The Differential Regional Effects of Monetary and Fiscal Policies in Brazil

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Abstract

The aim of this paper is to examine whether monetary and fiscal policies have symmetric effects across the regions of Brazil. For this, I use a SVAR model in which a Bayesian sign restrictions approach is adopted to identify the shocks. The results indicate that regional products tend to have similar reactions to monetary policy shocks, but asymmetric responses to fiscal policy shocks. Moreover, monetary policy shocks have more influence on economic activity than fiscal policy shocks in all regions.

Keywords: Monetary Policy, Fiscal Policy, SVAR.

Resumo

O objetivo deste artigo é analisar se as políticas monetária e fiscal apresentam efeitos simétricos entre as regiões brasileiras. Para tanto, estima-se um modelo SVAR e utiliza-se a abordagem Bayesiana de restrição de sinais para a identificação dos choques. Os resultados indicam que os produtos regionais tendem a apresentar reações similares a choques de política monetária, e reações assimétricas a choques de política fiscal. Além disso, os choques de política monetária influenciam mais a atividade econômica regional do que os choques de política fiscal.

Palavras-Chave: Políticas Monetária, Política Fiscal, SVAR.
JEL: E52, E62, C32.

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1 Introduction

This paper aims to analyze the impacts of economic policies on the output of the Brazilian regions, investigating whether monetary and fiscal policy shocks have different impacts on the different regions. For this, I estimate a Structural Vector Auto-Regressive (SVAR) model to get the impulse response functions that show how the regional outputs behave after orthogonal shocks prompted by policies. The identification of shocks in the model is performed with a Bayesian signs restriction approach proposed by Mountford and Uhlig (2009).

Concern about the differential impact of economic policies on the dynamics of a country's regions or a group of countries has become the subject of recent interest in the economic literature. Accordingly, Carlino and DeFina (1998) show that although there is little doubt about the impact of monetary policy on an aggregate entity, when analyzed from the perspective of regional and state economies, monetary policy has a differential impact depending on the economic diversity, demographics, financial development, and other factors of the economies concerned.

Likewise, Owyang et al. (2005) state that it is reasonable to assume that regional economies also tend to respond differently to fiscal shocks due to the differences discussed above or other possible characteristics, such as geographical heterogeneity, different stages of business cycles and fiscal indicators.

Important studies aimed to examine whether monetary policy shocks have different impacts on the economic dynamics of a country's regions or a group of countries (e.g., Gerlach and Smets, 1995; Carlino and DeFina, 1998, 1999; Di Giacinto, 2003; Owyang et al., 2005; Francis et al., 2009). In general, this studies show that monetary policy shock has different effects in the regions output, except Gerlach and Smets (1995) that find no different responses among G-7 countries. Carlino and DeFina (1999) find evidence that the response of the U.S. states is positively correlated to the share of manufacturing sector in the state output. Francis et al. (2009) argue that demographic and local government characteristics can also explain these different responses. On the other hand, Di Giacinto (2003) find evidence that the interactions across states tend to smooth out responses across space.

With few exceptions, the impacts of monetary shocks on the dynamics of the regional economies of Brazil have been little explored. I highlight the studies of Araújo (2004), Bertanha and Haddad (2008) and Rocha et al. (2011). These papers find evidence that monetary policies have different impacts in regional terms from the estimation of Vector Autoregressive (VAR) models. However, there are some significant differences in the results. Araújo (2004) finds that the South region is more affected by a monetary policy shock than Northeast region. Bertanha and Haddad (2008) state that North and Northeast regions are more vulnerable to monetary shocks. Finally, Rocha et al. (2011) find asymmetric responses between the states, but there is no evidence between regions.

Regarding the impact of fiscal policies, the studies have focused predominantly on the aggregate level (e.g., Fatás and Mihov, 1998; Blanchard and Perotti, 2002; Perotti, 2008; Mountford and Uhlig, 2009), with little or no effort to understand the disaggregate cases. In part, this neglect can be justified by the relative difficulty of reaching a consensus on the basic effects of fiscal shocks (as opposed to the relative consensus on the impacts of

monetary policies) as discussed by Perotti (2008).

This point is explored by Owyang and Zubairy (2009). The authors investigate how changes in military and non-military federal spending impact the dynamics of the U.S. states. They find evidence of significant asymmetries in how states respond to fiscal stimuli. They associate such asymmetries with differences in the propagation mechanisms of shocks in federal military and non-military spending. While the former affect the economies with larger retailers and manufacturing sectors more strongly, the latter affects the states with more diverse industrial composition more strongly. The results also showed that government spending impacts the states with lower per capita income more intensely.

Some papers have also focused on identifying the impacts of fiscal shocks on the Brazilian aggregate-level economy. For example, Mendonça et al. (2009) estimate an SVAR model and use a sign restrictions approach in the identification of shocks. The authors investigate how changes in current government spending and net public revenues affect the Gross Domestic Product (GDP), private consumption and inflation. The results suggest that an unexpected increase in government spending causes an increase in private consumption, a fall in GDP and an increase in interest rates, providing evidence for the effect of the crowding out of private investment by the public. The authors also show that an increase in net public revenues (i.e., a net increase in taxes) causes a reduction in GDP and private consumption. The authors suggest that fiscal policy in Brazil is pro-cyclical, in contrast to how fiscal policy has been implemented in developed countries (Perotti, 2008).

Peres and Ellery Jr. (2009), on the other hand, use an identification scheme based on the methodology of Blanchard and Perotti (2002) to investigate the effects of fiscal shocks on GDP. They show that unexpected increases in federal government spending are positively related to the output, while increases in the tax burden are negatively related. In short, they show typical Keynesian results.

In summary, this paper contributes to the literature by investigating whether various economic shocks have differential impacts on the regions of Brazil, a country characterized by regional diversity in productive structure, level of financial development and income. Moreover, it is the first attempt to study shocks and regions in an integrated approach using advanced techniques of shocks identification.

The results indicate that regions tend to have similar reactions in terms of business cycles and monetary policy shocks, but asymmetric responses to fiscal policy shocks. Furthermore, monetary shocks are more important than fiscal shocks in explaining product fluctuations in all regions.

