0005	0.0003	0.0015	0.0005	0.0003	0.0009	0.0007	0.0012	0.0011	0.0010	0.0018	0.0004	0.0004	0.0009	0.0040	0.0006	0.0076	0.0035	0.0011	0.0013	0.0024	0.0006	0.0004	0.0012	0.1305	**0.1652**

Source: Elaborated by the authors

Table 34. Impact on Exports Volume in International Trade, by Origin of Exports: Brazil, 2015 (in percentage change)

Origin of exports	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	-0.0109	-0.0013	-0.0032	-0.0020	-0.0056	-0.0024	-0.0012	-0.0035	-0.0026	-0.0054	-0.0046	-0.0047	-0.0083	-0.0018	-0.0018	-0.0089	-0.0189	-0.0031	-0.0384	-0.0183	-0.0073	-0.0066	-0.0122	-0.0036	-0.0030	-0.0041	-0.0432	**-0.2270**
AC	-0.0033	-0.0159	-0.0031	-0.0020	-0.0055	-0.0025	-0.0012	-0.0035	-0.0026	-0.0052	-0.0045	-0.0046	-0.0082	-0.0018	-0.0018	-0.0089	-0.0188	-0.0031	-0.0392	-0.0181	-0.0072	-0.0065	-0.0120	-0.0035	-0.0028	-0.0040	-0.0415	**-0.2312**
AM	-0.0025	-0.0011	-0.0121	-0.0027	-0.0058	-0.0025	-0.0012	-0.0035	-0.0026	-0.0053	-0.0046	-0.0046	-0.0082	-0.0018	-0.0018	-0.0089	-0.0184	-0.0030	-0.0375	-0.0178	-0.0071	-0.0065	-0.0119	-0.0035	-0.0029	-0.0040	-0.0430	**-0.2250**
RR	-0.0031	-0.0011	-0.0063	-0.0680	-0.0062	-0.0027	-0.0012	-0.0038	-0.0027	-0.0057	-0.0051	-0.0052	-0.0091	-0.0019	-0.0019	-0.0093	-0.0192	-0.0033	-0.0415	-0.0185	-0.0073	-0.0067	-0.0126	-0.0036	-0.0028	-0.0041	-0.0420	**-0.2947**
PA	-0.0012	-0.0005	-0.0015	-0.0010	-0.0066	-0.0014	-0.0007	-0.0020	-0.0015	-0.0029	-0.0025	-0.0025	-0.0045	-0.0010	-0.0010	-0.0047	-0.0098	-0.0016	-0.0201	-0.0095	-0.0038	-0.0034	-0.0063	-0.0018	-0.0015	-0.0022	-0.0234	**-0.1188**
AP	-0.0028	-0.0012	-0.0037	-0.0023	-0.0075	-0.0568	-0.0016	-0.0046	-0.0035	-0.0069	-0.0059	-0.0060	-0.0106	-0.0023	-0.0023	-0.0113	-0.0233	-0.0038	-0.0480	-0.0225	-0.0090	-0.0081	-0.0151	-0.0043	-0.0034	-0.0050	-0.0527	**-0.3247**
TO	-0.0017	-0.0007	-0.0022	-0.0014	-0.0049	-0.0020	-0.0063	-0.0033	-0.0022	-0.0044	-0.0037	-0.0038	-0.0066	-0.0014	-0.0015	-0.0073	-0.0142	-0.0024	-0.0297	-0.0136	-0.0053	-0.0049	-0.0089	-0.0026	-0.0020	-0.0032	-0.0353	**-0.1753**
MA	-0.0019	-0.0008	-0.0024	-0.0016	-0.0060	-0.0023	-0.0013	-0.0107	-0.0034	-0.0056	-0.0047	-0.0046	-0.0080	-0.0017	-0.0017	-0.0081	-0.0163	-0.0027	-0.0341	-0.0156	-0.0062	-0.0057	-0.0104	-0.0030	-0.0023	-0.0035	-0.0383	**-0.2027**
PI	-0.0016	-0.0006	-0.0019	-0.0013	-0.0045	-0.0020	-0.0009	-0.0037	-0.0100	-0.0055	-0.0046	-0.0041	-0.0072	-0.0015	-0.0015	-0.0071	-0.0129	-0.0023	-0.0277	-0.0123	-0.0048	-0.0044	-0.0080	-0.0023	-0.0018	-0.0028	-0.0309	**-0.1682**
CE	-0.0024	-0.0010	-0.0031	-0.0020	-0.0064	-0.0027	-0.0014	-0.0045	-0.0036	-0.0160	-0.0061	-0.0061	-0.0109	-0.0021	-0.0021	-0.0104	-0.0202	-0.0033	-0.0407	-0.0194	-0.0077	-0.0069	-0.0128	-0.0037	-0.0029	-0.0043	-0.0474	**-0.2500**
RN	-0.0026	-0.0011	-0.0034	-0.0022	-0.0069	-0.0030	-0.0014	-0.0049	-0.0037	-0.0093	-0.0242	-0.0104	-0.0143	-0.0025	-0.0024	-0.0117	-0.0216	-0.0038	-0.0456	-0.0209	-0.0082	-0.0075	-0.0138	-0.0039	-0.0031	-0.0046	-0.0527	**-0.2898**
PB	-0.0025	-0.0010	-0.0031	-0.0020	-0.0063	-0.0027	-0.0014	-0.0043	-0.0032	-0.0070	-0.0074	-0.0142	-0.0127	-0.0025	-0.0022	-0.0107	-0.0206	-0.0035	-0.0422	-0.0199	-0.0079	-0.0072	-0.0133	-0.0038	-0.0030	-0.0045	-0.0488	**-0.2580**
PE	-0.0026	-0.0011	-0.0034	-0.0022	-0.0067	-0.0028	-0.0015	-0.0046	-0.0036	-0.0074	-0.0071	-0.0081	-0.0199	-0.0028	-0.0025	-0.0117	-0.0217	-0.0036	-0.0445	-0.0209	-0.0082	-0.0074	-0.0137	-0.0040	-0.0031	-0.0047	-0.0519	**-0.2716**
AL	-0.0035	-0.0014	-0.0044	-0.0029	-0.0089	-0.0038	-0.0019	-0.0059	-0.0045	-0.0091	-0.0085	-0.0094	-0.0166	-0.0094	-0.0037	-0.0157	-0.0292	-0.0048	-0.0595	-0.0278	-0.0110	-0.0099	-0.0184	-0.0054	-0.0042	-0.0063	-0.0687	**-0.3549**
SE	-0.0032	-0.0013	-0.0041	-0.0027	-0.0082	-0.0036	-0.0018	-0.0055	-0.0041	-0.0083	-0.0073	-0.0077	-0.0140	-0.0034	-0.0161	-0.0153	-0.0270	-0.0046	-0.0553	-0.0258	-0.0102	-0.0093	-0.0171	-0.0049	-0.0039	-0.0058	-0.0641	**-0.3347**
BA	-0.0024	-0.0010	-0.0030	-0.0020	-0.0060	-0.0026	-0.0014	-0.0039	-0.0031	-0.0063	-0.0053	-0.0055	-0.0100	-0.0022	-0.0025	-0.0164	-0.0209	-0.0038	-0.0435	-0.0199	-0.0078	-0.0071	-0.0131	-0.0038	-0.0030	-0.0045	-0.0521	**-0.2532**
MG	-0.0017	-0.0007	-0.0022	-0.0014	-0.0042	-0.0018	-0.0009	-0.0027	-0.0020	-0.0041	-0.0035	-0.0036	-0.0063	-0.0014	-0.0014	-0.0070	-0.0193	-0.0024	-0.0302	-0.0143	-0.0056	-0.0051	-0.0092	-0.0027	-0.0021	-0.0033	-0.0347	**-0.1738**
ES	-0.0014	-0.0006	-0.0018	-0.0012	-0.0036	-0.0015	-0.0008	-0.0023	-0.0017	-0.0034	-0.0029	-0.0030	-0.0053	-0.0012	-0.0012	-0.0061	-0.0124	-0.0047	-0.0263	-0.0117	-0.0046	-0.0042	-0.0076	-0.0022	-0.0017	-0.0026	-0.0289	**-0.1448**
RJ	-0.0019	-0.0007	-0.0024	-0.0015	-0.0045	-0.0020	-0.0010	-0.0029	-0.0022	-0.0044	-0.0038	-0.0039	-0.0068	-0.0015	-0.0015	-0.0076	-0.0162	-0.0027	-0.0472	-0.0158	-0.0062	-0.0056	-0.0102	-0.0030	-0.0023	-0.0035	-0.0390	**-0.2004**
SP	-0.0025	-0.0010	-0.0031	-0.0020	-0.0060	-0.0026	-0.0014	-0.0038	-0.0028	-0.0057	-0.0049	-0.0050	-0.0089	-0.0019	-0.0020	-0.0099	-0.0211	-0.0034	-0.0434	-0.0232	-0.0084	-0.0074	-0.0134	-0.0040	-0.0030	-0.0044	-0.0473	**-0.2427**
PR	-0.0024	-0.0010	-0.0030	-0.0020	-0.0058	-0.0025	-0.0013	-0.0037	-0.0028	-0.0057	-0.0048	-0.0050	-0.0087	-0.0019	-0.0020	-0.0097	-0.0205	-0.0034	-0.0428	-0.0210	-0.0114	-0.0077	-0.0132	-0.0039	-0.0029	-0.0044	-0.0474	**-0.2409**
SC	-0.0025	-0.0010	-0.0031	-0.0020	-0.0060	-0.0026	-0.0014	-0.0039	-0.0029	-0.0058	-0.0049	-0.0051	-0.0089	-0.0019	-0.0020	-0.0099	-0.0209	-0.0034	-0.0427	-0.0207	-0.0086	-0.0129	-0.0142	-0.0039	-0.0031	-0.0045	-0.0489	**-0.2477**
RS	-0.0021	-0.0008	-0.0026	-0.0017	-0.0050	-0.0022	-0.0011	-0.0033	-0.0024	-0.0049	-0.0042	-0.0043	-0.0075	-0.0016	-0.0017	-0.0083	-0.0172	-0.0028	-0.0356	-0.0169	-0.0068	-0.0065	-0.0178	-0.0032	-0.0025	-0.0037	-0.0398	**-0.2065**
MS	-0.0022	-0.0009	-0.0027	-0.0018	-0.0053	-0.0023	-0.0012	-0.0034	-0.0025	-0.0051	-0.0044	-0.0045	-0.0079	-0.0017	-0.0018	-0.0087	-0.0184	-0.0030	-0.0385	-0.0186	-0.0072	-0.0066	-0.0118	-0.0083	-0.0027	-0.0040	-0.0426	**-0.2182**
MT	-0.0019	-0.0007	-0.0021	-0.0013	-0.0039	-0.0017	-0.0009	-0.0025	-0.0018	-0.0038	-0.0032	-0.0033	-0.0058	-0.0012	-0.0013	-0.0063	-0.0131	-0.0022	-0.0271	-0.0125	-0.0049	-0.0045	-0.0082	-0.0024	-0.0040	-0.0029	-0.0313	**-0.1547**
GO	-0.0024	-0.0010	-0.0030	-0.0020	-0.0060	-0.0026	-0.0014	-0.0038	-0.0028	-0.0058	-0.0049	-0.0050	-0.0089	-0.0019	-0.0020	-0.0096	-0.0213	-0.0034	-0.0419	-0.0197	-0.0076	-0.0070	-0.0126	-0.0038	-0.0030	-0.0079	-0.0558	**-0.2471**
DF	-0.0026	-0.0010	-0.0032	-0.0021	-0.0066	-0.0028	-0.0015	-0.0042	-0.0031	-0.0064	-0.0054	-0.0055	-0.0098	-0.0021	-0.0022	-0.0106	-0.0226	-0.0037	-0.0460	-0.0211	-0.0083	-0.0076	-0.0138	-0.0041	-0.0033	-0.0057	-0.1081	**-0.3134**

Source: Elaborated by the authors

Table 35. Impact on Imports Volume in International Trade, by Destination of Imports: Brazil, 2015 (in percentage change)

