

## Sectoral Impacts of Public Expenditures on Real Wages: Evidence from Brazilian States

*João Paulo Rios e Silva*

MAER, Federal University of Ceará  
2700 Avenida da Universidade, 2º andar, Fortaleza, CE 60020-181, BRAZIL  
Tel: +55 (085) 3366-7751 E-mail: joaopaulorios92@gmail.com

Dr. *Elano Ferreira Arruda* (Correspondence Author)

DEA/MAER/CAEN, Federal University of Ceará  
2700 Avenida da Universidade, 2º andar, Fortaleza, CE 60020-181, BRAZIL  
Tel: +55 (085) 3366-7751 E-mail: elano@ufc.br

Dr. *Felipe de Sousa Bastos*

CAEN, Federal University of Ceará  
2700 Avenida da Universidade, 2º andar, Fortaleza, CE 60020-181, BRAZIL  
Tel: +55 (085) 3366-7751 E-mail: flpsbastos@gmail.com

Dr. *Pablo Urano de Carvalho Castelar*

Finance Course, Federal University of Ceará  
400 Rua Marechal Deodoro, Fortaleza, CE 60020-060, BRAZIL  
Tel: +55 (085) 3366-7590 E-mail: pcastelar@ufc.br

**Abstract:** This work analyzes the sectoral impacts of public spending on real wages in Brazilian states. A panel covering the period of 1995-2014 for Brazilian states is used, with information on public expenditures, gross domestic product and average real wages in seven sectors of activity, with impulse response functions extracted from panel VAR models. The sectors analyzed are Agriculture, Plant Extraction, Hunting and Fishing, Services, Commerce, Construction, Manufacturing, Public Utility Services and Mineral Extraction. The sectoral analysis is relevant given the possibility of asymmetries in real wage responses to fiscal policy in different sectors. From this exercise, it is possible to make inferences about the labor market in these sectors in Brazil, and infer if the outcomes are similar to those found in the Real Business Cycles tradition, *i.e.*, with negative responses of real wages to shocks in the budget spending of states, or if the fiscal shocks increase real wages, as observed in the New Keynesian models. The evidence suggests that both GDP and real wages respond positively to shocks in public spending in all sectors analyzed and that these impacts are greater in the states in the South, Southeast and Midwest regions of Brazil.

**Keywords:** Public expenditures; Labor market; Panel VAR; Impulse response function;  
Brazilian states

**JEL Classification:** E62, E24, E69, C33

## 1. Introduction

The recent fiscal problems faced by the Brazilian economy pose a challenge to governments at all levels (federal, state and municipal)<sup>1</sup>. This situation has accentuated the discussion about the role of macroeconomic policies on economic activity, especially in the labor market. In that sense, a relevant issue is the impact of fiscal shocks on real wages, for which both the theoretical aspects and empirical evidence are far from unanimous.

In terms of theoretical framework, there is a clear antagonism regarding these effects between proponents of New Keynesian (NK) and Real Business Cycle (RBC) models. The former argue that increases in public spending increase the demand for labor by firms, which, in an environment of price rigidity, produces an increase in real wages. On the other hand, advocates of RBC models claim that agents may anticipate increases in public expenditures at present as future increases in taxation levels, and therefore offer more jobs in the present. This excess in the supply of labor, in a flexible price scenario, ends up reducing real wages.

One can also observe the same divergence in the empirical literature. Ramey and Shapiro (1998), and Burnside, *et al.* (2004), for example, observe negative effects of military spending on real wages and household consumption. On the other hand, Aiyagari, *et al.* (1992), and Baxter and King (1993) use wider measures of public spending, finding evidence of decreasing wages vis-à-vis increases in public spending, results that are sustained by the RBC models, while authors such as Rotemberg and Woodford (1992) and Galí, *et al.* (2007) obtain results that support the NK tradition. In the case of Brazil, Carvalho, *et al.* (2013) observe results in the same direction as the NK models, while Lobato (2011) obtains evidence closer to the RBC line.

Although most of the literature applying panel data focuses on country level analysis, Pappa (2009) cautions that this issue may be more properly investigated when state level data are used, since monetary policy can be taken as given. Rickman (2010) also argues that regional economic models are built from their national counterparts and that macroeconometric techniques such as vector autoregression (VAR), restricted VAR, panel data VAR (PVAR), structural VAR (SVAR) and dynamic stochastic general equilibrium (DSGE) models have been underutilized in regional economic studies. For the author, these frameworks can produce important empirical evidence for understanding the macroeconomic relationships in a regional context.

Therefore, here we analyze the sectoral effects of fiscal shocks on real wages for Brazilian states using impulse response functions (IRF's) extracted from panel VAR models. To do so, we use panel data covering the period from 1995 to 2014 for the 26 Brazilian states plus the Federal District, with information on budget spending, gross domestic product (GDP) and average real wages in seven sectors. The sectoral analysis is relevant given the possibility of asymmetries in real wage responses to fiscal policy in different sectors.

The main contribution of this study is the application of a PVAR model, as presented in Rickman (2010), to Brazilian states in order to examine, in a regional context, the effects of public spending on real wages, considering the seven main sectors of economic activity.

In addition to this introduction, this work has four more sections. Section 2 presents the theoretical and empirical aspects of the impact of fiscal policy on the labor market, specifically on real wages. The third section presents and analyzes the database and the econometric technique employed. Then the results of the models are presented and discussed. Lastly, the concluding remarks are presented.

---

<sup>1</sup> See, for instance, Cunha Junior *et al.* (2016) and Cuevas *et al.* (2017).

## 2. Literature Review

Among the authors who have observed evidence in favor of the RBC tradition, we highlight Aiyagari, *et al.* (1992), Baxter and King (1993), Ramey and Shapiro (1998), and Burnside, *et al.* (2004).

Aiyagari, *et al.* (1992), using U.S. quarterly data from 1955 to 1983, found that the impact of a persistent shock in government consumption on aggregate output and employment always exceeds in magnitude the effect of a temporary one, both from a theoretical and empirical point of view. The authors estimated a neoclassical stochastic growth model and observed negative effects of public spending on wages.

Baxter and King (1993) analyzed four classic fiscal policy experiments within a quantitatively restricted neoclassical model and, among the results found, they noted that permanent changes in government consumption lead to short and long-term output multipliers larger than 1, and generate greater effects than temporary variations. Therefore, because of a more elastic supply of labor, real wages tend to respond negatively to increases in public spending.

