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Col·lecció d'Economia E23/444

FISCAL MULTIPLIER IN BOLIVIA: DO THE NATIONALIZATION PROCESS AND THE UNCONVENTIONAL MONETARY POLICY MATTER?

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ISSN 1136-8365

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Working Papers

UB Economics *Working Paper No. 444*

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JEL Codes: B22, E50, E62, H50.

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Date: May 2023

Acknowledgements:

I would like to thank my advisors, Hector Sala and Xavier Raurich, for their invaluable guidance and support. I would also like to thank the Central Bank of Bolivia for their enormous collaboration in providing data.

Fiscal Multiplier in Bolivia: Do the Nationalization Process and the Unconventional Monetary Policy matter?

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April 17, 2023

Abstract

This paper studies the fiscal multiplier in Bolivia considering key characteristics of the country and compares the results obtained for Bolivia with the fiscal multipliers estimated for Latin American countries. The main finding is that a positive shock to government spending increases output causing a larger short term response, with an impact multiplier of 0.74. This value is robust when the unconventional monetary policy is added, reaching a value of 0.73. Consideration of the Bolivian nationalization process in the analysis uncovers distinct impact multipliers, with a higher value during the Pre-nationalization (1990-2005) than the Post-nationalization (2006-2019) periods which correspond, respectively, to crisis and boom periods. A comparative analysis with Latin American countries confirms that fiscal multipliers are higher in the short term and economic downturns.

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1 Introduction

Macroeconomic policymakers and researchers have focused more on monetary policy than on fiscal policy during the Great Moderation (Ramey, 2019). However, this was interrupted by the Great Recession (2009) and then by the Great Lockdown (2020), which have put fiscal policy back on the agenda of many researchers. This shift in the study of fiscal policy, more specifically of public spending, has reactivated the debate about the fiscal multiplier.

Knowledge of the size of the fiscal multiplier is crucial for decision making and even more so in times of recession when a fiscal stimulus package is launched. Overestimating multipliers can lead countries to set unattainable and incorrect fiscal targets and this could seriously affect the credibility of fiscal policy programs (Batini et al., 2014). Thus, the size of the multiplier is important for a country and it can be higher or lower over time and across countries according to Blanchard & Leigh (2013). This is because the value of fiscal multipliers depends on country-specific characteristics, such as the level of development, exchange rate regime, openness to trade, monetary policy and the health of the financial system (Ilzetzki et al. 2013; Corsetti et al. 2012).

The fiscal multiplier literature is still limited and much of it focuses exclusively on the assessment of fiscal multipliers in developed economies with only a few studies exploring developing countries, such as those in Latin America. For example, J. E. Restrepo & Rincón (2006) calculate the multiplier for Chile, using the SVAR approach for the period 1990 - 2005 and find that the spending multiplier is 1.9. In the case of Peru, Tapia & Gil (2013) determines a spending multiplier of 1.2, using the SVAR approach for the period 1980 -2011. Matheson & Pereira (2016) evaluate the spending multiplier for Brazil, and find a multiplier of 0.5 using the SVAR approach for the period 1999-2014. J. Restrepo (2020) estimates the spending multiplier for Paraguay, which reaches the value of 0.95, using a SVAR approach and taking the period 2003-2017. Following the same author, he determines the spending multiplier for Mexico and finds a value of 0.40 for the period 1990-2017. García-Albán et al. (2020) calculate the spending multiplier of 0.07 for Ecuador, using a SVAR model with Bayesian methods for the period 2004-2019. In the case of Bolivia, it must be admitted that there are no specific studies related to the fiscal multiplier for this country.

In this context, our research questions posed are: What is the size of the fiscal multiplier in Bolivia? How do Bolivia's characteristics explain the value of its fiscal multiplier? In view of these challenges, our purpose in this study is to conduct a detailed empirical analysis to determine the size of the fiscal multiplier for Bolivia.

To achieve this, we follow the "structural VAR approach" to estimate the fiscal shocks and subsequently the fiscal multipliers. The main methodologies to identify fiscal shocks are the "recursive approach" (Sims, 1980; Fatás et al., 2001; Favero, 2003), the "narrative

approach" (Barro, 1981; Ramey & Shapiro, 1999), the "sign- restriction approach" (Faust, 1998; Canova & Nicolo, 2002; Uhlig, 2005; Mountford & Uhlig, 2009), and the "structural VAR approach" (Blanchard & Perotti, 2002; Perotti, 2005; Galí et al., 2007; Ilzetzki et al., 2013). The study chooses the SVAR methodology for two main reasons. First, it adequately addresses the current debate to identify fiscal shocks that arises because there are two possible directions of causality: (i) the public spending could affect output or, (ii) the output could affect the public spending. The SVAR's main assumption to identify fiscal shocks is that the fiscal policy require some time to respond to news about the state of the economy. It implies that fiscal authorities require a quarter period to respond to output shocks, rather than a full year. Therefore, quarterly data are crucial for identification of fiscal shocks. Second, the SVAR approach is adopted because of the availability of detailed quarterly data, which are crucial for the subsequent determination of the fiscal multiplier (Čapek & Crespo Cuaresma, 2020). In contrast to the other approaches, where data and information to apply the methodologies are difficult due to the availability and partial information for this country.[1]

A notable contribution of this study is in cataloguing quarterly data from 1990:Q1 to 2019:Q4 on gross domestic product (GDP), government spending (government consumption), public investment, oil revenue, tax revenue, trade openness, real exchange rate (RER), private credit, commodity prices and other variables for Bolivia. Similarly, the study provides new evidence on the effects of government spending on output by including country-specific characteristics of Bolivia such as the unconventional monetary policy, the incorporation of oil revenues instead of just tax revenues, the separate analysis for the Pre-nationalization (crisis) and Post-nationalization (boom) periods, and the inclusion of oil and mineral commodity prices. The study also contributes by making a comparative study of Bolivia's fiscal multiplier with Latin American countries, considering fiscal policy, unconventional monetary policy and the separate analysis of crisis and boom periods.

The baseline result shows that the impact multiplier reaches the value of 0.74 and over two and a half years decreases to 0.091. The results suggest that fiscal policy promotes economic activity in the short run. Adding unconventional monetary policy to the analysis, the value of the impact multiplier reaches 0.73. This result confirms that the fiscal multiplier is robust and also indicates that government spending remains a key component of the country's economy due to the slight change that occurs when unconventional monetary policy is added to the analysis (1990-2019).

Including tax revenues instead of oil revenues in the analysis, the impact multiplier is reduced to 0.35.[2] This result could be explained by the environment of the Bolivian

[1]The methodology of the SVAR approach is expanded upon in Section 3.

[2]The inclusion of tax revenues is due to the comparison between the two main sources of public

economy which is based on commodities, mainly hydrocarbons.[3] Incorporating the nationalization of hydrocarbons in the analysis shows that the spending multiplier during the Pre-nationalization period (1990-2005) reaches the value of 1.62 and in the Post-nationalization period (2006-2019) the value of 0.45. These results indicate that during the Pre-nationalization (crisis period) the impact multiplier is higher than in the Post-nationalization (boom period). This result may be due to the fact that, during the Pre-nationalization period, Bolivia was in a stabilization process and therefore was still experiencing the consequences of the crisis of the mid-1980's, and therefore required the fiscal impulse to sustain the economy more than the boom period.

In addition, an estimation and comparative analysis is made with the Latin American countries of Brazil, Paraguay, Mexico and Ecuador. The results depict that the response of output to the public spending shock is higher in the short term. Adding unconventional monetary policy to the analysis, based on private credit in each country's financial system, shows that the response of output to the public spending shock is also in the short term.[4] A separate analysis between crisis and boom periods is also performed for Latin American countries where fiscal multipliers are higher in times of crisis and these results are observed when fiscal policy is considered. In sum, these results for Bolivia and the Latin American countries are consistent with Christiano et al. (2011) , Corsetti et al. (2012), De Cos & Moral-Benito (2013) and Afonso et al. (2018), who find that the fiscal multipliers are higher during crisis periods.

The rest of the document is organized as follows: Section 2 documents the main characteristics of the Bolivian economy. Section 3 lays out the methodology. Section 4 presents the analysis and results. Section 5 details cross-country comparisons. Finally, the conclusions are in section 6.

2 The Bolivian economy

Bolivia is a landlocked country in Latin America whose economy, since colonial times, has depended heavily on minerals and hydrocarbons, first silver, then tin and later gas. Among the most notable historical events of this country are the hyperinflation and the fall in mineral prices in the mid-1980's, which marked a milestone in Bolivian history due to their devastating effect on the economy. These events were overcome with structural reforms (1990's), high prices of commodities (2004) and the nationalization (2005) of the

revenues and their effect on government spending.

[3]This result implies that oil revenue is the most relevant source of financing public spending than tax revenue.

[4]The credit portfolio of the financial system of each country is considered as a non-conventional monetary policy variable, since the central bank interest rate is incorporated in recent periods in Latin American countries. In addition, this variable allows for a more homogeneous analysis with Bolivia's monetary policy.

oil companies. This last event marked another important milestone, two key periods in the Bolivian economy, Pre-nationalization (before 2005) and Post-nationalization (after 2005) (Mercado et al. 2005; Mendez-Marcano & Pineda 2014; Kehoe et al. 2019). Based on the main milestones of bolivian economy, this section focuses on the following parts: (i) fiscal policy and fiscal revenues; and (ii) unconventional monetary policy.

2.1 Fiscal policy and fiscal revenues

The hyperinflation suffered prior to the 1990's causes a large deficit in the public sector, which is controlled with the issuing of Decree 21060. With this law, a strong control of fiscal policy was established, prohibiting the contracting of debt by state entities without prior authorization, eliminating the prohibition of foreign exchange transactions, liberalizing prices and interest rates, and implementing a tax reform. The previous context causes the 1990's to be a decade of fiscal controls (Mercado et al., 2005; Kehoe et al., 2019). Similarly, the 1990's are characterized by the capitalization of the state-owned oil companies (YPFB), which are the main sources of fiscal revenues for this country.

The capitalization takes place during the Sanchez de Lozada administration (1996), in which the amount of YPFB's capitalization is set at approximately USD 835 million and a 40-year risk sharing contract is established (Jubileo, 2009).[5] Subsequently, in 2003, a milestone is reached when the capitalized companies plan to export gas to the United States through a Chilean port and also in that year the government of Sanchez de Lozada plans to impose an income tax on the population. These two events cause great political turmoil and rejection by the population, which end with the resignation of President Sanchez de Lozada in October 2003 and the election of Morales Ayma in 2005, who nationalizes the capitalized companies.[6]

The following period of the Bolivian economy starts with the inauguration of the new government. Among the first measures adopted by the administration of Morales Ayma is the enactment of Decree 28701 of the *Nationalization* in May 2006.[7] The nationalization of oil companies represents new sources of fiscal revenue for the Bolivian State. The hydrocarbon sector is one of the largest contributors to the economy, in terms of GDP, exports, investments and especially in tax revenues (IEHD - special tax on hydrocarbons and their derivatives and IDH - direct tax on hydrocarbons). According to Bolivia's National Institute of Statistics, from 1990 to 2019, oil activity (including oil refining)

[5]On December 5, 1996, the US-British consortium Enron-Shell was awarded the Bolivian Hydrocarbon Transportation Unit for USD 263.5 million, while the Andean Exploration and Production Unit SAM was transferred to the consortium YPF S.A.-Pérez CompancPluspetrol (Argentina) for USD 264.8 million. On the other hand, the Exploration and Exploitation Unit Chaco SAM was transferred to the Amoco Bolivia Petroleum Co. consortium (USA) for USD 306.7 million (Jubileo, 2009).

[6]Bolivian population rejected the sale of gas to the United States thorough Chile ports because this country took the Bolivian coast in the War of the Pacific in 1879.

[7]Throughout its history, Bolivia has had three nationalizations (1937, 1969 and 2006) of its oil companies (YPFB).

contributed an average of 8.3 percent to GDP as is displayed in Figure 1. Oil exports represent 30 percent of the country's total exports with Brazil and Argentina being the main destination countries (Velasco-Portillo, 2022).