Destination	Goverment Spending																											
of imports	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0521	0.0013	0.0029	0.0017	0.0045	0.0019	0.0009	0.0027	0.0021	0.0041	0.0036	0.0036	0.0065	0.0014	0.0014	0.0069	0.0156	0.0024	0.0314	0.0155	0.0064	0.0057	0.0108	0.0031	0.0025	0.0032	0.0346	**0.2287**
AC	0.0036	0.0856	0.0036	0.0019	0.0050	0.0024	0.0011	0.0032	0.0024	0.0048	0.0041	0.0041	0.0074	0.0016	0.0016	0.0079	0.0167	0.0027	0.0346	0.0165	0.0067	0.0060	0.0114	0.0032	0.0025	0.0035	0.0379	**0.2819**
AM	0.0011	0.0004	0.0145	0.0012	0.0026	0.0011	0.0005	0.0014	0.0011	0.0021	0.0018	0.0018	0.0034	0.0007	0.0007	0.0034	0.0064	0.0011	0.0135	0.0065	0.0025	0.0024	0.0043	0.0012	0.0009	0.0014	0.0167	**0.0948**
RR	0.0023	0.0008	0.0053	0.2310	0.0050	0.0020	0.0010	0.0031	0.0022	0.0045	0.0040	0.0040	0.0071	0.0015	0.0015	0.0076	0.0162	0.0027	0.0344	0.0162	0.0066	0.0059	0.0115	0.0031	0.0024	0.0033	0.0328	**0.4181**
PA	0.0016	0.0006	0.0022	0.0013	0.0399	0.0019	0.0009	0.0025	0.0019	0.0038	0.0031	0.0032	0.0057	0.0012	0.0012	0.0059	0.0125	0.0021	0.0253	0.0123	0.0049	0.0044	0.0081	0.0023	0.0019	0.0027	0.0305	**0.1841**
AP	0.0019	0.0008	0.0027	0.0016	0.0053	0.1715	0.0011	0.0032	0.0026	0.0047	0.0042	0.0042	0.0072	0.0015	0.0016	0.0078	0.0167	0.0027	0.0353	0.0166	0.0068	0.0060	0.0115	0.0032	0.0023	0.0034	0.0353	**0.3615**
TO	0.0019	0.0007	0.0025	0.0015	0.0057	0.0022	0.0395	0.0039	0.0025	0.0046	0.0039	0.0039	0.0070	0.0015	0.0015	0.0080	0.0152	0.0025	0.0318	0.0147	0.0059	0.0054	0.0099	0.0028	0.0022	0.0033	0.0418	**0.2263**
MA	0.0017	0.0007	0.0024	0.0014	0.0065	0.0020	0.0013	0.0376	0.0043	0.0048	0.0044	0.0041	0.0071	0.0015	0.0015	0.0071	0.0150	0.0024	0.0330	0.0148	0.0061	0.0055	0.0105	0.0028	0.0021	0.0031	0.0347	**0.2184**
PI	0.0020	0.0008	0.0027	0.0017	0.0060	0.0025	0.0012	0.0053	0.0547	0.0064	0.0057	0.0048	0.0085	0.0018	0.0018	0.0088	0.0158	0.0028	0.0333	0.0154	0.0062	0.0057	0.0104	0.0029	0.0024	0.0034	0.0399	**0.2531**
CE	0.0019	0.0007	0.0025	0.0015	0.0052	0.0022	0.0011	0.0039	0.0035	0.0449	0.0053	0.0053	0.0094	0.0016	0.0015	0.0081	0.0153	0.0025	0.0303	0.0149	0.0060	0.0052	0.0099	0.0028	0.0022	0.0032	0.0375	**0.2285**
RN	0.0018	0.0007	0.0025	0.0015	0.0046	0.0021	0.0009	0.0036	0.0026	0.0078	0.0716	0.0076	0.0096	0.0017	0.0016	0.0080	0.0138	0.0026	0.0290	0.0139	0.0053	0.0049	0.0091	0.0025	0.0020	0.0030	0.0380	**0.2523**
PB	0.0022	0.0008	0.0026	0.0016	0.0052	0.0024	0.0011	0.0041	0.0028	0.0063	0.0081	0.0741	0.0124	0.0028	0.0018	0.0089	0.0160	0.0029	0.0329	0.0157	0.0062	0.0056	0.0103	0.0029	0.0023	0.0034	0.0423	**0.2778**
PE	0.0018	0.0007	0.0024	0.0015	0.0047	0.0020	0.0010	0.0035	0.0029	0.0054	0.0059	0.0074	0.0536	0.0025	0.0018	0.0085	0.0142	0.0024	0.0286	0.0140	0.0054	0.0049	0.0091	0.0026	0.0021	0.0031	0.0362	**0.2282**
AL	0.0019	0.0008	0.0024	0.0015	0.0049	0.0021	0.0010	0.0032	0.0028	0.0049	0.0054	0.0062	0.0111	0.0397	0.0022	0.0091	0.0165	0.0025	0.0322	0.0153	0.0060	0.0053	0.0103	0.0031	0.0022	0.0033	0.0385	**0.2345**
SE	0.0018	0.0007	0.0023	0.0014	0.0047	0.0020	0.0010	0.0032	0.0024	0.0047	0.0043	0.0044	0.0082	0.0024	0.0487	0.0088	0.0143	0.0026	0.0301	0.0139	0.0055	0.0050	0.0093	0.0026	0.0021	0.0030	0.0358	**0.2251**
BA	0.0013	0.0005	0.0018	0.0011	0.0034	0.0014	0.0008	0.0022	0.0018	0.0035	0.0030	0.0030	0.0056	0.0012	0.0016	0.0307	0.0121	0.0022	0.0248	0.0114	0.0045	0.0041	0.0078	0.0022	0.0017	0.0026	0.0333	**0.1696**
MG	0.0014	0.0006	0.0018	0.0011	0.0035	0.0015	0.0008	0.0022	0.0016	0.0033	0.0028	0.0028	0.0051	0.0011	0.0012	0.0055	0.0398	0.0020	0.0236	0.0116	0.0045	0.0042	0.0072	0.0022	0.0017	0.0028	0.0291	**0.1648**
ES	0.0012	0.0005	0.0016	0.0010	0.0032	0.0013	0.0007	0.0020	0.0015	0.0029	0.0025	0.0026	0.0046	0.0010	0.0010	0.0056	0.0111	0.0209	0.0256	0.0102	0.0040	0.0037	0.0066	0.0019	0.0015	0.0023	0.0258	**0.1471**
RJ	0.0014	0.0005	0.0018	0.0011	0.0033	0.0014	0.0008	0.0021	0.0016	0.0031	0.0027	0.0028	0.0049	0.0011	0.0011	0.0057	0.0124	0.0022	0.0871	0.0124	0.0046	0.0043	0.0075	0.0022	0.0018	0.0026	0.0323	**0.2048**
SP	0.0013	0.0005	0.0017	0.0011	0.0032	0.0014	0.0007	0.0020	0.0015	0.0030	0.0026	0.0026	0.0047	0.0010	0.0010	0.0053	0.0113	0.0018	0.0235	0.0194	0.0047	0.0041	0.0072	0.0022	0.0017	0.0023	0.0251	**0.1369**
PR	0.0014	0.0005	0.0018	0.0011	0.0033	0.0014	0.0007	0.0021	0.0015	0.0031	0.0027	0.0027	0.0048	0.0011	0.0011	0.0054	0.0113	0.0019	0.0238	0.0124	0.0192	0.0047	0.0075	0.0022	0.0017	0.0025	0.0286	**0.1506**
SC	0.0013	0.0005	0.0018	0.0011	0.0031	0.0014	0.0007	0.0022	0.0015	0.0030	0.0025	0.0027	0.0046	0.0010	0.0010	0.0053	0.0111	0.0018	0.0223	0.0117	0.0050	0.0247	0.0083	0.0021	0.0017	0.0024	0.0281	**0.1528**
RS	0.0014	0.0005	0.0019	0.0012	0.0033	0.0015	0.0008	0.0023	0.0016	0.0032	0.0028	0.0029	0.0050	0.0011	0.0011	0.0055	0.0109	0.0019	0.0224	0.0111	0.0045	0.0046	0.0323	0.0021	0.0018	0.0024	0.0262	**0.1561**
MS	0.0018	0.0007	0.0023	0.0014	0.0042	0.0019	0.0009	0.0026	0.0019	0.0038	0.0033	0.0033	0.0059	0.0013	0.0013	0.0065	0.0133	0.0023	0.0277	0.0140	0.0054	0.0051	0.0091	0.0380	0.0021	0.0030	0.0335	**0.1966**
MT	0.0019	0.0007	0.0023	0.0014	0.0040	0.0017	0.0008	0.0024	0.0018	0.0036	0.0031	0.0031	0.0055	0.0012	0.0012	0.0062	0.0125	0.0021	0.0255	0.0121	0.0048	0.0044	0.0081	0.0024	0.0191	0.0028	0.0321	**0.1669**
GO	0.0018	0.0007	0.0022	0.0015	0.0044	0.0019	0.0010	0.0028	0.0020	0.0040	0.0035	0.0035	0.0063	0.0014	0.0014	0.0067	0.0149	0.0024	0.0291	0.0143	0.0054	0.0051	0.0091	0.0026	0.0022	0.0222	0.0482	**0.2005**
DF	0.0029	0.0010	0.0032	0.0020	0.0069	0.0030	0.0017	0.0044	0.0031	0.0066	0.0058	0.0056	0.0103	0.0023	0.0025	0.0104	0.0229	0.0038	0.0466	0.0207	0.0079	0.0079	0.0138	0.0039	0.0036	0.0076	0.4050	**0.6153**

Source: Elaborated by the authors

Table 36. Impact on Real Household Consumption, by Region: Brazil, 2015 (in percentage change)

Region	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0962	0.0002	0.0001	0.0000	0.0003	0.0001	0.0000	0.0000	0.0001	0.0001	0.0003	0.0002	0.0002	0.0000	0.0000	0.0002	0.0016	0.0001	0.0043	0.0015	0.0013	0.0011	0.0025	0.0005	0.0000	-0.0001	-0.0036	**0.1072**
AC	0.0007	0.1112	0.0004	0.0000	0.0001	0.0003	0.0000	0.0002	0.0001	0.0002	0.0002	0.0001	0.0002	0.0001	0.0000	0.0003	0.0002	0.0001	0.0029	0.0005	0.0005	0.0005	0.0013	0.0000	-0.0002	-0.0002	-0.0027	**0.1167**
AM	-0.0003	-0.0002	0.0599	-0.0006	0.0000	0.0000	-0.0001	-0.0002	0.0000	-0.0002	-0.0001	-0.0001	-0.0002	-0.0001	-0.0001	-0.0004	-0.0010	-0.0002	-0.0003	-0.0010	0.0000	0.0000	-0.0002	-0.0002	-0.0005	-0.0004	-0.0050	**0.0486**
RR	0.0001	-0.0001	0.0012	0.3053	0.0000	-0.0001	-0.0001	0.0001	-0.0001	-0.0002	-0.0001	-0.0001	-0.0003	-0.0001	-0.0001	-0.0003	-0.0006	0.0000	0.0015	-0.0005	0.0002	0.0002	0.0010	-0.0001	-0.0004	-0.0006	-0.0093	**0.2967**
PA	0.0000	-0.0001	-0.0003	-0.0002	0.0716	0.0001	-0.0002	-0.0005	-0.0002	-0.0003	-0.0002	-0.0003	-0.0004	-0.0001	-0.0002	-0.0004	-0.0009	-0.0002	-0.0006	-0.0007	-0.0001	-0.0001	-0.0003	-0.0002	-0.0002	-0.0003	-0.0045	**0.0602**
AP	0.0000	0.0000	-0.0001	-0.0001	0.0003	0.2390	0.0000	0.0000	0.0003	0.0000	0.0004	0.0002	0.0002	0.0000	0.0000	0.0001	0.0010	0.0001	0.0047	0.0011	0.0009	0.0006	0.0016	0.0002	-0.0001	-0.0002	-0.0060	**0.2443**
TO	0.0002	0.0000	0.0002	0.0000	0.0009	0.0004	0.0760	0.0010	0.0003	0.0003	0.0005	0.0002	0.0004	0.0001	0.0001	0.0008	0.0000	0.0001	0.0023	-0.0006	0.0003	0.0002	0.0004	0.0000	-0.0001	-0.0003	0.0050	**0.0888**
MA	0.0000	0.0000	0.0000	-0.0001	0.0028	0.0002	0.0001	0.0619	0.0028	-0.0002	0.0011	0.0004	-0.0001	0.0000	0.0000	0.0000	0.0010	-0.0001	0.0077	0.0013	0.0012	0.0007	0.0018	0.0003	-0.0001	-0.0003	-0.0034	**0.0793**
PI	0.0003	0.0001	0.0002	0.0002	0.0012	0.0006	0.0001	0.0019	0.0881	0.0005	0.0017	0.0004	-0.0001	0.0002	0.0001	0.0006	0.0004	0.0002	0.0030	0.0003	0.0005	0.0004	0.0005	0.0000	0.0001	-0.0001	0.0008	**0.1020**
CE	0.0002	0.0001	0.0003	0.0002	0.0009	0.0004	0.0001	0.0009	0.0012	0.0660	0.0013	0.0013	0.0022	0.0001	0.0000	0.0009	0.0017	0.0002	0.0031	0.0015	0.0010	0.0006	0.0013	0.0004	0.0001	0.0002	0.0023	**0.0884**
RN	0.0003	0.0000	0.0005	0.0001	0.0005	0.0006	0.0000	0.0013	0.0006	0.0047	0.1170	0.0020	0.0009	0.0002	0.0000	0.0013	0.0001	0.0006	0.0013	0.0006	0.0002	0.0003	0.0005	0.0000	0.0000	0.0000	0.0074	**0.1407**
PB	0.0005	0.0000	0.0002	0.0000	0.0006	0.0006	0.0000	0.0014	0.0005	0.0012	0.0021	0.1136	0.0009	0.0014	0.0000	0.0010	0.0005	0.0005	0.0015	0.0005	0.0003	0.0003	0.0004	0.0001	0.0001	0.0000	0.0067	**0.1350**
PE	0.0004	0.0001	0.0003	0.0002	0.0008	0.0004	0.0001	0.0010	0.0008	0.0008	0.0018	0.0024	0.0849	0.0011	0.0002	0.0017	0.0015	0.0003	0.0031	0.0016	0.0007	0.0006	0.0011	0.0003	0.0002	0.0003	0.0043	**0.1108**
AL	0.0001	0.0000	0.0001	0.0000	0.0005	0.0002	0.0000	0.0001	0.0006	0.0003	0.0018	0.0018	0.0025	0.0562	0.0002	0.0007	0.0021	0.0000	0.0030	0.0010	0.0005	0.0003	0.0012	0.0004	0.0000	0.0000	0.0009	**0.0745**
SE	0.0003	0.0000	0.0003	0.0001	0.0007	0.0004	0.0000	0.0006	0.0004	0.0009	0.0009	0.0006	0.0013	0.0011	0.0864	0.0008	0.0005	0.0003	0.0033	0.0007	0.0004	0.0005	0.0009	0.0001	0.0000	-0.0001	0.0018	**0.1035**
BA	0.0000	0.0000	0.0000	0.0000	0.0002	0.0001	-0.0001	0.0000	0.0002	0.0002	0.0002	0.0000	-0.0001	0.0000	0.0003	0.0588	0.0015	0.0003	0.0032	0.0007	0.0004	0.0004	0.0013	0.0002	0.0000	0.0002	0.0082	**0.0761**
MG	0.0001	0.0000	0.0001	0.0000	0.0004	0.0002	0.0000	0.0001	0.0000	0.0003	0.0003	0.0001	0.0004	0.0001	0.0001	0.0001	0.0635	0.0001	-0.0006	-0.0001	0.0002	0.0003	0.0002	0.0000	0.0000	0.0003	0.0021	**0.0685**
ES	-0.0001	0.0000	-0.0001	-0.0001	0.0001	0.0000	-0.0001	0.0000	0.0000	-0.0001	0.0000	-0.0001	-0.0001	0.0000	-0.0001	-0.0003	0.0002	0.0464	0.0053	-0.0006	-0.0002	0.0000	-0.0004	-0.0001	-0.0001	-0.0002	-0.0026	**0.0466**
RJ	0.0002	0.0000	0.0001	0.0000	0.0002	0.0002	0.0000	0.0002	0.0001	0.0003	0.0002	0.0002	0.0004	0.0002	0.0001	0.0005	0.0014	0.0005	0.1230	0.0018	0.0003	0.0005	0.0004	0.0001	0.0002	0.0002	0.0105	**0.1418**
SP	0.0003	0.0001	0.0003	0.0002	0.0006	0.0003	0.0001	0.0003	0.0002	0.0005	0.0005	0.0004	0.0009	0.0002	0.0002	0.0008	0.0016	0.0003	0.0034	0.0218	0.0008	0.0008	0.0009	0.0003	0.0003	0.0003	0.0034	**0.0396**
PR	0.0003	0.0001	0.0002	0.0001	0.0004	0.0002	0.0000	0.0002	0.0001	0.0004	0.0003	0.0002	0.0006	0.0002	0.0001	0.0005	0.0006	0.0004	0.0019	0.0010	0.0356	0.0008	0.0004	0.0001	0.0001	0.0003	0.0075	**0.0526**
SC	0.0001	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000	0.0003	0.0001	0.0002	0.0001	0.0001	0.0002	0.0001	0.0000	0.0002	0.0000	0.0001	-0.0007	0.0004	0.0003	0.0452	0.0004	-0.0001	0.0001	0.0001	0.0048	**0.0523**
RS	0.0003	0.0001	0.0003	0.0002	0.0005	0.0004	0.0001	0.0004	0.0001	0.0005	0.0005	0.0005	0.0008	0.0002	0.0002	0.0008	0.0004	0.0003	0.0004	-0.0001	0.0003	0.0006	0.0561	0.0000	0.0003	0.0002	0.0008	**0.0652**
MS	0.0004	0.0001	0.0003	0.0001	0.0006	0.0004	0.0000	0.0003	0.0001	0.0004	0.0004	0.0002	0.0006	0.0002	0.0001	0.0003	-0.0002	0.0003	0.0003	-0.0005	0.0001	0.0004	0.0005	0.0799	0.0002	0.0003	0.0044	**0.0901**
MT	0.0004	0.0001	0.0004	0.0001	0.0005	0.0003	0.0000	0.0002	0.0001	0.0003	0.0004	0.0002	0.0005	0.0001	0.0001	0.0003	0.0000	0.0001	0.0002	-0.0008	0.0001	0.0002	0.0003	0.0000	0.0542	0.0000	0.0018	**0.0600**
GO	0.0003	0.0001	0.0003	0.0002	0.0008	0.0004	0.0001	0.0004	0.0002	0.0006	0.0006	0.0005	0.0010	0.0003	0.0002	0.0007	0.0015	0.0004	0.0038	0.0024	0.0006	0.0008	0.0012	0.0003	0.0003	0.0410	0.0140	**0.0729**
DF	0.0005	0.0001	0.0003	0.0002	0.0014	0.0005	0.0002	0.0007	0.0006	0.0009	0.0010	0.0008	0.0016	0.0004	0.0003	0.0007	0.0063	0.0007	0.0137	0.0057	0.0019	0.0020	0.0037	0.0010	0.0004	0.0014	0.3316	**0.3786**