Ramey and Shapiro (1998) used a neoclassical model with two sectors and observed that increases in military spending have a negative impact on real wages. Likewise, Burnside, *et al.* (2004) investigated the response of hours worked and real wages to fiscal shocks in the United States in the post-World War II period, and argued that a fiscal shock characterized by an increase in military spending is followed by a persistent decrease in real wages and an increase in hours worked.

Lobato (2011), based on Schmitt-Grohé and Uribe (2005), used a medium-sized DSGE model with four sources of nominal rigidity and five sources of real rigidity in order to elucidate the conduct of optimal monetary and fiscal policies for Brazil after the Real Plan<sup>2</sup>. A significant result found was that a shock in government spending generates a negative effect on the wage rate.

Supporting the New Keynesian tradition, Rotemberg and Woodford (1992) constructed a dynamic model of general equilibrium with oligopolistic competition and compared it with a model of perfect competition. The authors argued that shocks in aggregate demand (led by changes in government consumption) on economic activity are the consequence of imperfect competition. Comparing the two models against a shock in government spending, the oligopolistic behavior model presented a positive response of wages, while the model with perfect competition presented a negative response.

Galí, *et al.* (2007) used a DSGE model with the presence of consumers who do not borrow or save, but consume all their income. Using quarterly data for the U.S. economy, the reactions were estimated of several macroeconomic variables to a shock in government spending, assuming that shocks are not affected contemporaneously (during the quarter) by the other variables contained in the model. The authors found that both wages and hours worked persistently increase due to a shock in government spending.

Monacelli and Perotti (2008) explored the effects of wealth on the transmission of shocks in government spending, using a standard business cycle model, in which preferences may be consistent with arbitrarily small wealth effects on the labor supply. The results suggested that a shock on government spending leads to an increase in real wages.

---

<sup>2</sup> The Real Plan (*Plano Real*), implemented in 1994, finally tamed the rampant inflation that had plagued the country in the previous decade. It brought introduction Brazil's present currency, the Real (R\$).

Ramey (2011) argued that the VAR and Ramey-Shapiro models diverge in terms of the impact of fiscal policy shocks on real wages and consumption by not modeling the anticipation effect. After modeling such effects, the results of the two models were the same; a fall in real wages and consumption given a shock in government spending.

Forni, *et al.* (2009) reconsidered the economic effects of a fiscal policy using a DSGE model for the Eurozone. Using non-Ricardian agents and friction as featured in Christiano, *et al.* (2005), when estimating the model with quarterly data, the results obtained were that shocks in government spending and public sector income generate an increase in real wages.

Mountford and Uhlig (2009), using U.S. quarterly data from 1995 to 2000, applied VAR models to analyze the effects of a fiscal policy, specifically a tax cut. Using signal constraints, the authors identified a shock in government revenue, as well as an expenditure shock, while controlling for business cycle and monetary policy shocks. The results showed that tax cuts financed through the public deficit are the most appropriate to stimulate the economy. In addition, deficit spending contributes weakly to stimulate the economy, not causing an increase in real wages.

Pappa (2009) employed a structural VAR to analyze the transmission of fiscal shocks to the labor market. The identification strategy was based on the idea that a fiscal shock increases output and deficits, a result found in the RBC and NK models. The results showed that a positive shock in government consumption or investment increases real wages and employment, and an increase in government employment increases real wages and total employment.

Fisher and Peters (2010) explored a new approach to identify fiscal shocks, avoiding the weaknesses found in both the New Keynesian and Neoclassical models. This approach identifies government spending shocks with statistical innovations for the cumulative excess returns of large U.S. contractors. The results indicated that a shock in government spending is associated with an initial decline in real wages, but after one year these resume growing.

Mertens and Ravn (2012) developed a fiscal estimator for the SVAR model which is applicable when changes are anticipated. The authors use quarterly macroeconomic data from the United States, particularly consumption, output, and government spending. The authors did not find evidence that anticipating fiscal policy reverts the results already corroborated by the traditional SVAR models.

In a panel for 11 Eurozone countries, Bénétrix (2012) estimated the dynamic short-term effect of fiscal shocks on real wages. The main results corroborated the New Keynesian theory, in which positive fiscal shocks raise real wages.

Carvalho, *et al.* (2013) sought to understand the effects of fiscal shocks on the Brazilian labor market. The authors used a dynamic stochastic general equilibrium (DSGE) model, based on the Neoclassical Synthesis, to identify the sign of the variables as a strategy to identify fiscal shocks in an SVAR. Impulse response functions indicated that fiscal shocks increase real wages and employment.

Therefore, as argued by Pappa (2009) and Rickman (2010), more precise information is needed on the effects of fiscal shocks in the labor market in a regional context, since from that perspective, monetary and exchange rate asymmetries can be taken as given. Here we intend to contribute in this line.

### 3. Methodology

#### 3.1 Data

In order to evaluate the effects of public spending on real wages from a sectoral perspective, we use a dataset including information from the 26 Brazilian states plus the Federal District between 1995 and 2014. The average sector real wage data were obtained from the Annual List of Social Information (*Relação Anual de Informações Sociais* - RAIS), published by the Ministry of Labor. The sectors analyzed are: "Agriculture, Plant Extraction, Hunting and Fishing" (AGRO), "Services" (SERV), "Commerce" (COME), "Construction" (CONC), "Public Utility Services (SIUP)", "Manufacturing" (INDT) and "Mineral Extraction" (EXTM).

According to Greene (2012), there are several advantages of using econometrics with panel data. The main ones are (i) the possibility of considering the effect of the unobserved heterogeneity of the cross-section units in the estimation process; (ii) the greater quantity and variability of information; (iii) lower collinearity between variables; (iv) higher degrees of freedom and greater efficiency in the estimation process, and (v) minimization of the aggregation bias for modeling phenomena in economies of continental dimensions with large differences and/or regional disparities (which is the case of Brazil).

Chart 1. Description of the variables

Variables	Definitions	Source
<i>DORC</i>	Budget expenditure: depends on legislative authorization to be carried out.	STN/FINBRA
<i>PIB</i>	Gross domestic product: sum of all final goods and services produced in the state within a given period.	IBGE
<i>EXTM</i>	Average real wages from mineral extraction. This sector comprises the activities related to the extraction, processing and refining of minerals and crude oil.	RAIS
<i>INDT</i>	Average real wages in the manufacturing industry.	RAIS
<i>SIUP</i>	Average real wages of the public utility sector. This sector includes activities related to the electricity, natural gas, water, sewage and waste treatment and disposal.	RAIS
<i>CONC</i>	Average real wages of the construction industry.	RAIS
<i>COME</i>	Average real wages of the commerce sector.	RAIS
<i>SERV</i>	Average real wages of the services sector.	RAIS
<i>AGRO</i>	Average real wages of the agriculture, plant extraction, hunting and fishing sector.	RAIS

**Note:** All variables are adequately deflated.

The public spending variable employed is the state budget expenditure, made available by the National Treasury Secretariat (*Secretaria do Tesouro Nacional* - SNT) at the *Finanças Brasil* (FINBRA) website<sup>3</sup>. Lastly, data on gross domestic product (GDP) was obtained from the Brazilian

<sup>3</sup> [http://www.tesouro.fazenda.gov.br/pt\\_PT/contas-anuais](http://www.tesouro.fazenda.gov.br/pt_PT/contas-anuais). Accessed on 03-05-2018.

Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* -IBGE). All variables were appropriately deflated. Chart 1 summarizes the variables used.

The descriptive statistics of the variables used are shown in Table 1. The sectors that reported highest average real wages were the public utility services (SIUP) and the mineral extraction industry (EXTM), with values of R\$3,062.08 and R\$2,402.16, respectively, while the commerce sector (COME) and the agriculture sector (AGRO) featured average wages of R\$916.07 and R\$ 852.31, respectively, being the sectors with the lowest average remuneration.

The average state budget spending during the time span used was around R\$17.2 billion, with a dispersion of R\$26.9 billion. It is important to consider the extent of these expenditures, ranging from R\$1.1 to R\$265 billion, indicating a considerable degree of disparity among Brazilian states' spending. Meanwhile, the average GDP of the period, of R\$133 billion, ranged from R\$4.1 billion to R\$ 1.6 trillion.

**Table 1.** Descriptive statistics of the variables – in Brazilian Reais (R\$)

Variables	Mean	Standard Deviations	Amplitude	
			Min	Max.
PIB	133,609,867,672.65	240,838,011,637.43	4,151,239,829.73	1,662,529,704,231.02
DORC	17,236,796,382.21	26,957,041,553.30	1,107,267,328.67	265,227,410,438.80
EXTM	2,402.16	1,855.01	104.17	10,265.30
INDT	1,156.65	381.76	420.75	2,449.01
SIUP	3,062.08	836.00	1,444.85	6,948.23
CONC	1,168.91	303.67	357.08	2,310.32
COME	916.07	184.64	474.85	1,566.45
SERV	1,413.88	266.47	879.38	2,591.74
AGRO	852.31	249.62	264.91	2,025.56

**Source:** Prepared by the authors based on data from FINBRA / IBGE / RAIS

### 3.2 Econometric strategy

In order to examine the effects of public expenditures on real wages in the Brazilian states, an adaptation of the empirical PVAR model featured in Bénétrix (2012) is used.

$$Z_{i,t} = B(L)Z_{i,t-1} + DX_{i,t} + u_{it} \quad (1)$$

The structural form of this model is given by  $A_0Z_{i,t} = A(L)Z_{i,t-1} + CX_{i,t} + \varepsilon_{it}$ , where  $A(L) = A_0B(L)$ ,  $C = A_0D$ ,  $\varepsilon_{it} = A_0u_{it}$  and also,

$$Z_{i,t} = \begin{pmatrix} G_{i,t} \\ Y_{i,t} \\ W_{i,t} \end{pmatrix}; A_0 = \begin{pmatrix} 1 & -a_{gy} & -a_{gw} \\ -a_{yg} & 1 & -a_{yw} \\ -a_{wg} & -a_{wy} & 1 \end{pmatrix}; X_{i,t} = \begin{pmatrix} c_i \\ t_t \\ d_t \end{pmatrix}; \varepsilon_{i,t} = \begin{pmatrix} \varepsilon_{i,t}^g \\ \varepsilon_{i,t}^y \\ \varepsilon_{i,t}^w \end{pmatrix} \quad (2)$$

where  $i$  and  $t$  denote the state and year, respectively,  $Z_{i,t}$  is the vector of endogenous variables i.e., public expenditures,  $G_{i,t}$ , state GDP,  $Y_{i,t}$  and the average wages,  $W_{i,t}$ . The  $A_0$  matrix captures the contemporary relationships between the repressors. The  $A(L)$  matrix incorporates the effects of the endogenous variables and their lags. All the variables are expressed in logarithm.

Since a panel data model is used, it is important to take into account the unobserved heterogeneity of the states. Therefore, we used the fixed effects estimator, through the least-squares

with dummy variables (LSDV) for panel data model, where  $c_i$  in vector  $X_{i,t}$  incorporates the specific effect of each cross-sectional unit. It is worth noting that Nickell (1981) and Hahn and Kuersteiner (2002) showed that the LSDV estimator is consistent for panels with a reasonably large time dimension. Furthermore, in vector  $X_{i,t}$ , time trends can be incorporated,  $t_t$ , and dummy variables used to indicate changes in the structure of the economy,  $d_t$ . Lastly,  $\varepsilon_{i,t}$  contains the orthogonal structural shocks.

The identification strategy of recursive ordering was used in the estimation process, as described in Blanchard and Perotti (2002), Perotti (2005), Beetsma, *et al.* (2009), Peretti (2005), Beetsma, *et al.* (2009), Monacelli and Perotti (2010), and Bénétrix (2012). We assumed that public spending is not affected by the other variables within the same year, that GDP is explained by public spending and that real wages are influenced by both indicators; In other words, we assumed that  $a_{gy} = a_{gw} = a_{yw} = 0$ .

After the estimation, the evidence of the real wage responses to public expenditures is be extracted from the impulse response functions (IRF). The confidence intervals for the IRFs are obtained through the bootstrap procedure proposed by Hall (1992).

The econometric strategy can be summarized as follows: initially we analyze the order of integration of the series, and those that are shown to be I(1), i.e., stationary in the first difference, are incorporated into the model in terms of their growth rates. Then we estimate seven PVAR models, one for each analyzed sector, from which the IRFs are extracted with their respective confidence intervals.

## 4. Results

In order to expose the effects of fiscal shocks on real wages, we initially analyze the order of integration of the series used by Levin, Lin and Chu (2002), or the LLC test, which has as null hypothesis the presence of a common unit root of all units in the panel, and the Im, Pesaran and Shin (2003) test, or IPS, which considers the presence of an individual unit root in each cross-section. The results are summarized in Table 2.