The remainder of the article is divided as follows: the second part presents the methodology; the third part features the data; the fourth part is dedicated to the results; and the last part discusses the conclusions.

2 Empirical Model

The dynamic relationships among the variables of interest can be represented by a Structural Vector Auto-Regression (SVAR) model as follows:

$$\mathbf{y}_t' A_0 = \sum_{l=1}^{p} \mathbf{y}_{t-l}' A_l + \boldsymbol{\varepsilon}_t, 1 \leq t \leq T, \tag{1}$$

where: $\mathbf{y}_t$ is an $n \times 1$ column vector of model's edogeneous variables; A_0 is an $n \times n$ matrix of contemporary coefficients; A_l is an $n \times n$ matrix of the parameters of the lagged variables; $\boldsymbol{\varepsilon}_t$ is an $n \times 1$ column vector of the structural disturbances; p is the lag order; and T is the sample size.

The vector $\boldsymbol{\varepsilon}_t$ is Gaussian, conditional to past information, with the mean and variance-covariance matrix given by, respectivately, $E(\boldsymbol{\varepsilon}_t|\mathbf{y}_1, \ldots, \mathbf{y}_{t-l}) = 0$ e $E(\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t'|\mathbf{y}_1, \ldots, \mathbf{y}_{t-l}) = I_{n\times n}$.

Post-multiplying each element of (1) by A_0^{-1}, the Vector Auto-Regression model in its reduced form yields:

$$\mathbf{y}_t' = \sum_{l=1}^{p} \mathbf{y}_{t-l}' B_l + \mathbf{u}_t, 1 \leq t \leq T, \tag{2}$$

where $B_l = A_l A_0^{-1}$ (to $l = 1, 2, \ldots, p$) and $\mathbf{u}_t' = \boldsymbol{\varepsilon}_t' A_0^{-1}$. The residuals variance-covariance matrix in the reduced form is $E[\mathbf{u}_t'\mathbf{u}_t] = \Omega = (A_0' A_0)^{-1}$.

In this paper, the vector y_t is composed of the natural logarithms of: a Central-West region product measure, CW_t; a Northeast region product measure, NE_t; a North region product measure, N_t; a Southeast region product measure, SE_t; a South region product measure,S_t; a central government spending measure, G_t; a households consumption measure, C_t; a central government tax revenue measure, T_t; an inflation measure, π_t; an interest rate measure, i_t; an exchange rate measure, E_t; and a total credit measure, B_t:

$$y_t = (CW_t, NE_t, N_t, SE_t, S_t, Y_t, G_t, C_t, T_t, \pi_t, i_t, E_t, M_t, B_t). \tag{3}$$

Although the model to be estimated consists of the VAR in its reduced form, it is required by this study to obtain the response functions to orthogonal shocks. These functions represent the system endogenous variables' responses to a shock in one of the elements of the $\boldsymbol{\varepsilon}_t$ vector.

In this paper, I adopt the sign restriction approach proposed by Uhlig (2005) and Mountford and Uhlig (2009) to do the identification of the macroeconomic policy shocks. I present this methodology below.

Let $\boldsymbol{\Sigma}$ be the variance-covariance matrix of the VAR reduced-form residuals, $\tilde{A}$ is the Cholesky decomposition matrix and A a matrix such that $\boldsymbol{\Sigma} = AA' = \tilde{A}\tilde{A}'$. So $A = \tilde{A}Q$, where Q is an orthogonal matrix. Thus, we have that any impulse vector can be written as:

$$a = \tilde{A}\alpha, \tag{4}$$

where a is a columm of A that contains the contemporary responses of the variables to a particular shock, and α is a column of in the corresponding position. Thus, the shocks due to an impulse $a(r_t)$ in the k period can be calculated from the shocks of the Cholesky decomposition Cholesky (r_i):

$$r_a(k) = \sum_{i=1}^{m} \alpha_i r_i(k), \tag{5}$$

Based on the above equation, it is possible to determine the impulse vector corresponding to an economic policy shock. To do so, we must define such shocks. Accordingly, I use the shocks characterization proposed by Mountford and Uhlig (2009), which defines the economic shocks as follows: (a) business cycle shock, a_c, as a shock which jointly moves consumption and government revenue up for K periods; (b) monetary policy shock, a_m, as a shock which jointly moves interest rate up and monetary base and prices down for K periods and is orthogonal to the business cycle shock; (c) government spending shock,a_g, as a shock which moves up government spending for K periods and is orthogonal to the two previous shocks; and (d) government revenue shock, a_r, as a shock which moves the government tax revenue down for K and is orthogonal to the others shocks. In this paper, I consider $K = 6$, that is, for an impulse vector be considered a government spending shock, for example, it is necessary that it doesn't promote a reduction in the government spending in six months, at least.

These shock definitions aren't sufficient to ensure the exact identification, and must be complemented. For that, I use a Bayesian approach in which the VAR coefficients are considered random variables. Thus, the impulse vector set $\Psi(B, K, \Sigma)$, that can be generated from ordinary least squares estimated coefficients (B), its variance-covariance matrix (Σ), and the imposed sign restrictions, can have many elements.

The selection of the impulse vectors that show the necessary characteristics is made by the minimization of a penalty function. This function is defined in the unitary sphere, and penalizes every relevant deviation from the sign restrictions by solving

$$a = argmin\Phi(\tilde{A}\alpha), \tag{6}$$

where the criterion function $\Phi(a)$ is given by

$$\Phi(a) = \sum_{j \in J_{s,+}} \sum_{k=0}^{K} f(-\frac{r_{ja}(k)}{s_j}) + \sum_{j \in J_{s,-}} \sum_{k=0}^{K} f(\frac{r_{ja}(k)}{s_j}), \tag{7}$$

and

$$f(x) = \begin{cases} 100x, \ x \geq 0 \\ x, \ x \leq 0 \end{cases} \tag{8}$$

The criterion function $\Phi(a)$ adds the penalties during the $k = 0, \ldots, K$ periods following the shocks with respect to the index set of variables for which identification of a given shock restricts the impulse response to be positive $(J_{s,+})$ or negative $(J_{s,-})$. The responses are normalized by the standard deviation s_j of variable j.