Source: Elaborated by the authors

Table 37. Impact on the Aggregate Revenue from all Indirect Taxes, by Region: Brazil, 2015 (in percentage change)

Region	Goverment Spending																										
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0755	0.0017	0.0038	0.0023	0.0063	0.0026	0.0013	0.0038	0.0029	0.0058	0.0050	0.0051	0.0090	0.0019	0.0020	0.0097	0.0219	0.0034	0.0444	0.0216	0.0090	0.0080	0.0153	0.0043	0.0035	0.0045	0.0476	**0.3223**
AC	0.0045	0.1044	0.0043	0.0023	0.0064	0.0030	0.0014	0.0042	0.0030	0.0062	0.0053	0.0053	0.0094	0.0021	0.0021	0.0102	0.0214	0.0035	0.0447	0.0212	0.0086	0.0078	0.0147	0.0041	0.0032	0.0045	0.0485	**0.3565**
AM	0.0024	0.0010	0.0422	0.0026	0.0056	0.0024	0.0011	0.0032	0.0024	0.0048	0.0042	0.0042	0.0076	0.0016	0.0016	0.0080	0.0164	0.0027	0.0343	0.0162	0.0065	0.0060	0.0110	0.0032	0.0024	0.0035	0.0391	**0.2363**
RR	0.0029	0.0011	0.0063	0.2793	0.0064	0.0026	0.0013	0.0040	0.0029	0.0058	0.0051	0.0051	0.0090	0.0019	0.0020	0.0097	0.0207	0.0034	0.0442	0.0206	0.0084	0.0076	0.0147	0.0040	0.0030	0.0042	0.0419	**0.5181**
PA	0.0024	0.0009	0.0031	0.0019	0.0613	0.0028	0.0014	0.0038	0.0029	0.0057	0.0048	0.0048	0.0087	0.0019	0.0019	0.0091	0.0191	0.0032	0.0389	0.0187	0.0074	0.0068	0.0124	0.0035	0.0028	0.0042	0.0464	**0.2807**
AP	0.0026	0.0011	0.0033	0.0020	0.0070	0.2199	0.0014	0.0042	0.0034	0.0062	0.0056	0.0055	0.0095	0.0020	0.0021	0.0102	0.0220	0.0035	0.0466	0.0217	0.0089	0.0078	0.0151	0.0042	0.0031	0.0045	0.0460	**0.4692**
TO	0.0026	0.0010	0.0034	0.0020	0.0078	0.0030	0.0566	0.0054	0.0034	0.0063	0.0054	0.0054	0.0096	0.0021	0.0021	0.0110	0.0212	0.0035	0.0443	0.0204	0.0082	0.0075	0.0138	0.0039	0.0031	0.0046	0.0581	**0.3158**
MA	0.0025	0.0010	0.0032	0.0020	0.0091	0.0029	0.0017	0.0529	0.0060	0.0068	0.0063	0.0059	0.0100	0.0021	0.0021	0.0102	0.0215	0.0034	0.0474	0.0211	0.0088	0.0078	0.0149	0.0041	0.0030	0.0044	0.0493	**0.3104**
PI	0.0027	0.0010	0.0034	0.0022	0.0079	0.0033	0.0016	0.0068	0.0724	0.0081	0.0073	0.0062	0.0110	0.0024	0.0024	0.0115	0.0212	0.0037	0.0450	0.0207	0.0083	0.0077	0.0140	0.0039	0.0032	0.0046	0.0534	**0.3359**
CE	0.0026	0.0010	0.0034	0.0021	0.0072	0.0030	0.0015	0.0053	0.0047	0.0624	0.0073	0.0072	0.0128	0.0022	0.0022	0.0112	0.0216	0.0035	0.0429	0.0209	0.0084	0.0074	0.0139	0.0040	0.0031	0.0046	0.0521	**0.3185**
RN	0.0026	0.0010	0.0035	0.0021	0.0065	0.0030	0.0013	0.0052	0.0037	0.0110	0.1016	0.0105	0.0133	0.0024	0.0022	0.0113	0.0198	0.0037	0.0415	0.0198	0.0076	0.0070	0.0130	0.0036	0.0029	0.0042	0.0544	**0.3588**
PB	0.0029	0.0010	0.0034	0.0021	0.0069	0.0032	0.0014	0.0055	0.0038	0.0083	0.0105	0.0984	0.0157	0.0037	0.0024	0.0117	0.0214	0.0039	0.0442	0.0209	0.0083	0.0075	0.0138	0.0039	0.0031	0.0045	0.0567	**0.3693**
PE	0.0027	0.0010	0.0034	0.0021	0.0068	0.0029	0.0015	0.0051	0.0041	0.0078	0.0084	0.0102	0.0800	0.0036	0.0026	0.0124	0.0213	0.0036	0.0429	0.0208	0.0081	0.0073	0.0136	0.0039	0.0031	0.0046	0.0535	**0.3371**
AL	0.0025	0.0010	0.0032	0.0020	0.0066	0.0028	0.0014	0.0043	0.0037	0.0066	0.0073	0.0083	0.0147	0.0510	0.0030	0.0122	0.0223	0.0034	0.0439	0.0207	0.0081	0.0072	0.0140	0.0041	0.0030	0.0045	0.0517	**0.3137**
SE	0.0026	0.0010	0.0033	0.0020	0.0067	0.0029	0.0014	0.0046	0.0034	0.0068	0.0062	0.0063	0.0116	0.0034	0.0685	0.0126	0.0208	0.0037	0.0436	0.0201	0.0079	0.0073	0.0135	0.0038	0.0030	0.0044	0.0518	**0.3231**
BA	0.0022	0.0009	0.0029	0.0018	0.0056	0.0024	0.0013	0.0036	0.0030	0.0058	0.0050	0.0050	0.0093	0.0020	0.0025	0.0516	0.0201	0.0036	0.0415	0.0190	0.0075	0.0068	0.0129	0.0037	0.0028	0.0043	0.0542	**0.2812**
MG	0.0024	0.0009	0.0030	0.0019	0.0059	0.0025	0.0013	0.0037	0.0027	0.0056	0.0048	0.0048	0.0086	0.0019	0.0020	0.0094	0.0667	0.0033	0.0403	0.0194	0.0076	0.0070	0.0123	0.0037	0.0029	0.0047	0.0489	**0.2781**
ES	0.0022	0.0009	0.0028	0.0018	0.0057	0.0023	0.0012	0.0037	0.0027	0.0052	0.0045	0.0047	0.0082	0.0018	0.0019	0.0099	0.0198	0.0365	0.0452	0.0183	0.0072	0.0066	0.0118	0.0035	0.0027	0.0040	0.0454	**0.2603**
RJ	0.0022	0.0009	0.0028	0.0018	0.0053	0.0023	0.0012	0.0035	0.0026	0.0051	0.0044	0.0046	0.0080	0.0018	0.0018	0.0092	0.0201	0.0036	0.1291	0.0199	0.0074	0.0069	0.0121	0.0036	0.0029	0.0042	0.0521	**0.3194**
SP	0.0024	0.0009	0.0030	0.0019	0.0057	0.0025	0.0013	0.0036	0.0027	0.0054	0.0047	0.0048	0.0085	0.0019	0.0019	0.0094	0.0202	0.0033	0.0415	0.0335	0.0083	0.0073	0.0128	0.0039	0.0029	0.0042	0.0453	**0.2437**
PR	0.0024	0.0009	0.0029	0.0019	0.0055	0.0024	0.0012	0.0035	0.0026	0.0053	0.0045	0.0046	0.0082	0.0018	0.0018	0.0091	0.0190	0.0033	0.0399	0.0205	0.0322	0.0078	0.0126	0.0037	0.0028	0.0042	0.0485	**0.2533**
SC	0.0023	0.0009	0.0029	0.0018	0.0054	0.0024	0.0012	0.0037	0.0026	0.0051	0.0043	0.0045	0.0079	0.0018	0.0018	0.0089	0.0187	0.0031	0.0379	0.0193	0.0083	0.0408	0.0137	0.0035	0.0028	0.0041	0.0476	**0.2572**
RS	0.0025	0.0009	0.0031	0.0020	0.0058	0.0026	0.0013	0.0039	0.0027	0.0055	0.0048	0.0049	0.0085	0.0019	0.0019	0.0095	0.0187	0.0032	0.0385	0.0187	0.0077	0.0077	0.0556	0.0036	0.0030	0.0042	0.0449	**0.2674**
MS	0.0027	0.0010	0.0033	0.0021	0.0062	0.0027	0.0013	0.0038	0.0028	0.0056	0.0049	0.0049	0.0087	0.0019	0.0020	0.0096	0.0197	0.0034	0.0411	0.0204	0.0080	0.0074	0.0134	0.0577	0.0031	0.0045	0.0500	**0.2922**
MT	0.0029	0.0011	0.0035	0.0021	0.0061	0.0026	0.0013	0.0037	0.0027	0.0055	0.0047	0.0048	0.0085	0.0018	0.0019	0.0095	0.0192	0.0032	0.0393	0.0184	0.0074	0.0068	0.0125	0.0037	0.0331	0.0043	0.0496	**0.2601**
GO	0.0027	0.0010	0.0033	0.0022	0.0066	0.0028	0.0015	0.0041	0.0030	0.0060	0.0052	0.0052	0.0094	0.0021	0.0021	0.0100	0.0224	0.0036	0.0440	0.0213	0.0081	0.0076	0.0136	0.0040	0.0033	0.0346	0.0713	**0.3008**
DF	0.0033	0.0012	0.0037	0.0023	0.0081	0.0034	0.0019	0.0051	0.0037	0.0075	0.0065	0.0064	0.0117	0.0026	0.0027	0.0120	0.0278	0.0044	0.0571	0.0254	0.0097	0.0094	0.0169	0.0049	0.0040	0.0082	0.4044	**0.6542**

Source: Elaborated by the authors

Table 38. Impact on Aggregate Output (value-added weights), by Region: Brazil, 2015 (in percentage change)