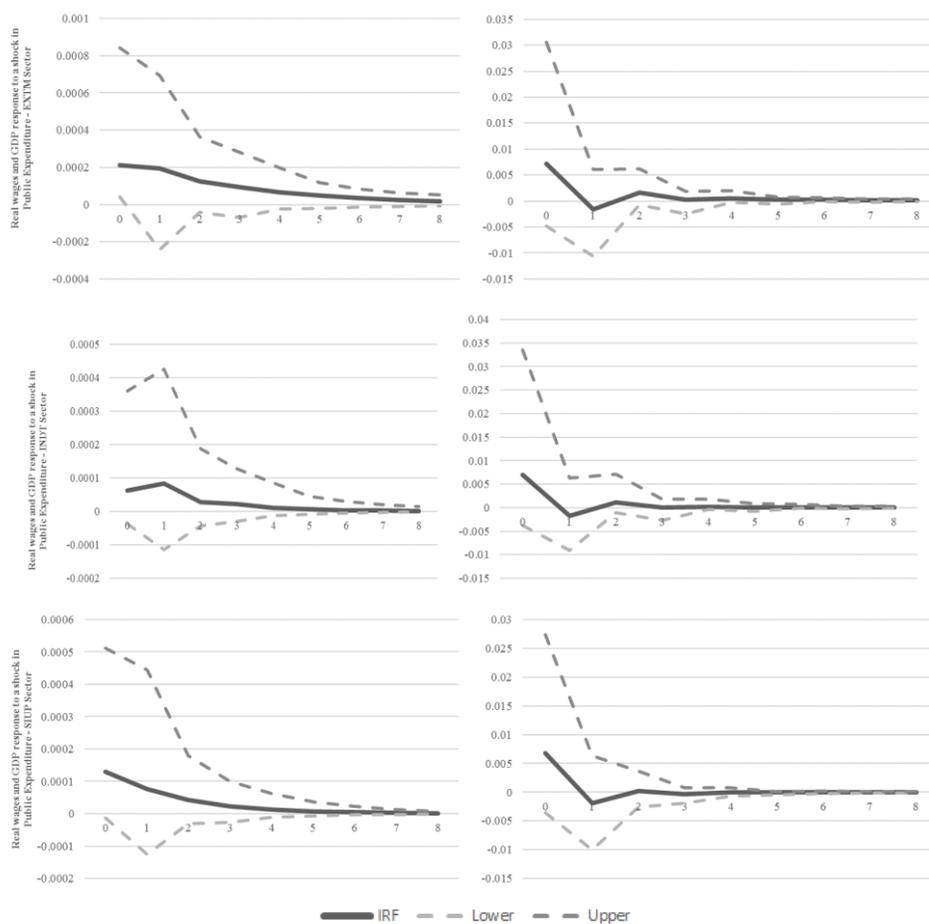
**Table 2.** Results of the unit root test (**Data source:** Prepared by the authors )

Variables		Test		
		Levin, Lin and Chu	Im, Pesaran and Shin	Result
DORC	Level	18.53 (1.00)	7.99 (1.00)	I(1)
	First Difference	-10.83*** (0.00)	-10.16*** (0.00)	
PIB	Level	-0.45 (0.36)	-0.53 (0.31)	I(1)
	First Difference	-13.22*** (0.00)	-15.72*** (0.00)	
EXTM	Level	-19.14*** (0.00)	-7.33*** (0.00)	I(0)

	First Difference	-17.37 <sup>***</sup> (0.00)	-13.65 <sup>***</sup> (0.00)	
INDT	Level	-13.19 <sup>***</sup> (0.00)	-2.26 <sup>***</sup> (0.01)	I(0)
	First Difference	-8.77 <sup>***</sup> (0.00)	-5.40 <sup>***</sup> (0.00)	
SIUP	Level	-79.25 <sup>***</sup> (0.00)	-18.82 <sup>***</sup> (0.00)	I(0)
	First Difference	-14.55 <sup>***</sup> (0.00)	-13.33 <sup>***</sup> (0.00)	
CONC	Level	-3.81 <sup>***</sup> (0.00)	-2.89 <sup>***</sup> (0.00)	I(0)
	First Difference	-12.26 <sup>***</sup> (0.00)	-12.36 <sup>***</sup> (0.00)	
COME	Level	-4.21 <sup>***</sup> (0.00)	-2.08 <sup>***</sup> (0.01)	I(0)
	First Difference	-18.01 <sup>***</sup> (0.00)	-13.31 <sup>***</sup> (0.00)	
SERV	Level	-4.41 <sup>***</sup> (0.00)	-3.52 <sup>***</sup> (0.00)	I(0)
	First Difference	-16.40 <sup>***</sup> (0.00)	-12.67 <sup>***</sup> (0.00)	
AGRO	Level	-17.79 <sup>***</sup> (0.00)	-7.42 <sup>***</sup> (0.00)	I(0)
	First Difference	-23.91 <sup>***</sup> (0.00)	-18.89 <sup>***</sup> (0.00)	

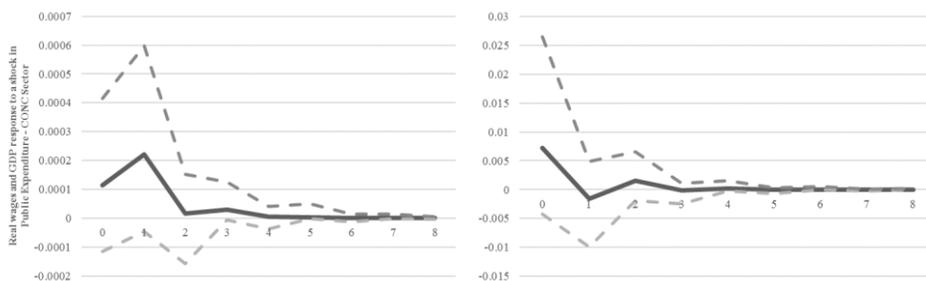
**Note:** p-value in parenthesis. Values followed by (\*\*\*) are significant at the 1% significance level.