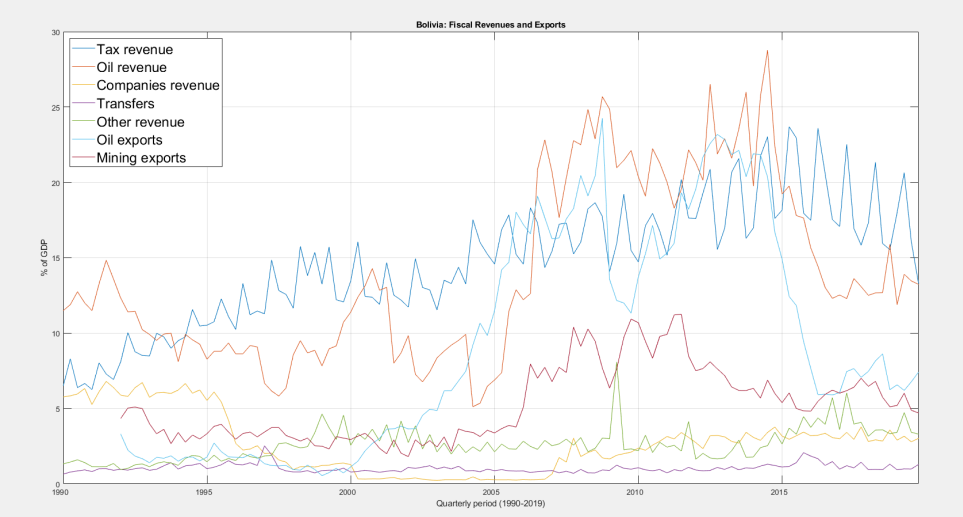

Figure 1: Fiscal revenues and exports as a percentage of GDP from 1990:Q1 to 2019:Q4

In this context, the Bolivian economy shows a fiscal surplus during the nationalization period (2006-2013) that had not been seen for many years. The fiscal surplus for 2006 reaches 4.5 percent of GDP and remains at an average of 1.8 percent until 2013. This performance is mainly explained by the international economic boom, which translates into high export prices for the country's products, in addition to fiscal revenues from the nationalization of oil companies. All these favorable conditions allow Bolivia to emerge from the crisis of the 1990's and to deal the financial recession of 2007-2009 and the fall in commodity prices in 2014. The government's fiscal position helps Bolivia avoid the worst effects of these events. It should be noted that this would not have been possible without the control the government gained over its oil production and revenues (Weisbrot et al., 2009; Machicado Salas et al., 2011). In this sense and for the purposes of the study, nationalization is considered in the analysis and divided into two periods Pre-nationalization (1990-2005) and Post-nationalization (2006-2019).[8]

[8]Pre-Nationalization is characterized by the absence of the revenues of the oil sector, high levels of public debt, fiscal deficit and low economic activity due to the previous crisis experienced during the 1980's, where the country showed a deceleration due to hyperinflation. Post-Nationalization period is distinguished by the nationalization of companies, high commodity prices, payment of public debt, increase of net international reserves of BCB and remonetization.

2.2 Unconventional monetary policy

Monetary policy during the 1990's is strict and focuses on stabilizing prices in the economy due to the hyperinflation of the 1980's.[9] Among the measures adopted are the liberalization of the financial market, the implementation of a bi-currency system (bolivianos and U.S. dollars), and the unification of the dual exchange rate (official and parallel exchange rate). With respect to this last measure, a crawling-peg regime with mini-devaluation is also established until 2005. Following the 2005 period, the exchange rate begins with small appreciation and in 2011 a fixed exchange rate is established of 6.96 bolivians per US dollar. This is possible due to the increase of international reserves.[10] The remonetization (Bolivianización) is also boosted in this period, which begins in 2004 and is promoted through a financial transaction tax, reduction of the reserve requirement for legal reserve for deposits in local currency, and fixed exchange rate (Orellana et al. 2000; Kehoe et al. 2019).[11]

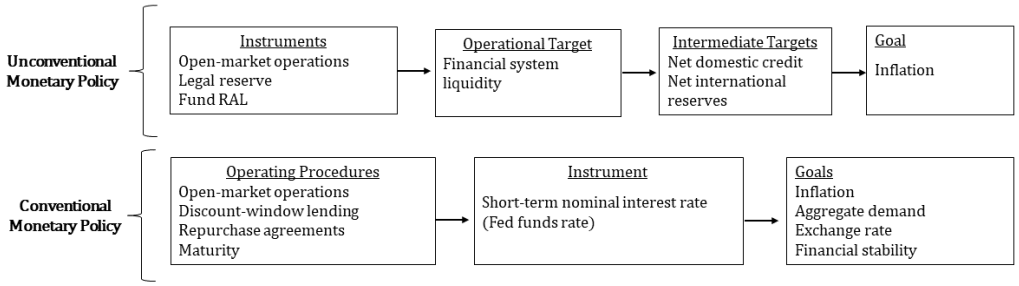

Figure 2: Unconventional Monetary Policy of Bolivia (BCB) and Conventional Monetary Policy

It is also necessary to point out that the monetary policy followed by the BCB differs from traditional economic literature, as shown in Figure 2. Instead of using the short-term interest rate as an instrument to achieve the inflation goal, the BCB uses a non-conventional instrument, which is the liquidity of the financial system, as a formal mechanism for the implementation of monetary policy. The Bolivian monetary policy is implemented through an operational target which is the "liquidity of the financial system", defined as the excess of bank reserves in the central bank. The liquidity of the financial system is a quantitative variable, controllable in the short term, whose variations have a direct impact on the intermediate target which is "net domestic credit" and subsequently on inflation (Orellana et al. 2000; BCB 2011). For example, when the central bank perceives inflationary pressures, it executes its contractionary actions through the operational target, which in turn is executed through open market operations, legal

[9]The Bolivian economy suffered the hyperinflation (1984-85), which reached to 25,000 percent per year (Kehoe et al., 2019).

[10]In 2012, it represented 51.8 percent of GDP and subsequently decreased to 27.5 in 2017

[11]In 2005, 84 percent of deposits and 93 percent of credits in the financial system were in U.S. dollars.

reserve or the RAL Fund. Changes in the operational target have a direct impact on the intermediate target and, therefore, on the ultimate goal of monetary policy, inflation.

In this context and for the purposes of the study, the credit portfolio of the Bolivian financial system is taken into account as a proxy variable for the financial system liquidity.[12]

3 Methodology and data

This section considers three parts: (i) the main variables of the model; (ii) the structural VAR approach; and (iii) the data specification.

3.1 Main variables

Prior to the specification of the structural VAR, it is necessary to determine the variables to be included in the model. In this sense, and following the advice of Čapek & Crespo Cuaresma (2020) who indicate that the structural VAR should be documented in detail, the analysis of the fiscal and monetary variables is carried out, as well as the analysis of fiscal revenues.

Figure 3 shows the analysis of fiscal and monetary policies during the period 1990-2019 in which are considered, government spending, private credit, oil prices and inflation rate. The first graph depicts the annual growth rate of government spending which presents two different growth patterns. The first pattern is between 1990-2005, which shows a low growth rate of government spending and the second pattern is between 2006-2019, which depicts a high growth rate of government spending. These patterns can be explained by the crisis of the mid-1980's in which Bolivia experienced a period of fiscal control and low commodity prices, mainly oil, as shown in the second graph. Similarly, the second pattern can be attributed by high oil prices and the nationalization of oil companies that generate a large flow of fiscal revenues. The third graph shows the annual growth rate of credit, which also shows two different growth patterns. The first pattern is between 1990-2001 where a high credit growth rate is observed and also a high inflation rate (fourth graph), mainly explained by the hyperinflation of the mid-1980's. The second pattern is between 2002-2019 where the credit growth rate slows down and this feature is also reflected in the inflation rate. These behaviors are mainly attributed to the economic reforms of price stabilization carried out by the Central Bank of Bolivia. These patterns of fiscal and monetary policy suggest that the fiscal multiplier may take distinct values due to the different behavior exhibited in each period. In this context, these patters also constitute a motivation to undertake this study.

[12]Credit portfolio is taken into account as a proxy variable because data on the liquidity of the financial system is not available for the study period.

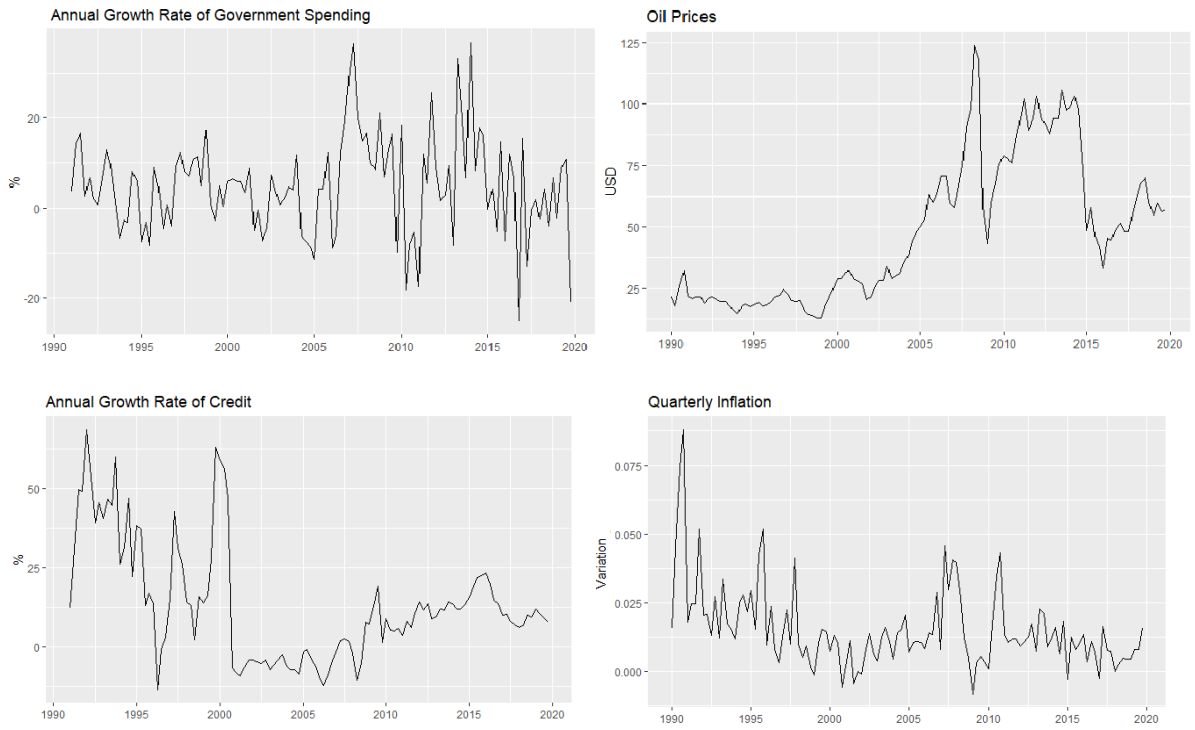

Figure 3: Annual Growth Rate of Bolivian Government Spending, Oil Prices (WTI) expressed in US Dollars per Barrel, Annual Growth Rate of Bolivian Credit expressed in percent, and Quarterly inflation rate (1990-2019)

Figure 4 shows the IRFs analysis to compare fiscal revenues, oil and tax revenues to be incorporated in the structural VAR model. It can be observed in the figure that government spending responds positively to oil revenues rather than tax revenues, which respond negatively. Based on this comparison, oil revenues are taken into account in the model as the main variable to finance public spending and subsequently impact GDP. For further analysis, tax revenues are also incorporated in the model, but in a general way and for comparative purposes only.