Region	Goverment Spending																											
	RO	AC	AM	RR	PA	AP	TO	MA	PI	CE	RN	PB	PE	AL	SE	BA	MG	ES	RJ	SP	PR	SC	RS	MS	MT	GO	DF	Total
RO	0.0730	0.0006	0.0003	0.0001	-0.0002	-0.0001	-0.0001	-0.0003	-0.0002	-0.0005	-0.0003	-0.0003	-0.0007	-0.0002	-0.0002	-0.0008	-0.0003	-0.0002	-0.0009	0.0000	0.0004	0.0002	0.0009	0.0002	0.0002	-0.0003	-0.0047	**0.0658**
AC	0.0016	0.0897	0.0007	0.0001	-0.0002	0.0001	-0.0001	-0.0001	-0.0001	-0.0003	-0.0002	-0.0003	-0.0005	-0.0001	-0.0001	-0.0006	-0.0011	-0.0002	-0.0016	-0.0008	-0.0002	-0.0002	0.0000	-0.0001	-0.0001	-0.0004	-0.0040	**0.0811**
AM	0.0000	0.0000	0.0425	0.0004	-0.0002	-0.0001	-0.0001	-0.0004	-0.0002	-0.0006	-0.0005	-0.0005	-0.0009	-0.0002	-0.0002	-0.0011	-0.0023	-0.0004	-0.0041	-0.0020	-0.0006	-0.0006	-0.0011	-0.0003	-0.0003	-0.0006	-0.0059	**0.0197**
RR	0.0002	0.0000	0.0026	0.2645	-0.0002	-0.0003	-0.0002	-0.0002	-0.0003	-0.0007	-0.0005	-0.0005	-0.0010	-0.0002	-0.0002	-0.0011	-0.0019	-0.0003	-0.0024	-0.0014	-0.0004	-0.0005	0.0000	-0.0002	-0.0003	-0.0007	-0.0106	**0.2433**
PA	-0.0001	-0.0001	-0.0002	-0.0002	0.0504	0.0001	0.0000	-0.0003	-0.0001	-0.0004	-0.0004	-0.0005	-0.0008	-0.0002	-0.0002	-0.0011	-0.0022	-0.0003	-0.0045	-0.0020	-0.0008	-0.0007	-0.0013	-0.0004	-0.0002	-0.0005	-0.0044	**0.0287**
AP	-0.0002	0.0000	-0.0002	-0.0002	0.0003	0.2212	-0.0001	-0.0001	0.0002	-0.0004	0.0000	-0.0002	-0.0006	-0.0001	-0.0002	-0.0008	-0.0010	-0.0003	-0.0004	-0.0006	0.0000	-0.0003	0.0003	-0.0001	-0.0003	-0.0005	-0.0080	**0.2077**
TO	0.0000	-0.0001	0.0001	-0.0001	0.0011	0.0002	0.0482	0.0011	0.0003	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0003	-0.0008	-0.0001	-0.0009	-0.0009	-0.0003	-0.0003	-0.0004	-0.0002	-0.0001	-0.0002	0.0049	**0.0517**
MA	-0.0001	-0.0001	-0.0001	-0.0001	0.0020	0.0001	0.0003	0.0400	0.0024	0.0004	0.0007	0.0003	0.0001	0.0000	0.0000	-0.0003	-0.0004	-0.0001	0.0018	-0.0002	0.0002	0.0001	0.0006	0.0000	-0.0001	-0.0003	-0.0022	**0.0451**
PI	0.0000	0.0000	0.0000	0.0000	0.0012	0.0004	0.0001	0.0023	0.0643	0.0014	0.0014	0.0005	0.0007	0.0002	0.0001	0.0006	-0.0009	0.0000	-0.0007	-0.0008	-0.0003	-0.0002	-0.0004	-0.0002	-0.0001	-0.0003	0.0010	**0.0707**
CE	0.0000	0.0000	0.0000	0.0000	0.0006	0.0002	0.0000	0.0010	0.0015	0.0545	0.0016	0.0015	0.0024	0.0001	0.0000	0.0004	-0.0005	-0.0001	-0.0022	-0.0005	-0.0001	-0.0004	-0.0003	-0.0001	-0.0001	-0.0002	-0.0003	**0.0590**
RN	0.0000	-0.0001	0.0002	-0.0001	0.0001	0.0003	-0.0001	0.0010	0.0006	0.0044	0.0943	0.0044	0.0028	0.0002	0.0000	0.0008	-0.0018	0.0002	-0.0031	-0.0013	-0.0007	-0.0006	-0.0009	-0.0004	-0.0003	-0.0005	0.0033	**0.1028**
PB	0.0002	0.0000	0.0000	-0.0001	0.0003	0.0003	0.0000	0.0012	0.0005	0.0016	0.0043	0.0856	0.0048	0.0015	0.0002	0.0008	-0.0011	0.0002	-0.0021	-0.0009	-0.0004	-0.0004	-0.0007	-0.0002	-0.0001	-0.0003	0.0034	**0.0983**
PE	0.0001	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000	0.0009	0.0009	0.0011	0.0024	0.0041	0.0690	0.0013	0.0003	0.0015	-0.0007	0.0000	-0.0021	-0.0006	-0.0004	-0.0004	-0.0006	-0.0002	-0.0001	-0.0002	0.0012	**0.0779**
AL	-0.0001	0.0000	-0.0001	-0.0001	0.0001	0.0000	0.0000	0.0002	0.0005	0.0001	0.0015	0.0023	0.0036	0.0408	0.0007	0.0013	0.0000	-0.0002	-0.0015	-0.0008	-0.0004	-0.0005	-0.0003	0.0000	-0.0002	-0.0003	-0.0007	**0.0457**
SE	0.0001	0.0000	0.0000	-0.0001	0.0003	0.0002	0.0000	0.0005	0.0004	0.0005	0.0007	0.0008	0.0016	0.0013	0.0665	0.0019	-0.0009	0.0001	-0.0011	-0.0010	-0.0004	-0.0004	-0.0005	-0.0002	-0.0002	-0.0004	0.0002	**0.0697**
BA	-0.0002	-0.0001	-0.0002	-0.0002	-0.0004	-0.0002	-0.0001	-0.0002	0.0001	-0.0001	0.0000	-0.0002	0.0000	0.0001	0.0004	0.0412	-0.0003	0.0002	-0.0005	-0.0008	-0.0004	-0.0004	-0.0002	-0.0001	-0.0001	-0.0002	0.0046	**0.0419**
MG	-0.0001	-0.0001	-0.0002	-0.0001	-0.0003	-0.0001	-0.0001	-0.0002	-0.0002	-0.0004	-0.0003	-0.0003	-0.0006	-0.0001	-0.0001	-0.0006	0.0440	-0.0001	-0.0027	-0.0010	-0.0005	-0.0004	-0.0011	-0.0002	-0.0001	0.0000	-0.0006	**0.0338**
ES	-0.0002	-0.0001	-0.0003	-0.0002	-0.0003	-0.0002	-0.0001	-0.0002	-0.0001	-0.0006	-0.0004	-0.0004	-0.0008	-0.0001	-0.0002	-0.0001	-0.0008	0.0298	0.0019	-0.0016	-0.0007	-0.0006	-0.0013	-0.0003	-0.0003	-0.0004	-0.0033	**0.0180**
RJ	-0.0002	-0.0001	-0.0003	-0.0002	-0.0006	-0.0002	-0.0001	-0.0003	-0.0002	-0.0006	-0.0005	-0.0005	-0.0009	-0.0001	-0.0002	-0.0004	-0.0004	0.0002	0.0949	0.0000	-0.0005	-0.0003	-0.0010	-0.0002	-0.0001	-0.0003	0.0044	**0.0913**
SP	0.0000	0.0000	-0.0001	0.0000	-0.0002	-0.0001	0.0000	-0.0001	-0.0002	-0.0003	-0.0002	-0.0002	-0.0004	-0.0001	-0.0001	-0.0003	-0.0003	-0.0001	-0.0007	0.0140	0.0003	0.0000	-0.0004	0.0001	0.0000	-0.0002	-0.0022	**0.0079**
PR	0.0000	-0.0001	-0.0001	-0.0001	-0.0004	-0.0001	-0.0001	-0.0002	-0.0002	-0.0004	-0.0004	-0.0004	-0.0006	-0.0001	-0.0001	-0.0005	-0.0012	-0.0001	-0.0021	0.0002	0.0233	0.0004	-0.0006	-0.0001	-0.0001	-0.0002	0.0011	**0.0167**
SC	-0.0002	-0.0001	-0.0002	-0.0002	-0.0006	-0.0002	-0.0001	-0.0001	-0.0002	-0.0007	-0.0006	-0.0005	-0.0010	-0.0002	-0.0002	-0.0008	-0.0019	-0.0003	-0.0045	-0.0010	0.0001	0.0334	0.0002	-0.0003	-0.0002	-0.0004	-0.0005	**0.0187**
RS	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0000	0.0000	0.0000	-0.0001	-0.0003	-0.0002	-0.0001	-0.0004	-0.0001	-0.0001	-0.0003	-0.0015	-0.0001	-0.0033	-0.0012	-0.0003	0.0003	0.0385	-0.0002	0.0000	-0.0002	-0.0028	**0.0275**
MS	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	-0.0003	-0.0002	-0.0003	-0.0004	-0.0001	-0.0001	-0.0004	-0.0011	0.0000	-0.0021	-0.0003	-0.0002	-0.0001	-0.0003	0.0461	0.0001	-0.0001	0.0003	**0.0404**
MT	0.0003	0.0001	0.0003	0.0001	0.0001	0.0000	0.0000	0.0000	-0.0001	-0.0002	-0.0002	-0.0002	-0.0004	-0.0001	-0.0001	-0.0002	-0.0009	-0.0001	-0.0021	-0.0012	-0.0004	-0.0003	-0.0005	-0.0001	0.0300	-0.0001	0.0009	**0.0247**
GO	0.0001	0.0000	0.0000	0.0001	0.0002	0.0001	0.0001	0.0001	0.0000	-0.0001	0.0000	-0.0001	-0.0001	0.0000	0.0000	-0.0002	0.0005	0.0001	-0.0003	0.0002	-0.0002	0.0000	-0.0002	0.0000	0.0001	0.0274	0.0145	**0.0423**
DF	0.0004	0.0001	0.0001	0.0000	0.0009	0.0002	0.0003	0.0005	0.0005	0.0004	0.0005	0.0004	0.0007	0.0002	0.0002	0.0003	0.0044	0.0004	0.0089	0.0030	0.0009	0.0011	0.0021	0.0006	0.0004	0.0021	0.3052	**0.3347**

Source: Elaborated by the authors

Table 39. Sensitivity analysis to elasticities – Macro effects (Brazil)

Macros for Brazil	**Baseline Scenario**	Domestic/Foreign Armington elasticity					Interregional Armington elasticity					Export Demand elasticity				
		0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.
Aggregate tariff revenue	**0.1727**	0.0779	0.1221	0.2322	0.3051	↑	0.1696	0.1713	0.1739	0.1747	↑	0.2834	0.2250	0.1219	0.0675	↓
Aggregate payments to capital	**0.3967**	0.5453	0.4751	0.3071	0.2001	↓	0.3929	0.3951	0.3978	0.3980	↑	0.6204	0.5005	0.2992	0.1987	↓
Aggregate payments to labor	**0.4009**	0.5323	0.4703	0.3215	0.2272	↓	0.3968	0.3992	0.4020	0.4021	↑	0.5833	0.4870	0.3173	0.2282	↓
National average utility	**0.2513**	0.2872	0.2701	0.2301	0.2074	↓	0.2450	0.2484	0.2536	0.2550	↑	0.2922	0.2720	0.2289	0.2029	↓
National employment	**0.0782**	0.0897	0.0842	0.0715	0.0642	↓	0.0771	0.0777	0.0785	0.0785	↑	0.0915	0.0848	0.0712	0.0634	↓
Aggregate capital stock, rental weights	**0.0000**	0.0000	0.0000	0.0000	0.0000	●	0.0000	0.0000	0.0000	0.0000	●	0.0000	0.0000	0.0000	0.0000	●
Real GDP from expenditure side	**0.0471**	0.0537	0.0506	0.0432	0.0390	↓	0.0465	0.0468	0.0473	0.0475	↑	0.0561	0.0516	0.0422	0.0366	↓
Aggregate real investment expenditure	**0.0000**	0.0000	0.0000	0.0000	0.0000	●	0.0000	0.0000	0.0000	0.0000	●	0.0000	0.0000	0.0000	0.0000	●
Real Household consumption	**0.0801**	0.0920	0.0864	0.0731	0.0656	↓	0.0786	0.0795	0.0806	0.0809	↑	0.0941	0.0872	0.0726	0.0640	↓
Aggregate real regional gov. demand	**-0.0466**	-0.0512	-0.0492	-0.0432	-0.0373	↑	-0.0476	-0.0471	-0.0463	-0.0462	↑	-0.0539	-0.0500	-0.0431	-0.0383	↑
Aggregate real Federal gov.demand	**0.9213**	0.9075	0.9139	0.9305	0.9436	↑	0.9093	0.9156	0.9266	0.9321	↑	0.9136	0.9178	0.9247	0.9292	↑
Export volume	**-0.2157**	-0.3128	-0.2668	-0.1579	-0.0904	↑	-0.2090	-0.2126	-0.2185	-0.2209	↓	-0.0849	-0.1539	-0.2760	-0.3414	↓
Import Volume	**0.1730**	0.0750	0.1212	0.2327	0.3060	↑	0.1706	0.1719	0.1738	0.1743	↑	0.2844	0.2256	0.1223	0.0694	↓
Economy-wide terms of trade	**0.1979**	0.2881	0.2453	0.1444	0.0821	↓	0.1916	0.1950	0.2004	0.2027	↑	0.3808	0.2791	0.1284	0.0648	↓
Investment price index	**0.2381**	0.3377	0.2906	0.1782	0.1072	↓	0.2348	0.2366	0.2391	0.2395	↑	0.3746	0.3024	0.1761	0.1108	↓
Consumer price index	**0.3137**	0.4328	0.3766	0.2416	0.1550	↓	0.3105	0.3123	0.3146	0.3148	↑	0.4819	0.3927	0.2378	0.1578	↓
Export price index	**0.1979**	0.2881	0.2453	0.1444	0.0821	↓	0.1916	0.1950	0.2004	0.2027	↑	0.3808	0.2791	0.1284	0.0648	↓
Regional Gov. Demand price index	**0.3363**	0.4549	0.3989	0.2647	0.1790	↓	0.3347	0.3357	0.3366	0.3363	↓	0.5000	0.4133	0.2621	0.1834	↓
Federal Gov. Demand price index	**0.3592**	0.4779	0.4218	0.2875	0.2013	↓	0.3675	0.3633	0.3551	0.3501	↓	0.5218	0.4357	0.2855	0.2074	↓
GDP price index, expenditure side	**0.3335**	0.4614	0.4010	0.2564	0.1643	↓	0.3303	0.3321	0.3345	0.3347	↑	0.5193	0.4203	0.2512	0.1655	↓
Price index - interregional trade: total	**0.3013**	0.4222	0.3650	0.2287	0.1426	↓	0.2982	0.3000	0.3022	0.3024	↑	0.4726	0.3816	0.2246	0.1445	↓