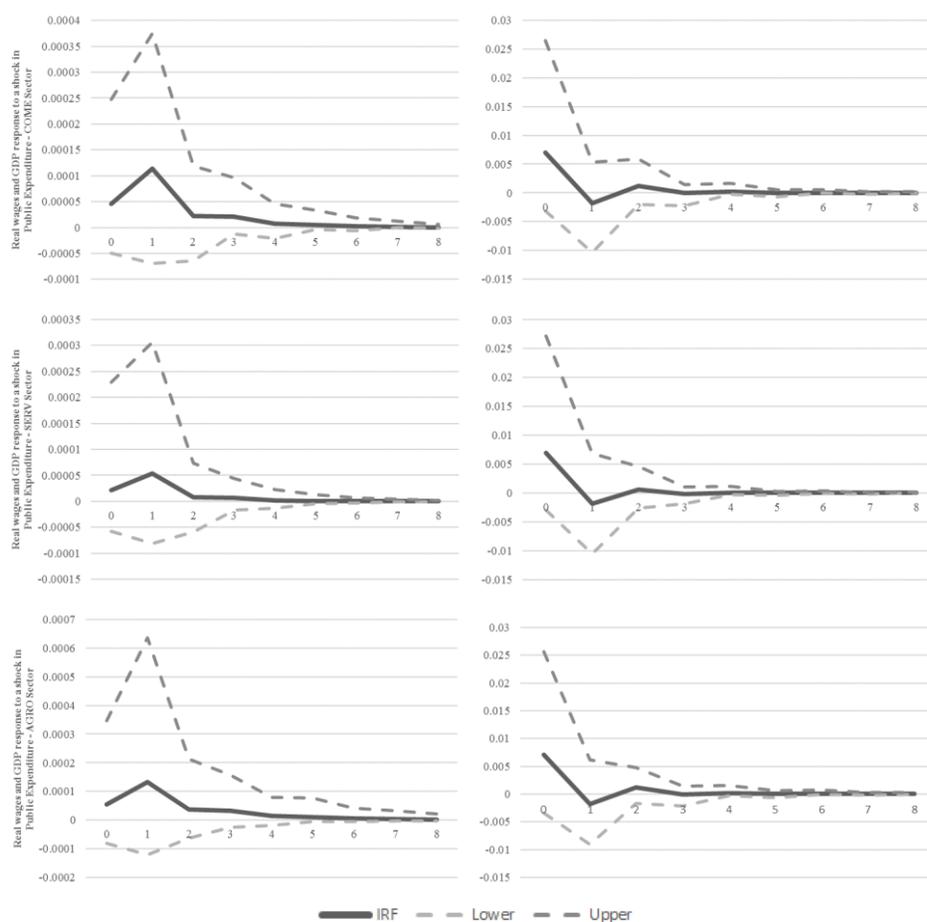
The results of the LLC and IPS tests indicate that the real wage series are stationary at level, and that the GDP and budget expenditure variables are first-order integrated, I(1). Since all variables are in logarithm, the first difference representations express their growth rates. Therefore, in all the estimated models, the expenditure and GDP variables are included in terms of their growth rates.



**Figure 1.a** IRF results of sectoral models  
**Source:** Elaborated by the authors

Therefore, seven PVAR models are estimated, in the format presented in the previous section, one for each sector analyzed. The Schwartz information criterion indicated 1 as the optimal number of lags in all models analyzed. Next, we analyze the IRFs in all the models. The results are shown in Figure 1 (1.a and 1.b). The left and right graphs denote, respectively, the real wage and state GDP responses to the shocks in public spending for each sector analyzed.





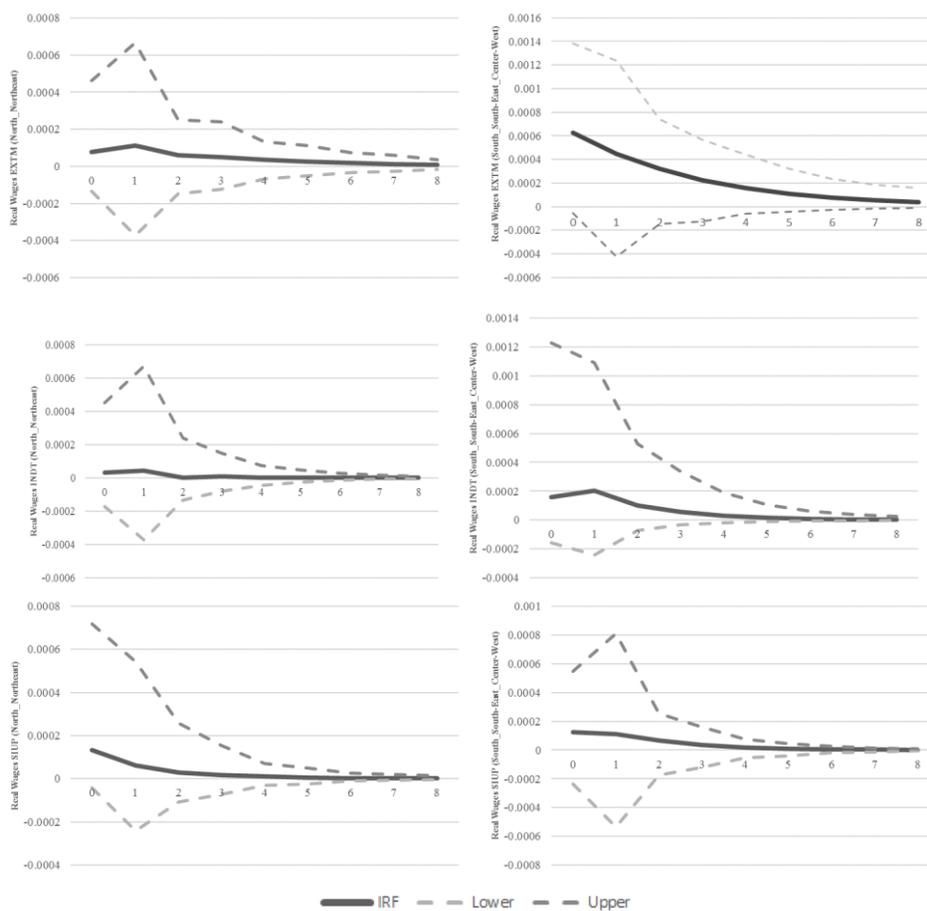
**Figure 1.b** IRF results of sectoral models  
**Source:** Elaborated by the authors

Initially, a positive response of the state GDP to shocks in public spending is observed in all the estimated models, which is the expected response according to economic theory. These impacts have very proximate magnitudes, regardless of the model considered, and duration of about three years until their effects are dissipated. Similar results were also observed by Mertens and Ravn (2012).

Considering the impacts of fiscal shocks on real wages, the results indicate a positive and immediate response of this indicator in all sectors analyzed, especially real wages in the EXTM and SIUP sectors, respectively, which felt the greatest repercussions. In addition, these effects showed durations ranging from four to eight years, depending on the sector, and the most durable effect was in the MEXT sector.

Therefore, as found in Pappa (2009) and Monacelli and Perotti (2008), this evidence indicates that the New Keynesian approach more adequately explains the Brazilian labor market response to fiscal shocks. In other words, there is evidence that the increase in demand for labor is higher than the increase in the labor supply in response to an increase in public spending, reflecting an excess of demand for labor, which, *ceteris paribus*, tends to increase real wages. Furthermore, no asymmetries were observed in the responses among the sectors considered, indicating a certain robustness in these results from the sectoral point of view.