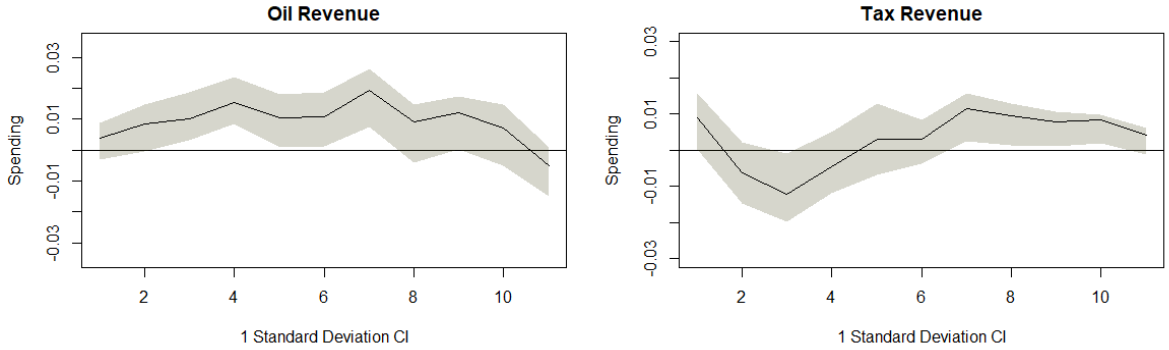

Figure 4: IRFs of Oil and Tax Revenues Shocks
Note: The figure plots the impulse of oil and tax revenues and the response of government spending. Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

3.2 Structural VAR approach

A central issue in the current debate on fiscal multipliers is that there is a disagreement on how to proceed in identifying fiscal shocks. This identification problem arises because there are two possible directions of causality: first, the public spending could affect output or, second, the output could affect the public spending (for example, the automatic stabilizer and the implicit or explicit policy rules). Taking these aspects into account, the structural VAR approach of Ilzetzki et al. (2013), which in turn adopts the method of Blanchard & Perotti (2002) is followed to address this identification problem.

The main SVAR specification is estimated according to $Y_t = A(L)Y_{(t-1)} + U_t$, where $Y_t = [o_t, g_t, c_t, y_t]'$ is a vector of four variables expressed quarterly: o_t oil income, g_t government spending, c_t credit, and y_t gross domestic product (GDP), expressed quarterly.[13] The $A(L)$ is a quarter lag polynomial that allows the coefficients at each lag to depend on the particular quarter that indexes the dependent variable. In other words, describes the relationship between the coefficients in each quarter. $U_t = [u_t^o, u_t^g, u_t^c, u_t^y]'$ is the vector of the reduced form of residual, which in general will have non-zero cross correlations. The equation $u_t^o = a_1 u_t^y + a_2 e_t^g + a_3 e_t^c + e_t^o$ states that unexpected movements in oil revenue within a quarter, u_t^o, can be due to one of four factors: the response to unexpected movements in GDP, captured by $a_1 u_t^y$, the response to structural shocks to public spending captured by $a_2 e_t^g$, the response to structural shocks to credit captured by $a_3 e_t^c$ and to structural shocks to oil income, captured by e_t^o. The following equations have the same interpretation. In order to be able to draw conclusions on causality within fiscal policy, and given that the residual in the reduced form is not very informative in itself, the structural shocks of residual must be recovered and estimated, e_t^o, e_t^g, e_t^c and e_t^y which are mutually uncorrelated.

The fundamental assumptions regarding the strategy for identifying expenditure shocks is presented in parameters a_1, a_2, a_3, b_1, c_1 and c_3. Following economic intuition, we assume that the parameter $a_1 = 0$, due to the GDP does not affect oil revenue. It should be considered that the Bolivian economy does not influence international oil prices because this country only assumes the prices already set by the Organization of the Petroleum Exporting Countries (OPEC), for this reason we assume that the parameter is zero. For the parameter a_2 and a_3, we assume that they are also zero, as explained above. With respect to parameter b_1, it contains two types of information: endogenous changes in government spending due to changes in GDP and exogenous changes in fiscal policy in response to unexpected extraordinary movements in GDP. Since quarterly data is used, it is assumed that the second channel is not possible in the same quarter, as a government is not able to react quickly and automatically. For example, a new spending decision usually has to go before the legislature and requires their acceptance to be activated, this

[13] Prior to the main specification, a baseline estimate was made to determine the impact of government spending on output, considering only the variables of oil revenue, government spending and output.

implies that $b_1 = 0$. Therefore, the main assumption is that fiscal policy shocks cause effects when they are implemented and not when they are announced. The parameter $c_1 = 0$ due to GDP does not affect credit in the same quarter. The parameter $c_3 = 0$ because the government spending does not affect credit and this depends only on oil revenue.

Lastly, the SVAR can be estimated by incorporating all of the above-mentioned constraints and obtaining the corresponding impulse-response functions (IRFs) that describe the reaction of the variables explained in the system to changes in structural errors or exogenous changes.[14] Once the values are obtained from the IRFs, it has to construct the spending multipliers, both impact and cumulative. The impact multiplier is defined as the measures of the ratio of the change in output to a change in government spending at the moment the impulse to government spending occurs, and cumulative multiplier which is calculated to evaluate the effect of fiscal policy on longer forecast horizons.

$$Impact\ Multiplier = \frac{\Delta y_t}{\Delta g_t} = \underbrace{\frac{\partial y_t}{\partial e_{g,t-1}}}_{Sensitivity} \underbrace{\frac{Y_t}{G_t}}_{Impact} (1+i)^{-t} \tag{1}$$

$$Cumulative\ Multiplier = \frac{\sum_{t=0}^{T}(1+i)^{-t}\Delta y_t}{\sum_{t=0}^{T}(1+i)^{-t}\Delta g_t} \tag{2}$$

To check the robustness of the model and the size of the fiscal multiplier, other specifications are included such as public investment, trade openness, real exchange rate and commodity prices.[15]. These variables are also added in order to look at the effectiveness of fiscal policy, as it is known that the impact of government spending shocks depends crucially on key country characteristics.[16]

3.3 Data

Quarterly data are crucial for identification of fiscal shocks as it is mentioned previously, the structural VAR's main assumption is that the fiscal policy require some time to respond to news about the state of the economy. It implies that fiscal authorities require a quarter period to respond to output shocks, rather than a full year. Taking into account this feature, we proceed to the cataloging of the data.

The data processed in this study is selected from official sources such as the Ministry of Economy of Bolivia (MEFP), the National Institute of Statistics of Bolivia (INE), the Central Bank of Bolivia (BCB), the London Metal Exhange (LME), and the Federal

[14]Thirty-two SVAR regression models were performed, for more details see the Online Appendix

[15]Gross capital formation is used as a proxy for public investment. There is no quarterly data on public investment, only from the 2013 period on-wards.

[16]For more details see Appendix A.1. Structural VAR Specification

Reserve Bank of St. Louis Economic Data (FRED). Appendix, Figure A1 shows the quarterly data collected for the analysis which are (i) GDP, (ii) government spending, (iii) public investment, (vi) oil revenue, (v) tax revenue, (vi) exchange rate, (vii) trade openness, and (viii) credits, from 1990:Q1 to 2019:Q4. Appendix, Figure A2 displays the external shocks of commodity prices (oil, gold, silver, lead, cooper, zinc and tin) from 1990:Q1 to 2019:Q4.

Before running the model, the data is transformed. The GDP deflator is used to express the variables in real terms and the difference of natural logarithm is applied ($logx_t - logx_{t-4}$) to obtain stationary variables.[17] With respect to commodity shocks quarter-on-quarter (qoq) growth rate are applied. Formal unit-root tests of Augmented Dickey Fuller (ADF), Kwiatkowski Phillips Schmidt Shin (KPSS), and Phillips Perron (PP) are also applied to determine the stationarity of the variables (Appendix, Table A1). The Akaike's criteria (AIC), Hannan Quinn (HQ), Schwarz criterion (SC) and Final Prediction Error (FPE) are then applied to determine the numbers of lags (K) in the model (Appendix, Table A2). With respect to the determination of lags suggested by the different tests performed, it is determined to use 6 lags for the case of oil revenues and 4 lags for tax revenues. A dummy is also included in the model to control for the effect of nationalization. In addition, the VAR and SVAR model are subjected to different tests to obtain robust results.[18]

4 The effects of government spending shocks

4.1 Baseline spending multipliers

The baseline model of the spending multipliers is calculated based on the oil revenue, government spending and GDP. Figure 5 depicts the results of the IRFs of government spending shocks and the responses of GDP. The impact response reaches the value of 0.28 percent, the impact multiplier of 0.74 and the cumulative multiplier of 2.64 (Table 1). These results suggest that the effect of government spending shock to GDP is positive and significant in the first quarters. In the same way, when commodity prices (S's) are added into the model as exogenous shocks, the impact response changes slightly but maintain the same behavior.[19] When the control variables, real exchange rate and trade openness, are added the impact response is slightly reduced. This change may be due to Bolivia's mixed exchange rate regimes from 1990 to 2019. From 1990 to 2011, Bolivia

[17]Before applying the log difference, the author worked with Hodrick Prescott and U.S.Census Bureau's X-13 method to remove the seasonality and trend of the variables, however it was identified that the variables lost their quality and significance. For this purpose, the difference of logarithms is applied to eliminate both the seasonality and the trend of the variables (Enders, 2015)

[18]For more details see Online Appendix

[19]The main commodity prices include oil, gold, lead, cooper, silver, tin and zinc

has a crawling peg regime and from 2011 to 2019 a fixed exchange regime. Similarly, this change can be attributed to the fact that the trade in this country is closed.[20]

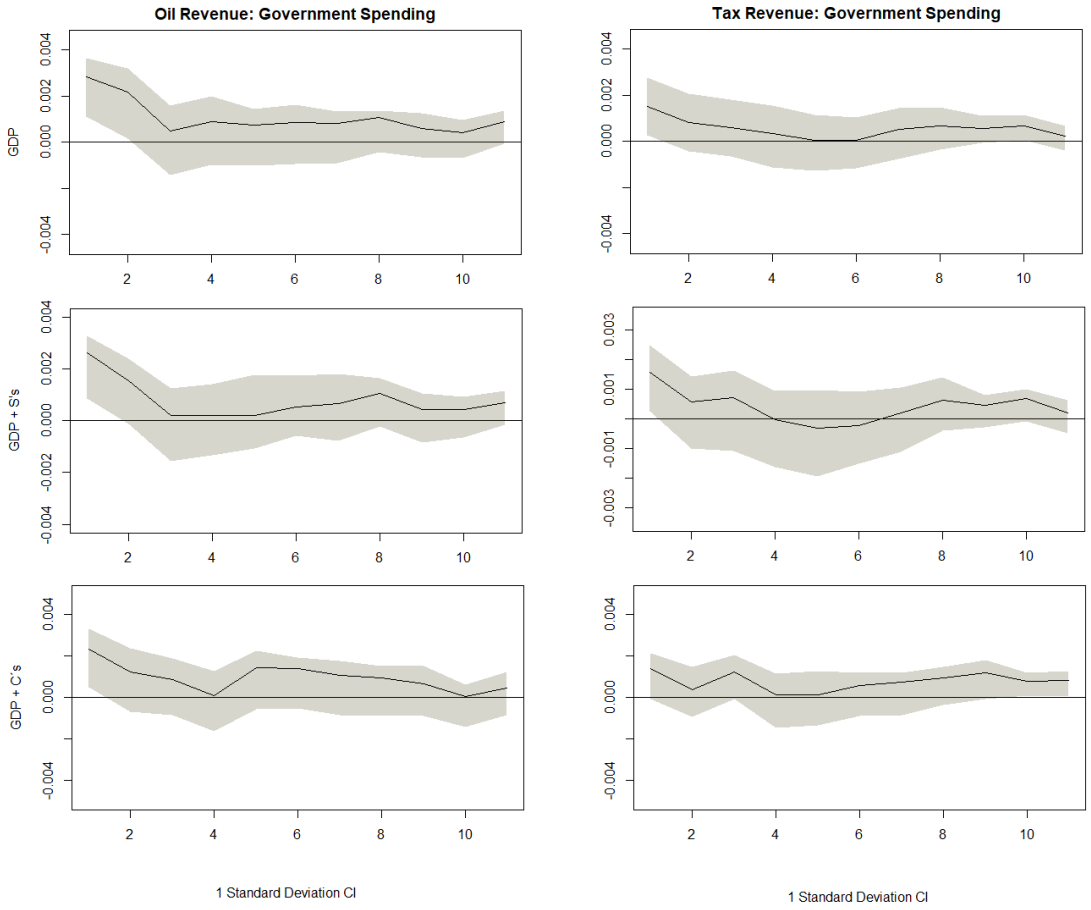

Figure 5: IRFs of Government Spending Shocks and Fiscal Policy
Note: The figure plots the impulse of government spending and the response of GDP. First column takes into account oil revenue, and the second column considers the tax revenue. The first row considers just GDP. The second row takes into account GDP and international prices of commodities. Third row includes GDP and control variables (trade openness and real exchange rate) Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

In addition, the impact response and multipliers are calculated taking into account the tax revenue, government spending and GDP. The impact response reaches the value of 0.15 percent, the impact multiplier of 0.39 and the cumulative multiplier of 1.39. Making a comparison between the two models (Figure 5), the effect is greater when oil revenue (first column) is considered in the model than tax revenue (second column).