Source: Elaborated by the authors

Table 40. Qualitative Sensitivity analysis to elasticities – Total Multiplier

UF	Baseline Scenario	DomFor. and Interreg.Armington elasticity					Domestic/Foreign Armington elasticity					Interregional Armington elasticity					Export Demand elasticity				
		0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.
RO	**0.8274**	0.9755	0.9043	0.7410	0.6447	↓	0.9609	0.8980	0.7477	0.6605	↓	0.8405	0.8336	0.8202	0.8096	↓	0.9815	0.9056	0.7421	0.6427	↓
AC	**0.9273**	1.0887	1.0111	0.8352	0.7324	↓	1.0702	1.0029	0.8441	0.7495	↓	0.9421	0.9356	0.9180	0.9030	↓	1.0862	1.0087	0.8403	0.7362	↓
AM	**0.6230**	0.7082	0.6696	0.5697	0.5104	↓	0.7324	0.6811	0.5576	0.4826	↓	0.5934	0.6105	0.6338	0.6439	↑	0.7412	0.6833	0.5578	0.4801	↓
RR	**0.8644**	0.9936	0.9331	0.7863	0.6971	↓	0.9880	0.9299	0.7914	0.7095	↓	0.8689	0.8679	0.8595	0.8499	↓	1.0027	0.9347	0.7893	0.7007	↓
PA	**0.7891**	0.9326	0.8632	0.7077	0.6189	↓	0.9170	0.8565	0.7132	0.6294	↓	0.8017	0.7952	0.7830	0.7755	↓	0.9384	0.8646	0.7069	0.6091	↓
AP	**0.8455**	0.9837	0.9171	0.7661	0.6778	↓	0.9726	0.9122	0.7697	0.6868	↓	0.8550	0.8499	0.8413	0.8355	↓	0.9908	0.9189	0.7653	0.6697	↓
TO	**0.8260**	0.9662	0.9000	0.7436	0.6520	↓	0.9644	0.8994	0.7448	0.6555	↓	0.8265	0.8265	0.8245	0.8199	↓	0.9823	0.9053	0.7409	0.6418	↓
MA	**0.7842**	0.9492	0.8694	0.6920	0.5932	↓	0.9389	0.8655	0.6931	0.5929	↓	0.7876	0.7865	0.7814	0.7754	↓	0.9597	0.8732	0.6882	0.5756	↓
PI	**0.8957**	1.1060	1.0052	0.7780	0.6552	↓	1.0659	0.9853	0.7951	0.6845	↓	0.9272	0.9130	0.8747	0.8478	↓	1.0864	0.9918	0.7911	0.6698	↓
CE	**0.8248**	0.9902	0.9101	0.7314	0.6291	↓	0.9629	0.8974	0.7426	0.6523	↓	0.8473	0.8362	0.8121	0.7958	↓	0.9801	0.9034	0.7390	0.6361	↓
RN	**0.7808**	0.9199	0.8529	0.7007	0.6133	↓	0.9123	0.8501	0.7029	0.6172	↓	0.7847	0.7830	0.7779	0.7730	↓	0.9278	0.8553	0.6996	0.6026	↓
PB	**0.8766**	1.0629	0.9726	0.7733	0.6630	↓	1.0371	0.9611	0.7818	0.6775	↓	0.8942	0.8861	0.8662	0.8525	↓	1.0572	0.9682	0.7775	0.6598	↓
PE	**0.7640**	0.9110	0.8401	0.6806	0.5897	↓	0.8961	0.8335	0.6857	0.5991	↓	0.7743	0.7694	0.7579	0.7503	↓	0.9122	0.8391	0.6820	0.5834	↓
AL	**0.7958**	0.9219	0.8619	0.7208	0.6370	↓	0.9216	0.8617	0.7213	0.6396	↓	0.7942	0.7955	0.7948	0.7909	↓	0.9389	0.8686	0.7160	0.6191	↓
SE	**0.8169**	0.9508	0.8877	0.7369	0.6462	↓	0.9390	0.8811	0.7449	0.6648	↓	0.8278	0.8231	0.8088	0.7971	↓	0.9556	0.8870	0.7411	0.6505	↓
BA	**0.7198**	0.8693	0.7974	0.6347	0.5428	↓	0.8621	0.7947	0.6356	0.5428	↓	0.7220	0.7212	0.7178	0.7145	↓	0.8814	0.8016	0.6313	0.5274	↓
MG	**0.7104**	0.8388	0.7776	0.6356	0.5535	↓	0.8345	0.7757	0.6368	0.5557	↓	0.7130	0.7118	0.7087	0.7061	↓	0.8540	0.7831	0.6315	0.5388	↓
ES	**0.6842**	0.7877	0.7394	0.6212	0.5506	↓	0.8000	0.7450	0.6157	0.5412	↓	0.6708	0.6782	0.6894	0.6939	↑	0.8200	0.7529	0.6099	0.5227	↓
RJ	**0.6835**	0.7831	0.7369	0.6214	0.5493	↓	0.7825	0.7356	0.6253	0.5623	↓	0.6876	0.6857	0.6808	0.6774	↓	0.8011	0.7431	0.6188	0.5426	↓
SP	**0.6557**	0.7557	0.7093	0.5937	0.5223	↓	0.7583	0.7098	0.5947	0.5269	↓	0.6559	0.6559	0.6555	0.6553	↓	0.7724	0.7145	0.5939	0.5276	↓
PR	**0.6576**	0.7546	0.7098	0.5971	0.5282	↓	0.7698	0.7167	0.5911	0.5177	↓	0.6428	0.6509	0.6637	0.6694	↑	0.7876	0.7235	0.5863	0.5033	↓
SC	**0.6552**	0.7602	0.7113	0.5912	0.5194	↓	0.7710	0.7163	0.5864	0.5100	↓	0.6444	0.6502	0.6600	0.6648	↑	0.7903	0.7238	0.5804	0.4912	↓
RS	**0.6403**	0.7388	0.6931	0.5798	0.5130	↓	0.7584	0.7026	0.5702	0.4925	↓	0.6201	0.6307	0.6497	0.6595	↑	0.7764	0.7093	0.5654	0.4775	↓
MS	**0.6814**	0.7828	0.7361	0.6187	0.5488	↓	0.7983	0.7427	0.6125	0.5374	↓	0.6661	0.6746	0.6875	0.6925	↑	0.8150	0.7493	0.6092	0.5272	↓
MT	**0.6533**	0.7317	0.6967	0.6007	0.5396	↓	0.7581	0.7083	0.5912	0.5244	↓	0.6292	0.6423	0.6630	0.6726	↑	0.7728	0.7138	0.5879	0.5123	↓
GO	**0.6504**	0.7415	0.7002	0.5913	0.5237	↓	0.7674	0.7118	0.5812	0.5061	↓	0.6253	0.6387	0.6607	0.6705	↑	0.7841	0.7181	0.5762	0.4879	↓
DF	**0.5583**	0.5905	0.5806	0.5243	0.4788	↓	0.6332	0.5977	0.5143	0.4661	↓	0.5278	0.5441	0.5714	0.5846	↑	0.6430	0.6014	0.5114	0.4548	↓
BR	**0.6641**	**0.7562**	**0.7143**	**0.6046**	**0.5359**	↓	**0.7686**	**0.7191**	**0.6023**	**0.5344**	↓	**0.6550**	**0.6601**	**0.6673**	**0.6699**	↑	**0.7841**	**0.7249**	**0.5982**	**0.5206**	↓

Source: Elaborated by the authors

Table 41. Qualitative Sensitivity analysis to elasticities – Intra Multiplier

UF	Baseline Scenario	Both DomFor. and Interreg.Armington elasticity					Domestic/Foreign Armington elasticity					Interregional Armington elasticity					Export Demand elasticity				
		0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.
RO	**0.8274**	1.1141	1.0729	0.9927	0.9318	↓	1.0362	1.0358	1.0336	1.0297	↓	1.1110	1.0718	0.9936	0.9331	↓	1.0392	1.0374	1.0312	1.0231	↓
AC	**0.9273**	1.3119	1.2481	1.1208	1.0354	↓	1.1906	1.1895	1.1842	1.1749	↓	1.3045	1.2451	1.1227	1.0377	↓	1.1877	1.1877	1.1876	1.1872	↓
AM	**0.6230**	0.8968	0.8436	0.7643	0.7231	↓	0.8101	0.8066	0.7948	0.7813	↓	0.8795	0.8369	0.7691	0.7313	↓	0.8020	0.8022	0.8007	0.7970	↓
RR	**0.8644**	1.1632	1.1293	1.0507	0.9900	↓	1.0956	1.0949	1.0914	1.0852	↓	1.1587	1.1274	1.0520	0.9917	↓	1.0936	1.0937	1.0937	1.0935	↓
PA	**0.7891**	1.0810	1.0294	0.9377	0.8857	↓	0.9836	0.9835	0.9821	0.9781	↓	1.0780	1.0284	0.9380	0.8856	↓	0.9910	0.9871	0.9785	0.9711	↓
AP	**0.8455**	1.1349	1.0986	1.0293	0.9801	↓	1.0667	1.0661	1.0634	1.0585	↓	1.1308	1.0971	1.0303	0.9814	↓	1.0659	1.0657	1.0644	1.0626	↓
TO	**0.8260**	1.1592	1.1051	1.0018	0.9425	↓	1.0550	1.0545	1.0524	1.0486	↓	1.1548	1.1037	1.0024	0.9432	↓	1.0560	1.0550	1.0521	1.0484	↓
MA	**0.7842**	1.1057	1.0530	0.9441	0.8709	↓	1.0031	1.0022	0.9987	0.9935	↓	1.0994	1.0507	0.9451	0.8720	↓	1.0039	1.0025	0.9987	0.9950	↓
PI	**0.8957**	1.2187	1.1679	1.0321	0.9423	↓	1.1074	1.1065	1.1026	1.0960	↓	1.2130	1.1656	1.0334	0.9438	↓	1.1056	1.1054	1.1047	1.1038	↓
CE	**0.8248**	1.2165	1.1501	1.0149	0.9244	↓	1.0926	1.0896	1.0793	1.0657	↓	1.2035	1.1446	1.0192	0.9313	↓	1.0885	1.0874	1.0823	1.0744	↓
RN	**0.7808**	1.1062	1.0573	0.9608	0.8982	↓	1.0144	1.0129	1.0073	0.9991	↓	1.0980	1.0540	0.9628	0.9008	↓	1.0112	1.0111	1.0099	1.0076	↓
PB	**0.8766**	1.2079	1.1527	1.0395	0.9706	↓	1.1001	1.0991	1.0954	1.0898	↓	1.2018	1.1504	1.0407	0.9722	↓	1.0977	1.0978	1.0973	1.0962	↓
PE	**0.7640**	1.1315	1.0611	0.9318	0.8570	↓	1.0044	1.0011	0.9909	0.9795	↓	1.1176	1.0554	0.9360	0.8639	↓	0.9984	0.9979	0.9951	0.9910	↓
AL	**0.7958**	1.0924	1.0376	0.9390	0.8769	↓	0.9901	0.9895	0.9871	0.9829	↓	1.0876	1.0360	0.9397	0.8771	↓	0.9914	0.9902	0.9861	0.9786	↓
SE	**0.8169**	1.1437	1.0897	0.9780	0.9046	↓	1.0392	1.0382	1.0341	1.0276	↓	1.1374	1.0873	0.9795	0.9064	↓	1.0373	1.0371	1.0360	1.0341	↓
BA	**0.7198**	1.0870	1.0219	0.8980	0.8237	↓	0.9689	0.9653	0.9552	0.9451	↓	1.0741	1.0164	0.9023	0.8314	↓	0.9693	0.9654	0.9553	0.9454	↓
MG	**0.7104**	1.0477	0.9868	0.8708	0.8008	↓	0.9403	0.9354	0.9224	0.9112	↓	1.0327	0.9800	0.8768	0.8119	↓	0.9469	0.9382	0.9202	0.9065	↓
ES	**0.6842**	0.9955	0.9469	0.8543	0.7951	↓	0.9044	0.9033	0.8993	0.8937	↓	0.9897	0.9446	0.8558	0.7969	↓	0.9084	0.9051	0.8980	0.8927	↓
RJ	**0.6835**	0.9635	0.9235	0.8320	0.7667	↓	0.8909	0.8862	0.8748	0.8654	↓	0.9523	0.9179	0.8375	0.7769	↓	0.8988	0.8908	0.8686	0.8488	↓
SP	**0.6557**	0.9220	0.8704	0.7479	0.6630	↓	0.8654	0.8413	0.7814	0.7404	↓	0.8721	0.8433	0.7804	0.7354	↓	0.8653	0.8415	0.7796	0.7306	↓
PR	**0.6576**	0.9757	0.9261	0.8261	0.7610	↓	0.8856	0.8821	0.8723	0.8634	↓	0.9650	0.9211	0.8308	0.7704	↓	0.8940	0.8863	0.8672	0.8495	↓
SC	**0.6552**	0.9796	0.9285	0.8291	0.7657	↓	0.8871	0.8840	0.8748	0.8654	↓	0.9690	0.9238	0.8333	0.7735	↓	0.8917	0.8867	0.8708	0.8531	↓
RS	**0.6403**	1.0091	0.9547	0.8415	0.7684	↓	0.9099	0.9057	0.8933	0.8805	↓	0.9955	0.9484	0.8473	0.7793	↓	0.9172	0.9093	0.8889	0.8679	↓
MS	**0.6814**	1.0055	0.9592	0.8674	0.8085	↓	0.9158	0.9154	0.9134	0.9101	↓	1.0019	0.9580	0.8680	0.8091	↓	0.9203	0.9176	0.9108	0.9032	↓
MT	**0.6533**	0.9464	0.9037	0.8315	0.7897	↓	0.8679	0.8676	0.8660	0.8633	↓	0.9432	0.9027	0.8320	0.7906	↓	0.8736	0.8702	0.8634	0.8567	↓
GO	**0.6504**	1.0222	0.9587	0.8538	0.7953	↓	0.9102	0.9079	0.9011	0.8936	↓	1.0125	0.9548	0.8566	0.8002	↓	0.9110	0.9082	0.9009	0.8931	↓
DF	**0.5583**	0.7494	0.7115	0.6434	0.6036	↓	0.6793	0.6785	0.6753	0.6705	↓	0.7440	0.7095	0.6446	0.6052	↓	0.6767	0.6771	0.6773	0.6769	↓
BR	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Elaborated by the authors