To evaluate the regularity of this evidence, in addition to the empirical analysis discussed above, we now perform some additional exercises. The models are estimated only with the states of the North and Northeast regions, and are then compared to the models that incorporate only the states in the Southeast, South and Midwest<sup>4</sup> regions (Figure 2, a and b), and a comparative analysis of these previous results with those of a 2001-2014 subsample (Figure 3). The reason for choosing that specific subsample is because in 2000, Brazil implemented an important legislative change, the Fiscal Responsibility Law (*Lei de Responsabilidade Fiscal*). As Mello and Callegari (2017) argue, that law has since then guided the state bureaucracy as well as the citizenry in regard to monitoring and supervising public expenditures, leading to a different perspective and practical results in terms of commitment to fiscal discipline.



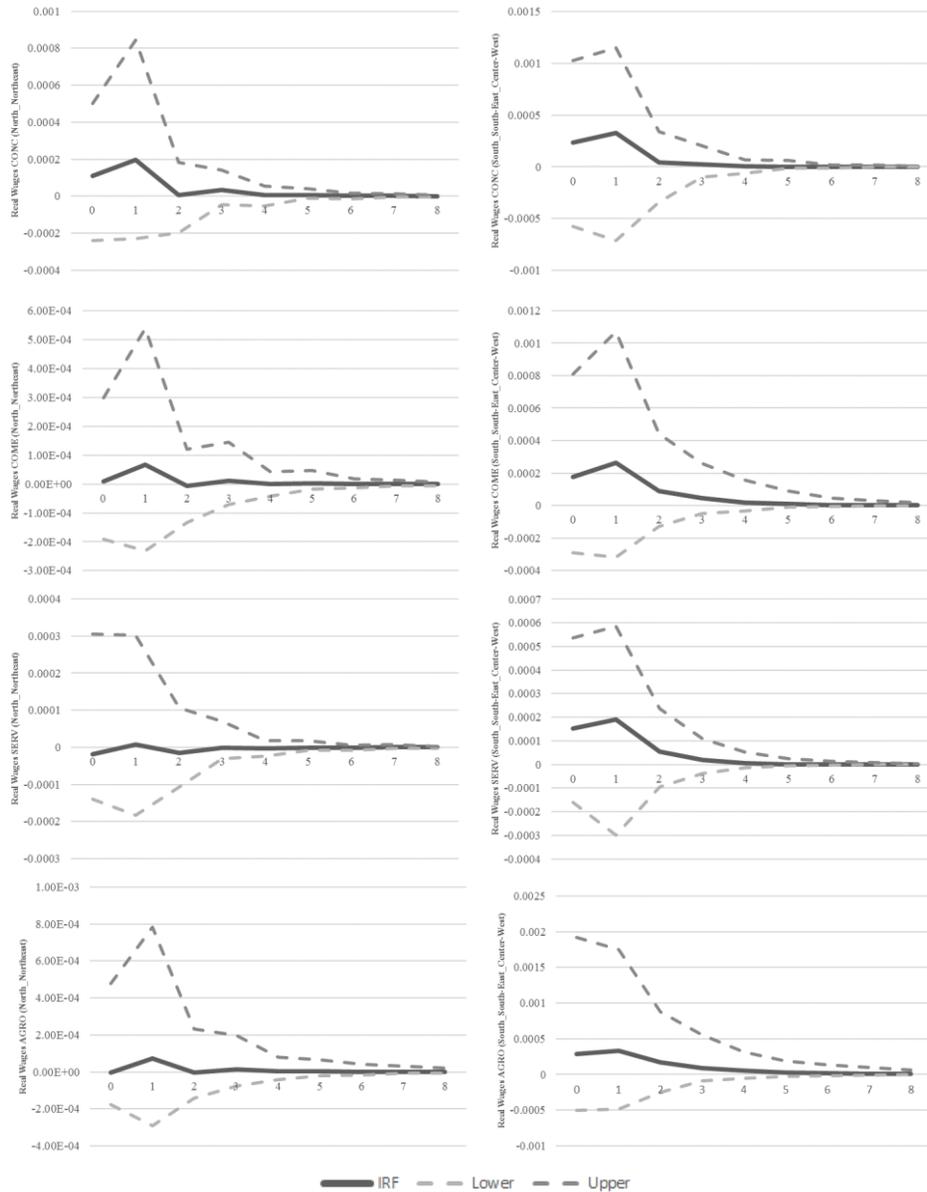
**Figure 2.a** Robustness analysis of the Impulse Response Functions using regional models

Source: Prepared by the authors

In general terms, no changes can be observed in relation to the previous evidence considering the regional models; that is, real wages continue to respond positively to fiscal shocks, according to Figure 2 (2.a and 2.b). However, the results indicate that these repercussions are greater in the