4.2 Spending multipliers and unconventional monetary policy

Adding the unconventional monetary policy to the baseline model in the form of private credit from Bolivia's financial system displays the IRFs of Figure 6. The impact

[20]Following the definition of Ilzetzki et al. (2013), who consider two types of trade, open trade is when the ratio of trade (export + import) exceeds 60 percent of GDP, and closed trade is when the ratio is below 60 percent of GDP.

response reaches the value of 0.28 percent, the impact multiplier of 0.73 and the cumulative multiplier of 2.74 as shown in Table 1. These results suggest that the effect of government spending shock to GDP is positive and significant in the first quarters. In addition, the outcome of the impact multiplier implies that an additional boliviano (bolivian currency) of government spending provides 73 cents of additional output in that quarter of implementation. The result also confirms the relevance of government spending on GDP.

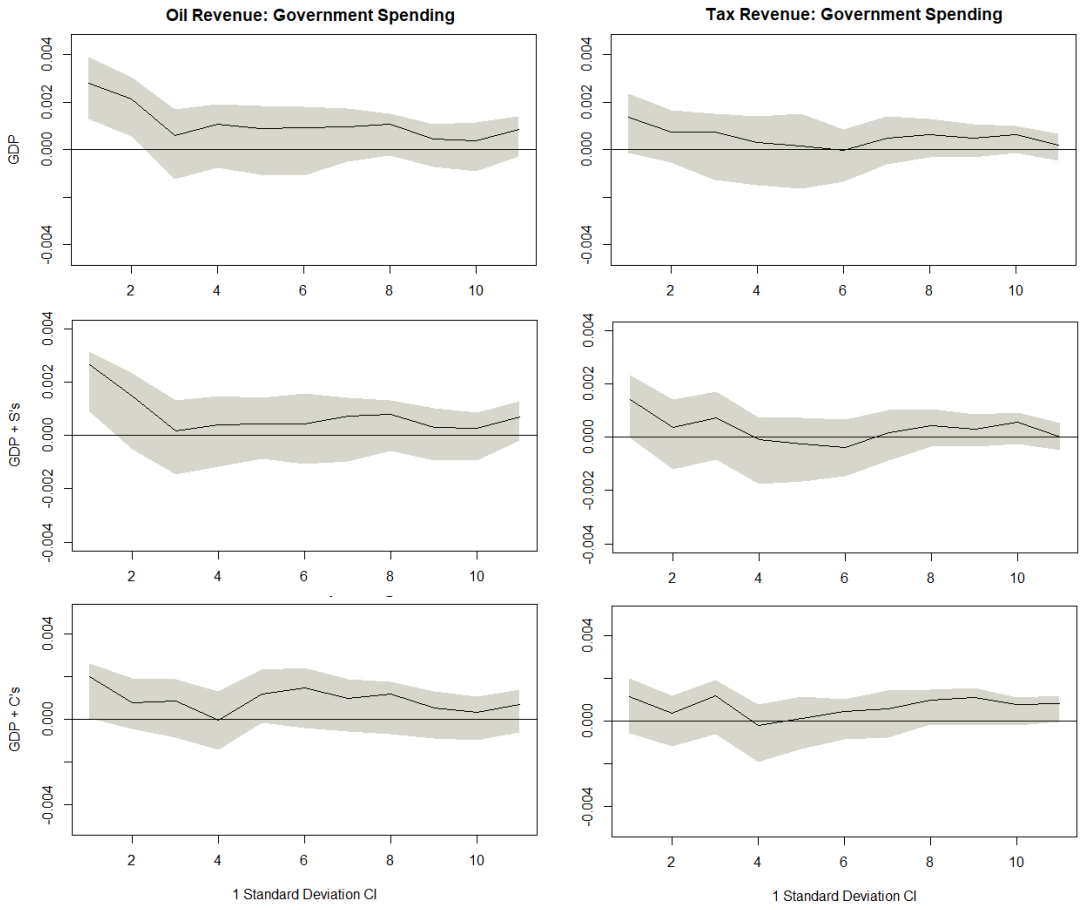

Figure 6: IRFs of Government Spending Shocks and Unconventional Monetary Policy
Note: The figure plots the impulse of government spending and the response of GDP. First column takes into account oil revenue, and the second column considers the tax revenue. The first row considers just GDP. The second row takes into account GDP and international prices of commodities. Third row includes GDP and control variables (trade openness and real exchange rate) Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

These outcomes also suggest that a positive innovation in government spending has a positive impact on GDP in the short run. The results should come as no surprise, given the different pace at which fiscal and monetary policy decisions are made and implemented. Fiscal policy, takes longer to implement than monetary policy, but both are implemented within the year. For example, the national budget is an annual government document which has to go through different approval processes and subsequent implementation but this happens in a short time because the implementation must be

done immediately. Another example is how many developing and developed countries responded with fiscal measures in the first quarter of 2009 to the economic consequences of the collapse of Lehman Brothers and AIG at the end of the third quarter of 2008. Similarly, monetary policy is implemented in a shorter time frame because the monetary authority has independence to make decisions.

Figure 6. also shows the results of IRFs from government spending to GDP taking into account tax revenues. The impact response reaches the value of 0.14 percent, the impact multiplier of 0.35 and the cumulative multiplier of 1.32. This comparison is made to determine the impact of tax revenues to finance government spending, as compared to oil revenues. As can be seen, the response is higher for oil revenues than for tax revenues.

	Oil Revenue				**Tax Revenue**			
	Impact Response %	Impact Multiplier	Multiplier 10th quarter	Cumulative Multiplier	Impact Response %	Impact Multiplier	Multiplier 10th quarter	Cumulative Multiplier
Fiscal Policy								
Spending Multiplier	0.28	0.7405	0.0909	2.6440	0.15	0.3941	0.1426	1.3895
Pre-Nationalization	0.51	1.4722	0.3617	0.7559	0.33	0.9656	0.0794	-1.3474
Post-Nationalization	0.24	0.5338	0.0319	3.1784	0.15	0.3244	0.1507	2.8437
Spending Multiplier+S's	0.26	0.6832	0.0904	1.9153	0.16	0.4097	0.1473	1.0404
Pre-Nationalization	0.36	1.0348	0.2937	-2.8904	0.26	0.7457	0.1390	-3.8553
Post-Nationalization	0.20	0.4462	0.4424	4.3464	0.12	0.2742	0.1295	-0.1529
Spending Multiplier+C´s	0.23	0.6085	0.0084	2.4414	0.14	0.3658	0.1689	1.7797
Pre-Nationalization	0.61	1.7708	0.4238	2.2482	0.29	0.8279	-0.1334	-2.0408
Post-Nationalization	0.30	0.6680	-0.0408	3.7261	0.16	0.3640	0.1683	3.2951
Spending Multiplier+S's+C's	0.27	0.7010	0.0770	1.9000	0.16	0.4040	0.1616	1.0751
Pre-Nationalization	0.42	1.2185	0.3952	-1.0817	0.17	0.4782	-0.2238	-5.0344
Post-Nationalization	0.33	0.7263	2.0512	11.252	0.28	0.6325	0.6867	3.7720
Fiscal Policy and Unconventional Monetary Policy								
Spending Multiplier	0.28	0.7293	0.0810	2.7443	0.14	0.3530	0.1358	1.3186
Pre-Nationalization	0.56	1.6167	0.2480	0.9863	0.29	0.8298	0.1815	-1.3920
Post-Nationalization	0.20	0.4500	0.0204	2.3764	0.16	0.3600	0.0829	2.0363
Spending Multiplier+S´s	0.27	0.6925	0.0589	1.8770	0.14	0.3665	0.1179	0.7916
Pre-Nationalization	0.34	0.9936	0.0148	-3.4236	0.30	0.8602	0.0804	-3.9704
Post-Nationalization	0.21	0.4668	0.2167	2.9247	0.18	0.3967	0.3818	3.0073
Spending Multiplier+C's	0.20	0.5212	0.0713	2.2405	0.11	0.2968	0.1643	1.5551
Pre-Nationalization	0.82	2.3762	0.4371	3.9915	0.44	1.2818	0.0623	-0.7781
Post-Nationalization	0.15	0.3302	-0.1229	1.0304	0.06	0.1298	-0.0414	0.6152
Spending Multiplier+S's+C's	0.26	0.6724	0.1018	1.7114	0.15	0.3784	0.1448	0.8692
Pre-Nationalization	0.67	1.9486	0.0814	0.7382	0.53	1.5459	-0.1217	-2.7096
Post-Nationalization	0.15	0.3372	-0.9729	-4.5900	0.23	0.5199	-2.3020	-8.5252

Table 1: Fiscal Multiplier
Note: Table details the results obtained of the impact response and impact multipliers for each model. The first column describes the impact response, second column the impact multiplier, third column the multiplier at 10th quarter and the fourth column the cumulative multiplier with oil revenue as main variable. The fifth column details the impact response, the sixth column the impact multiplier, the seventh column the multiplier at 10th, and the eighth column the cumulative multiplier with tax revenue as main variable. The first block considers the results of the fiscal multipliers, considering only fiscal policy. The second block details the results of the fiscal multipliers considering both fiscal and monetary policy. The first sub block of the row represents the baseline results; the second displays the baseline and the commodity shock (S's); the third considers the baseline and control variables (C's); and the fourth takes into account the baseline, commodity shocks (S'S) and control variables (C's).

4.3 The nationalization and the fiscal multiplier

Figure 7 displays the results of the IRFs of goverment spending shocks and the responses of GDP for the Pre-and Post-nationalization period. The baseline results for the Pre-nationalization period show that the impact response reaches the value of 0.51 percent, the impact multiplier of 1.47 and the cumulative multiplier of 0.76 (Table 1). Adding unconventional monetary policy to this analysis yields an impact response of 0.56 percent, an impact multiplier of 1.62 and a cumulative multiplier of 0.99.

The results for the Pre-nationalization period suggest that monetary policy accommodates to fiscal policy due to the impact multiplier increases from 1.47 to 1.62. This analysis also indicates that a positive innovation in government spending accompanied by a monetary policy has a positive impact on GDP in the short term, which implies in the year. Fiscal policy occurs in the year but it presents a longer decision-making process because its approval must generally pass through the legislature. In the case of monetary policy, it reacts more quickly than fiscal policy because of the independence, autonomy and goal of the monetary authorities. For example, the authority should make decisions more frequently because it receives a constant flow of data and information to fulfill the institutional goal, which is to control inflation.