Similary to Uhlig (2005) and Mountford and Uhlig (2009), I take up 250 attempts from the VAR reduced-form coefficients posterior distribution (Normal-Wishart), and identify the shocks for each of them.

3 Data

The data base covers the period from January 2003 to December 2012, at monthly frequency. For the estimation of the SVAR model, I consider the following information: indexes of regional economic activity of the five Brazilian regions, BCB; spending of the central government in funding and capital, STN; chained index of apparent consumption of final goods, IPEA; central government revenue, STN; interest rate Over / Selic (% per month), BCB; monthly inflation measured by the consumer price index (IPCA), IBGE; monetary base, BCB; index of the Effective Real Exchange rate, IPEA; and, loans to the private sector, BCB. All series are seasonally adjusted and placed in logarithms (except the interest rate and inflation).

4 Results

The impulse response functions of the estimated SVAR model , which show the behavior of the variables after an economic shock, are discussed in this section. The lag order of the model is taken to be one lag, as indicated by the selection criteriaons (Akaike, Schwarz and Hannan-Quinn). Table 1 shows the results.

Table 1: Lag Selection Criteria of the VAR Model

Lags	AIC	SBC	HQ
0	5683.852	5719.174	5698.040
1	4524.564	4971.273	4675.39
2	4740.893	5482.623	4911.992
3	5129.496	5988.490	5143.111
4	5739.066	6423.776	5303.649
5	6819.463	6801.080	5406.204
6	8799.126	6958.295	5288.671

In response to the business cycles shock (Figure 1), consumption and government revenue increase in the first six months by construction. In addition, government revenue and expenditures increase in similar proportion (approximately 4%). Prices also increase, probably due to the demand increment. The interest rate has a small reduction at the time of the shock, but reveals an upward trend in the following months, indicating that the response of the monetary authority occurs with some lag. As a result of the shock, the monetary base increases, the real exchange rate appreciates, and the credit falls in the first three months, then rises. In regional terms, the production of all regions increases. The South, Southeast (as we expected) and North (unexpected) are the regions with the greatest response occurring around the fifth month. However, the North is the only region that presents a negative contemporaneous response.Besides, the response of the Central-West's output is the smallest. This results suggest a positive correlation between the effect of a business cycle shock and the share of manufacturing in the regional output. Finally, shock effects tend to disappear in fifteenth months for all five regions.

In the case of monetary policy shock (Figure 2), interest rate increases, while prices and monetary base decrease by construction. Both revenue and spending increase momentarily but are little affected later. In addition, real exchange rate appreciates, only contemporaneously, and amount of credit is reduced. Consumption and regional production contemporaneously increase, except in the Central-West region, but tend to have a negative response in the following months. The behaviors of the regions after the shock are not very different. The regional output tends to fall, between 0.2 and 0.3%, at most (around the fifth month). This result is in line with Di Giacinto (2003) who report that interaction across regions tend to smooth out the responses to a monetary policy shock.

Regarding the shock that reduces government revenue by construction (Figure 3), it is observed that government spending also falls by a similar scale. The credit and exchange rate are not affected significantly. Inflation and consumption display contemporary positive responses and then stabilize. The production of all regions has contemporaneous positive responses but does not seem to be significantly affected in the long term. The Central-West and North regions showed lowest responses, while the South and Southeast showed the highest.

The shock that increases government spending (Figure 4) also promotes an equivalent increase in revenue. Exchange rate, credit and monetary base are not affected. Consumption and inflation fall contemporaneously, but the shock dissipates quickly. The production of the regions does not respond significantly to the shock.