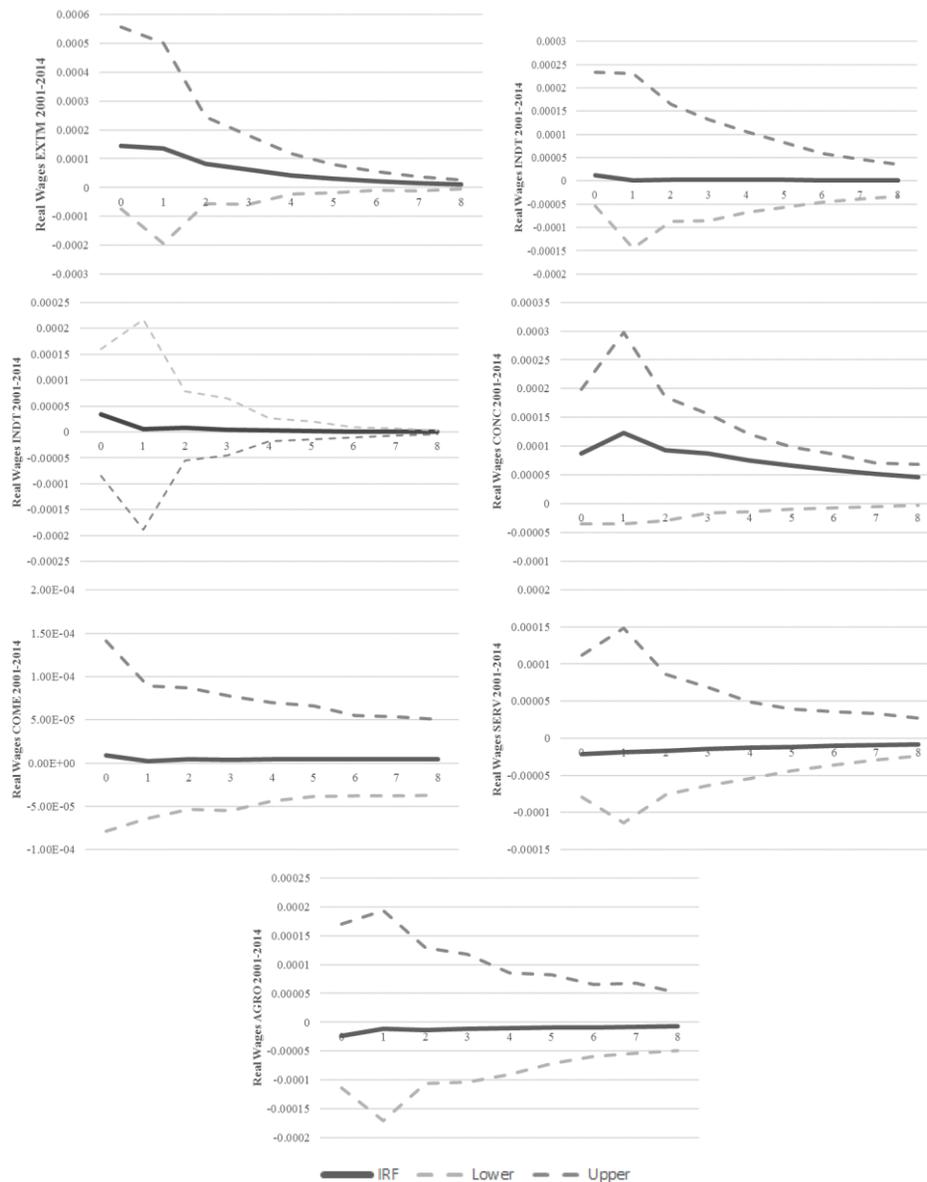
<sup>4</sup> The Federal District, located in the Midwest, is treated as a state.

South, Southeast and Midwest regions, which have a more dynamic labor market. In addition, the wages of the mineral extraction sector continue to stand out for having the greatest effects.



**Figure 2.b** Robustness analysis of the Impulse Response Functions using regional models  
**Source:** Prepared by the authors

Figure 3 summarizes the sectoral real wage responses to public spending, considering the 2001-2014 subsample. The evidence remains the same for most of the sectors analyzed. Only the agriculture and service sector wages presented slightly negative responses to public expenditures.



**Figure 3.** Robustness analysis of the Impulse Response Functions (2001-2014 Sub-Sample)  
**Source:** Prepared by the authors

Therefore, in light of these results, it can be inferred that there is strong evidence that the labor market of the states of Brazil behaves according to the models of the New Keynesian tradition, even taking into account sectoral and regional aspects.

In short, the evidence presented by the IRFs for GDP is in line with that reported by authors such as Mountford and Uhlig (2009) and Mertens and Ravn (2012), who obtained similar results. Regarding the behavior of real wages in response to shocks in public spending, similar results were observed for the American economy by Galí, Vallés and López-Salido (2007), Ramey (2009) and Pappa (2009). For countries in the Eurozone, Forni, Monteforte and Lessa (2009) and Bénétrix (2012) also found comparable evidence in that sense. Additionally, Rotemberg and Woodford (1992) and Monacelli and Perotti (2008) presented evidence which corroborates this result. Finally,

Carvalho, Da Silva and Silva (2013) also found evidence in this line through the application of DSGE and SVAR with national data for Brazil.

Lastly, the results seem to indicate, in a robust manner, that real wages respond positively to public spending. In this sense, the evidence observed here points to the adequacy of the NK tradition. However, such findings should be viewed with caution, since it cannot be inferred that wage increases would be followed by increases in labor productivity. If there is no increase in productivity in counterpart to the wage increase, one can assume there will be restrictions in the productive sector, which will affect relative prices, generating inflationary pressure and eroding the purchasing power of economic agents, in addition to obscuring the forecast horizon of those agents.

## 5. Concluding Remarks

This work develops an analysis of the impact of public expenditures on real wages, from a sectoral perspective, considering panel data with information from Brazilian states between 1995 and 2014, and the IRFs extracted from the PVAR models.

Considering the state GDP responses to public spending, the evidence indicates that state economic activity responds positively and immediately to shocks in public spending in all models considered. Results in this direction were also reported by Mountford and Uhlig (2009), and Mertens and Ravn (2012), and confirm the observations of the Keynesian models that highlight the importance of public spending on GDP growth.

The results also indicate that real wages respond positively to shocks in public spending in all sectors considered, a result in line with the NK approach. This framework indicates that there will be an increase in the demand for labor that exceeds its supply, generating excess demand for labor that increases the bargaining power of workers, and consequently real wages.

These results were shown to be regular in the robustness analyses carried out and there are indications that these impacts are greater in the South, Southeast and Midwest regions of Brazil. Authors like Carvalho, Da Silva and Silva (2013) reported evidence in this direction for Brazil; Forni, Monteforte and Lessa (2009), and Bénétrix (2012) for the countries of the Eurozone; and Galí, Vallés and López-Salido (2007), Ramey (2009) and Pappa (2009) for the United States.

In addition, the sectoral analysis allows us to analyze the magnitude and duration of the impact of fiscal shocks on the real wages of each sector. Particularly, the mineral extraction industry deserves to be highlighted, since the real wages in this sector presented the largest and most durable responses to public spending among all the estimated models.

However, despite the fact that these findings are robust, given the lack of asymmetries among the sectors, prudence is required, as the approach employed does not allow a deeper analysis of the regional economic system in order to monitor whether these gains are accompanied by increases in labor productivity. If not, this increase in wages may be harmful, by discouraging the productive sector and generating inflation, which in turn impairs the forecast horizon of economic agents and increases relative price volatility.

Thus, although this work represents an initial effort to make a regional and sectoral analysis, it can be expanded in several ways. The main one would be to use a regional DSGE model, as indicated by Rickman (2010), which would allow the identification of applicable restrictions in a more complete regional system to make inferences about these results concerning labor productivity.