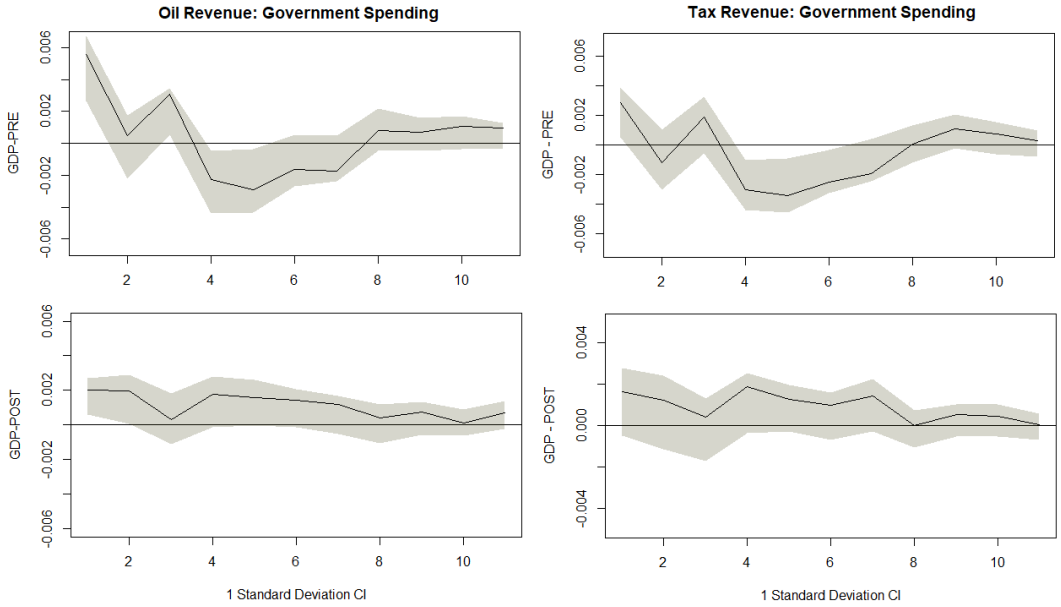

Figure 7: IRFs of Government Spending Shocks and Nationalization (Fiscal Policy and Unconventional Monetary Policy).
Note: The figure plots the IRFs of the government spending shocks and depicts the comparison of revenues between oil and tax. The first row shows the government spending shock and the response of GDP during the Pre-Nationalization period. The second row displays the government spending shock and the response of GDP during the Post-Nationalization period. Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

The Post-nationalization's baseline results show that the impact response reaches the value of 0.24 percent, the impact multiplier of 0.53 and the cumulative multiplier of 3.18. Adding unconventional monetary policy to this analysis yields an impact response of 0.20 percent, an impact multiplier of 0.45 and a cumulative multiplier of 2.38. These results indicate that a positive innovation in government spending accompanied by monetary policy has a positive impact on GDP in the short term. These outcomes also suggest that the monetary policy does not accommodates to fiscal policy during the Post-nationalization period because of the decrease of impact multiplier from 0.53 to 0.45.

Making a comparison between nationalization periods, the Pre-nationalization period presents a dominant fiscal policy, implying that this policy is an important component

in boosting GDP during the period (1990-2005) than in the Post-nationalization period (2006-2019). Also, these results suggest that the fiscal multiplier is higher in the Pre-nationalization period, i.e., in times of crisis, than in the Post-nationalization period, i.e., in boom times.

4.4 The effects of public investment shocks

The result shows that the impact of public investment shock on GDP is 0.42 percent.[21] On the other hand, the impact of government spending on GDP is 0.28 percent. Comparing both results, it is observed that public investment has a greater impact on GDP than government spending, considering oil as the main fiscal revenue. Similarly, the impact of public investment on GDP is 0.32 percent and that of government spending is 0.15 percent, considering taxes as the main fiscal revenue. In sum, both results suggest that the impact response is higher for public investment.[22]

5 Cross-country comparisons

Beyond the conventional analysis of the fiscal multiplier, a comparative analysis with other Latin American countries is considered necessary because of the common economic characteristics and the useful context it provides for understanding the size of the fiscal multiplier not only for Bolivia but also for other countries in the region. However, the comparative analysis only considers three key variables: GDP, public spending and credit, which are key for the comparative study. To go deeper into the results of the fiscal multipliers for the countries analyzed in this section, a more detailed study and more variables are required, since fiscal multipliers also depend on the specific characteristics of each country. Nevertheless, the results obtained for Latin American countries are a good reference to observe the behavior of fiscal multipliers and are a first step for future research on the subject. In this regard, this section presents two key issues of the effect of public spending on GDP. The first estimates the fiscal multiplier for Brazil, Paraguay, Mexico and Ecuador.[23] The second performs a cross-country comparative analysis of the spending multiplier, taking into account the sensitivity of the Bolivian spending multiplier and the impact of the output-spending ratio of Latin American countries.

[21] See Appendix, Table A3 and Figure A3.

[22] Due to the limited availability of data on public investment, the fiscal multiplier is not estimated. However, it is considered necessary to determine the effect on GDP. For this purpose, the proxy variable of gross capital formation is used and the impact of output on public investment is determined, considering oil and tax revenues as the main variables.

[23] These countries are chosen due to the availability of published official quarterly data.

5.1 Fiscal Multipliers in Latin America countries

The fiscal multipliers for Brazil, Paraguay, Mexico and Ecuador are estimated based on structural VAR approach developed in Section 3.[24] Figure 8 depicts the government spending shocks to GDP, considering fiscal policy based on the government spending and GDP. Similarly, Appendix, Figure A6, shows the government spending shock to GDP by period (crisis and boom). Figure 9 displays the government spending shocks to GDP including unconventional monetary policy based on government spending, private credit and GDP. Private credit in each country's financial system is used as a unconventional monetary mechanism to homogenize the monetary policy analysis and make it comparable with Bolivia. Appendix, Figure A7, also shows the impact of government spending to GDP, including unconventional monetary policy, by period (crisis and boom).

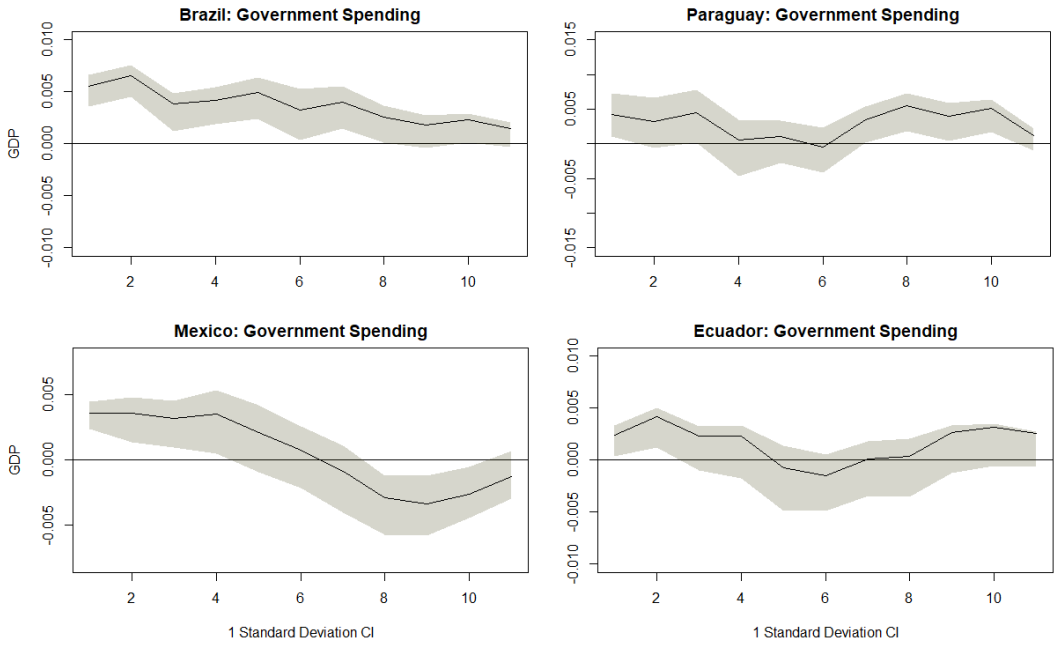

Figure 8: IRFs from Latin America countries and fiscal policy
Note: The figure plots the impulse of government spending and the response of GDP for Brazil, Paraguay, Mexico and Ecuador. Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

Table 2 describes the fiscal multiplier results for Brazil, Paraguay, Mexico and Ecuador, including fiscal and unconventional monetary policies. The results for fiscal policy suggest that the impact responses are short-run and the impact multipliers are higher in the crisis period. On the other hand, the results when adding unconventional monetary policy suggest that the impact responses are short-term and the impact multiplier is higher in the crisis period for Brazil and Paraguay and for Mexico and Ecuador in the boom

[24]The quarterly data are obtained from official sources in Brazil (Ipeadata), Paraguay (Central Bank of Paraguay), Mexico (Institute of Statistics-INEGI), and Ecuador (Central Bank of Ecuador). Each country presents a different study period due to the availability of data (Appendix, Figure A4 and Figure A5)

period. These latter results suggest that fiscal policy is still relevant to boost the economy in boom periods. A more detailed analysis by country is presented in the following paragraphs.

Brazil shows a short-run response of public spending to GDP and a higher spending multiplier for the crisis period. For the fiscal analysis, the impact response is 0.55 percent and the impact multiplier is 2.55. Adding the unconventional monetary policy to the fiscal analysis, the impact response is reduced to 0.43 percent and the impact multiplier to 2.01. The result suggests that the monetary policy does not accommodate to fiscal policy. A separate analysis between periods shows that the crisis period has higher spending multiplier. These results could be explained by the high growth rate of public spending between 1990 and 2005. Also, during this period, Brazil experienced a period of high inflation and monetary crisis, leaving fiscal policy as an active tool to boost the economy. Subsequently, Brazil adopts different economic measures such as the stabilization plan or Real Plan (1994), the Fiscal Responsibility Law (2000), the floating exchange rate regime (1999), an inflation targeting (1999), among others to stabilize the economy (Matheson & Pereira 2016; Kehoe & Nicolini 2022).

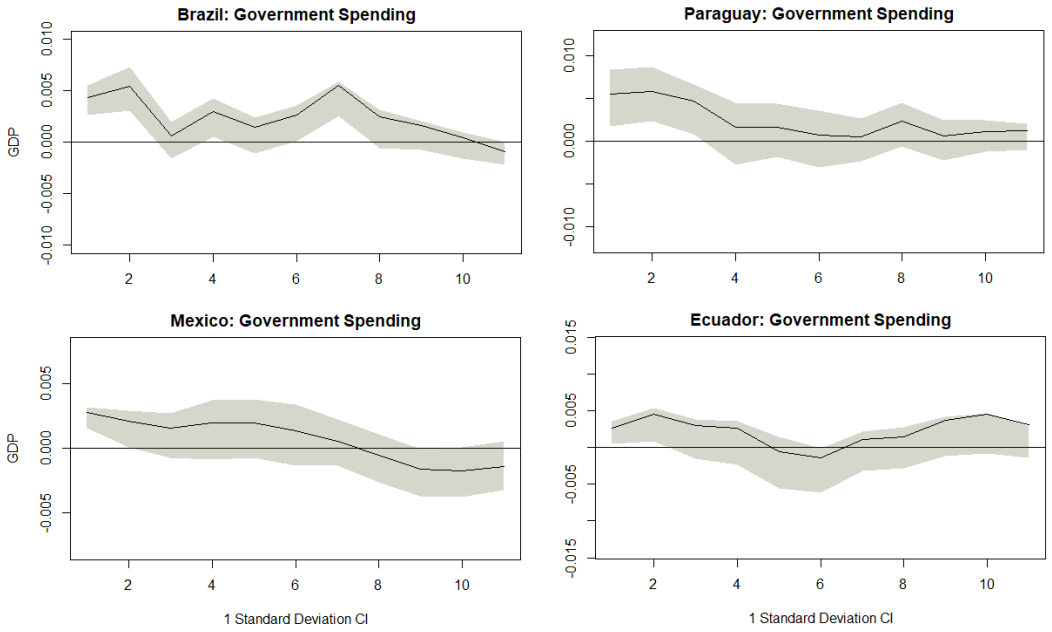

Figure 9: IRFs from Latin America countries and unconventional monetary policy
Note: The figure plots the impulse of government spending and the response of GDP for Brazil, Paraguay, Mexico and Ecuador. The model considers the variables of government spending, private credit and GDP. Shades represent 1 standard deviation confidence intervals based on bootstrapping with 100 runs.

Paraguay depicts a short-run response of public spending to GDP and a higher spending multiplier for the crisis period. If fiscal policy is taken into account, the impact response reaches a value of 0.42 percent and the impact multiplier 3.56. If unconventional monetary policy is added, the impact response increases to 0.55 percent and the impact multiplier to 4.69. The results suggest that monetary policy accommodates fiscal policy.

A separate analysis between periods shows that the crisis period has higher spending multipliers than the boom period. These results could be explained by the end of the 34-year dictatorship in the 1990s, three financial crises (1995, 1997, 2002), the fiscal reform (2003), the high dependence of the Paraguayan economy on the agricultural sector and the Itaípu hydroelectric power plant, the fiscal reform (2013) that imposes limits on the fiscal deficit and public spending growth, and the adoption of inflation targets (2011) (David 2017; Kehoe & Nicolini 2022).