Table 42. Qualitative Sensitivity analysis to elasticities – Inter Multiplier

UF	Baseline Scenario	Both DomFor. and Interreg.Armington elasticity					Domestic/Foreign Armington elasticity					Interregional Armington elasticity					Export Demand elasticity				
		0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.	0.2x	0.5x	2.0x	5.0x	Adjust.
RO	**0.8274**	-0.1386	-0.1686	-0.2517	-0.2871	↓	-0.0753	-0.1378	-0.2859	-0.3692	↓	-0.2706	-0.2382	-0.1733	-0.1234	↑	-0.0753	-0.1378	-0.2859	-0.3692	↓
AC	**0.9273**	-0.2232	-0.2370	-0.2856	-0.3031	↓	-0.1204	-0.1866	-0.3401	-0.4254	↓	-0.3624	-0.3095	-0.2047	-0.1347	↑	-0.1204	-0.1866	-0.3401	-0.4254	↓
AM	**0.6230**	-0.1886	-0.1739	-0.1946	-0.2127	↓	-0.0777	-0.1254	-0.2372	-0.2986	↓	-0.2861	-0.2264	-0.1353	-0.0874	↑	-0.0777	-0.1254	-0.2372	-0.2986	↓
RR	**0.8644**	-0.1696	-0.1961	-0.2644	-0.2929	↓	-0.1076	-0.1650	-0.3000	-0.3757	↓	-0.2898	-0.2595	-0.1925	-0.1418	↑	-0.1076	-0.1650	-0.3000	-0.3757	↓
PA	**0.7891**	-0.1484	-0.1662	-0.2300	-0.2668	↓	-0.0665	-0.1270	-0.2689	-0.3487	↓	-0.2763	-0.2332	-0.1550	-0.1101	↑	-0.0665	-0.1270	-0.2689	-0.3487	↓
AP	**0.8455**	-0.1512	-0.1815	-0.2632	-0.3023	↓	-0.0941	-0.1539	-0.2937	-0.3717	↓	-0.2758	-0.2471	-0.1890	-0.1459	↑	-0.0941	-0.1539	-0.2937	-0.3717	↓
TO	**0.8260**	-0.1930	-0.2051	-0.2582	-0.2905	↓	-0.0906	-0.1552	-0.3076	-0.3931	↓	-0.3283	-0.2772	-0.1779	-0.1233	↑	-0.0906	-0.1552	-0.3076	-0.3931	↓
MA	**0.7842**	-0.1565	-0.1835	-0.2520	-0.2777	↓	-0.0642	-0.1368	-0.3056	-0.4006	↓	-0.3118	-0.2642	-0.1637	-0.0966	↑	-0.0642	-0.1368	-0.3056	-0.4006	↓
PI	**0.8957**	-0.1128	-0.1627	-0.2541	-0.2870	↓	-0.0416	-0.1212	-0.3075	-0.4115	↓	-0.2857	-0.2525	-0.1588	-0.0960	↑	-0.0416	-0.1212	-0.3075	-0.4115	↓
CE	**0.8248**	-0.2263	-0.2400	-0.2836	-0.2953	↓	-0.1296	-0.1922	-0.3367	-0.4133	↓	-0.3562	-0.3084	-0.2071	-0.1355	↑	-0.1296	-0.1922	-0.3367	-0.4133	↓
RN	**0.7808**	-0.1863	-0.2044	-0.2601	-0.2849	↓	-0.1021	-0.1628	-0.3044	-0.3818	↓	-0.3133	-0.2710	-0.1849	-0.1279	↑	-0.1021	-0.1628	-0.3044	-0.3818	↓
PB	**0.8766**	-0.1449	-0.1801	-0.2661	-0.3076	↓	-0.0630	-0.1381	-0.3136	-0.4123	↓	-0.3076	-0.2643	-0.1745	-0.1197	↑	-0.0630	-0.1381	-0.3136	-0.4123	↓
PE	**0.7640**	-0.2205	-0.2210	-0.2512	-0.2673	↓	-0.1082	-0.1675	-0.3053	-0.3804	↓	-0.3433	-0.2861	-0.1781	-0.1136	↑	-0.1082	-0.1675	-0.3053	-0.3804	↓
AL	**0.7958**	-0.1705	-0.1757	-0.2182	-0.2399	↓	-0.0685	-0.1278	-0.2658	-0.3432	↓	-0.2934	-0.2404	-0.1448	-0.0862	↑	-0.0685	-0.1278	-0.2658	-0.3432	↓
SE	**0.8169**	-0.1930	-0.2020	-0.2411	-0.2583	↓	-0.1003	-0.1571	-0.2891	-0.3628	↓	-0.3096	-0.2642	-0.1707	-0.1092	↑	-0.1003	-0.1571	-0.2891	-0.3628	↓
BA	**0.7198**	-0.2177	-0.2245	-0.2633	-0.2809	↓	-0.1067	-0.1706	-0.3196	-0.4023	↓	-0.3521	-0.2952	-0.1846	-0.1168	↑	-0.1067	-0.1706	-0.3196	-0.4023	↓
MG	**0.7104**	-0.2088	-0.2092	-0.2353	-0.2472	↓	-0.1059	-0.1597	-0.2856	-0.3556	↓	-0.3197	-0.2683	-0.1681	-0.1058	↑	-0.1059	-0.1597	-0.2856	-0.3556	↓
ES	**0.6842**	-0.2078	-0.2074	-0.2331	-0.2445	↓	-0.1045	-0.1583	-0.2836	-0.3525	↓	-0.3189	-0.2664	-0.1663	-0.1030	↑	-0.1045	-0.1583	-0.2836	-0.3525	↓
RJ	**0.6835**	-0.1804	-0.1866	-0.2106	-0.2174	↓	-0.1083	-0.1506	-0.2495	-0.3031	↓	-0.2647	-0.2322	-0.1566	-0.0995	↑	-0.1083	-0.1506	-0.2495	-0.3031	↓
SP	**0.6557**	-0.1662	-0.1611	-0.1542	-0.1407	↑	-0.1070	-0.1315	-0.1867	-0.2135	↓	-0.2162	-0.1874	-0.1249	-0.0801	↑	-0.1070	-0.1315	-0.1867	-0.2135	↓
PR	**0.6576**	-0.2212	-0.2162	-0.2290	-0.2328	↓	-0.1158	-0.1653	-0.2811	-0.3457	↓	-0.3222	-0.2703	-0.1670	-0.1010	↑	-0.1158	-0.1653	-0.2811	-0.3457	↓
SC	**0.6552**	-0.2194	-0.2172	-0.2379	-0.2464	↓	-0.1160	-0.1677	-0.2884	-0.3554	↓	-0.3246	-0.2736	-0.1733	-0.1086	↑	-0.1160	-0.1677	-0.2884	-0.3554	↓
RS	**0.6403**	-0.2703	-0.2616	-0.2617	-0.2554	↑	-0.1514	-0.2032	-0.3231	-0.3880	↓	-0.3754	-0.3177	-0.1975	-0.1198	↑	-0.1514	-0.2032	-0.3231	-0.3880	↓
MS	**0.6814**	-0.2227	-0.2231	-0.2487	-0.2596	↓	-0.1175	-0.1727	-0.3010	-0.3727	↓	-0.3358	-0.2834	-0.1804	-0.1166	↑	-0.1175	-0.1727	-0.3010	-0.3727	↓
MT	**0.6533**	-0.2147	-0.2070	-0.2308	-0.2501	↓	-0.1098	-0.1593	-0.2748	-0.3389	↓	-0.3140	-0.2604	-0.1690	-0.1179	↑	-0.1098	-0.1593	-0.2748	-0.3389	↓
GO	**0.6504**	-0.2808	-0.2585	-0.2625	-0.2716	↓	-0.1427	-0.1961	-0.3199	-0.3875	↓	-0.3872	-0.3162	-0.1959	-0.1297	↑	-0.1427	-0.1961	-0.3199	-0.3875	↓
DF	**0.5583**	-0.1589	-0.1309	-0.1191	-0.1248	↓	-0.0461	-0.0808	-0.1610	-0.2044	↓	-0.2162	-0.1654	-0.0731	-0.0205	↑	-0.0461	-0.0808	-0.1610	-0.2044	↓
BR	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Elaborated by the authors

9. ANNEX: SPECIFICATION OF THE BMARIA MODEL

This appendix presents the analytical, functional, and numerical structures of the interregional general equilibrium model for Brazil, the BMARIA model. The specification of the linearized form of the model is provided, based on different groups of equations. The notational convention uses uppercase letters to represent the levels of the variables and lowercase for their percentage-change representation. Superscripts *(u)*, $u = \{0, 1j, 2j, 3, 4, 5, 6\}$ refer, respectively, to output *(0)* and to the six different regional-specific users of the products identified in the model[41]: producers in sector *j (1j)*, investors in sector *j (2j)*, households *(3)*, purchasers of exports *(4)*, regional governments *(5)*, and Federal government *(6)*; the second superscript *(r)* identifies the domestic region where the user is located. Two subscripts identify inputs: the first *(i)* takes the values *1, ..., g*, for commodities, *g + 1*, for primary factors; the second subscript identifies the source of the input, being it from domestic region *b (1b)* or imported *(2)*, or coming from labor *(1)* or capital *(2)*, the two primary factors in the model. The symbol (•) is employed to indicate a sum over an index.

We define the following sets: $G = \{1, \ldots, g\}$, where g is the number of composite goods; $G^* = \{1, \ldots, g, g+1\}$, where $g+1$ is the number of composite goods and primary factors, with $G^* \supset G$; $H = \{1, \ldots, h\}$, where h is the number of industries; $U = \{(3), (4b), (5), (6), (kj)\}$ for $k = (1), (2)$ and $j \in H$, is the set of all users in the model; $U^* = \{(3), (5), (6), (kj)\}$ for $k = (1), (2)$ and $j \in H$, with $U \supset U^*$, is the subset of domestic users; $S = \{1, \ldots, r, r+1\}$, where $r+1$ is the number of all regions (including foreign); $S^* = \{1, \ldots, r\}$, with $S \supset S^*$, is the subset with the r domestic regions; and $F = \{1, \ldots, f\}$ is the set of primary factors. In the BMARIA model, $g = h = 67$, $r = 27$, and $f = 3$.

We model the sourcing of composite goods based on multilevel structures, which enable a significant number of substitution possibilities. We employ nested sourcing functions to create composite goods, available for consumption in the regions of the model. We assume that domestic users, i.e., firms, investors, households, and government, use combinations of composite goods specified within two-level CES nests. At the bottom level, bundles of domestically produced goods are formed as combinations of goods from different regional sources. At the top level, substitution is possible between domestically produced and imported goods. Equations (A1) and (A2) describe, respectively, the regional sourcing of domestic goods,

[41] We have specified a seventh residual user, *(7)*, to deal with statistical discrepancies in the balancing of the model's absorption matrix based on the Brazilian interregional input-output system (IIOS).

and the substitution between domestic and imported products.

$$x_{(i(1b))}^{(u)r} = x_{(i(1\bullet))}^{(u)r} - \sigma 1_{(i)}^{(u)r} \left(p_{(i(1b))}^{(u)r} - \sum_{l \in S^*} \left(\frac{V(i,1l,(u),r)}{V(i,1\bullet,(u),r)} \right) \left(p_{(i(1l))}^{(u)r} \right) \right)$$

$$i \in G;\ b \in S^*; (u) \in U^*;\ r \in S^* \qquad \text{(A1)}$$

where $x_{(i(1b))}^{(u)r}$ is the demand by the user *(u)* in region *r* for good *i* in the domestic region *(1b)*; $p_{(i(1b))}^{(u)r}$ is the price paid by user *(u)* in region *r* for good *i* in the domestic region *(1b)*; $\sigma 1_{(i)}^{(u)r}$ is a parameter measuring the user-specific elasticity of substitution between alternative domestic sources of commodity *i*, known as the regional trade Armington elasticity; and $V(i,1l,(u),r)$ is an input-output flow coefficient that measures purchasers' value of good *i* from domestic source *l* used by the user *(u)* in region *r*.

$$x_{(is)}^{(u)r} = x_{(i\bullet)}^{(u)r} - \sigma 2_{(i)}^{(u)r} \left(p_{(is)}^{(u)r} - \sum_{l=1\bullet,2} \left(\frac{V(i,l,(u),r)}{V(i,\bullet,(u),r)} \right) \left(p_{(il)}^{(u)r} \right) \right)$$

$$i \in G;\ s = 1\bullet, 2; (u) \in U^*;\ r \in S^* \qquad \text{(A2)}$$

where $x_{(is)}^{(u)r}$ is the demand by the user *(u)* in region *r* for either the domestic composite or the foreign good *i*; $p_{(is)}^{(u)r}$ is the price paid by user *(u)* in region *r* for either the domestic composite or the foreign good *i*; $\sigma 2_{(i)}^{(u)r}$ is a parameter measuring the user-specific elasticity of substitution between the domestic bundle and imports of good *i*, known as the international trade Armington elasticity; and $V(i,l,(u),r)$ is an input-output flow coefficient that measures purchasers' value of good *i* from either the aggregate domestic source or the foreign source *l* used by the user *(u)* in region *r*.