**References**

- [1] Aiyagari, S. R., Christiano, L. J., and Eichenbaum, M. (1992). "The Output, Employment and Interest Rate Effects of Government Consumption". *Journal of Monetary Economics*, 30(1): 73–86. [https://doi.org/10.1016/0304-3932\(92\)90045-4](https://doi.org/10.1016/0304-3932(92)90045-4) .
- [2] Baxter, M., and King, R. G. (1993). "Fiscal Policy in General Equilibrium". *The American Economic Review*, 83(3): 315–334.
- [3] Beetsma R, Giuliadori, M., and Klaassen, F. (2009). "Temporal aggregation and SVAR identification, with an application to fiscal policy". *Economic Letters*, 105(3): 253–255. <https://doi.org/10.1016/j.econlet.2009.08.010> .
- [4] Bénétrix, A. S. (2012). "Fiscal Shocks and Real Wages". *International Journal of Finance and Economics*, 17(3): 203–220. <https://doi.org/10.1002/ijfe.452> .
- [5] Blanchard, O., and Perotti R. (2002). "An empirical characterization of the dynamic effects of changes in government spending and taxes on output". *Quarterly Journal of Economics*, 117(4): 1329–1368. <https://doi.org/10.1162/003355302320935043> .
- [6] Burnside, C., Eichenbaum, M., and Fisher, J. D. M. (2004). "Fiscal Shocks and their Consequences". *Journal of Economic Theory*, 115(1): 89–117. [https://doi.org/10.1016/S0022-0531\(03\)00252-7](https://doi.org/10.1016/S0022-0531(03)00252-7) .
- [7] Carvalho, D. B., Da Silva, M. E. A., and Silva, I. E. M. (2013). "Efeitos dos Choques Fiscais sobre o Mercado de Trabalho Brasileiro". *Revista Brasileira de Economia*, 67(2): 177–200. <https://doi.org/10.1590/S0034-71402013000200002> .
- [8] Cuevas, A., Karpowicz, I., Mulas-Granados, C., and Soto, M. (2017). *Fiscal Challenges of Population Aging in Brazil*. IMF Working Paper, 2017(99): 29. <https://doi.org/10.5089/9781475595550.001>.
- [9] Cunha Junior, L.A.P., Knopp, G.C., Xavier, D.C., and Aureliano Junior, E. (2016). *Crise Fiscal do Estado Brasileiro: Saídas pela via da Gestão*. IX Congresso CONSAD de Gestão Pública.
- [10] Fisher, J. D. M., and Peters, R. (2010). "Using Stock Returns to Identify Spending Shocks". *The Economic Journal*, 120(544): 414–436. <https://doi.org/10.1111/j.1468-0297.2010.02355.x>
- [11] Forni, L., Monteforte, L., Sessa. (2009). "The general equilibrium effects of fiscal policy: Estimates for the Euro area". *Journal of Public Economics*, 93(3-4): 559–585. <https://doi.org/10.1016/j.jpubeco.2008.09.010> .
- [12] Galí, J. Vallés, J., and López-Salido, J. D. (2007). "Understanding the Effects of Government Spending on Consumption". *Journal of the European Economic Association*, 5(1): 227–270. <https://doi.org/10.1162/JEEA.2007.5.1.227> .
- [13] Greene, W. H. (2012). *Econometric Analysis*, Prentice Hall, New York University.
- [14] Hahn, J., and Kuersteiner, G. (2002). "Asymptotically Unbiased Inference for a Dynamic Panel Model with Fixed Effects when both  $n$  and  $t$  are large". *Econometrica*, 70(4): 1639–1657. <https://doi.org/10.1111/1468-0262.00344> .
- [15] Hall, P. (1992). *The Bootstrap and Edgeworth Expansion*, Springer, New York . <https://doi.org/10.1007/978-1-4612-4384-7> .
- [16] Lobato, Carlos Eduardo (2011). *Política Fiscal e Monetária Ótimas em um Modelo de médio porte para o Brasil Pós-plano Real*. Porto Alegre: UFRGS, 2011. 30 f. Tese (Mestrado em Economia) - Programa de Pós-graduação em Economia, Faculdade de Economia, Universidade Federal do Rio Grande do Sul, Porto Alegre.

- [17] Mello, M.P., and Callegari, J. A. (2017). "The Brazilian Fiscal Responsibility Law: Cultural and Structural changes of State Management". *Sociology and Anthropology*, 5(1): 19–26. <https://doi.org/10.13189/sa.2017.050103> .
- [18] Mertens, K., and Ravn, M. O. (2010). "Measuring the impact of fiscal policy in the face of anticipation: A Structural VAR Approach". *The Economic Journal*, 120(544): 393–413. <https://doi.org/10.1111/j.1468-0297.2010.02361.x> .
- [19] Monacelli, T., and Perotti, R. (2008). *Fiscal Policy, Wealth Effects, and Markups*. National Bureau of Economic Research. Working Paper, n° 14584.
- [20] Monacelli, T., and Perotti, R. (2010). "Fiscal Policy, the Real Exchange Rate and Traded Goods". *The Economic Journal*, 120(544): 437–461. <https://doi.org/10.1111/j.1468-0297.2010.02362.x> .
- [21] Mountford, A., and Uhlig, H. (2009). "What are the Effects of Fiscal Policy Shocks?". *Journal of Applied Econometrics*, 24(6): 960–992. <https://doi.org/10.1002/jae.1079> .
- [22] Nickell, S. J. (1981). "Biases in Dynamic Models with Fixed Effects". *Econometrica*, 49(6): 1417–1426. <https://doi.org/10.2307/1911408> .
- [23] Pappa, E. (2009). "The Effects of Fiscal Shocks on Employment and the Real Wage". *International Economic Review*, 50(1): 217–244. <https://doi.org/10.1111/j.1468-2354.2008.00528.x> .
- [24] Perotti R. (2005). *Estimating the effects of fiscal policy in OECD countries*. CEPR Discussion Paper, n° 4842.
- [25] Ramey, V. A. (2011). "Identifying Government Spending Shocks: It's All in the Timing". *Quarterly Journal of Economics*, 126(1): 1–50. <https://doi.org/10.1093/qje/qjq008> .
- [26] Ramey, V. A., and Shapiro, M. D. (1998). *Costly Capital Reallocation and the Effects of Government Spending*. Carnegie-Rochester Conference Series on Public Policy, 48(1): 145–194. [https://doi.org/10.1016/S0167-2231\(98\)00020-7](https://doi.org/10.1016/S0167-2231(98)00020-7) .
- [27] Rickman, D. S. (2010). "Modern macroeconomics and regional economic modeling". *Journal of Regional Science*, 50(1): 23–41. <https://doi.org/10.1111/j.1467-9787.2009.00647.x> .
- [28] Rotemberg, J. J., and Woodford, M. (1992). "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity". *The Journal of Political Economy*, 100(6): 1153–1207. <https://doi.org/10.1086/261857> .