Mexico displays a short-term response of public spending to GDP. A higher spending multiplier in the crisis period if fiscal policy is considered and a higher spending multiplier in the boom period if monetary policy is added. Considering the fiscal analysis for the entire period, the impact response reaches the value of 0.36 percent and the impact multiplier is 3.10. Including monetary policy, the impact response decreases to 0.28 percent and the impact multiplier to 2.38. The outcome suggests that monetary policy does not accommodate fiscal policy. Similarly, the results could be explained by the debt crisis (1995), the bank bailout (1995), the adoption of inflation targeting (2002), the financial crisis (2007) and the U.S. border compartment. The latter implies that any economic phenomenon occurring in the U.S. has an immediate impact on the Mexican economy due to the proximity between the two countries (J. Restrepo 2020; Kehoe & Nicolini 2022).

Country	Impact Response %	Impact Multiplier	Multiplier 10^{th} quarter	Cumulative Multiplier
		Fiscal Policy		
Brazil (1996-2019)	0.55	2.5545	1.0662	18.0814
Crisis period (1996-2005)	0.85	4.3315	0.8757	30.6239
Boom period (2006-2019)	0.49	2.2022	0.1662	13.9507
Paraguay (1994-2019)	0.42	3.5633	4.3444	26.2776
Crisis period (1994-2005)	0.72	6.7780	1.7556	13.0333
Boom period (2006-2019)	0.05	0.4651	-0.3438	-6.6960
Mexico (1993-2019)	0.36	3.0965	-2.2355	6.0400
Crisis period (1993-2009)	0.42	3.3289	-3.7135	-2.2492
Boom period (2010-2019)	0.29	2.3455	0.7513	9.5560
Ecuador (2000-2019)	0.24	1.8715	2.4666	11.8834
Crisis period (2000-2005)	1.14	9.9725	0.5727	18.4536
Boom period (2006-2019)	0.55	3.8756	0.0790	43.1428
		Fiscal Policy and Unconditional Monetary Policy		
Brazil (1997-2019)	0.43	2.0112	0.2026	12.7801
Crisis period (1997-2005)	0.64	3.2666	-0.4336	20.2604
Boom period (2006-2019)	0.41	1.8631	-0.4639	4.7707
Paraguay (1994-2019)	0.55	4.6869	0.9349	20.9521
Crisis period (1994-2005)	0.64	5.9855	1.2568	22.7092
Boom period (2006-2019)	0.16	1.3431	1.78378	-1.1113
Mexico (1995-2019)	0.28	2.3789	-1.5049	7.2120
Crisis period (1995-2009)	-0.08	-0.6150	-3.5469	-18.9640
Boom period (2010-2019)	0.26	2.1563	1.1431	5.7071
Ecuador (2000-2019)	0.27	2.0967	3.5006	16.8453
Crisis period (2000-2005)	-0.13	-1.0948	1.4607	6.4783
Boom period (2006-2019)	046	3.2748	3.4970	47.9423

Table 2: Fiscal Multiplier and unconventional monetary policy in Latin America countries
Note: Table details the results obtained of Impact Multiplier and Cumulative Multiplier for Brazil, Paraguay, Mexico and Ecuador. The first column describes the impact response; the second column displays the impact multiplier; the third column depicts the multiplier to 10th quarter and; the fourth column shows the cumulative multiplier. The first block considers the results of the fiscal multipliers, considering only fiscal policy. The second block details the results of the fiscal multipliers considering both fiscal and unconventional monetary policy.

Ecuador shows a short-term response of public spending to GDP and a higher spending multiplier for the crisis period if fiscal policy is considered and a higher spending multiplier in the boom period if monetary policy is included. In the case of the fiscal

policy analysis, the impact response is 0.24 percent and the impact multiplier is 1.87, for the entire period. In the case of unconventional monetary policy, the impact response increases to 0.27 percent and the impact multiplier to 2.10, for the entire period. The result suggests that monetary policy accommodates fiscal policy. In addition, these outcomes could be explained by the external debt restructuring (Brady Plan - 1994), the default on Brady bonds (1999), the dollarization (2000), the fiscal responsibility law (2002), strong regulations to curb inflation (2002), the increase in oil prices, Ecuador's main raw material (2006), the removal of central bank independence (2008) and the return to international financial markets (2014)(García-Albán et al. 2020; Kehoe & Nicolini 2022).

In sum, fiscal multipliers in Latin America have a positive and significant impact on GDP in the short term and a higher fiscal multiplier in the crisis period.

5.2 Cross fiscal multiplier of Latin America countries

A cross fiscal multiplier analysis is carried out to compare the behavior of the spending multiplier obtained for Bolivia with the other countries in the Latin American region. This cross analysis allows to observe whether the behavior with respect to government spending presents the same tendency as Bolivia, given that the region shares to some extent the same behavior such as the balance of payments problems studied in Kehoe & Nicolini (2022). For this purpose, Equation 1 is used to determine the cross fiscal multiplier, in which the sensitivity of the spending multiplier (IRFs) corresponds to Bolivia, and the impact of the output-spending ratio corresponds to the Latin American countries.

Country	Ratio GS/GDP	Ratio GDP/GS	Impact Multiplier	Multiplier 10^{th} quarter	Cumulative Multiplier
Argentina (2004-2019)	0.12	8.20	1.2129	0.4391	4.2768
Brazil (1996-2019)	0.21	4.65	0.6878	0.2490	2.4252
Chile (2013-2019)	0.13	7.41	1.0961	0.3968	3.8648
Colombia (2005-2019)	0.14	7.16	1.0591	0.3834	3.7344
Ecuador (2000-2019)	0.13	7.80	1.1538	0.4176	4.0682
Mexico (1993-2019)	0.07	8.51	1.2588	0.4557	4.4385
Paraguay (1994-2019)	0.12	8.46	1.2514	0.4530	4.4124
Peru (2007-2019)	0.11	9.02	1.3342	0.4830	4.7045

Table 3: Cross Fiscal Multiplier from Latin America Countries
Note: Table details the results obtained of Impact Multiplier and Cumulative Multiplier for each country of Latin America. The first column details the ratio of government spending to GDP. Second column describes the ratio of GDP to the government spending. Third column the impact multiplier. Fourth column the multiplier at 10th quarter. Fifth column the cumulative multiplier.

In this sense, the cross fiscal multiplier is estimated for Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay and Peru. The results shown in Table 3 suggest that the fiscal impact on GDP has a positive impact on GDP. Making a cross-country comparison with the size of the magnitude of the fiscal multiplier, it can be said that the results obtained are quite similar to the spending multipliers estimated independently for each country, such as Brazil (0.5), Ecuador (0.07), Mexico (0.40) and Paraguay (0.95).[25]

[25]For more details see Section 1

These results also suggest that the behavior of government spending is homogeneous among the countries of the region and therefore also for Bolivia.

6 Conclusion

The recent crises have reactivated the opening of the agenda of government spending and its role in economic activity, not only in developed countries, but also in developing countries, such as the case of Bolivia. This country did not have any study on the size of the fiscal multiplier and unconventional monetary policy. To this effect, the present study determines, through the application of the SVAR approach, the size of the fiscal multiplier, taking into account country-specific characteristics such as unconventional monetary policy, Pre-and Post nationalization (crisis and boom) period and oil revenues.

The results of the impact multiplier suggest that fiscal policy promotes economic activity in the short term and this effect is higher in times of crisis. This means that the effect of government intervention on GDP through public spending is greater when there is a crisis. An example of this is that during the Pre-nationalization period, Bolivia had a long period of crisis and government spending was an active public policy tool to overcome this period. In addition, oil revenue is identified as the main transmission mechanism of the Bolivian economy because it affects the main economic variables of this country. Moreover, by including unconventional monetary policy in the analysis, the results suggest that unconventional monetary policy accommodates to fiscal policy in times of crisis.

Comparison with other Latin American countries such as Brazil, Paraguay, Mexico and Ecuador shows that the behavior of the fiscal multiplier is similar and the impact of public spending on output is also larger in the short term. A separate period-by-period analysis suggests that the spending multiplier is higher in the crisis period, as observed in Bolivia. A cross-analysis of the fiscal multiplier between Bolivia and Latin American countries indicates that the fiscal multipliers obtained are similar to those estimated on a country-by-country basis.

As the impact of government spending is higher in times of crisis than in booming times, the fiscal policy should be considered as a countercyclical policy.

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Appendix

Figure A1. Data.

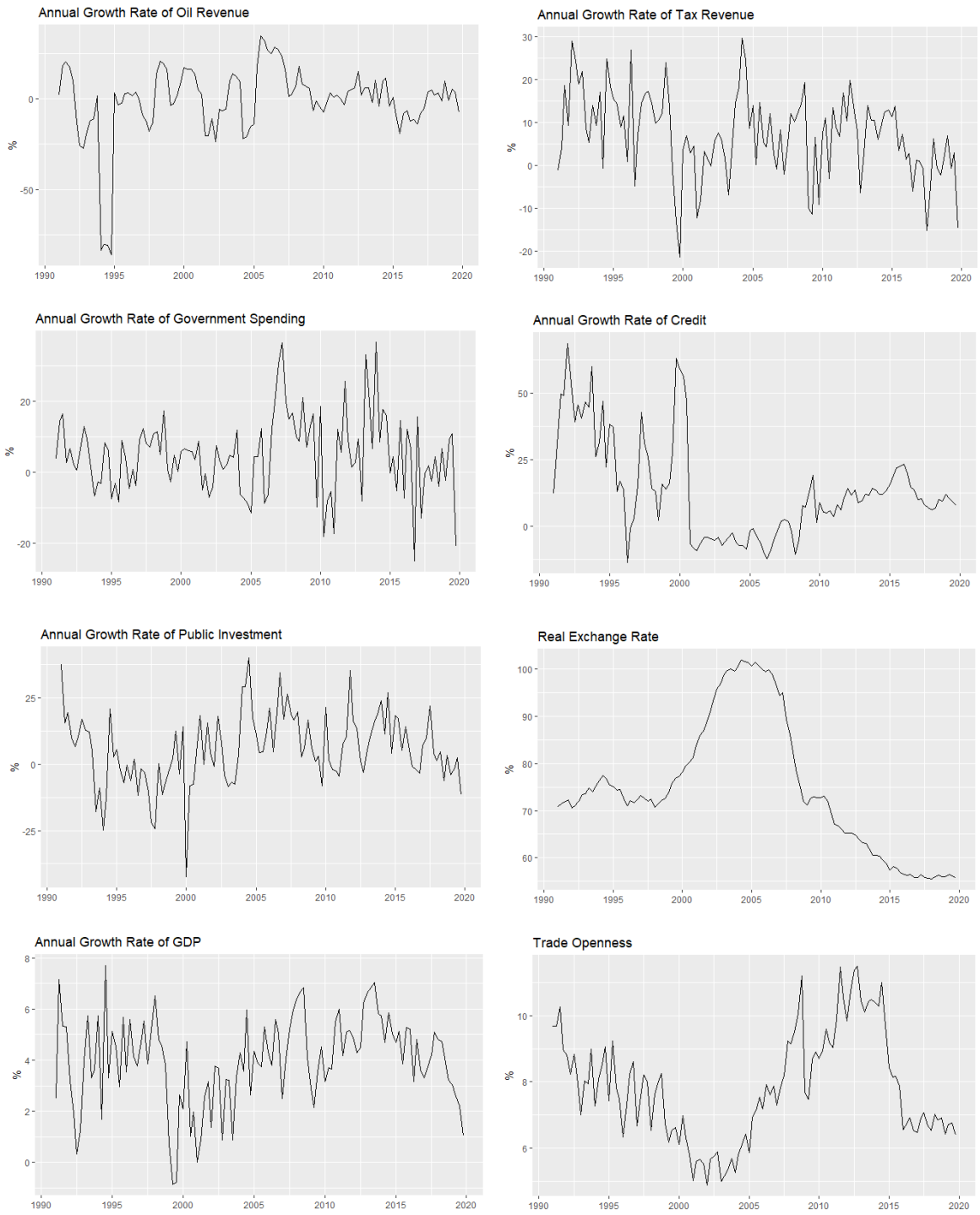


Figure A1: Data

This figure plots the annual growth rate of oil revenue, the annual growth rate of tax revenue, the annual growth rate of government spending, the annual growth rate of credit, the annual growth rate of public investment, the real exchange rate, the annual growth rate of GDP and the trade openness.