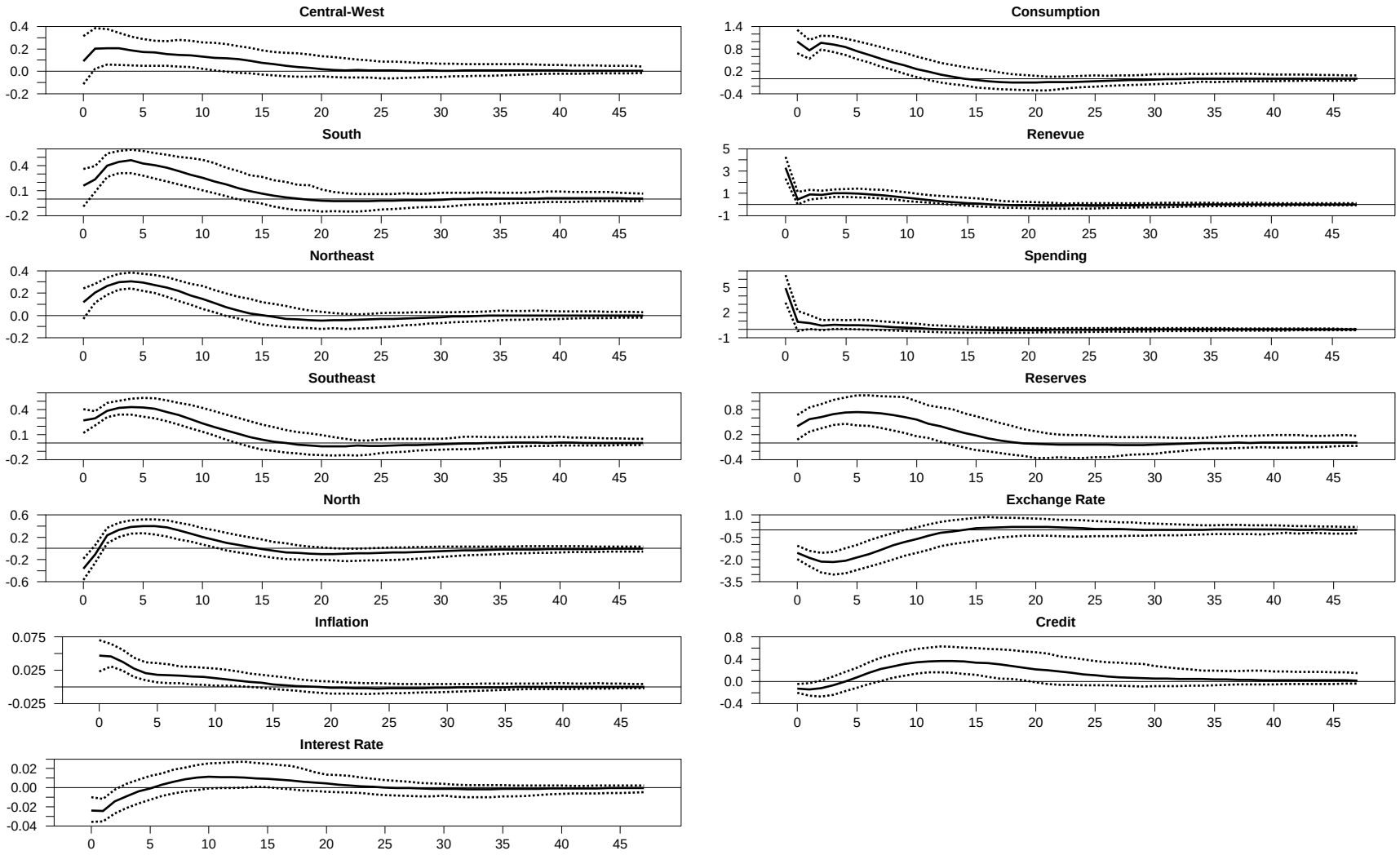


Figure 1: Business Cycle Shock

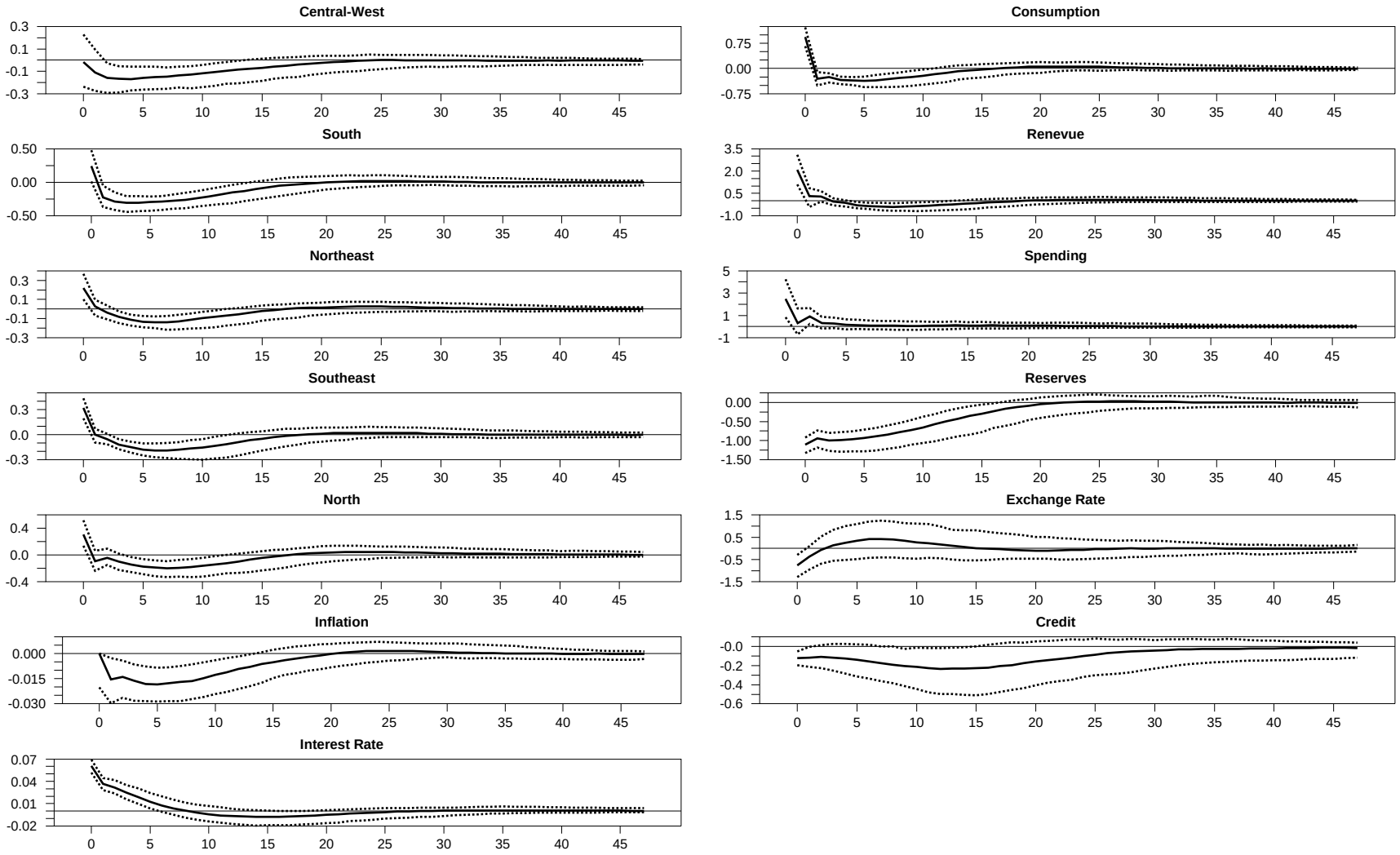


Figure 2: Monetary Policy Shock

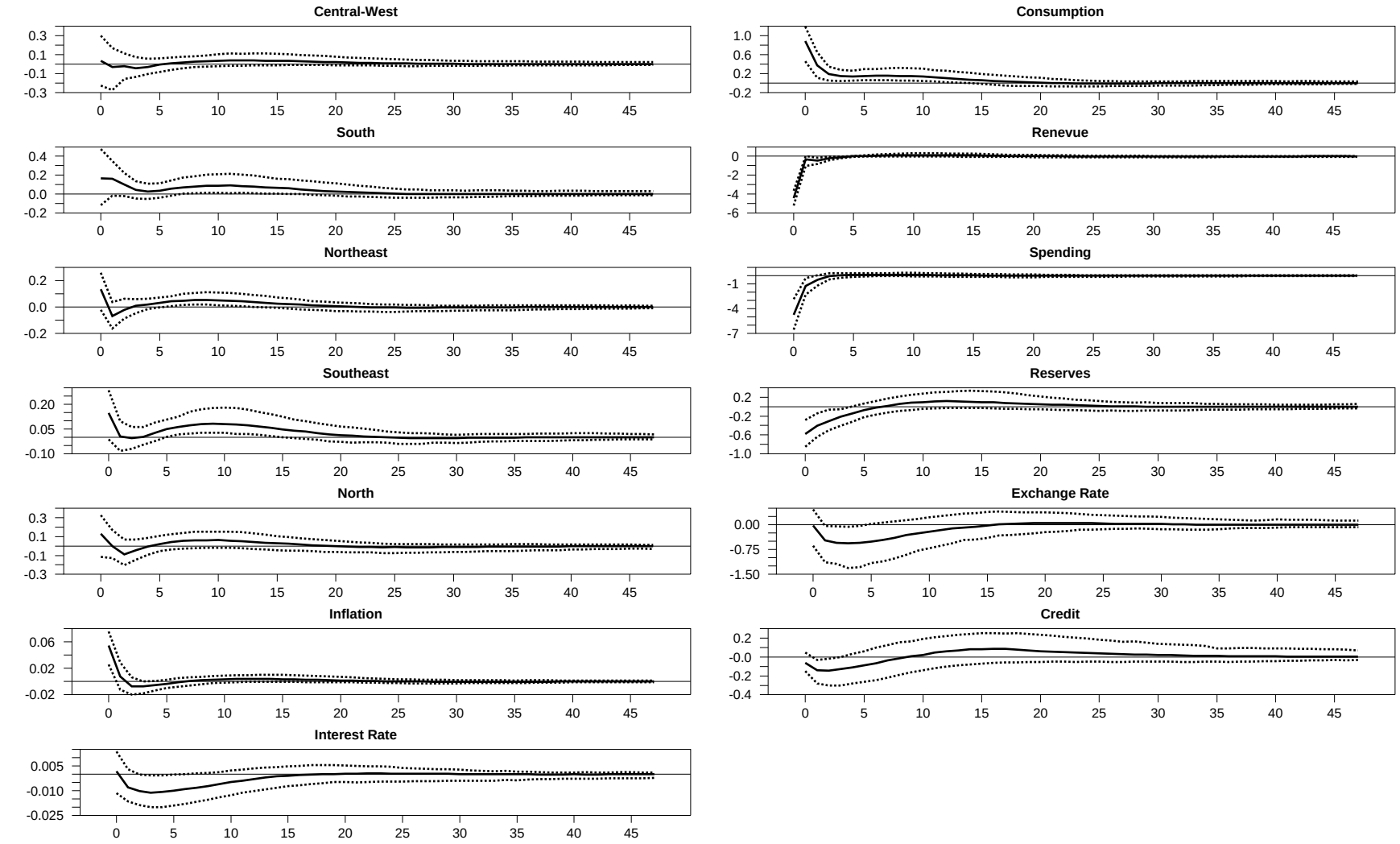


Figure 3: Government Revenue Shock

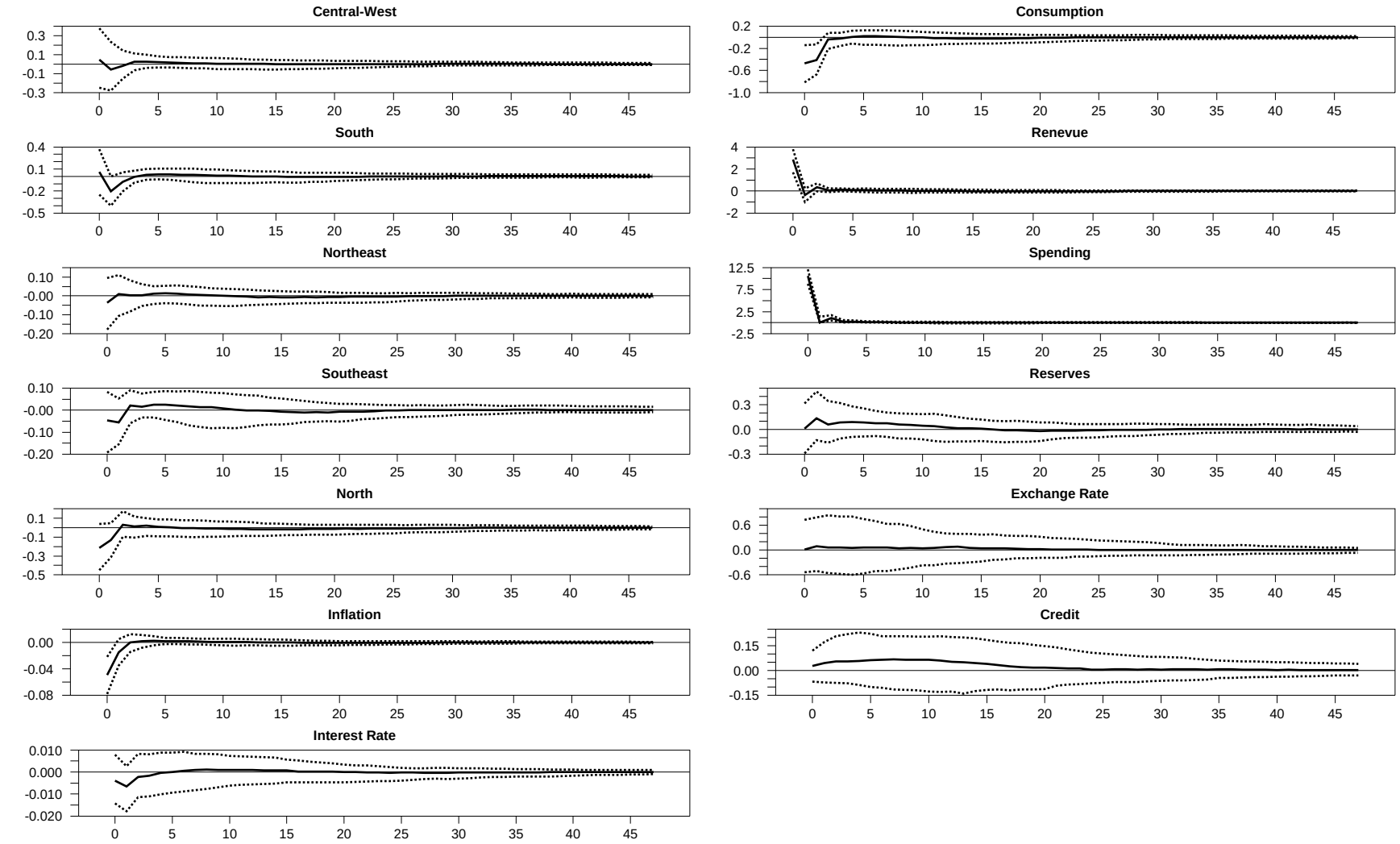


Figure 4: Government Spending Shock

Based on the estimated SVAR model, I also calculated the variance decomposition of the forecast error of the levels of regional production in relation to the four studied shocks. The results are shown in Table 2.