In addition to goods used as intermediate inputs, firms in the model also demand primary production factors. The equations that describe the industry *j*'s demands inputs are derived under Leontief technology's assumption with Armington nests (imperfect substitution between inputs of the same type from different sources). In our specification of the nested production functions, we assume firms to use combinations of composite intermediate inputs, formed according to Equations (A1) and (A2), and primary factor composites. In the case of the primary factor bundle, substitution is possible among different types of primary factors. Equation (A3) specifies the substitution between labor and capital in the model. It is derived under the assumption that industries choose their primary factor inputs to minimize costs subject to obtaining sufficient primary factor inputs to satisfy their technological requirements (nested

Leontief/CES specification). We have included technical change variables to allow for factor-specific productivity shocks. We model the combination of intermediate inputs and the value-added (primary factors) aggregate in fixed proportions, at the very top of the nested production function, assuming that there is no substitution between primary factors and other inputs. The Leontief specification is presented in Equation (A4). More flexible functional forms have been rarely introduced in multi-regional models, mainly due to data availability constraints. In addition to a technical coefficient in the relation between the sectoral demand for the primary factor composite and the total output, we have also included a scale parameter. This modeling procedure has been based on previous studies made by Haddad and Hewings (2005), which allows for the introduction of Marshallian agglomeration (external) economies by exploring local properties of the CES function.

$$x_{(g+1,s)}^{(1j)r} - a_{(g+1,s)}^{(1j)r} = \alpha_{(g+1,s)}^{(1j)r} x_{(g+1,\bullet)}^{(1j)r} - \sigma 3_{(g+1)}^{(1j)r} \left(p_{(g+1,s)}^{(1j)r} + a_{(g+1,s)}^{(1j)r} - \sum_{l \in F} \left(\frac{V(g+1,l,(1j),r)}{V(g+1,\bullet,(1j),r)} \right) \left(p_{(g+1,l)}^{(1j)r} + a_{(g+1,l)}^{(1j)r} \right) \right)$$

$$j \in H;\ s \in F;\ r \in S^* \qquad \text{(A3)}$$

where $x_{(g+1,s)}^{(1j)r}$ is the demand by sector *j* in region *r* for each primary factor; $a_{(g+1,s)}^{(1j)r}$ is the exogenous sector-specific variable of (saving) technical change for primary factor *s* in region *r*; $p_{(g+1,s)}^{(1j)r}$ is the price paid by sector *j* in region *r* for primary factor *s*; $\sigma 3_{(g+1)}^{(1j)r}$ is a parameter measuring the sector-specific elasticity of substitution among different primary factors; and $V(g+1, l, (1j), r)$ is an input-output flow coefficient that measures purchasers' value of factor *l* used by sector *j* in region *r*.

$$x_{(i\bullet)}^{(1j)r} = \mu_{(g+1,\bullet)}^{(1j)r} z^{(1j)r} + a_{(i)}^{(1j)r}$$

$$j \in H;\ i \in G^*;\ r \in S^* \qquad \text{(A4)}$$

where $x_{(i\bullet)}^{(1j)r}$ is the demand by sector *j* in region *r* for the bundles of composite intermediate inputs and primary factors *i*; $z^{(1j)r}$ is the total output of sector *j* in region *r*; $a_{(i)}^{(1j)r}$ is the exogenous sector-specific variable of technical change for composite intermediate inputs and primary factors in region *r*; and $\mu_{(i\bullet)}^{(1j)r}$ is a scale parameter measuring the sector-specific returns to the composite of primary factors in each region.

Units of capital stock are created for industry *j*, at minimum cost. Commodities are combined via a Leontief function, as specified in Equation (A5). As described in Equations (A1) and (A2), regional, and domestic and imported commodities are combined, respectively, via a CES specification (Armington assumption). No primary factors are used in capital creation. The use of these inputs is recognized through the capital goods producing sectors in the model, mainly machinery and equipment industries, construction, and support services.

$$x_{(i\bullet)}^{(2j)r} = z^{(2j)r} + a_{(i)}^{(2j)r}$$
$$j \in H;\ i \in G;\ r \in S^{*} \qquad \text{(A5)}$$

where $x_{(i\bullet)}^{(2j)r}$ is the demand by sector *j* in region *r* for the bundles of composite capital goods *i*; $z^{(2j)r}$ is the total investment of sector *j* in region *r*; $a_{(i)}^{(2j)r}$ is the exogenous sector-specific variable of technical change for changing the composition of the sectoral unit of capital in region *r*.

In deriving the household demands for composite commodities, we assume that households in each region behave as a single, budget-constrained, utility-maximizing entity. The utility function is of the Stone-Geary or Klein-Rubin form. Equation (A6) determines the optimal composition of household demand in each region. Total regional household consumption is determined as a function of real household income. The demands for the commodity bundles in the nesting structure of household demand follow the CES pattern established in Equations (A1) and (A2), in which an activity variable and a price-substitution term play significant roles. In Equation (A6), consumption of each commodity *i* depends on two components: first, for the subsistence component, which is defined as the minimum expenditure requirement for each commodity, changes in demand are generated by changes in the number of households and tastes; second, for the luxury or supernumerary part of the expenditure in each good, demand moves with changes in the regional supernumerary expenditure, changes in tastes, and changes in the price of the composite commodity. Their respective shares weight the two components of household expenditure on the composite commodities in the composite commodity's total consumption.

$$V(i,\bullet,(3),\mathrm{r})\left(p_{(i\bullet)}^{(3)r} + x_{(i\bullet)}^{(3)r} - a_{(i\bullet)}^{(3)r}\right)$$
$$= \gamma_{(i)}^{r} P_{(i\bullet)}^{(3)r} Q^{r}\left(p_{(i\bullet)}^{(3)r} + x_{(i\bullet)}^{(3)r} - a_{(i\bullet)}^{(3)r}\right)$$
$$+ \beta_{(i)}^{r}\left(C^{r} - \sum_{j\in G} \gamma_{(j)}^{r} P_{(j\bullet)}^{(3)r} Q^{r}\left(p_{(j\bullet)}^{(3)r} + x_{(j\bullet)}^{(3)r} - a_{(i\bullet)}^{(3)r}\right)\right)$$

$i \in G;\ r \in S^*$ (A6)

where $p_{(i\bullet)}^{(3)r}$ is the price paid by household in region *r* for the composite good *i*; $x_{(i\bullet)}^{(3)r}$ is the household demand in region *r* for the composite good *i*; $a_{(i\bullet)}^{(3)r}$ is the commodity-specific variable of regional taste change; Q^r is the number of households in region *r*; $C^r$is the total expenditure by household in region *r*, which is proportional to regional labor income; $\gamma_{(i)}^r$ is the subsistence parameter in the linear expenditure system for commodity *i* in region *r*; $\beta_{(i)}^r$ is the parameter defined for commodity *i* in region *r* measuring the marginal budget shares in the linear expenditure system; and $V(i, \bullet, (3), \mathrm{r})$ is an input-output flow coefficient that measures purchasers' value of good *i* consumed by households in region *r*.

As noted by Peter et al. (1996), a feature of the Stone-Geary utility function is that only the above-subsistence, or luxury, component of real household consumption, $utility^{(r)}$, affects the per-household utility, as described in Equation (A7).

$$utility^{(r)} = \left(C^r - \sum_{j \in G} \gamma_{(j)}^r P_{(j\bullet)}^{(3)r} Q^r \left(p_{(j\bullet)}^{(3)r} + x_{(j\bullet)}^{(3)r} - a_{(i\bullet)}^{(3)r}\right)\right) - q^r - \sum_{i \in G} \beta_{(i)}^r\, p_{(i\bullet)}^{(3)r}$$

$r \in S^*$ (A7)

where q^r is the percentage change in the number of households in each region.

In Equation (A8), foreign demands (exports) for domestic good *i* depend on the percentage changes in a price, and three shift variables which allow for vertical and horizontal movements in the demand curves. The price variable which influences export demands is the purchaser's price in foreign countries, which includes the relevant taxes and margins. The parameter $\eta_{(is)}^r$ controls the sensitivity of export demand to price changes.

$$\left(x_{(is)}^{(4)r} - fq_{(is)}^{(4)r}\right) = \eta_{(is)}^r \left(p_{(is)}^{(4)r} - phi - fp_{(is)}^{(4)r}\right)$$

$i \in G;\ r, s \in S^*$ (A8)

where $x_{(is)}^{(4)r}$ is foreign demand for domestic good *i* produced in region *s* and sold from region *r* (in the model, there are no re-exports, so that *r* = *s*); $p_{(is)}^{(4)r}$ is the purchasers' price in the domestic currency of exported good *i* demand in region *r*; phi is the nominal exchange rate;

and $fq_{(is)}^{(4)r}$ and $fp_{(is)}^{(4)r}$ are, respectively, quantity and price shift variables in foreign demand curves for regional exports.

Governments consume mainly public goods provided by the public administration sectors. Equations (A9) and (A10) show government consumption movement concerning movements in real tax revenue for regional governments and the Federal government, respectively.

$$x_{(is)}^{(5)r} = taxrev^{r} + f_{(is)}^{(5)r} + f^{(5)r} + f^{(5)}$$

$$i \in G;\ s = 1\text{b}, 2;\ r, b \in S^{*} \qquad \text{(A9)}$$

$$x_{(is)}^{(6)r} = nattaxrev + f_{(is)}^{(6)r} + f^{(6)r} + f^{(6)}$$

$$i \in G;\ s = 1\text{b}, 2;\ r, b \in S^{*} \qquad \text{(A10)}$$

where $x_{(is)}^{(5)r}$ and $x_{(is)}^{(6)r}$ are the regional *(5)* and Federal *(6)* governments demand in region *r* for good *i* from region *s*; $f_{(is)}^{(5)r}$, $f^{(5)r}$ and $f^{(5)}$ are, respectively, commodity and source-specific shift term for regional governments expenditure in region *r*, shift term for regional government expenditure in region *r*, and an overall shift term for regional government expenditure. Similar shift terms ($f_{(is)}^{(6)r}$, $f^{(6)r}$ and $f^{(6)}$) appear in Equation (A10) related to Federal government expenditure. Finally, $taxrev^{r}$ is the percentage change in real revenue from indirect taxes in region *r*, and $nattaxrev$ refers to the percentage change in aggregate real revenue from indirect taxes, so that government demand moves with endogenous changes in regional and national tax bases.

Equation (A11) specifies the sales tax rates for different users. They allow for variations in tax rates across commodities and their sources and destinations. Tax changes are expressed as percentage-point changes in the *ad valorem* tax rates.

$$t_{(is)}^{(u)r} = f_i + f_i^{(u)} + f_i^{(u)r}$$

$$i \in G;\ s = 1\text{b}, 2;\ b, r \in S^{*};\ u \in U \qquad \text{(A11)}$$

where $t_{(is)}^{(u)r}$ is the power of the tax on sales of commodity (*is*) to the user (*u*) in region *r*; and f_i, $f_i^{(u)}$, and $f_i^{(u)r}$ are different shift terms allowing percentage changes in the power of tax.

Equations (A12) and (A13) impose the equilibrium conditions in the market's domestic and imported commodities. Notice that there is no margin commodity in the model. Moreover, there is no secondary production in the model. In Equation (A12), demand equals supply for regional domestic commodities.

$$\sum_{j\in H} Y(l,j,r)x_{(l1)}^{(0j)r} = \sum_{(u)\in U} B(l,1b,(u),r)x_{(l1)}^{(u)r}$$

$$l \in G, b, r \in S^{*} \qquad \text{(A12)}$$

where $x_{(l1)}^{(0j)r}$ is the output of domestic good *l* by industry *j* in region *r*; $x_{(l1)}^{(u)r}$ is the demand of the domestic good *l* by the user *(u)* in region *r*; $Y(l,j,r)$ is the input-output flow measuring the basic value of the output of domestic good *l* by industry *j* in region *r*; and $B(l,1,(u),r)$ is the input-output flow measuring the basic value of domestic good *l* used by *(u)* in region *r*.

Equation (13) imposes zero pure profits in importing. Where $p_{(i(2))}^{(0)}$ is the basic price in the domestic currency of good *i* from a foreign source; $p_{(i(2))}^{(w)}$ is the world (Cost, Insurance and Freight) C.I.F. price of imported commodity *i*; phi is the nominal exchange rate; and $t_{(i(2))}^{(0)}$ is the power of the tariff. i.e., one plus the tariff rate on imports of *i*. Equation (A13) thus, defines the basic price of a unit of imported commodity *i* – the revenue earned per unit by the importer – as the international C.I.F. price converted to domestic currency, including import tariffs.

$$p_{(i(2))}^{(0)} = p_{(i(2))}^{(w)} - phi + t_{(i(2))}^{(0)}$$

$$i \in G \qquad \text{(A13)}$$

Together with Equation (A13), Equations (A14) and (A15) constitute the model's pricing system. The price received for any activity is equal to the costs per unit of output. As can be noticed, the assumption of constant returns to scale adopted here precludes any activity variable from influencing basic prices, i.e., unit costs are independent of the scale at which activities are conducted. Thus, Equation (A14) defines the percentage change in the price received by producers in regional industry *j* per unit of output as equal to the percentage change in *j*'s costs, which are affected by changes in technology and changes in input prices.

$$\sum_{l \in G} Y(l,j,r)\left(p_{(l1)}^{(0)r} + a_{(l1)}^{(0)r}\right) = \sum_{l \in G^*,F} \sum_{s \in S} V(l,s,(1j),r) p_{(ls)}^{(1j)r}$$

$$j \in H;\; r \in S^* \qquad \text{(A14)}$$

where $p_{(l1)}^{(0)r}$ is the basic price of domestic good *i* in region *r*; $a_{(l1)}^{(0)r}$ refer to technological changes, measured as a weighted average of the different types of technical changes with influence on *j*'s unit costs; $p_{(ls)}^{(1j)r}$ is the unit cost of sector *j* in region *r*; $Y(l,j,r)$ is the input-output flow measuring the basic value of the output of domestic good *l* by industry *j* in region *r*; and $V(l,s,(1j),r)$ are input-output flows measuring purchasers' value of good or factor *l* from source *s* used by sector *j* in region *r*.