Figure A2. External Shocks.

Figure A2: External Shocks

This figure plots the prices of main commodities exported by Bolivia for the period 1990:Q1 to 2019:Q4. The data of oil, gold, silver, lead, copper, zinc and tin are expressed and quarter-over-quarter (qoq).

Table A1. Unit Root Test.

	ADF	KPSS	PP
Oil Revenue	-4.33	0.13	-4.24
Government Spending	-4.76	0.09	-8.61
GDP	-3.99	0.14	-6.22
Trade Openness	-4.35	0.19	-4.69
RER	-4.14	0.15	-5.74
Tax Income	-5.30	0.09	-6.58
Public Investment	-4.45	0.16	-6.49
Credit	-3.30	0.35	-3.21
Critical Value			
1%	-3.99	0.216	-3.49
5%	-3.43	0.146	-2.89
10%	-3.13	0.119	-2.58

(a) Unit Root Test of Main Variables

	ADF	KPSS	PP
Oil Prices	-7.84	0.12	-9.13
Gold Prices	-6.19	0.21	-8.80
Silver Prices	-6.74	0.12	-8.63
Copper Prices	-7.40	0.13	-7.96
Zinc Prices	-5.95	0.05	-6.74
Lead Prices	-6.47	0.10	-7.68
Tin Prices	-7.32	0.11	-7.20
Critical Value			
1%	-3.99	0.216	-3.49
5%	-3.43	0.146	-2.89
10%	-3.13	0.119	-2.58

(b) Unit Root Test of External Shocks

Table A1: Unit Root Test

Table (a) displays the Unit Root Test for main variables and Table (b) depicts the Unit Root Test of external shocks. As can be seen in the tables, the variables are stationary.

Table A2. Number of Lags (K).

Lags	AIC	HQ	SC	FPE
1	-2.14E+01	-2.12E+01*	-2.08E+01*	4.96E-10
2	-2.14E+01	-2.10E+01	-2.04E+01	4.98E-10
3	-2.14E+01	-2.08E+01	-2.00E+01	5.20E-10
4	-2.16E+01	-2.08E+01	-1.97E+01	4.43E-10
5	-2.17E+01	-2.08E+01	-1.95E+01	3.67E-10
6	-2.20E+01	-2.10E+01	-1.93E+01	3.01E-10
7	-2.19E+01	-2.06E+01	-1.88E+01	3.43E-10
8	-2.21E+01*	-2.07E+01	-1.86E+01	2.91E-10*

(a) Optimal Lags to determine VAR model with Oil Revenue

Lags	AIC	HQ	SC	FPE
1	-2.25E+01	-2.23E+01*	-2.19E+01*	1.62E-10
2	-2.27E+01	-2.22E+01	-2.16E+01	1.44E-10
3	-2.25E+01	-2.19E+01	-2.11E+01	1.66E-10
4	-2.28E+01	-2.20E+01	-2.09E+01	1.30E-10
5	-2.28E+01*	-2.19E+01	-2.06E+01	1.26E-10*
6	-2.28E+01	-2.17E+01	-2.02E+01	1.29E-10
7	-2.26E+01	-2.13E+01	-1.96E+01	1.61E-10
8	-2.27E+01	-2.13E+010	-1.93E+01	1.45E-10

(b) Optimal Lags to determine VAR model with Tax Revenue

Table A2: Number of Lags (K)

Table (a) displays the lags for oil revenue VAR Model and Table (b) presents the lags for tax revenue VAR model. Akaike information criterion (AIC), Hannan Quinn (HQ), Schwarz criterion (SC), Final Prediction Error (FPE) criteria suggest the inclusion of lags.

A.1. Structural VAR Specification.

The study follows the SVAR identification that considers the following equations and procedures. In this part, we extend the main model of the study with control variables (trade openness and real exchange rate) and external shocks (commodity prices).

$$Y_t = A(L)Y_{(t-1)} + U_t + S_t \tag{3}$$

$$Y_t = [o_t, g_t, c_t, to_t, rer_t, y_t]' \tag{4}$$

$$U_t = [u_t^o, u_t^g, u_t^c, u_t^{to}, u_t^{rer}, u_t^y]' \tag{5}$$

$$S_t = [oi_t, go_t, si_t, le_t, co_t, zi_t, ti_t]' \tag{6}$$

The SVAR specification is estimated according to Y_t, where is a vector of 6 variables, (o_t) oil income, (g_t) government spending, (c_t) credit, (to_t) trade openness, (rer_t) real exchange rate and (y_t) Gross Domestic Product (GDP), expressed quarterly. The $A(L)$ is a quarter lag polynomial. U_t, is the vector of reduced form of residual. S_t are the exogenous shocks of commodity prices, (oi) oil, (go), gold, (si) silver, (le) lead, (co) cooper, (zi) zinc and (ti) tin.

$$u_t^o = a_1 u_t^y + a_2 e_t^g + a_3 e_t^c + a_4 e_t^{to} + a_5 e_t^{rer} + e_t^o \tag{7}$$

$$u_t^g = b_1 u_t^y + b_2 e_t^o + b_3 e_t^c + b_4 e_t^{to} + b_5 e_t^{rer} + e_t^g \tag{8}$$

$$u_t^c = c_1 u_t^y + c_2 e_t^o + c_3 e_t^g + c_4 e_t^{to} + c_5 e_t^{rer} + e_t^c \tag{9}$$

$$u_t^{to} = d_1 u_t^y + d_2 e_t^o + d_3 e_t^g + d_3 e_t^c + d_3 e_t^{rer} + e_t^{to} \tag{10}$$

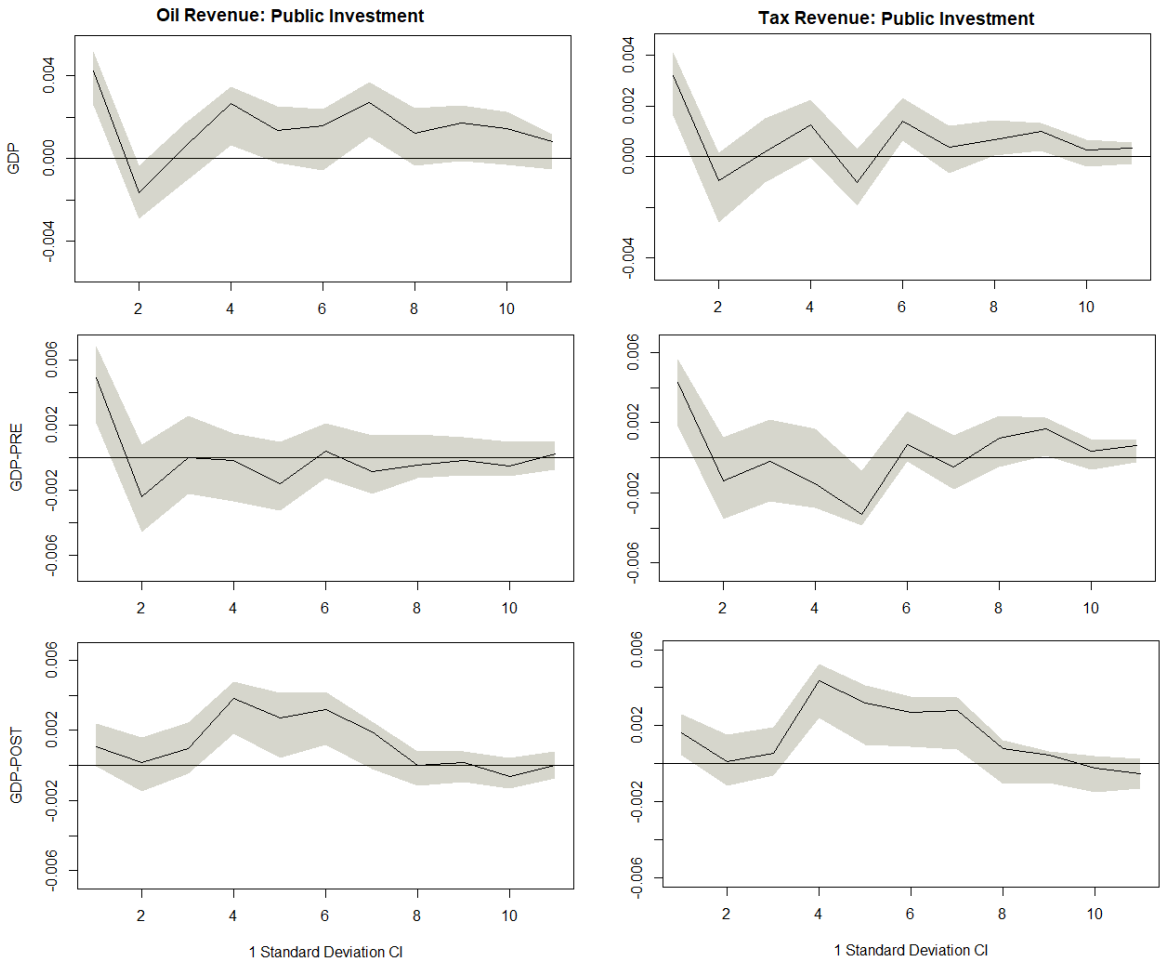
$$u_t^{rer} = f_1 u_t^y + f_2 e_t^o + f_3 e_t^g + f_4 e_t^c + f_5 e_t^{to} + e_t^{rer} \tag{11}$$

$$u_t^y = g_1 u_t^o + g_2 u_t^g + g_3 u_t^c + g_4 u_t^{to} + g_5 u_t^{rer} + e_t^y \tag{12}$$

In order to be able to draw conclusions on causality within fiscal policy, and given that the residual in the reduced form is not very informative in itself, the structural shocks of residual must be recovered and estimated, e_t^o, e_t^g, e_t^c, e_t^{to}, e_t^{rer} and e_t^y, which are mutually uncorrelated.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ b_2 & 1 & b_3 & b_4 & b_5 & 0 \\ c_2 & 0 & 1 & 0 & 0 & 0 \\ d_2 & 0 & d_3 & 1 & 0 & 0 \\ f_e & 0 & f_4 & f_5 & 1 & 0 \\ g_1 & g_2 & g_3 & g_4 & g_5 & 1 \end{bmatrix} \begin{bmatrix} u_t^o \\ u_t^g \\ u_t^c \\ u_t^{to} \\ u_t^{rer} \\ u_t^y \end{bmatrix} = \begin{bmatrix} e_t & 0 & 0 & 0 & 0 & 0 \\ 0 & e_t & 0 & 0 & 0 & 0 \\ 0 & 0 & e_t & 0 & 0 & 0 \\ 0 & 0 & 0 & e_t & 0 & 0 \\ 0 & 0 & 0 & 0 & e_t & 0 \\ 0 & 0 & 0 & 0 & 0 & e_t \end{bmatrix} \begin{bmatrix} e_t^o \\ e_t^g \\ e_t^c \\ e_t^{to} \\ e_t^{rer} \\ e_t^y \end{bmatrix} \tag{13}$$

Figure A3. IRFs from public investment shocks and Nationalization.



IRFs from public investment shocks and Nationalization

Figure A3: IRFs from public investment shocks and Nationalization

The figure plots the effects of public investment shocks to output for oil revenue (first column) and tax revenue (second column). They take into consideration only the fiscal policy. The first row shows the public investment shock and the response of GDP; the second row depicts the impulse of public investment shock and the response of GDP for the Pre-Nationalization period; and the third row displays the impulse of public investment shock and the response of GDP for the Post-Nationalization period. Shades represent 1 standard deviation confidence intervals based on boostrapping with 100 runs.

Table A3. Impact Response of Fiscal Policy.

	Oil Income Spending	Tax Income Spending	Oil Income Investment	Tax Income Investment
Impact Response	Output %	Output %	Output %	Output %
Impact Response	0.28	0.15	0.42	0.32
Pre-Nationalization	0.51	0.33	0.49	0.43
Post-Nationalization	0.24	0.15	0.11	0.16
Impact Response +S's	0.26	0.16	0.41	0.31
Pre-Nationalization	0.36	0.26	0.47	0.43
Post-Nationalization	0.20	0.12	0.15	0.22
Impact Response +C´s	0.23	0.14	0.30	0.31
Pre-Nationalization	0.61	0.29	0.41	0.36
Post-Nationalization	0.30	0.16	0.17	0.20
Impact Response+S's+C's	0.27	0.16	0.31	0.30
Pre-Nationalization	0.42	0.17	0.18	0.35
Post-Nationalization	0.33	0.28	0.26	0.32

Table A3: Impact Response of Fiscal Policy

It describes the impact response for government spending and public investment. Also it includes oil and tax revenues as main variables of the model (columns). The first block of the row represents the baseline results; the second displays the baseline and the commodity shock (S's); the third considers the baseline and control variables (C's); and the fourth takes into account the baseline, commodity shocks (S'S) and control variables (C's).