The variance of the forecast error in the activity level of the five Brazilian regions is explained for the most part by the business cycles shocks. The monetary shock is the second most important, especially in the short term (one to three months). The Central-West region is the one in which the fiscal policy shocks, especially ones in government spending, explain a significant portion of the variance of the forecast error in the short term.

Mountford and Uhlig (2009) argue that fiscal shocks can be described as a linear combination of changes in spending and revenues. To deal with this problem, the fiscal shocks were estimated again considering three different scenarios: (1) only government spending increases in the period; (2) only government revenue decreases in a given period; (3) revenue and spending increase in the same proportion (balanced budget).

In the case of a policy characterized by a balanced budget (Figure 5), inflation falls for the first month and then stabilizes. The interest rate increases from the second month, the monetary base expands, the exchange rate depreciates and the credit volume increases slightly during the first six months, and then the variables stabilize. Regarding the level of regional activity, there is a decrease in the South and Southeast regions. The Central-West and North do not seem to be affected. The Northeast has a mild reduction in the level of activity from the sixth month lasting about a year until it stabilizes again.

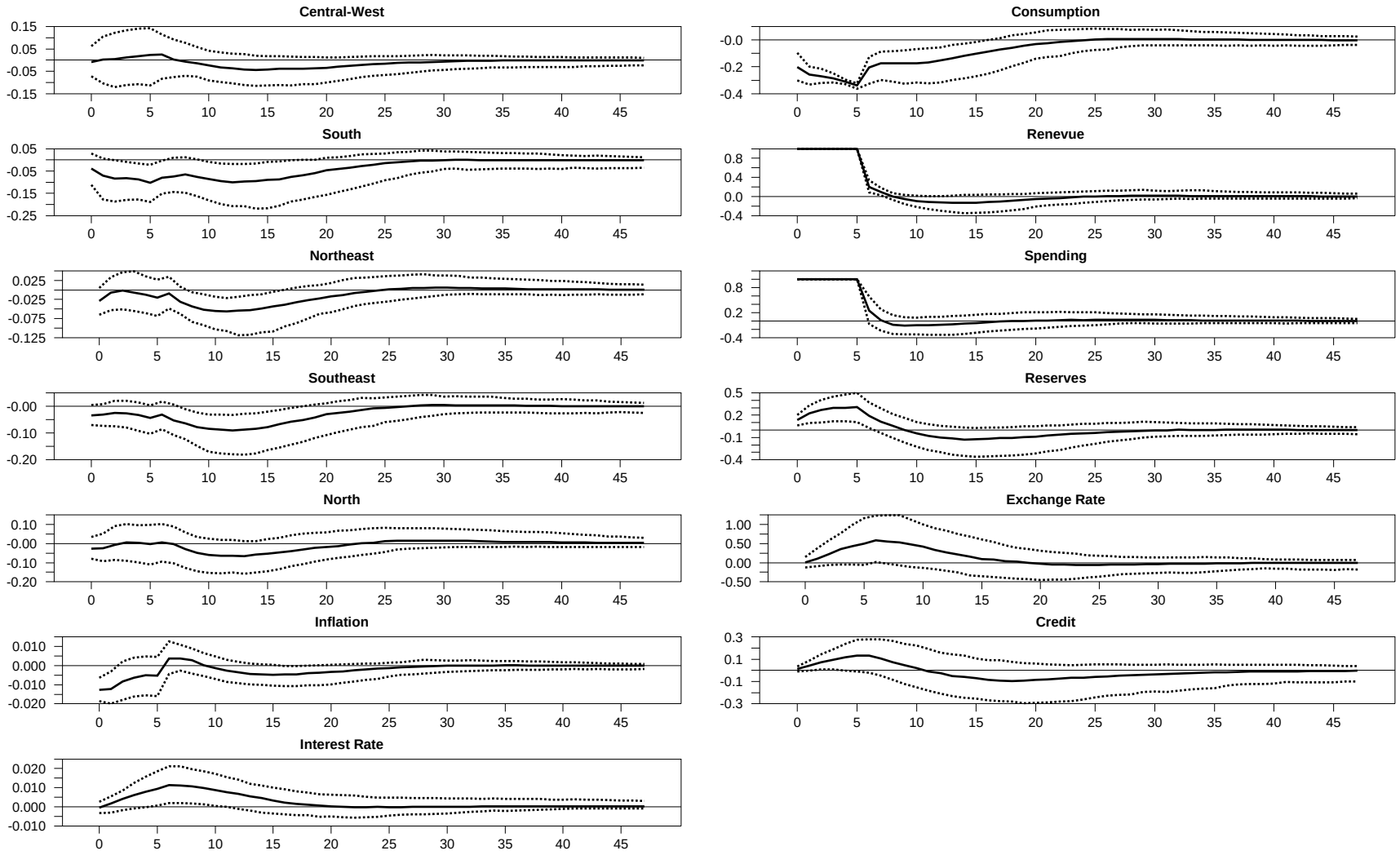
For the fiscal policy in which the level of government spending increases and the revenue remains constant (Figure 6), it is observed that consumption and inflation are little affected. The interest rate is reduced in the first six months and then stabilizes. There are no significant changes in credit, exchange rate or monetary base. The regional activity also shows no significant changes in the Central-West or North. In the Northeast, South and Southeast, there are small increases in production from the sixth month. The response of the South is greater.