Equation (A15) imposes zero pure profits in the distribution of commodities to different users. Prices paid for commodity *i* from region *s* in industry *j* in region *r* by each user equate to the sum of its basic value and the costs of the relevant taxes.

$$V(i,s,(u),r) p_{(is)}^{(u)r} = \left(B(i,s,(u),r) + T(i,s,(u),r)\right)\left(p_{(is)}^{(0)} + t_{(is)}^{(u)r}\right)$$

$$i \in G;\; s = 1\text{b},2;\; b,r \in S^*;\; u \in U \qquad (15)$$

where $p_{(is)}^{(u)r}$ is the price paid by user *(u)* in region *r* for good *(is)*; $p_{(is)}^{(0)}$is the basic price of domestic good *(is)*; $t_{(is)}^{(u)r}$ is the power of the tax on sales of commodity *(is)* to the user *(u)* in region *r*; $V(i,s,(u),r)$ are input-output flows measuring purchasers' value of good *i* from source *s* used by the user *(u)* in region *r*; $B(i,s,(u),r)$ is the input-output flow measuring the basic value of good *(is)* used by *(u)* in region *r*; and $T(i,s,(u),r)$ is the input-output flow associated with tax revenue of the sales of *(is)* to *(u)* in region *r*.

The theory of the allocation of investment across industries is represented in Equations (A16) to (A19). The comparative-static nature of the model restricts its use to short-run and long-run policy analysis. When running the model in the comparative-static mode, there is no fixed relationship between capital and investment. The user decides the required relationship based on the requirements of the specific simulation. Equation (A16) defines the percentage change in the current rate of return on fixed capital in regional sectors. Under static expectations, rates of return are defined as the ratio between the rental values and the cost of a unit of capital in each industry – defined in Equation (A17) –, minus the rate of depreciation.

$$r_{(j)}^{r} = \psi_{(j)}^{r}\left(p_{(g+1,2)}^{(1j)r} - p_{(k)}^{(1j)r}\right)$$

$$j \in H;\; r \in S^* \qquad \text{(A16)}$$

where $r^{r}_{(j)}$ is the regional-industry-specific rate of return; $p^{(1j)r}_{(g+1,2)}$ is the rental value of capital in sector j in region r; $p^{(1j)r}_{(k)}$ is the cost of constructing units of capital for regional industries; and $\psi^{r}_{(j)}$ is a regional-industry-specific parameter referring to the ratio of the gross to the net rate of return.

Equation (A16) defines $p^{(1j)r}_{(k)}$ as:

$$V(\bullet,\bullet,(2\mathrm{j}),\mathrm{r})\left(p^{(1j)r}_{(k)} - a^{(1j)r}_{(k)}\right) = \sum_{i\in G}\sum_{s\in S} V(\mathrm{i},\mathrm{s},(2\mathrm{j}),\mathrm{r})\left(p^{(2j)r}_{(is)} - a^{(2j)r}_{(is)}\right)$$
$$j \in H;\ r \in S^{*} \qquad \text{(A17)}$$

where $p^{(2j)r}_{(is)}$ is the price paid by user *(2j)* in region *r* for good *(is)*; $a^{(1j)r}_{(k)}$ and $a^{(2j)r}_{(is)}$ are technical terms; and $V(\mathrm{i},\mathrm{s},(2\mathrm{j}),\mathrm{r})$ represents input-output flows measuring purchasers' value of good *i* from source *s* used by the user *(2j)* in region *r*.

Equation (A18) says that if the percentage change in the rate of return in a regional industry grows faster than the national average, capital stocks in that industry will increase at a higher rate than the average national stock. For industries with a lower-than-average increase in their return rates to fixed capital, capital stocks increase at a lower-than-average rate, i.e., capital is attracted to higher return industries. The shift variable, $f^{(1j)r}_{(k)}$, exogenous in long-run simulation, allows shifts in the industry's rates of return.

$$r^{r}_{(j)} - \omega = \varepsilon^{r}_{(j)}\left(x^{(1j)r}_{(g+1,2)} - x^{(\bullet)r}_{(g+1,2)}\right) + f^{(1j)r}_{(k)}$$
$$j \in H;\ r \in S^{*} \qquad \text{(A18)}$$

where $r^{r}_{(j)}$ is the regional-industry-specific rate of return; ω is the overall rate of return on capital; $x^{(1j)r}_{(g+1,2)}$ is the capital stock in industry *j* in region *r*; $f^{(1j)r}_{(k)}$ the capital shift term in sector *j* in region *r*; and $\varepsilon^{r}_{(j)}$ measures the sensitivity of capital growth to rates of return of industry *j* in region *r*.

Equation (A19) implies that the percentage change in an industry's capital stock, $x^{(1j)r}_{(g+1,2)}$, is equal to the percentage change in the industry's investments in the period, $z^{(2j)r}$.

$$z^{(2j)r} = x^{(1j)r}_{(g+1,2)} + f^{(2j)r}_{(k)}$$

$j \in H;\ r \in S^*$ (A19)

where $f^{(2j)r}_{(k)}$ allows for exogenous shifts in sectoral investments in region r.

In the specification of the labor market, Equation (A20) defines the regional aggregation of labor prices (wages) across industries. Equation (A21) shows movements in regional wage differentials, $wage\_diff^{(r)}$, defined as the difference between the movement in the aggregate regional real wage received by workers and the real national wage.

$$V(\mathrm{g}+1{,}1{,}\bullet{,}\mathrm{r})\left(p^{(\bullet)r}_{(g+1,1)} - a^{(\bullet)r}_{(g+1,1)}\right) = \sum\nolimits_{j\in H} V(\mathrm{g}+1{,}1{,}(1\mathrm{j}){,}\mathrm{r})\left(p^{(1j)r}_{(g+1,1)} - a^{(1j)r}_{(g+1,1)}\right)$$

$r \in S^*$ (A20)

where $p^{(1j)r}_{(g+1,1)}$ is the wage in sector *j* in region *r*, $a^{(1j)r}_{(g+1,1)}$ is a technical term, and $V(\mathrm{g}+1{,}1{,}(1\mathrm{j}){,}\mathrm{r})$ represents input-output flows measuring sectoral labor payments in region r.

$$wage\_diff^{(r)} = p^{(\bullet)r}_{(g+1,1)} - cpi - natrealwage$$

$r \in S^*$ (A21)

where cpi is the national consumer price index, computed as the weighted average of $p^{(3)r}_{(is)}$ across regions *r* and consumption goods *(is)*; and $natrealwage$ is the national consumer real wage.

The regional population is defined through the interaction of demographic variables, including interregional migration. Links between regional population and regional labor supply are provided. Demographic variables are usually defined exogenously, and together with the specification of some of the labor market settings, labor supply can be determined together with either interregional wage differentials or regional unemployment rates. In summary, either labor supply and wage differentials determine unemployment rates, or labor supply and unemployment rates determine wage differentials.

Equation (A22) defines the percentage-point change in regional unemployment rates regarding percentage changes in labor supply and employed workers.

$$LABSUP(r)del\_unr^{(r)} = EMPLOY(r)\left(labsup^{(r)} - x_{(g+1,1)}^{(\bullet)r}\right)$$
$$r \in S^* \qquad \text{(A22)}$$

where $del\_unr^{(r)}$ measures percentage-point changes in the regional unemployment rate; $labsup^{(r)}$ is the variable for regional labor supply; and the coefficients $LABSUP(r)$ and $EMPLOY(r)$ are the benchmark values for regional labor supply and regional employment, respectively. The variable $labsup^{(r)}$ moves with regional workforce participation rate, proportional to the regional population, and population of working age. Equation (A23) defines regional population changes in the model as ordinary changes in flows of net regional migration ($d\_rm^{(r)}$), net foreign migration ($d\_fm^{(r)}$), and natural population growth ($d\_g^{(r)}$).

$$POP(r)pop^{(r)} = d\_rm^{(r)} + d\_fm^{(r)} + d\_g^{(r)}$$
$$r \in S^* \qquad \text{(A23)}$$

where $POP(r)$ is a coefficient measuring regional population in the benchmark year.

Equation (A24) shows movements in per-household utility differentials, $util\_diff^{(r)}$, defined as the difference between the movement in regional utility and the overall national utility (agg_util), including a shift variable, $futil^{(r)}$.

$$util\_diff^{(r)} = utility^{(r)} - agg\_util + futil^{(r)}$$
$$r \in S^* \qquad \text{(A24)}$$

Finally, we can define changes in regional output as weighted averages of changes in regional aggregates, according to Equation (A25) below:

$$GRP^r grp^r = C^r x_{(\bullet\bullet)}^{(3)r} + INV^r z^{(2\bullet)r} + GOV^{(5)r} x_{(\bullet\bullet)}^{(5)r} + GOV^{(6)r} x_{(\bullet\bullet)}^{(6)r} + \left(FEXP^r x_{(\bullet\bullet)}^{(4)r} - FIMP^r x_{(\bullet 2)}^{(\bullet)r}\right) + \left(DEXP^r x_{(\bullet(1r))}^{(\bullet)s} - DIMP^r x_{(\bullet(1s))}^{(\bullet)r}\right)$$
$$r \in S^*; s \in S^* \text{ for } s \neq r \qquad \text{(A25)}$$

where grp^r is the percentage change in real Gross Regional Product in region *r*; and the coefficients GRP^r, INV^r, $GOV^{(5)r}$, $GOV^{(6)r}$, $FEXP^r$, $FIMP^r$, $DEXP^r$, and $DIMP^r$ represent, respectively, the following regional aggregates: investments, regional governments spending, Federal government spending, foreign exports, foreign imports, domestic exports, and domestic imports. National output, GDP, is, thus, the sum of GRP^r across all regions *r*. Notice that regional domestic trade balances cancel out.

To close the model, we set the following variables exogenously, which are usually exogenous both in short-run and long-run simulations: $a_{(g+1,s)}^{(1j)r}$, $a_{(i)}^{(1j)r}$, $a_{(i)}^{(2j)r}$, $a_{(i\bullet)}^{(3)r}$, $fq_{(is)}^{(4)r}$, $fp_{(is)}^{(4)r}$, $f_{(is)}^{(5)r}$, $f^{(5)r}$, $f^{(5)}$, $f_{(is)}^{(6)r}$, $f^{(6)r}$, $f^{(6)}$, f_i, $f_i^{(u)}$, $f_i^{(u)r}$, $p_{(i(2))}^{(w)}$, $t_{(i(2))}^{(0)}$, $a_{(l1)}^{(0)r}$, $a_{(k)}^{(1j)r}$, $a_{(is)}^{(2j)r}$, $a_{(g+1,1)}^{(\bullet)r}$, ω, $f_{(k)}^{(2j)r}$, $d\_fm^{(r)}$, $d\_g^{(r)}$, and $futil^{(r)}$. To complete the short-run environment, we also set unchanged current stocks of capital ($x_{(g+1,2)}^{(1j)r}$), the national real wage ($natrealwage$), regional wage differentials, ($wage\_diff^{(r)}$), and regional population, by keeping regional migration unchanged ($d\_rm^{(r)}$).[42]

There are other definitions of variables computed using outcomes from simulations based on the system of equations (A1)-(A25). Of particular interest to our discussion is the definition of regional/national GDP and its components.

Calibration

The calibration of the model requires two subsets of data to define its numerical structure to implement the model empirically. First, we need information from an absorption matrix derived from interregional input-output sources to calculate the model's coefficients based on the following input-output flows.

- $B(i, 1b, (u), r)$, with $i \in G^*, (u) \in U, b, r \in S^*$
- $T(i, s, (u), r)$, with $i \in G^*, s \in S, (u) \in U, r \in S^*$
- $V(i, s, (u), r)$, with $i \in G^*, s \in S, F, (u) \in U, r \in S^*$
- $Y(i, j, r)$, with $i \in G^*, j \in H, r \in S^*$

We complete this information with supplementary demographic data from the Brazilian Institute of Geography and Statistics (IBGE) to calibrate the coefficients $LABSUP(r)$, $EMPLOY(r)$ and $POP(r)$, with $r \in S^*$. Because these estimates are based on snapshot observations for a single year revealing the economic structure of the economic system, this subset of data is denoted “structural coefficients” (Haddad et al., 2002).

[42] In a long-run closure, the assumptions on interregional mobility of capital and labor are relaxed by swapping variables $x_{(g+1,2)}^{(1j)r}$, $natrealwage$, $wage\_diff^{(r)}$ and $d\_rm^{(r)}$, for $f_{(k)}^{(1j)r}$, $del\_unr^{(r)}$ and $util\_diff^{(r)}$.

The second piece of information, necessary to calibrate the model, is represented by the subset of data defining various parameters, mainly elasticities. These are called "behavioral parameters." Empirical estimates for some of the parameters of the model are not available in the literature. We have thus relied on "best guesstimates" based on typical values employed in similar models. We set to 2.0 the values for both regional trade elasticities, $\sigma 1_{(i)}^{(u)r}$ in Equation (A1) and international trade elasticities, $\sigma 2_{(i)}^{(u)r}$ in Equation (A2), in the manufacturing sector and to 1.0 in the other sectors. Substitution elasticity between primary factors, $\sigma 3_{(g+1)}^{(1j)r}$ in Equation (A3) was set to 1.0. The current version of the model runs under constant returns to scale, so that we set to 1.0 the values of $\mu_{(g+1,\bullet)}^{(1j)r}$ in Equation (A4). The marginal budget shares in regional household consumption, $\beta_{(i)}^{r}$ in Equation (6), were calibrated from the input-output data, assuming the average budget share to be equal to the marginal budget share, and the subsistence parameter $\gamma_{(i)}^{r}$, also in Equation (A6), was associated with a Frisch parameter equal to -3.0. We have set to -2.0 the export demand elasticities, $\eta_{(is)}^{r}$ in Equation (A8). The ratio of gross to the net rate of return, $\psi_{(j)}^{r}$ in Equation (A15), was set to 1.0. Finally, we set to 4.0 the parameter for the sensitivity of capital growth to rates of return, $\varepsilon_{(j)}^{r}$ in Equation (A17).