Figure A4. Data from Latin American countries.

Figure A4: Data from Latin American countries

This figure plots the annual growth rate of GDP and government spending, for Brazil (1996-2019), Paraguay (1994-2019), Mexico (1993-2019) and Ecuador (2000-2019).

Figure A5. Data of Credit from Latin American countries.

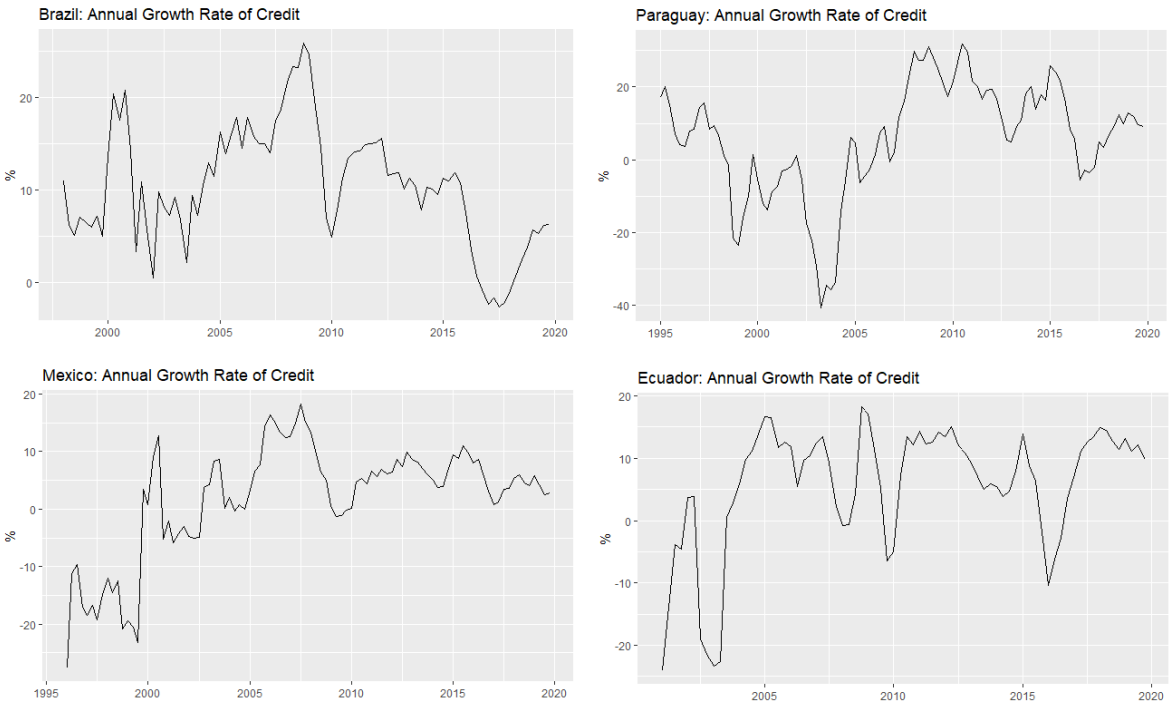


Figure A5: Data of Credit from Latin American countries

This figure plots the annual growth rate of Credit, for Brazil (1997-2019), Paraguay (1994-2019), Mexico (1995-2019) and Ecuador (2000-2019).

Figure A6. IRFs from Latin America countries and fiscal policy.

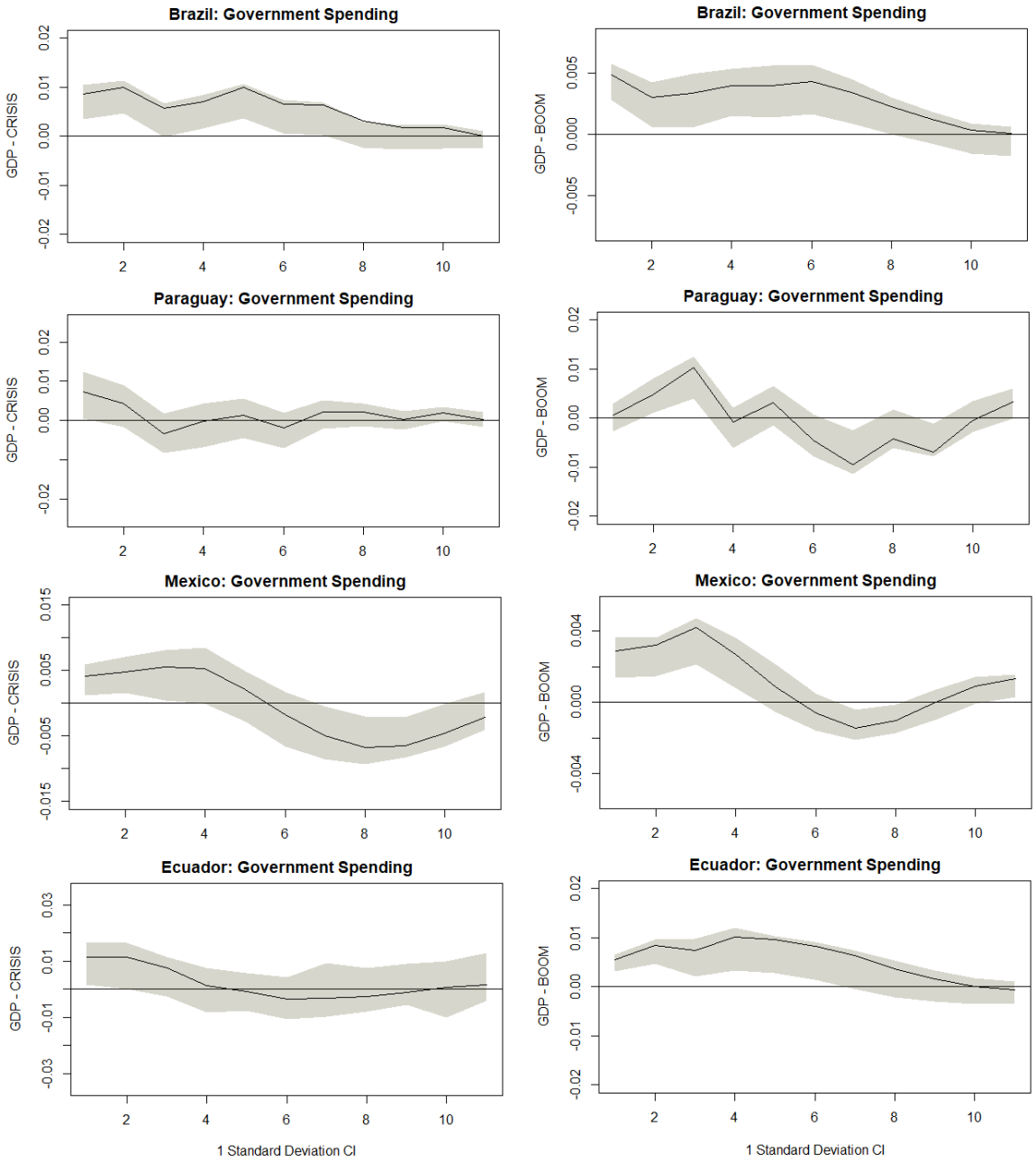


Figure A6: IRFs from Latin America countries and fiscal policy

The figure plots the impulse of government spending and the response of GDP for Brazil, Paraguay, Mexico and Ecuador. The first column shows the crisis period and the second column the boom period. Shades represent 1 standard deviation confidence intervals based on boostrapping with 100 runs.

Figure A7. IRFs from Latin America countries and unconventional monetary policy.

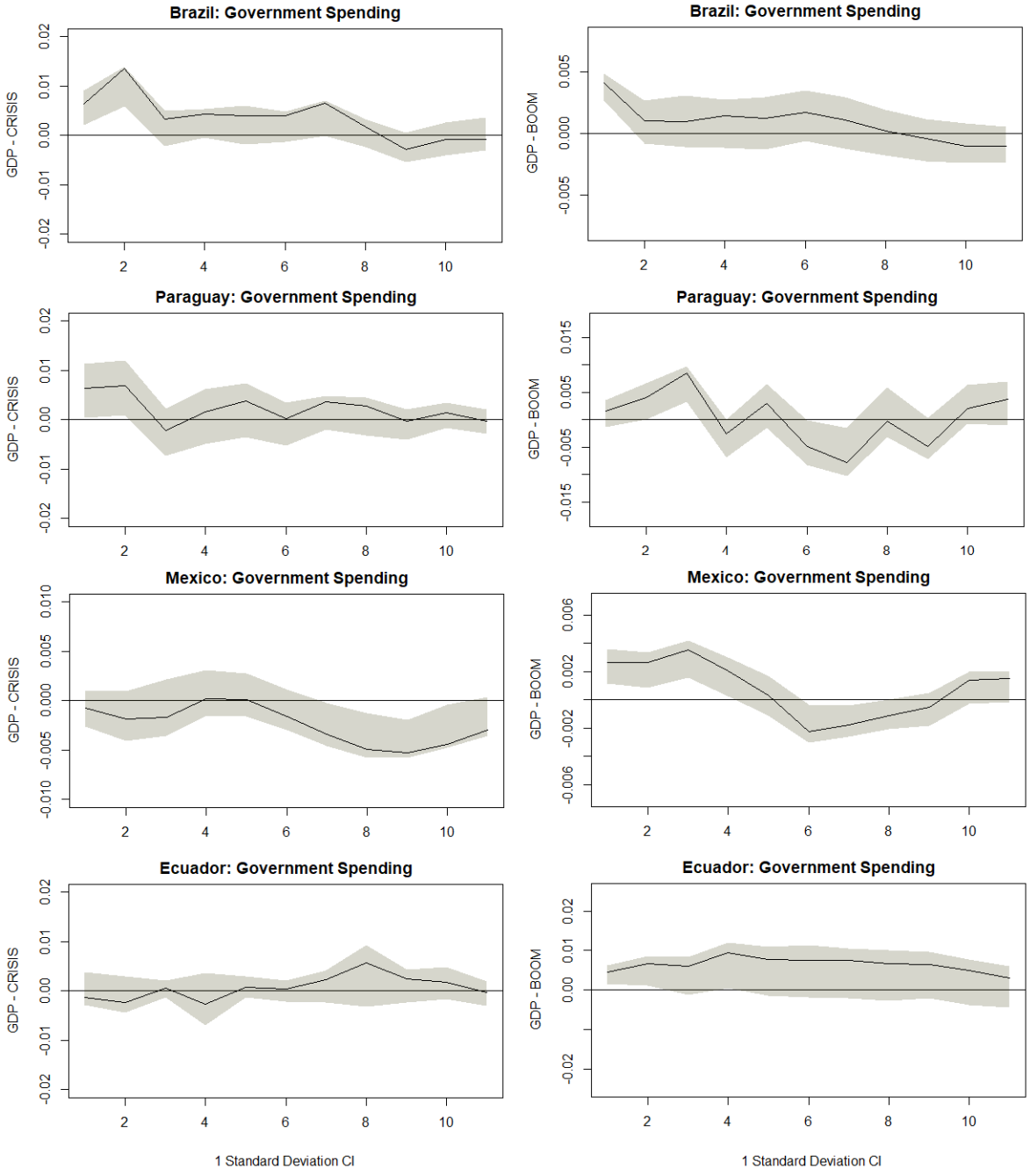


Figure A7: IRFs from Latin America countries and unconventional monetary policy

The figure plots the impulse of government spending and the response of GDP for Brazil, Paraguay, Mexico and Ecuador, taking into account the private credit from the financial system of each country. The first column shows the crisis period and the second column the boom period. Shades represent 1 standard deviation confidence intervals based on boostrapping with 100 runs.