Finally, an isolated reduction in government revenue (Figure 7) promotes increased consumption, inflation, exchange rate appreciation, and reduction in the monetary base and volume of credit. The interest rate decreases in the first month following the shock. Regional outputs behave similarly to the previous case, the Central-West and North are unaffected, and the Northeast, Southeast and South have positive changes. Again, the response of the South is greater. Considering the past results, the fiscal policy seems to affect more the regions with greater share of secondary and tertiary sectors in GRP.

The variance decomposition of the forecast error of the regions output considering the three scenarios of fiscal policy are shown in Table 3. The results indicate that the product of the five Brazilian regions is explained for the most part by the fiscal policy shock caracterized by a decrease of government revenue. The balanced budget shock is the second most important.

Table 2: Variance Decomposition

Horizon	Business Cycle	Monetary Policy	Revenue	Spending
		Central-West		
1	15.4	12.5	18.1	24.3
3	23.5	17.2	17.4	23.3
6	28.8	24.5	15.3	17.5
12	34.9	28.4	12.3	15.2
48	39.4	28.0	11.1	12.8
		South		
1	9.9	25.5	17.3	15.4
3	29.9	26.9	13.7	16.6
6	45.8	30.3	8.8	9.3
12	48.5	31.4	8.7	7.3
48	47.7	32.1	9.4	7.0
		Northeast		
1	12.0	36.5	17.0	11.9
3	46.2	19.8	14.1	10.9
6	65.0	17.2	7.8	6.4
12	65.9	19.1	8.0	5.2
48	62.6	21.2	8.8	5.3
		Southeast		
1	29.2	39.8	10.4	7.5
3	59.7	19.9	7.7	7.0
6	72.2	16.2	4.5	4.5
12	70.4	18.0	5.6	3.9
48	65.5	20.2	6.8	4.2
		North		
1	42.0	24.0	8.5	12.2
3	40.2	22.1	13.5	19.3
6	54.6	16.9	9.4	12.3
12	58.5	20.0	7.8	8.8
48	56.8	22.2	8.8	8.7



Responses to Balanced Budget

Figure 5: Fiscal Policy Combination - Balanced Budget

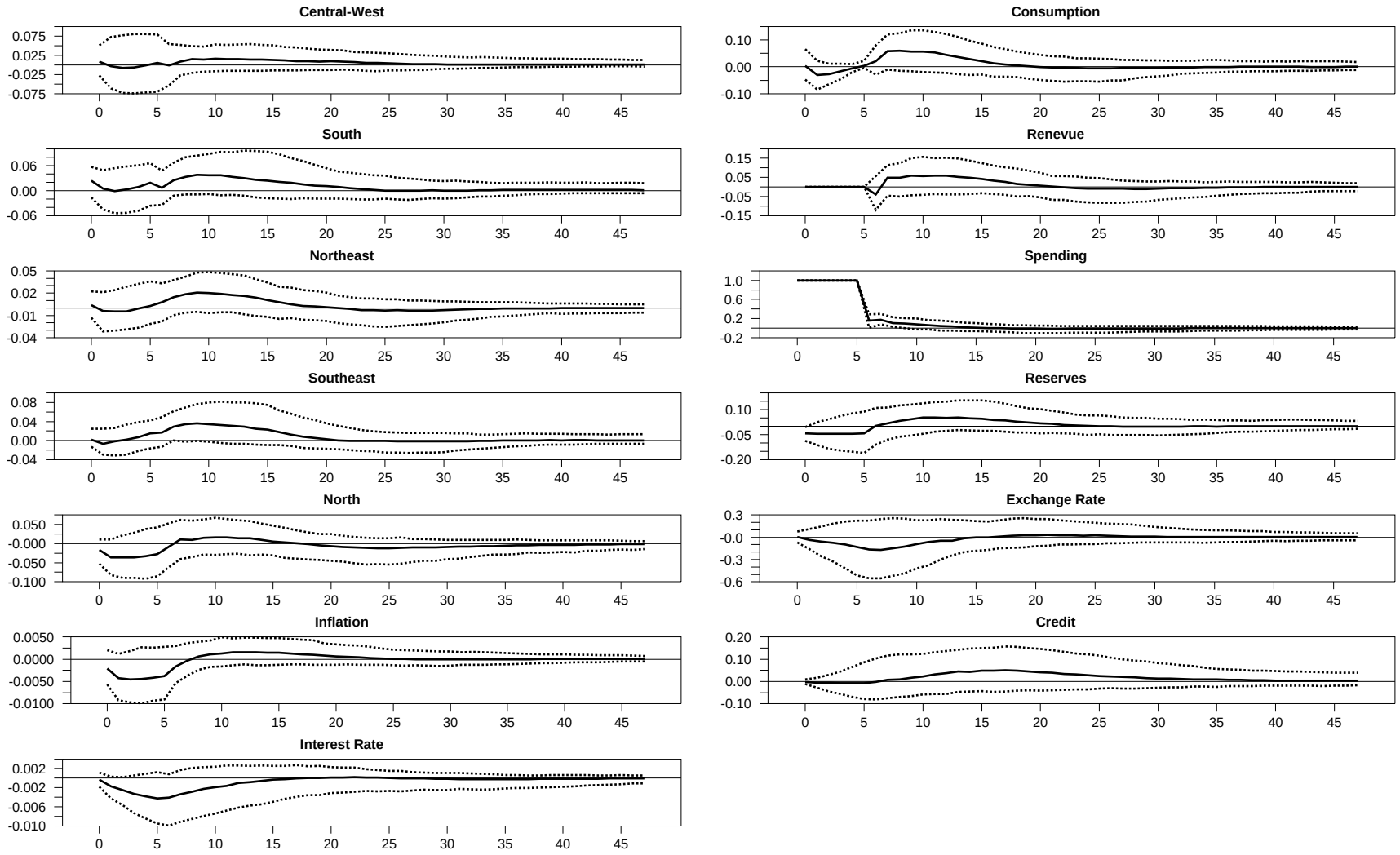
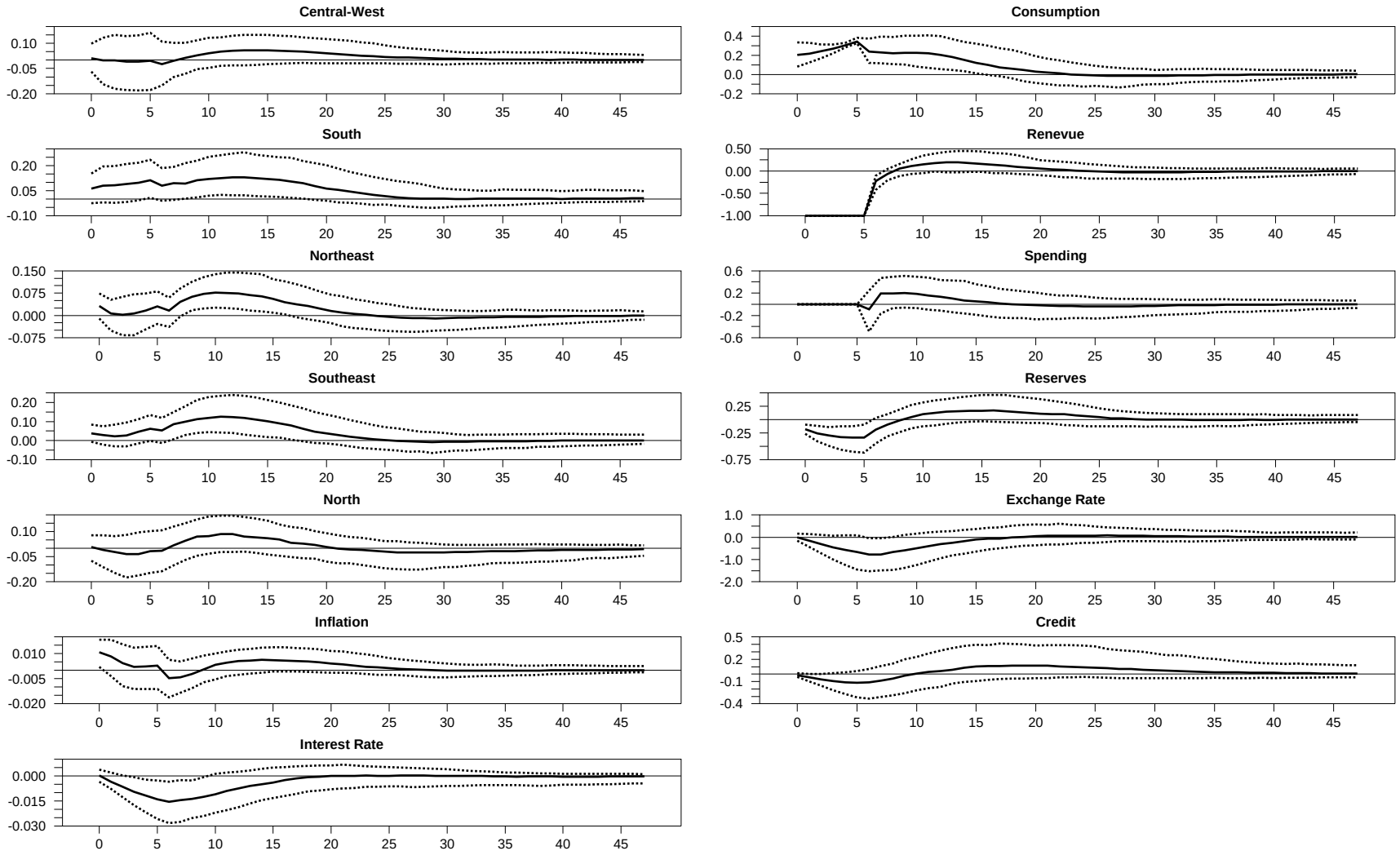


Figure 6: Fiscal Policy Combination - Only Spending Increases



Responses to Only Revenue

Figure 7: Fiscal Policy Combination - Only Revenue Decreases

Table 3: Variance Decomposition - Fiscal Policy Combination

Horizon	Only Spending	Only Revenue	Balanced Budget
		Central-West	
1	11.4	53.5	37.5
6	10.7	52.7	36.2
12	9.5	55.4	36.1
48	8.7	53.8	37.3
		South	
1	7.9	57.0	36.2
6	6.9	51.2	41.9
12	7.0	55.2	38.1
48	6.4	55.5	37.9
		Northeast	
1	6.5	55.2	39.6
6	10.3	52.0	37.9
12	8.6	57.3	35.1
48	7.7	55.8	36.3
		Southeast	
1	6.5	53.0	41.4
6	10.8	53.0	39.1
12	7.4	57.6	34.6
48	6.8	57.0	35.8
		North	
1	18.4	39.3	44.7
6	16.6	49.8	37.0
12	12.1	52.3	35.1
48	10.0	53.6	36.0

5 Conclusions

This paper aims to analyze the effects of monetary and fiscal policy shocks on the Brazilian economy from a regional perspective. Therefore, we estimate a VAR model with the output from each of the five Brazilian regions, policy variables and other relative macroeconomic variables. The sign restrictions approach is used to identify the shocks.

The results indicate that there are no significant differences in how the production of each region responds to a business cycle shock. All regions show a positive and lasting response.

The regional products also behave similarly in response to monetary policy shocks.

The output tends to fall in short run in all regions. The effects of the monetary policy shock are shorter lived than those of the business cycle.

With respect to a reduction in government revenue, it is noticeable that the South and Southeast regions respond more sharply, but this shock has no long-term effects in any of the regions. If the revenue reduction is not accompanied by changes in spending, the responses are more extensive in all regions.

Finally, none of the regions seem to be affected significantly by an increase in government spending. However, when a spending increase occurs without a change in government revenue, the Northeast, Southeast and South regions exhibit a significantly positive response after about six months. These are the regions in which secondary and tertiary sectors are relatively more important.

Thus, it is concluded that the Brazilian regions exhibit different behaviors in responses to economic shocks, especially in terms of various given scenarios of fiscal policy. The government should consider these differences when tailoring policies to achieve its various goals. Future research should seek to clarify the reasons for these differences.

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